



## SELECT COMMITTEE ON ECONOMIC AFFAIRS

### The Economic Impact on UK Energy Policy of Shale Gas and Oil

#### Oral and Written Evidence

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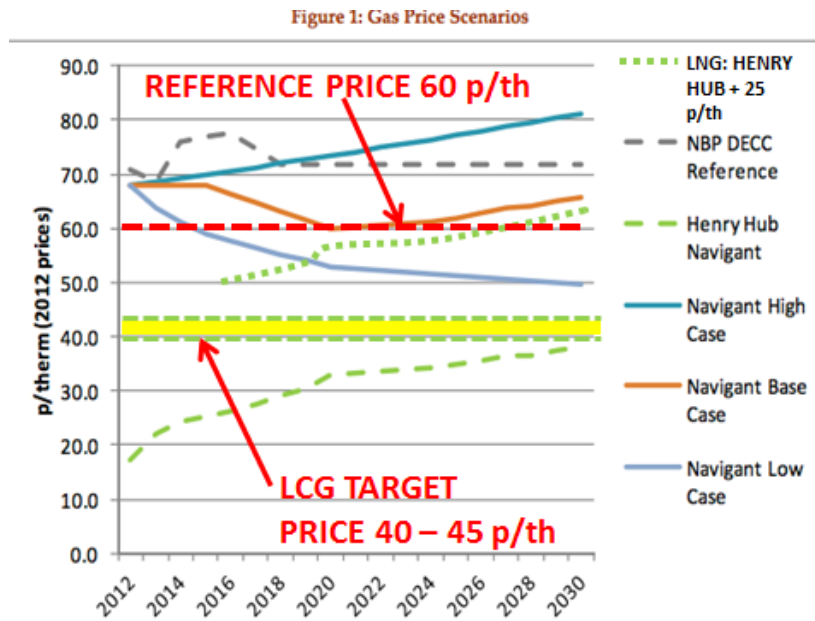
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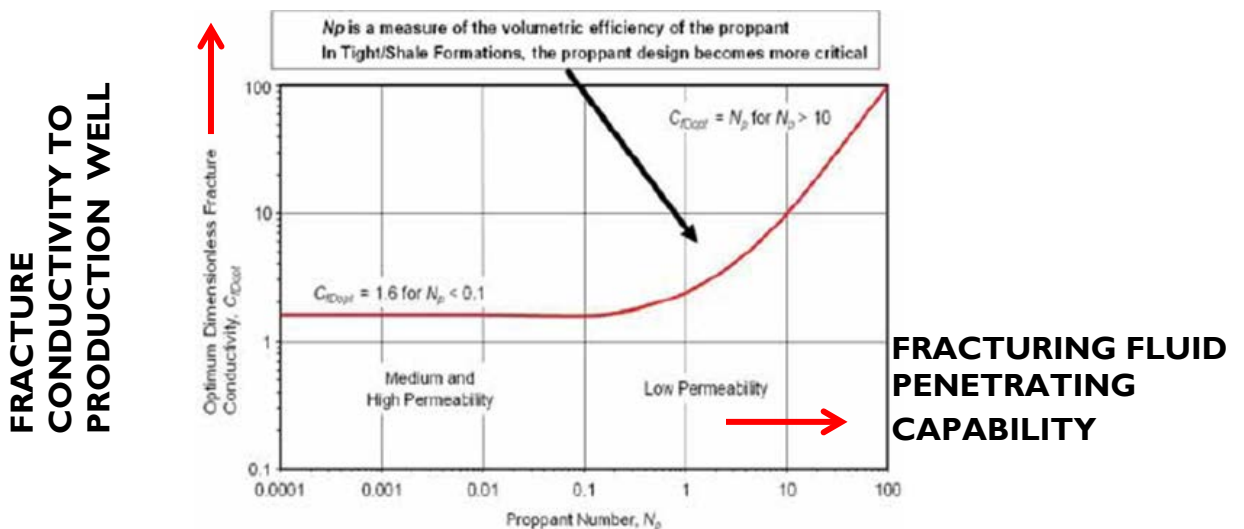
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**A.R Day—Written evidence**

EXECUTIVE SUMMARY

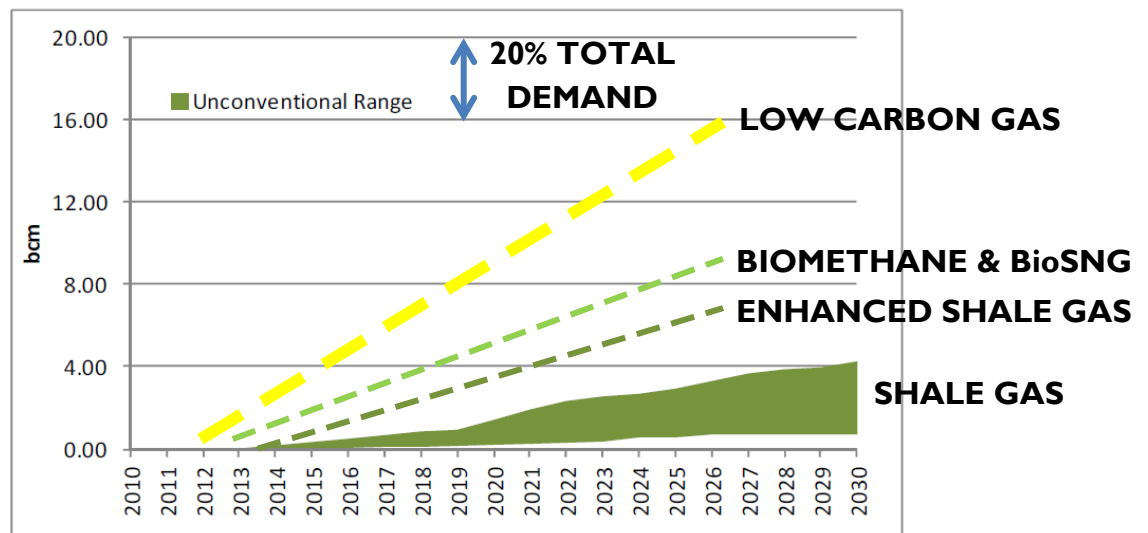


1. DECC’s central projected UK gas price is 60 p/therm based on convergence with Henry Hub price plus 25 p/therm LNG liquefaction and shipping costs. Shale gas costs reduce by around 50% if the estimated ultimate recovery (EUR) increases from 10% to 30%. Low Carbon Gas can be produced for 40 to 45 p/therm. Taken together, this could partly decarbonise gas supplies at source and reduce the price of storable gas to around 50 p/therm, and the implied price of dispatchable gas fired power generation to around £50/MWh.
2. High pressure carbon negative Low Carbon Gas (LCG) can be produced at 76.75% efficiency for 40 to 45 p/therm, plus 99.6% pure supercritical CO<sub>2</sub> at 40 p/tonne, excluding site specific Transport and Storage costs approximately 25 to 33% per unit energy the T and S costs of CCS on fossil fuel power generation.
- 3.

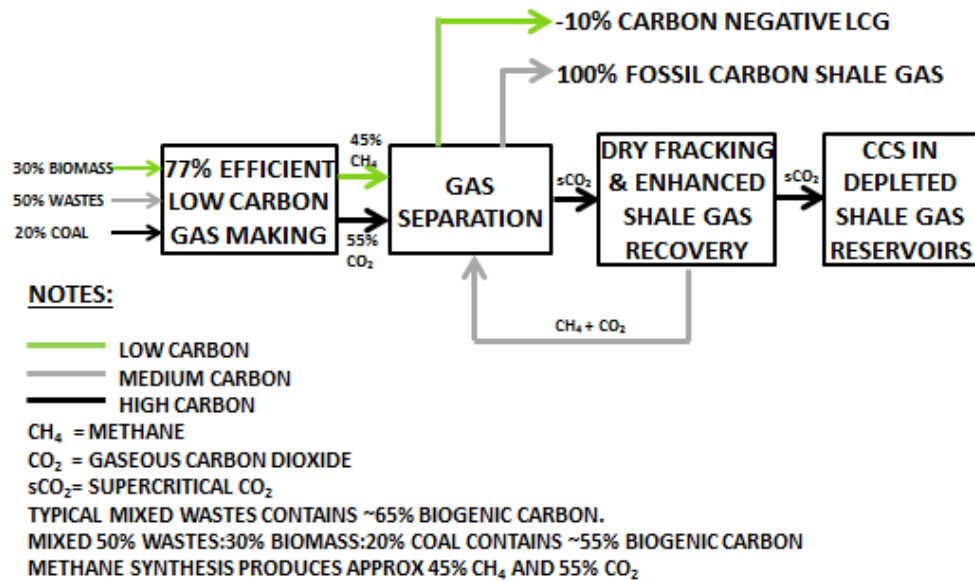


4. The viscosity of supercritical CO<sub>2</sub> is 2 orders of magnitude less than the viscosity of water thus increasing its penetrating power when used for fracking. 5 molecules of CO<sub>2</sub> will selectively desorb 1 molecule of CH<sub>4</sub> from the surface of shale particles. Dissolved CO<sub>2</sub> reduces the viscosity of shale oil. Supercritical CO<sub>2</sub> can be used for oil and gas well re-pressurisation. This can increase estimated ultimate recovery from 10% to around 30%.
5. Shale gas is likely to contain CO<sub>2</sub> which will require separation prior to shale gas injection into the gas grid. CO<sub>2</sub> separation uses the identical technology as used to produce supercritical CO<sub>2</sub> with LCG.
6. CO<sub>2</sub> separation and supercritical CO<sub>2</sub> can be used for drilling, ‘dry’ fracking, ‘green’ completions, enhanced shale oil and gas recovery, well re-pressurisation and CCS. Integrating LCG and shale gas production with CCS in depleted shale gas or oil reservoirs will deliver a low cost onshore low carbon gas industry.

Figure 28: UK forecast unconventional gas production



7. DECC estimates that to decouple UK and EU oil indexed gas prices requires unconventional gas supplying 20% of UK gas demand (or 50% of imports), i.e. 16 to 20 cubm pa. DECC estimates that 1 to 4bn cubm pa of 100% fossil carbon shale gas might be produced in UK by 2030. Enhanced gas recovery could increase this by a factor of 2 to 3, giving a mid-range estimate of (say) 7 bn cubm pa. We estimate that around 28 bn cubm pa of -10% fossil carbon LCG, plus around 65 mtpa of supercritical CO<sub>2</sub>, can be produced from 75 mtpa of mixed waste, biomass and coal, plus 2 bn cubm pa of 0% fossil carbon biomethane from anaerobic digestion. Taken together, onshore shale gas, LCG and biomethane could supply 50% of total UK gas demand at a net fossil carbon intensity of 10%. Gas currently provides around 40% of UK energy supply. This implies the decoupling of UK gas price from EU oil indexed gas prices, and a reduction in total UK fossil CO<sub>2</sub> emissions of around 20%.



**INTEGRATED ONSHORE SHALE AND LOW CARBON GAS CONCEPT**

**SUBMISSION**

8. This is the third of 3 responses to current Parliamentary inquiries. I have also recently responded to the House of Commons Select Committee inquiries into CCS and heat. The common thread running through the 3 responses is the role that Low Carbon Gas (LCG) making can play in reducing the cost of delivering UK energy policy, and hence assisting in delivering economic growth. This response also considers the opportunity for low cost supercritical CO<sub>2</sub> produced as a by-product of LCG to assist enhanced shale oil and gas recovery.
9. I provide policy and economic advice to companies currently developing ex-British Gas Synthetic Natural Gas (SNG), ie synthetic methane technology, in China. Substantially identical technology, with only minor changes, can be also used to produce low cost negative emissions Low Carbon Gas (LCG) at large scale from mixed wastes, biomass and coal feedstocks, integrated with: low emissions ‘dry’ fracking; enhanced shale gas recovery; CCS, and bulk intermittent renewable energy storage using the high pressure gas grid, which is UK’s largest and fastest discharge rate energy store. Please see the attached technical appendix.
10. Our objective is to supply low carbon energy at lower cost than incumbent fossil fuels. The organisations engaged in this endeavour are: GL Noble Denton Ltd (formerly Advantica plc, shortly to merge with DNV kema); Timmins CCS Ltd; Johnson Matthey plc, Davy Process Technology; Jacobs Engineering Group Inc; ITM-Power Ltd, and Cambridge University. Substantial decarbonising of UK gas supplies is not supported by HMGovernment.

11. None of these ideas are new, but previous consideration by HMG of waste, biomass and coal co-gasification in 2002/3 was only in the context of power generation, and did not consider CCS. The 2002/3 report was led by UK Coal plc on behalf of DTI, and over-reported the cost of power from waste, biomass and coal co-gasification at 400 MWe scale by a factor of 1000%. At that time it was assumed that the future of UK energy lay in large scale electrification by a combination of nuclear, renewables and coal with CCS, and that the gas grid would eventually wither away, thus reversing the 1000% expansion of UK gas supplies, largely at the expense of coal and nuclear, between 1960 and 2000. Due to the high 'whole system' cost of electrification and renewables, and the discovery of plentiful new gas supplies, that trend in policy is now reversing.
12. The projected output cost of 60 bar (60 atmospheres pressure) gas grid compliant LCG is around 40 to 45 p/therm for a 1.0 to 1.5 mpta multi-fuel co-gasification plant. LCG production is inherently carbon capture ready, and produces a 150 bar 99.6% pure supercritical CO<sub>2</sub> side stream as a waste by-product at the low cost of around 40 p/tonne supercritical CO<sub>2</sub>, excluding site specific transport and storage costs. The transport and storage cost per unit output energy is around 25 to 33% the transport and storage cost of fossil fuel power generation.
13. There is a good deal of current USA Federal and State supported R and D investigating ways of using supercritical CO<sub>2</sub> to reduce the cost and emissions, and enhance the ultimate gas recovery rate, from shale gas 'fracking', with the ultimate objective of using depleted shale gas reservoirs for CCS. This depends critically on the cost of supercritical CO<sub>2</sub>. The current market price in USA of supercritical CO<sub>2</sub> for enhanced oil recovery (EOR) is around \$15/tonne. EOR is inherently far more profitable than enhanced gas recovery (EGR). For EGR to be profitable, the cost of supercritical CO<sub>2</sub> needs to be substantially reduced. LCG can deliver this objective.
14. The two specific technical advantages of using supercritical CO<sub>2</sub> for shale fracturing and EGR are:
  - a. Supercritical CO<sub>2</sub> has the characteristics of both a gas and a liquid. Its viscosity is nearly 2 orders of magnitude less than water. It is suitable for driving down-hole well bits, and for hydraulic fracturing. Its lower viscosity increases its 3-dimensional penetrating power, and is suitable for high volume fracturing, which could be suitable for multi-level wells in the deep Bowland Shale. Assuming average 3 kilometer long horizontal well 'laterals', it is possible that between 10 and 15 cubic miles of Bowland Shale could be accessed from a single drilling pad. This would imply a much more concentrated, and less geographically diffuse, pattern of shale gas exploitation in UK than in USA. Supercritical CO<sub>2</sub> would drive multi-level EGR from the bottom up.
  - b. Methane is a 'sticky' gas which adsorbs onto the surface of organic molecules in coal and shale. CO<sub>2</sub> selectively displaces the organic molecular bonds thus desorbing methane and making it available for recovery at the rate of approximately 5 molecules of CO<sub>2</sub> per molecule of methane. Initial studies on a test well in Kentucky suggest that commencing EGR at around 80% well depletion produces optimum results. When the produced CO<sub>2</sub> to



methane ratio becomes excessive, the production well is capped. Supercritical CO<sub>2</sub> injection then continues to provide CCS.


15. If ‘dry’ fracking and EGR can be made economic in UK, using low cost supercritical CO<sub>2</sub> co-produced with partly renewable LCG with CCS, this will form a virtuous circle where shale gas can be integrated with an onshore UK LCG industry. Retaining a partly decarbonised gas grid at its current size will be far less expensive than current UK energy policy based on decarbonisation via electrification. The method by which this might be achieved is explained in the attached technical appendix. This is not futurology, and requires only relatively minor modifications to the joint HMG/British Gas Corporation ‘30 Year Plan’ coal to SNG technology successfully developed between 1955 and 1992. The chemical engineering processes named herein: Selexol, HICOM, ADAPT, BGL, etc, are readily available and commercially proven processes. Gas ‘sweetening’ has been practised by the international gas industry for several decades.

**The economics of shale gas in the UK**  
**UK Shale Gas Development Costs**

*Costs are almost as high as North Sea costs but should reduce with time*

Drilling Capex	20 p/therm	£6 million cost and 3 bcf gas per well or lateral
Facilities Capex	2.5 p/therm	£30 million for single drillpad for 120 bcf gas
Opex	22.5 p/therm	£0.5 million/bcf and 2.5% capex per year
Appraisal	2 p/therm	
Restoration	3 p/therm	
<b>Sub total</b>	<b>50 p/therm</b>	
<b>Gas Price (NBP 2014)</b>	<b>67 p/therm</b>	
17 p/therm for profit , tax, financing costs, ROI, etc		
A profitable development if gas prices stay on average above 50 p/therm.		
A worthwhile investment if gas prices average 60 p/therm.		

A multiwell production site



16. Estimates of ultimate recoverable shale gas vary between 10% in UK, and 30% with enhancement in USA. 18% recovery is considered the norm for a good well in USA, without enhancement. If CAPEX is 50% of the total cost of shale gas, and output per well can be increased by a factor of 3, the output cost of shale gas will be reduced by 50%. This is reflected in EIA’s estimated 25% to 50% variance in shale gas price depending on EUR.

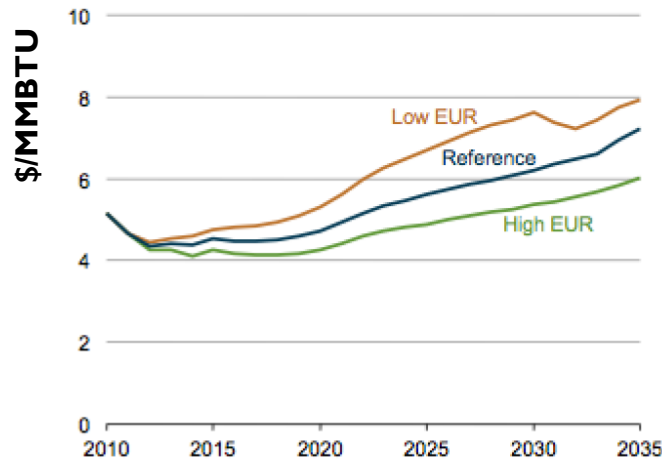
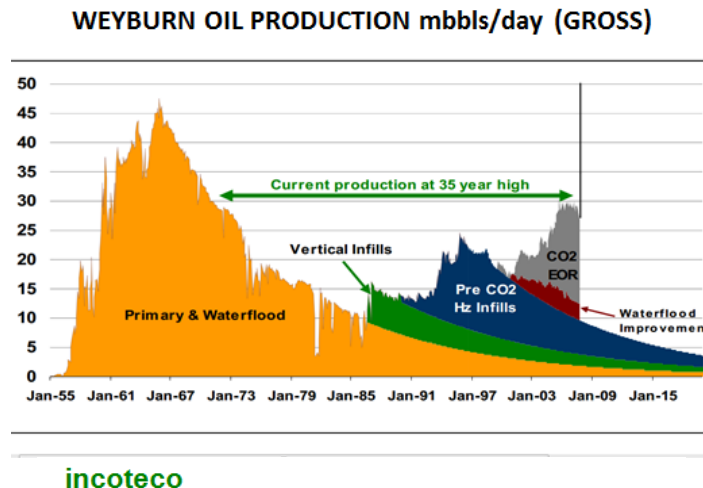
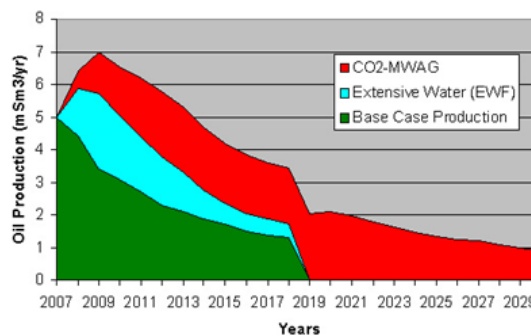


Figure 21: EIA electric power natural gas price predictions.  
EUR= Estimated Ultimate Recovery. Source: EIA (2012b)

17. EGR lengthens the productive life of shale gas wells; offsetting the high initial depletion rate; improving cash flow, and reducing financial risk. The diagram below is for supercritical CO<sub>2</sub> enhanced oil recovery (EOR) with secondary water flood. The geophysics of EGR and EOR are significantly different. It is, however, indicative of well life production and profitability being enhanced by supercritical CO<sub>2</sub>. Enhanced shale gas recovery is currently being tested in Kentucky. Initial indications are that commencing EGR at 80% depletion is optimum.



### Statoil's Evaluation of Gullfaks



Taking the above facts into account, we can answer the Select Committee's inquiries as follows:

*How much scope is there for shale gas and oil – from domestic and overseas sources – to be used in the UK? Over what time frame?*

18. There is no theoretical limit to the amount of indigenous and imported shale gas and oil which might be consumed by the UK. Some estimates suggest that by the 2030's gas will overtake coal and oil as the World's principle and cleanest hydrocarbon fuel. Gas will form a major part of UK's energy system until well after 2050.

*How will the costs, including those on the environment, of accessing UK's shale oil and gas resources, compare to those of other energy resources?*

19. Shale gas and LCG are cheaper per unit energy than any other dispatchable and storable indigenous energy resource. Below ground environmental impacts will be managed in accordance with HMG and EU drilling regulations, etc. Above ground environmental impacts can be minimised by maximising the volume of shale accessed per well pad; using 'dry' fracking techniques, and underground pipelines carrying supercritical CO<sub>2</sub> and mixed methane and gaseous CO<sub>2</sub> to and from gas processing 'hubs'. Atmospheric environmental emissions can be minimised by using 'green' completions; CO<sub>2</sub> separation and reuse; integration with LCG production, and CCS. None of these measures need be excessively costly; have large land use and; be visually intrusive, or hazardous,

provided they are sensitively sited and planned in accordance with normal Planning and environmental criteria.

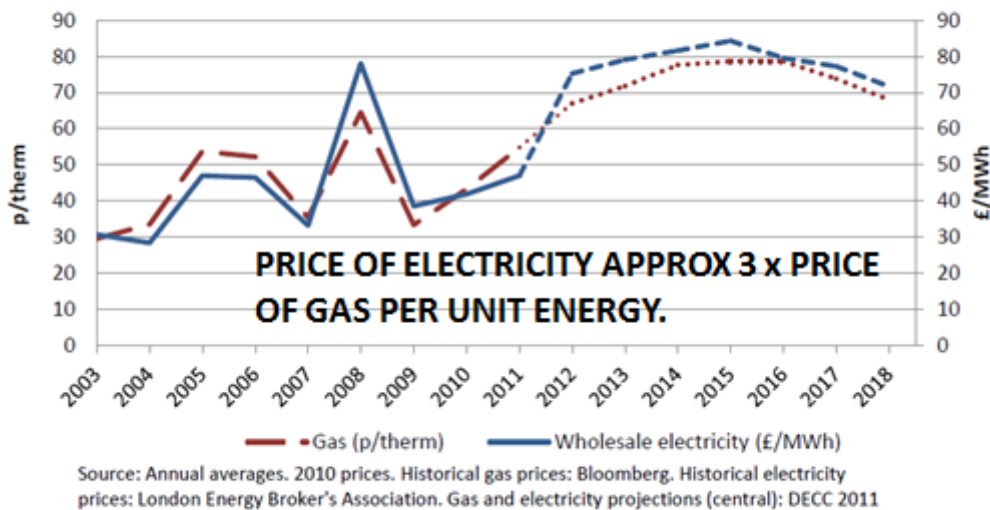
*What is the potential impact of shale gas and oil on local economies in areas where development is possible?*

20. Conventional economic theory suggests that, subject to proper Planning and environmental controls, and appropriate distribution of wealth, shale gas and oil will have a positive impact on local economies.

*What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants, and how will it compare to other forms of generation including nuclear, coal and renewables?*

21. 60 p/therm gas price implies £60/MWh power price due to gas normally being the marginal generator in the UK power market. New nuclear, coal with CCS and renewables cannot compete with this price. Existing 'paid down' coal fired power stations will remain cost competitive.

**Chart 1: Historic and projected electricity and gas prices**



*Will the UK electricity market be easily able to absorb shale gas in future, or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?*

22. Gas is a fungible energy resource. Gas fired power generation is easy to build at low capital cost. Coal and gas fired generation are largely interchangeable depending on the relative input to output cost 'spreads'. The extent to which substitution, or lock-in, occurs depends largely on HM Government energy policy.

*Which forms of electricity generation is shale gas likely to displace, and by how much?*

23. Assuming that renewables remain highly subsidised and shielded from market forces, shale gas is likely to displace new nuclear and new coal fired power generation in UK.

## A.R Day—Written evidence

Except to the extent that new nuclear and coal are subsidised, or gas is driven out of the market by a combination of policy and the Carbon Floor Price, there will be no economic driver to develop new nuclear or coal in UK, except for over-riding security of supply purposes.

*What impact will shale gas and oil have on household energy bills?*

24. In an open competitive liberalised energy market increased energy supplies should reduce household energy bills. The UK energy market is a tightly regulated and taxed oligopoly. The extent to which reduced wholesale energy prices reduce household energy bills is in the hands of HMGovernment, OFGEM and National Grid plc.

*What effect will the use of shale gas and oil have on carbon emissions compared with other combinations of energy sources?*

25. Assuming 33% of total UK power generation is provided by mixed Natural Gas, biomethane and LCG fired conventional power stations, an economically viable low carbon power generating system can be developed meeting the following criteria: 50% renewable energy; 50 gCO<sub>2</sub>/kWh 'whole system' emissions intensity, and 50% 'whole system' plant load factor. Please see attached technical appendix.

*Will shale gas and oil increase UK energy security?*

26. Yes, provided the increase in UK energy security is not undone by the unintended consequences of other energy policies. The economic benefits to the Nation will be reduced if the profits from shale gas and oil are either impounded by HMTreasury, and then not used for wealth creating measures, or are exported by external investors domiciled outside UK. The gas grid is UK's largest and fastest discharge rate energy store, and thus supports energy security. HMG's recent decision not to assist UK gas storage development, compared with massive financial support for renewable power generation, sent the wrong signal to the energy market.

*What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?*

27. Please refer to para 18 above for types of infrastructure requirements. Nowhere on the British mainland is very far from the UK gas grid. Shale gas and oil should be profitable investments. Therefore, pipeline investments should not be massively expensive. Traditional gas pipeline investment methods should be adequate, perhaps with some financial assistance from HMG to overcome initial investor risk aversion and to 'prime' the market. Long-term ultimate risk cover for CCS will probably have to be provided by HMG.

*What changes to public policies are necessary to maximise the potential of any shale gas development?*

28. HMG should abandon electrification as the core of UK energy policy. HMG should develop a single energy policy for both gas and electricity, with equal affordability, security and sustainability criteria applied to both markets. CCS on synthetic gas making is orders of magnitude cheaper than CCS on power generation. Policy should support

putting the lowest cost CO<sub>2</sub> underground first, and the most expensive CO<sub>2</sub> last. Policy should support the development of onshore integrated shale gas, LCG and CCS 'hubs' inter-connected by underground pipelines. The capital cost per MWkm of gas pipelines is around 1/15<sup>th</sup> the cost of underground power grids.

*Will shale gas and oil lead to UK being less dependent on energy from less reliable parts of the World such as the Middle East and Russia?*

29. Shale gas and oil will reduce imported energy dependency. UK has not been held to ransom directly by Russia or OPEC. Reduced import dependency will deliver balance of payments, tax revenue, price volatility, supply chain and employment benefits.

*What lessons can be learnt from the US experience of shale gas and oil?*

30. Enhanced shale gas recovery R and D is ongoing in USA, Poland, Japan and the Middle East. UK should engage with this knowledge base. UK should develop LCG, 'dry' fracking, 'green' completions, enhanced shale oil and gas recovery (50% of the CO<sub>2</sub> used for EOR stays underground), and low cost CCS in depleted shale gas and oil reservoirs, with gas and CO<sub>2</sub> pipeline infrastructure.

*September 2013*

## Bloomberg—Written evidence

### Natural gas

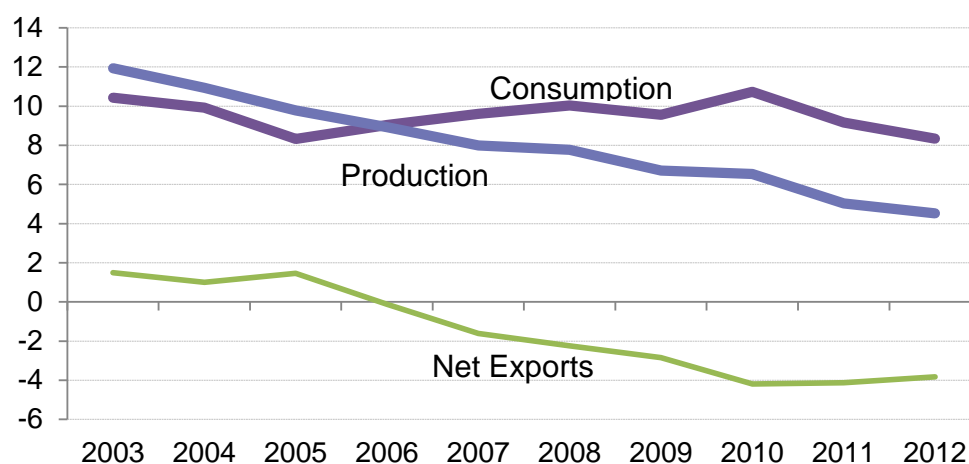
#### The economic impact on UK energy policy of shale gas and oil

Bloomberg New Energy Finance has been monitoring and researching energy markets for the past 10 years. We have been covering the UK gas market, the North American gas markets and the impact of the shale boom for the past two years. This response to the House of Lords Call for Evidence is given as a summation of our research on the topics pertinent to the questions asked.

#### 1. How much scope is there for shale gas and oil – from domestic and overseas sources – to be used in the UK? Over what timeframe?

1. The UK has moved from a position of being a net exporter of natural gas to being an increasingly large net importer since 2006 due to the rapid decline of dry and associated gas production from the UK continental shelf (Figure 1). This has left the UK as a net importer of some 4bcfd (billion cubic feet per day), or 42 billion cubic meters per annum. The deficit would have been even larger had the fall in coal and carbon prices not left UK gas generators running second to coal generators in the generation mix.

**Figure 1: UK gas supply and demand (Bcfd)**

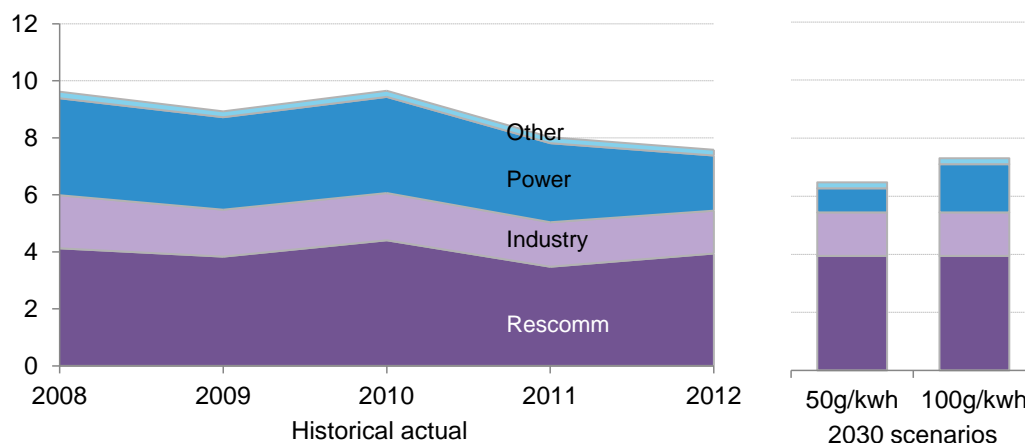


Source: Bloomberg New Energy Finance, National Grid

2. The UK would thus be able to absorb up to 4bcfd of additional gas production without changing the fundamental dynamics of the market and while using current infrastructure. This 4bcfd is the maximum level at which we foresee the UK being able to produce shale gas under our most bullish scenario.
3. The UK has a long-term, legally binding target to reduce emissions at least 80% by 2050 from 1990 levels. The UK Committee on Climate Change has recommended that the carbon intensity of the power sector as a whole should fall to 50gCO<sub>2</sub>/kWh by 2030 for the UK to stay on course to achieve its long-term emissions reduction goals.

- A 50gCO<sub>2</sub>/kWh limit would imply UK power sector gas demand of 7.6–8.8bcm in 2030 (0.83bcfd), assuming power demand in 2030 of 340TWh and the elimination of coal generation by then. This implies that gas consumption for power would need to fall to less than half its value in 2012. Despite this implied demand destruction in the power sector, there should still be ample demand for gas from the residential and industrial sectors to be met by UK shale gas in 2030 (Figure 2).

**Figure 2: UK natural gas consumption by sector (bcfd)**



Source: Bloomberg New Energy Finance, Dukes. Note: scenarios in 2030 assume residential and industrial demand remain flat from 2012. Assumed power demand in 2030 is BNEF scenario of 335TWh.

## 2. How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those for other sources of energy?

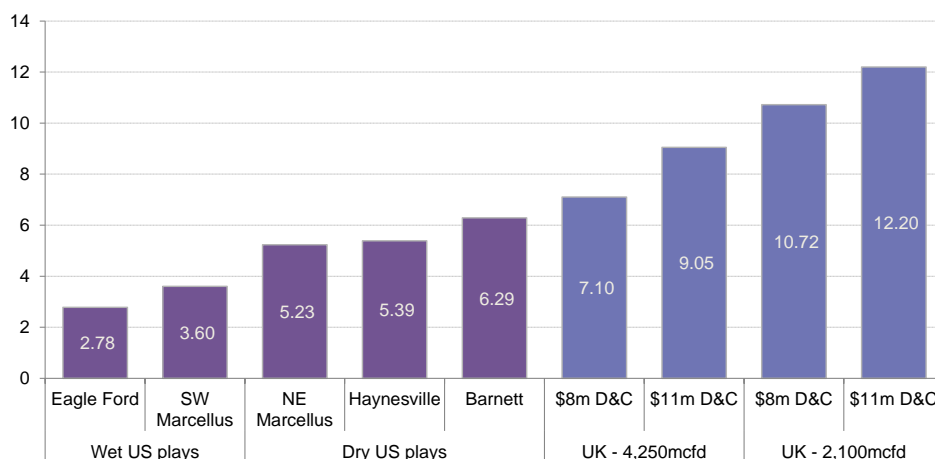
### UK shale gas costs

- Political, environmental and legal concerns will play a significant role in the trajectory of shale gas development in the UK. Ultimately, however, it will be economics that will be the deciding factor: unless the gas is profitable to extract and distribute, the total volume of UK shale gas resources is immaterial.
- Because of the paucity of data, very little has been published on the cost of shale drilling in the UK or the flow rates which might be expected. We can, however, make educated estimates of these two variables, based on an understanding of comparable figures in the US and anecdotal information from drillers, servicers and geologists.
- Our analysis focuses on the economics of a single drilling pad (a facility from which several wells can be drilled) and uses our in-house valuation tool to calculate a 'breakeven gas price' – one that covers all out-of-pocket costs and gives an appropriate internal rate of return (IRR) to the driller and their investors. As with all natural resource assets, the main variables affecting unit production costs are upfront costs (known as drilling and completion, or D&C) and production rates (the higher the output, the lower the unit costs will be). In the examples below we present two scenarios reflecting optimistic to pessimistic views on costs and production rates:



- In our favourable case, we assume D&C costs for UK shale gas wells of \$8m. An analogous well in the US would cost around \$4m to drill and complete, but we have assumed higher D&C costs resulting from the limited availability of drilling service providers. We estimate that it would cost a further \$2m to acquire the land, prepare the site and build a one-mile gathering line. We assume six wells being drilled at a single pad site, all of which use the same gathering/processing system. This means that the first well is more expensive than the next. We assume that exploratory works have been completed and that the play is mature – in other words there are no provisions for ancillary costs or unexpected production delays.
  - In the pessimistic scenario, we believe D&C costs could be as high as \$11m per well. These costs are based on quotes from the oilfield services company Schlumberger on drilling costs in Poland (overall the central European country is likely to have similar costs for onshore shale gas development to the UK). A further \$2.5m is spent on land, site preparation and gathering.
  - On the production side, our favourable case assumes a 30-day initial production (IP) rate of 4,250mcf/d. This is akin to wells in the US Marcellus and Eagle Ford shales.
  - In our less favourable case, we drop the IP rate to 2,100mcf/d. This is closer to a well in the Barnett Shale. That said, in this scenario we also drop the number of frack stages from 15 to eight, saving over \$1m in D&C costs per well versus where they would otherwise be in this scenario.
8. Certain US plays also benefit from the presence of natural gas liquids (NGLs) in the gas stream. NGLs sell into the oil market and can fetch higher prices than gas, so they provide some economic uplift. But, while the gas composition of UK shale plays is unknown, a sizeable liquids cut would also necessitate the construction of capital-intensive fractionators and parallel pipeline systems for the liquids, potentially outweighing the economic benefits. In any case, the Bowland Shale is thought to be largely dry. We therefore assume that UK shale gas is dry and assign no NGL uplift.
9. Based on the above, UK unit costs for shale gas extraction are likely to be considerably higher than those seen in the US (Figure 3). While dry US plays such as the Marcellus, Haynesville and Barnett have breakeven costs of some \$5-6/MMBtu (always assuming a 15% after tax equity IRR), we believe the comparable range for the UK is likely to lie between \$7.10 and \$12.20/MMBtu. This is close to the \$8-11/MMBtu range in which spot UK gas prices have traded over the past two years.

**Figure 3: Breakeven gas price for 15% after-tax equity IRR (\$/MMBtu)**

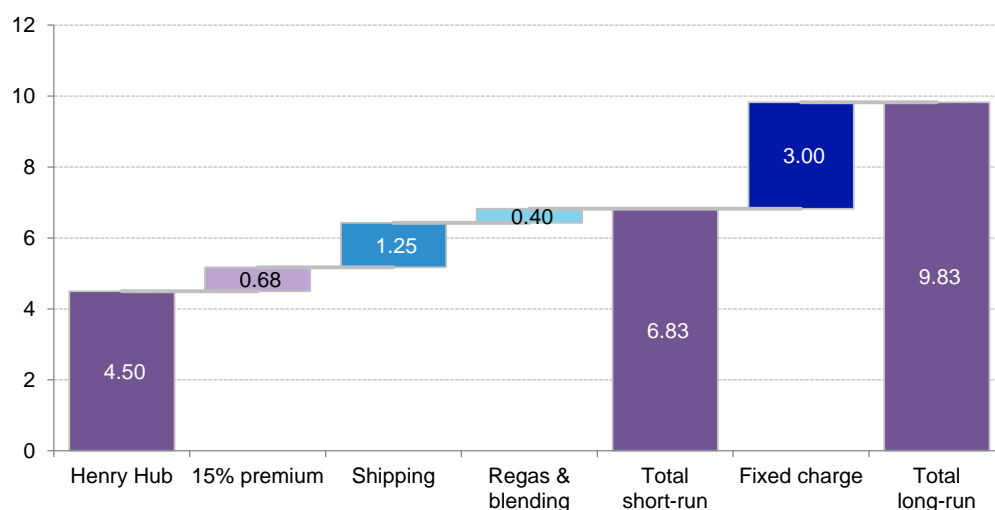


Source: Bloomberg New Energy Finance Note: We invite readers to use our in-house valuation model to reproduce our results for the UK.

### Cost of alternative supplies of natural gas

10. The UK has two major alternative sources of supply for Natural gas other than domestic shale. It can either import more from Europe, or import more LNG from the Atlantic basin.
11. The United States will emerge as a significant supplier of LNG into the Atlantic basin over the next five years as the early LNG export projects come to fruition. This source of supply, which will likely amount to 7-8bcfd of capacity or around twice our bullish case for UK shale production, comes with the added advantage of being delivered on highly flexible terms for volume and price, based on the most liquid gas hub in the world at the Henry Hub. Figure 4 shows a typical cost build up in both short-run and long-run terms for US gas delivered to Europe. This range of prices compares favourably with our estimates for the cost of UK shale given in Figure 3.

**Figure 4: LNG cost build-up, US Gulf to Europe (\$/MMBtu)**



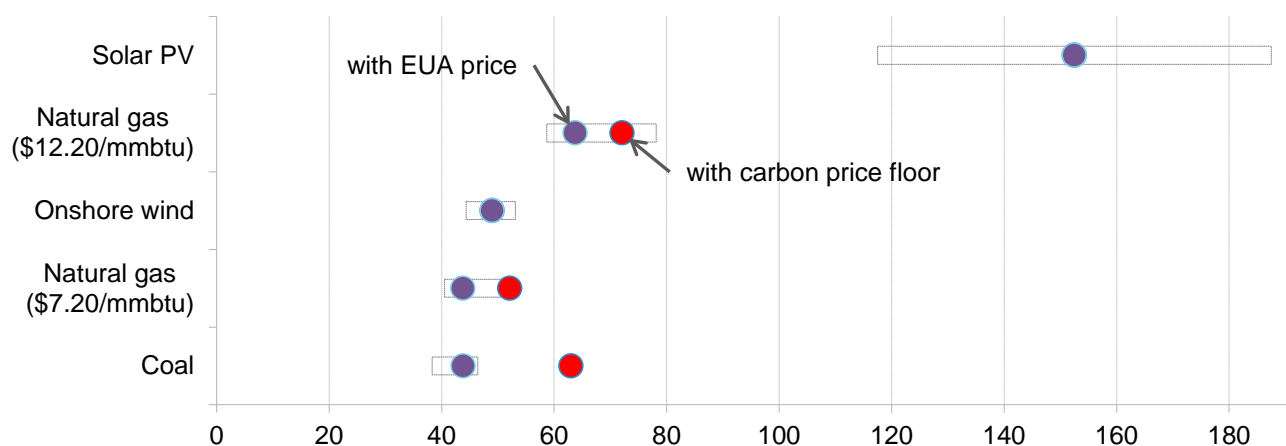
Source: Bloomberg New Energy Finance Note: The fixed charge is the levelised cost of building and financing the

liquefaction facility in the US.

## Cost of alternative sources of electricity

12. The long run cost of electricity supply is set by a combination of capital costs for the equipment, operating costs to keep the plant running, financing costs and the cost of fuel to run the plant. Bloomberg New Energy Finance track this closely in our levelised Cost of energy research. Figure 5 shows the relative costs of different sources of electricity at current fuel prices prevalent in the UK.

**Figure 5: UK levelised cost of energy (GBP/MWh)**



Source: Bloomberg New Energy Finance Note: Natural gas is for a new baseload CCGT unit at 54% HHV efficiency and 85% load factor. Coal is for a new baseload super-critical unit at 42% HHV and 85% load factor. Solar PV is utility scale installation at 10% load factor. Onshore wind is a new installation at 28-31% load factor.

13. The current low cost of carbon from the EU ETS scheme, combined with low coal prices gives coal the lowest levelised cost of energy before taking account of the carbon price floor.
14. We include natural gas-fired generation under two scenarios for the cost of gas from shale. In the lower gas cost scenario a new baseload CCGT is GBP5/MWh cheaper than an onshore wind farm in our central case, without the carbon price floor. In our higher cost gas scenario a new baseload CCGT is GBP14/MWh higher than an onshore wind farm.
15. With the carbon price floor, which rises to GBP46/tonne in 2020 and as high as GBP137/tonne in 2030, energy from onshore wind is cheaper than that from natural gas-fired generation in both our high and low cost shale gas scenario.

### 3. What is the potential impact of shale gas and oil on the local economies in areas where development is possible?

16. Bloomberg New Energy Finance has done detailed research on the jobs impact of renewable energy technologies but has yet to do the same for shale gas.

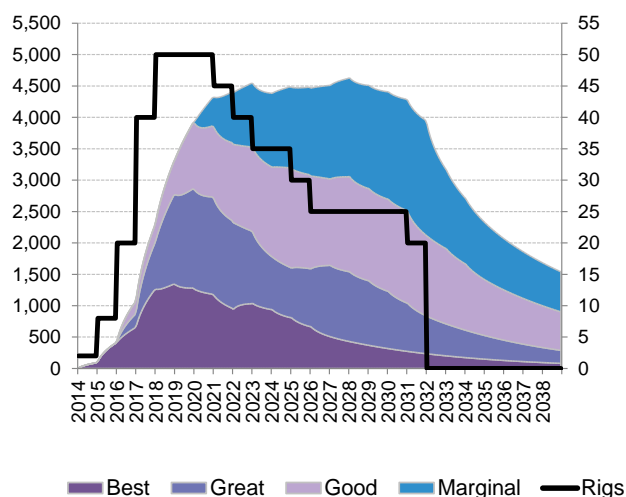
**4. What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

17. Shale gas will only have an impact on the cost of electricity generated at gas-fired power plants in the UK if it changes the price of natural gas in the UK. The price of natural gas in the UK is set at the National Balancing Point (NBP) by the cost of supplying the marginal therm of natural gas. To impact this price, UK shale would need to displace more expensive sources of gas, notably LNG. Further for the UK to see a repeat of the US level of production and price impact, price separation would need to occur between the UK and continental Europe. This effectively requires that the UK become self-sufficient in gas and be able to export sufficient gas to cause export bottlenecks in the gas pipeline network.
18. Technically recoverable shale gas resources in the UK have not yet been estimated with any precision and figures vary hugely. For example, Cuadrilla Resources, which is actively exploring the Bowland Shale, has suggested a figure of 200Tcf, with 10% recoverable, while a preliminary report from the British Geological Survey gave a more conservative estimate of 4.7Tcf of recoverable resources in the same basin. Ultimately, however, no matter how large the resource, in order to have a substantial effect on UK gas prices, the rate of growth of production must be high enough to displace imports.
19. To establish a production rate that would substantially affect UK prices, we examine the gas balance and market structure. As noted in our answer to question 1, annual gas production has fallen by 60% over the past 10 years, turning the UK into a net importer since 2005-06 (Figure 1). Because it has the highest share of spot gas sales (vs. long-term contracts) of any country in Europe, the marginal Btu of gas sets the price. UK producers respond to this by ramping up gas production in the winter months.
20. Therefore, we assume that production must rise to the point where imports are more or less completely displaced in order to lead to a sizeable drop in prices.
21. Using a target production rate of 4.0-4.5Bcfd (total UK natural production in 2011 was 5Bcfd, against total consumption of 9Bcfd) and our more optimistic assumptions on flow rates, some 3,000 wells would need to be drilled over a 5-6-year ramp-up period. At the height of activity, around 50 rigs would be drilling one well per 20 days each, or around 900 wells per year. After this initial high level of activity, drilling would slow over the subsequent 10 years to the rate required in order to maintain production. We estimate that approximately a further 7,000 wells would be drilled over this 10-year plateau period, given likely rates of production decline but given also the fact that producers would re-frack their best-performing wells in order to coax out more production without having to drill anew (Figure 6).
22. Assuming that each well drains an area of 90 acres, based on comparable figures in the US, this equates to 870,000 acres drained. For one of the larger US shale plays, these would be eminently achievable targets. However, given that the entire county of Lancashire – home to the highly prospective Bowland Shale – is 761,000 acres in size, drilling 10,000 wells would hardly be realistic. On the other hand, the Bowland is thought to be substantially thicker than its US counterparts, potentially allowing different

horizontals to be targeted in sequence. This would reduce the need to expand laterally and allow drillers to drill more wells from the same pad. (A useful analogue is the Williston Basin in the US, where drillers target both the Bakken and deeper Three Forks formations from the same pad.)

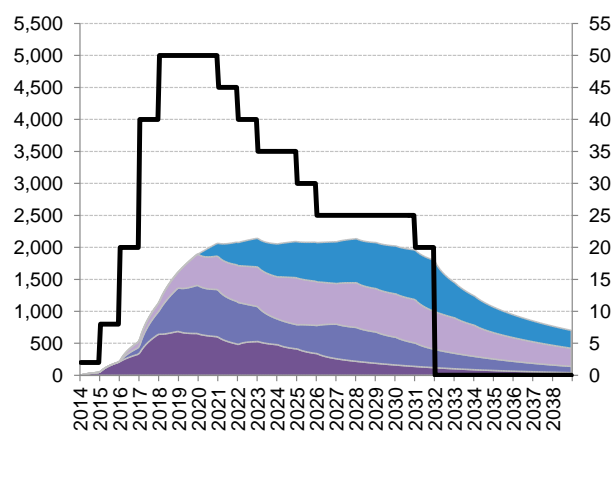
**Figure 6: UK shale production, high production**

Production (MMcfd) Rigs running



**Figure 7: UK shale production, low production**

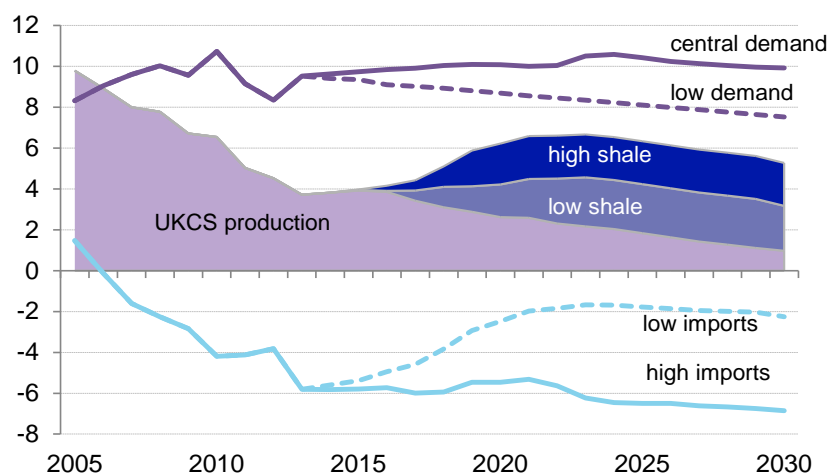
Production (MMcfd) Rigs running



Source: Bloomberg New Energy Finance

23. Nevertheless, as in all things oil and gas, size does matter. The top 10 operators in the Marcellus Shale hold just under 7m acres, and the core area is thought to underlie more than 15m acres. The commercial area of the Barnett Shale is closer to 2-3m acres.
24. Moreover, were UK shale wells to flow at lower rates (more like the Barnett), those same 10,000 or so wells on 870,000 acres would only amount to peak production of just 2.0-2.1Bcfd. This could offset production declines from legacy assets, but not much more (Figure 7).
25. In summary, while it is not unimaginable that hundreds of drilling sites holding thousands of wells could be set up in the UK, it would require favourable geology, public acceptance and the establishment of a services industry and onshore gathering and midstream infrastructure. None of these can be done quickly.
26. Our conclusion is that even under the most favourable case for shale gas production, with production reaching 4.5bcfd in the mid-2020s, and low demand driven by a power sector emissions target of 50gCO<sub>2</sub>/kWh, the UK will not be self-sufficient in gas (Figure 8). The reliance on continued imports will ensure that UK gas prices remain tied to European and world markets and so the direct impact of shale on the cost of electricity in the UK will be limited.

**Figure 8: UK gas production, demand and imports through 2030 (bcfd)**



Source: Bloomberg New Energy Finance, Dukes, DECC, UK Oil and Gas

**5. Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

- 27. Purchases of natural gas for electricity generation are done as part of company hedging activities to lock in profits for future years. These activities typically begin around four years ahead of the delivery year and the proportion of generation hedged out increases steadily, reaching 50% two years from delivery, and with almost all generation hedged the month before delivery.
- 28. The profile of hedging indicates that UK gas generators will be more than able to respond to a change in the source of gas from UK offshore and European imports to shale gas over the time-frame over which shale gas is likely to be developed.

**6. Which forms of electricity generation is shale gas likely to displace and by how much?**

- 29. As discussed in question 4 above, shale gas will only displace other forms of generation, relative to a base case for gas generation, if it has a meaningful effect on the price of gas in the UK. We do not believe it will and so do not see electricity generated from shale gas displacing other technologies.
- 30. Our view on this would change should the government believe the advent of shale gas allows for a higher proportion of gas generation in the mix – allowing it to move away from the use of CfDs for nuclear generation. This would make construction of new nuclear generation in the UK effectively impossible and increase our share of gas in the mix at the expense of nuclear.

31. The build-out of renewables, being almost entirely driven by decarbonisation policy, and supported by the ROC and CfD schemes, would not be directly affected by shale gas if UK gas prices remain unaffected.

**7. What impact will shale gas and oil have on household energy bills?**

32. We refer to the previous discussion on the impact of shale gas on UK wholesale gas prices. Consumer bills will be affected to the extent that wholesale gas prices will be affected – albeit with a damped and delayed effect. For this reason our view is that shale gas will not have a noticeable impact on UK household energy bills.

**8. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

33. We refer to the previous discussion on the impact of shale gas on the UK generation mix. Gas can affect the UK power generation mix either by delivering low-total-cost generation that undercuts renewable generation on a long-run basis, so making it impossible to build and thus increasing carbon dioxide emissions, or by undercutting coal-fired generation on a short-run cost basis and therefore reducing carbon dioxide emissions.

34. However, in the UK the development of renewable energy generation is an entirely policy-driven undertaking supported by significant out-of-market payments through the ROC scheme and, in future, the CfD scheme. These schemes give price and/or volume certainty for renewable generation and so prevent gas prices having a significant impact on future renewable build. Similarly, in the UK, coal-fired generation is subject to a high and rising carbon price floor. Should this tax continue on its current trajectory, coal-fired capacity will be largely phased out by the early 2020s as it is unable to justify the investments needed to meet the emission requirements set in the Industrial Emissions Directive and will be unable to run economically.

35. For these reasons shale gas is unlikely to have a significant impact on UK carbon dioxide emissions either positively or negatively.

**9. Will shale gas and oil increase UK energy security?**

36. Bloomberg New Energy Finance does not have a view on this question.

**10. What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?**

37. Bloomberg New Energy Finance has not specifically investigated the investment requirements needed in exploration and production, pipeline gathering systems, gas processing and other infrastructure to support UK shale development, and so does not have a view on this question.

### **11. What changes to public policies are necessary to maximise the potential of any shale gas development?**

38. A key enabler of the US shale gas boom has been that landowners are strongly incentivised to lease their land for development. This is due to the fact that they own the mineral resources under their feet and so are able to extract significant lease payments for the privilege of drilling and extracting the oil and gas.
39. In the UK however, the resources belong to the state. This, it is often argued, is an impediment to exploitation of underground assets as there is no immediate commercial arrangement that can be struck between the developer and land owner. State approvals are required, which can take time, and the landowner may have no economic incentive to welcome drilling.
40. The opposite is true in the US, which allows landowners to collect royalties on all the petroleum extracted from their plot. This better aligns the incentives of drillers and landowners and encourages development. Drillers need not pay upfront for the use of the land, which may turn out to be worthless if production is uneconomical. Rather, a relatively small upfront sum is agreed, but the landowner is entitled to a portion (generally 12-20%) of production proceeds (usually the payment is made in cash, rather than in kind). Therefore, if the well is productive, both the landowner and driller profit. If it is not, the driller does not need to take a write-down.
41. For the UK to embrace drilling to the same extent as the US, approvals from the state will be required. In theory the state could act in a similar way to private landowners in the US, with more balanced risk-return arrangements, though the wheels of the UK state generally turn more slowly than those in the US private sector. More importantly, landowners and local communities will have to be compensated for damage and nuisance if they are not to use the means at their disposal to delay or block fracking operations.

### **12. Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

42. UK shale gas will, all other things equal, allow for the displacement of alternative sources of gas supply, and will increase to a small extent the supply diversity of global gas. As gas security of supply is an international issue, given the interconnectedness of UK markets with those of the rest of Europe and the world, this diversity will benefit all consuming nations.
43. However, even under our most bullish case of 4.5bcfd of production in the 2020s, UK shale production will still constitute less than one third of Russia-to-Europe gas flows and under 1% of total global gas production. The UK will remain dependent on imports to some extent (Figure 8) and so will not be able to avoid taking an interest in global security of supply.

### **13. What lessons can be learnt from the US experience of shale gas and oil?**

44. The US experience has shown just how low the cost of extracting gas from shale can be under favourable conditions. We believe however that this is unlikely to be repeated in the UK for the following four key reasons.



## Geology

45. The British Geological Survey assessment of the UK's shale gas resources<sup>1</sup> suggests that the Bowland Shale is by far the largest and most attractive onshore UK shale basin, and the mineralogy is thought to be suitable for gas extraction. Total organic content is satisfactorily high and the rock is brittle, which allows for good fracture propagation.
46. Useful data are, however, still sparse because earlier wells generally stopped before penetrating the Bowland Shale (conventional oil and gas drilling targets the reservoir rock that overlies the shale source rock) or simply did not core the Bowland Shale layers. This data is needed to assess permeability, porosity and overpressure – key variables in determining production rates.
47. The composition of the gas is also unknown, although much of the shale is thought to be firmly in the dry gas window in terms of thermal maturity. Lastly, the Bowland Shale is quite thick – it is conceivable that multiple depths of the rock could be targeted for extraction. (The Williston Basin in the US is an example of a 'stacked play' – wells drilled from the same pad site target both the Bakken and the deeper Three Forks formations.) This may be important, given the relatively small horizontal extent of the Bowland.
48. Geologists suspect that the UK also has large offshore shale gas resources. Moreover, the UK offshore industry is one of the best developed in the world – the North Sea has been under constant development for more than 50 years. However, offshore shale drilling is currently (and, perhaps, inherently) uneconomical because shale developments rely on continuous drilling to make up for rapid decline curves, but day rates for drill-ships, semisubmersibles and jack-ups are much higher than for onshore rigs.

## Land rights

49. Another key difference between the US and the UK – and one that is unlikely to change – is that landowners in the European country do not own the resources beneath their feet. The resources belong to the state. This, it is often argued, is an impediment to exploitation of underground assets as there is no immediate commercial arrangement that can be struck between the developer and land owner. State approvals are required, which can take time, and the landowner may have no economic incentive to welcome drilling.
50. The opposite is true in the US, which allows landowners to collect royalties on all the petroleum extracted from their plot. This better aligns the incentives of drillers and landowners and encourages development.
51. For the UK to embrace drilling to the same extent as the US, approvals from the state will be required. In theory the state could act in a similar way to private landowners in the US, with more balanced risk-return arrangements, though the wheels of the UK state generally turn more slowly than those in the US private sector. More importantly, landowners and local communities will have to be compensated for damage and nuisance if they are not to use the means at their disposal to delay or block fracking operations.

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<sup>1</sup> The assessment applies to Pennine Basin shale gas resources, which are thought to be the most prospective.

### **Lack of drilling services market**

52. There are currently around 1,700 land rigs operating in the US, compared with around 80 in all of Europe, according to oilfield services company Baker Hughes. Over 10,000 onshore oil and gas wells are drilled in the US each year, meaning that the market for onshore drilling services is, by a large margin, the largest and most competitive in the world. Drilling service companies undertake various tasks, from early-stage exploration and formation evaluation to development-stage drilling and fracking, as well as later-stage well work-overs and various support functions. While the companies do not produce petroleum, they are essential to the market.
53. The UK does have a very well-developed offshore services market, but it has almost no experience in onshore work. In addition to the lack of experience, there is a lack of equipment – the vast majority of high-horsepower rigs and pressure pumping systems needed to frack are located in North America.

### **Lack of midstream infrastructure**

54. Once a well is brought to production, the gas must find a path to market. While the UK has a robust transmission and distribution system, it lacks the ‘gathering’ pipelines that take raw gas from the wellhead and bring it to a central processing facility. These gathering lines are relatively small and easy to build, but land easements must be obtained and the pipelines buried. Once again, the UK’s system of land ownership and planning, as well as its population density, is likely to make the process of laying gathering lines more time-consuming and costly than in the US.
55. Gas must be processed before it makes its way into the mainline transmission system. This processing removes various inert or toxic gases (such as nitrogen, carbon dioxide and hydrogen sulphide) and also separates out heavier hydrocarbons, leaving a stream of predominantly methane. Currently, the UK’s processing capacity is located at receiving terminals on the coast. If onshore production is to contribute to the UK’s energy mix, cryogenic processing plants must be built, and – if the raw gas stream contains a substantial portion of heavier hydrocarbons – expensive fractionators and a parallel system of pipelines will have to be constructed to transport these products.

*September 2013*

**British Geological Survey and Department of Energy and Climate Change—Oral Evidence (QQ 17-32)**

TUESDAY 15 OCTOBER 2013

*Evidence Session No. 2*

*Heard in Public*

*Questions 17 - 32*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Lipsey  
Lord May of Oxford  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Smith of Clifton

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**Witnesses**

**Professor Mike Stephenson**, Director of Science and Technology, British Geological Survey, and **Ms Toni Harvey**, Senior Geoscientist, Department of Energy and Climate Change

**Q17 The Chairman:** Can I welcome you to the Economic Affairs Committee? This is the second public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. I ought to state at the outset that copies are available in the Room of members' entries in the Register of Interests. I was not able to be here last week so today I ought to declare my own interests, which are somewhat indirect, as chairman of the British Energy Pension Fund Trustees and also of the Eggborough Power Ltd Pension Fund Trustees. As I said, they are somewhat indirect but they get me involved a bit in energy matters. Professor Stevenson and Ms Harvey, thank you very much for coming. We understand that you are not here today to answer questions about policy as such but about your work on the geology of the UK shale resource and much wider than that. It is very much the science that we want to ask you questions about today. I would be grateful if you would speak loud and clear for the webcast and the shorthand writer. I ought just to mention that this is being televised. Our questions are mostly to you both but where one of you answers the question completely, the other does not need to feel that they must come in. Just come in if you have anything additional to say. As I said, the emphasis is very much on the scientific side today. You may find some of our questions elementary but in fact for our inquiry to a large extent this session is a fact-finding one and it would be very helpful to us to have your responses. I start with a very basic question: is shale gas usually found in traditional coal and oil-producing areas such as the UK? Are large coal reserves in a given area a good pointer to a substantial shale gas resource in the same area? That is a fairly straightforward opening question.

**Toni Harvey:** There were two questions there. First, do you find shale gas associated with producing oil and gas? The answer is definitely yes. The source rock is generally shale. Over

geological time, the hydrocarbons in that source rock will migrate into more porous and permeable reservoir rocks that are produced in conventional oil and gas. It is the same source rock, generally. If you can find producing fields in the area, you generally have a good petroleum system and there is probably shale that either contains gas or oil in the subsurface. The relationship between coal and shale is not quite as straightforward. Basins subside and when they do the rocks that are deposited in those basins are preserved. If by chance the basin was subsiding when the marine shale was deposited, and then was also subsiding at the time that the coal was deposited, they will both be preserved in the rock record. That does not always happen, particularly here in the UK where there is a very complex tectonic history. The basin may have been subsiding for these deep shale basins but was then uplifted and did not ever receive any coal deposits. Or they may have both been deposited, were later tectonically uplifted and the coal was stripped off. For example, in the part of Lancashire where Cuadrilla drilled its wells there is no coal present even though as you move further south into the Lancashire coalfields there is plenty of coal. That is because uplift stripped off the coal in Lancashire. Yet if you move further east, say for example into the Gainsborough Trough in Nottinghamshire, there is almost a complete section preserved where you get both the coal and the deeper shales still present.

**Mike Stephenson:** There is not much I can add to what Toni said. In a sense, she is absolutely right: shale is associated with oil and gas because shale rock contains the organic matter—or mush—from lakes, streams, rivers and seas where it was deposited. That organic stuff is cooked up to make oil and gas. When it is stuck in the rock, the shale, it is what we call shale gas but if it escapes and gets into rocks above it that are sandstones, it is not shale gas any more but conventional gas. Toni is absolutely right: you would expect to find oil and gas associated with shale. The connection with coal is less clear. In much of Britain shale rock is succeeded by coal—what we call the coal measures in Britain. Over large parts of northern Britain there are several thousand feet of shale and then above it there are several hundred feet of coal measures. The shale is about 330 million years old and the coal is about 300 million years old. The coal is a bit younger and sits on top of the shale. In many places you can find coal where there is shale. As Toni says, that is not always true because sometimes the coal has been eroded away off the top of the shale and another rock has been laid down on top of it so the coal is completely missing. In parts of Lancashire, for example, although we have a very great thickness of shale, we have no coal. In answer to your second question, large coal reserves are not really a good pointer. They can be associated with shale but not necessarily.

**Toni Harvey:** I know you cannot see it but I would refer you to figure 42 in the document, which shows the relationship between coals in grey and oil and gas in shale in orange. The document is the Bowland Shale report on the DECC website.

**Q18 The Chairman:** Obviously there is now a huge interest in fracking, but how long has it been known or suspected that there could be a substantial shale resource in the UK?

**Toni Harvey:** Dick Selley is probably the best person to talk to about that because he has been talking about it since the early 1980s when he tried to get DTI interested in doing some shale gas studies. You should get Dick Selley to tell you about the history of shale gas in the UK.

**The Chairman:** Presumably, it has been to some extent the developments in the US that have created the greater excitement here in the UK about shale.

**Mike Stephenson:** Yes, the thing about shale is that we have known there is shale in Britain for hundreds of years. Shale gas is something else. We have not really started thinking about

that until recently. As Toni said, some university people thought about shale gas over a decade ago. We have known there is shale. If you go walking in the Peak District in the north of England, in some areas you are walking on shale. It is not a rare rock but a common one. You usually do not see it at the surface because it is rather soft. In fact, Toni has brought a lump of it for you to have a look at. It is rather soft so it does not stick up very much but it is there all over the north of England. We have known there is shale for donkey's years. In fact, it has interesting fossils in it so geologists have been studying it for a long, long time. But I suppose that the shale connection is something that came from the United States. It was clear that somebody was getting gas out of shale so slowly interest began to develop. You are right that since about 2005, when American shale gas has really taken off, the interest has reached much higher levels here in Britain and Europe.

**Lord Griffiths of Fforestfach:** To what extent do your answers bear any relationship to the whole issue of North Sea and offshore oil?

**Toni Harvey:** The source rock for most offshore oil and gas is still shale. It is just that it has not been prospected for as a target to date.

**Lord Griffiths of Fforestfach:** But there could be huge reserves of shale oil and gas in the North Sea, where we currently get oil from?

**Mike Stephenson:** There probably are because there is shale of the same lower carboniferous type. When I say lower carboniferous, I mean a particular age of about 330 million years old. Underneath the east Irish Sea, offshore of Liverpool and north Wales, we know that there is shale of that age because it continues out from Lancashire under the Irish Sea. We know it is there. We also know that it goes down deep under the western part of the southern North Sea. We have maps to show where it is and we know from seismic studies that it is there. There is no reason why it should not contain gas in the same way that the onshore shale of the same age does—we think. But drilling very deep sub-sea, being able to frack and all these other things mean that offshore shale gas is really only an idea. To my knowledge, it has never been tried anywhere in the world.

**Q19 Lord May of Oxford:** I should first declare an interest that I sometimes forget. First as Chief Scientific Adviser and then as President of the Royal Society I was quite associated with movement on climate change and I am now a member of the Climate Change Committee. I will keep reminding this committee that we have, whatever it means, legally binding commitments to an 80% level of decarbonised energy and that will not be easy. That leads to my question: I have an imperfect understanding but I have the impression that the quality and character of shale gas is a great deal more variable than conventional oil. I would welcome expert opinion on whether that is a misapprehension, to what extent it is one and to what extent it might mean that some of the direct comparisons with shale gas in the United States are less applicable here.

**Mike Stephenson:** Do you mean that shale gas is different to conventional gas?

**Lord May of Oxford:** Well, that shale gas in site A and shale gas in site B may bear small or significant differences in the rate at which they have made the transition to being conventional oil, as it were. My understanding is that conventional oil is a good deal less variable in the character of what you get. I have had it put to me by some people that this makes direct comparisons between the benefits that it can give in the States and the benefits it might give here less applicable. I would welcome an expert correcting misapprehensions that I might well have because I could not be more ignorant.

**Mike Stephenson:** Okay. As Toni said, the shale we are talking about is an all-purpose source rock. What petroleum geologists mean by source rock is that it is the source of hydrocarbons of various kinds. The main difference between shale gas and conventional gas is that the shale gas is still stuck in the place where it was formed, essentially. It has not moved anywhere. In conventional gas, that gas has moved to somewhere where there is a space for it to occupy. It is the same stuff, the same methane, but there are differences about the way the gas is held in shale. There are uncertainties, as you say. For example in shale, gas is not held in the spaces between the particles in a simple way. The gas is also held in an absorbed form on to the surface of organic matter and on to the surface of clay particles. A difference is that if you drill and open up a piece of shale, like Toni's piece, the free gas that is allowed to move inside the porous spaces can get out but the absorbed gas might stick to the particles longer. We do not know, for example in our shale gas here, how much is free gas and how much is absorbed. We do not know quite how fast absorbed gas desorbs from the surface of particles in the shale. So there are some uncertainties but essentially the gas is the same because it has come from the same place. Answering your American question, an example of the shales in the United States that have been very successful is the Barnett Shale in Texas. That is of pretty much the same age as the lower carboniferous shales that we are interested in in the north of England. It was deposited over much wider areas and ours were deposited in much narrower, deeper basins but most geologists do not see a huge difference between American shales of that age and ours. Apart from the fact that the shales seem to be thicker here, I do not think there is an awful lot of difference. In answer to your question, "Do you think that our geology here means that we can build up an industry like they can in the United States?", I do not think it is a question of geology but that we are different countries, with different views about the countryside and different population densities. That is a much stronger influence in my opinion.

**Toni Harvey:** Just to add one thing to that, the composition of the gas or liquids that you get out is largely determined by the type of organic material that was originally deposited in the rocks. One of the things that we do not really understand very well about the UK is whether we are looking at marine organic material or more of a terrestrial, woody material. If we have marine organic material we are more likely to get oil that will crack to a gas, which is more similar to the North American successful plays. The resultant composition of liquid and gas you get out is a function of the organic material that went in and the thermal history - how long it was cooked and at what depths. Whether it comes out of a conventional reservoir or an unconventional one, it is a function of that chemistry and thermal history.

**Lord May of Oxford:** That is very helpful. You may be relieved that I will not ask that question again.

**Q20 Lord Shipley:** I, too, would like to ask about your respective roles. We have two organisations here: the Department of Energy and Climate Change and the British Geological Survey. Could you tell us what each of your responsibilities is in terms of estimating shale gas resources in the UK?

**Toni Harvey:** DECC commissioned a study of shale gas in the UK back in 2010. It looked like this. The BGS did the work for us. We then realised that we needed a more detailed resource estimation so DECC again commissioned a study for BGS to do. DECC wrote the conditions of that study. We wrote what the objectives and deliverables were and at various steps along the way we authorised expenditure. The people that did the actual work were the geoscientists at the BGS. BGS employees did the seismic interpretation, the log evaluation, the rock evaluation, the thermal history modelling, the biochemistry and the

nanofossil analysis. I was the project manager at DECC for the work with the BGS. I worked with them on a very close basis to look at progress on the report and consider some of the decisions that had to be made along the way about what the assumptions were—the technical assumptions on the project. As the project started to grow and as it became more complicated than we originally scoped out, I had to authorise more expenditure.

**Lord Shipley:** How do you know it is right?

**Toni Harvey:** I have confidence that they are technically some of the best geoscientists that we have.

**Mike Stephenson:** Toni represents DECC and I represent the British Geological Survey. We are a geological research institute. We are not the same as a university because we have a more long-term strategic view. We will tackle problems of a strategic nature that are important for the country as a whole. We are different from a university but we have a set of scientists who are here to answer these very questions. In the past, we have done surveys of coal, tin or whatever. We have made inventories of the country's resources: that is our job. We are still here to do that same kind of work for new resources, as and when they come along. Our particular value is that we have a lot of data. We have existed for a very long time so we understand the geology of Britain very, very well. We can provide that kind of service pretty well uniquely to the Department of Energy and Climate Change. Can I just say one other thing? We are very, very careful in producing reports like this that, rather like a schoolkid doing his homework with a maths problem, you show your working. The working is very, very clear in here. There is an enormous amount where we show how we worked it out. Any geologist can look at this and see where our assumptions are, what numbers we made and what variabilities we included, so it is very transparent.

**Lord Shipley:** Have there been any comments? Is there any kind of peer review or should we simply accept it as being right?

**Toni Harvey:** Yes, we have two external reviewers. One, admittedly, was transitioning out of the BGS but he was an expert in his field. The other was Al Fraser at Imperial College, who gave us very detailed comments back on the document that we integrated into the final version.

**Lord Shipley:** So what we have is an agreed statement that broadly speaking everybody in the field could sign up to—is that what you are saying?

**Toni Harvey:** It is an interpretation. If you give two geologists two seismic lines and two logs, they will come up with varying interpretations. There is the issue with seismic data quality in the UK because it is mixed vintage and can only be acquired over a licence as it exists. You have lots of itty-bitty little lines that have to be interpreted. The geophysical interpreters at the BGS did an outstanding job at that but they were making an interpretation and we had to make some assumptions and say, "We are going to go this way, making this assumption". If you threw six other good geologists the same data, they might come up with a slightly different map.

**Lord Smith of Clifton:** That sounds worse than the House of Commons.

**Q21 Baroness Blackstone:** Is there any large-scale research to replicate what you are doing, and possibly to come up with something slightly different, in departments of geoscience or geology in British universities? Are the research companies funding this sort of work, or are you really the only source of evidence on this subject for the UK?

**Mike Stephenson:** No, we are not. A number of university departments are doing lots of work on shale gas that does not necessarily repeat what we have done. I think there is a broad agreement that this assessment of resources is a good starting point. There is broad agreement that the methodologies that were decided on were good. The data have limitations, but we were very observant of them. I think there is a broad understanding that this is a good starting point, but as I say other universities are looking at shale gas and at a whole range of issues that are just as important to cover. Here we are really looking at resources. It is very important to remember that it is simply what we think might be underground. It is not that we are sure what can be got out of the ground; that is a very different question. There are a lot of geological problems that have to be solved to try to understand that question as well. So there is a range of research activity going on in universities.

It is also good to remember that resource estimates have been done by private companies of parts of the area that we have looked at, and they are broadly consistent, compensating for different areas and thicknesses and so on. All the evidence is pointing to this being a reliable first go, but as I say it is only a resource estimate; it is not a reserve. Understanding how much you can get out of the ground is a very, very different question.

**Lord Rowe-Beddoe:** Could you kindly inform us what the main outputs were from your joint report, which was published in July this year?

**Mike Stephenson:** It is a long report and there is a lot in there. In brief, we showed that there seems to be a large resource of around 1,300 trillion cubic feet, which again sounds like an enormous figure but which again I would say is a resource figure. We calculated the volume of shale in the area of Britain roughly between Lancaster in the north-west, Wrexham in the south-west, Scarborough in the north-east and Nottingham in the south-east. We calculated the volume of shale quite accurately, and we made some assumptions about the amount of gas per unit volume of shale, which is how we got this very large figure of 1,300 trillion cubic feet. That is the headline message: that there is a large resource in this part of the country, the north of England.

The second thing you could say is that it is not the same all over the north of England. In large parts of central northern England, in the Pennines, there is very little shale, because it has been eroded away or because it is so close to the surface that the gas will probably have gone anyway. Either side of the Pennines, the shale goes down deep. You cannot see it at the surface but it is, for example, under Cheshire, north Lancashire, parts of Yorkshire and parts of Lincolnshire. Broadly all that area has shale underneath it, but there are four or five places where the shale gets to quite extraordinary thicknesses of 5 kilometres. It is not the same thickness in all places. That is the next message.

Another message is that we think there are two layers of shale that are probably quite good: an upper layer and a lower layer. Neither of those is found all over and not always together either. Where they are found together, one is on top of another, and then you really have a lot of shale thickness. The lower layer is rather complex and deep, and we do not know as much about it because it is further away. The upper layer we are more confident about, because we have more wells that have penetrated it, our seismic is more reliable and we have more information.

I suppose the last message, which probably again Toni would amplify, is that although this is a large figure it will take a long time before we know how much of it could ever be produced. We never went into the business of recovery factors here. That was not part of



the study's remit. We stopped very clearly at simply trying to define the resource with the best data and information we had.

I would say that that was a simple summary.

**Q22 Lord Rowe-Beddoe:** I have a question on the lower and the upper levels. I understand from your report that the upper layer has been easier to quantify, if I may use that word, than the lower, however there has been a substantial increase in your findings between the report of 2010 and that of 2013. Would you like to comment on that?

**Mike Stephenson:** That is easy to answer. The 2010 report, which we also produced for DECC, was not a resource figure; it was a calculation of a reserve figure. It sounds odd that you would do it in that order, but in essence we used a different method to calculate. Admittedly it was a first go; I think we would all agree that. We all wanted to know at first what potential there was in the country. So to calculate that first figure, we worked out the area of shale in the north of England and looked at shales in North America, and we found out what the yield of shale gas was per square unit—per square kilometre, or square mile. We simply took that figure and multiplied it by the figure in Britain to get a number. That number is like a reserve figure. It is the small version, if you like.

This is a resource figure, so it is a much, much more rigorous assessment. It is not a reserve figure, so the two figures are not comparable.

**Lord Lipsey:** Can I just ask you to clarify the difference between the resource figure and the reserve figure, which I do not think is instantly grasped?

**Toni Harvey:** A resource figure is the gas in the container; it is how much gas is in the sub-surface. A reserve figure is how much you can ultimately produce. There are lots of unknowns before we get to that place. Only one well was fracked in the UK and was partially tested before we paused shale gas for some time. Until we have a number of wells tested for an extended period, we will not know how productive each well will be, and it is on that per well basis that we should be able to come up with some estimate of how much might be produced to become a reserve.

**Lord Smith of Clifton:** Where there are two layers, are there any constraints on which one you frack first? Are there any indications that the lower one or the upper one will be, as it were, more profitable, given the output? My inclination is that if you frack below, you are likely to create problems above, so you would frack above before you fracked from below. Does that make sense?

**Toni Harvey:** I am not an engineer, but I think people generally try to start at the bottom so that they can do some testing and then move up the hole and do the next and so on. In the most efficient test scheme, you would start at the bottom or at the toe of a horizontal well and work back up so that the results of the previous frack did not affect you further up the well.

**Mike Stephenson:** One of the other uncertainties about this is that although I said that there are places where the shale is five kilometres thick, we do not really know which parts of those five kilometres would be good or what the variability within the shale is. Really, this is very much a first pass. It is up to the companies whether they choose to drill a well and to investigate. First they have to decide where they want to drill. Then, having drilled a well, they will get information about which layers in the shale seem to be best and which are not so good. We have done our job in the sense that we have tried to make an assessment of the size of the potential. That is what a geological survey does; it takes a resource,

advertises it and makes it open for inward investment. Really, it is the commercial prospect that takes over after that. It is the companies that decide where wells are drilled and why they are drilled. We will not go that far.

**Lord Griffiths of Fforestfach:** My question is about how you go from an estimate of a resource to an estimate of a reserve. My immediate instinct would be say that it depends on how many resources people in companies put into a resource to try to convert it into a reserve. There might also be something scientific and technical that prevents that. Even if companies put more resources in, it would not be easy to move from one to the other. Could you explore that a little for us?

**Toni Harvey:** The conventional way to calculate a reserve number is to calculate a resource and a recovery factor. A certain percentage, say, could be recovered, and then you would fine tune that recovery factor. The experience in North America, particularly in the US, is that the USGS has developed a different methodology for coming up with resource assessments, and ultimately reserves. They found that that old recovery factor method just did not work. For unconventional reservoirs, it is how much each individual well can produce; it is the estimated ultimate recovery of a well. Then you just decide how many wells you are going to drill. They have also found that the estimated ultimate recovery changes quite a bit throughout a basin, so you need to narrow it down to where the sweet spots are in that basin. The USGS do all their work now by looking at the decline rates on the wells that have been drilled and put into production. From that, they extrapolate to say what the entire basin will be. We just do not have the data yet to be able to do that.

**Lord Griffiths of Fforestfach:** The report that you held up then is about shale gas. It is not about tight oil. Could tight oil also be a substantial addition to the UK's shale resource?

**Toni Harvey:** When DECC commissioned the report, we were focused on shale gas. It came somewhat as a surprise to us, because we thought that Bowland shale was going to be very deeply buried and entirely in the gas window, but there actually is some Bowland shale in the oil window, which is less deeply buried. So again, back to this figure of 42, the light orange is the Bowland shale that is in the oil window, and the dark orange is the Bowland shale that is in the gas window. Because most of it was in the gas window and we had not scoped out the report to do an oil estimate, we stopped at gas. DECC has now commissioned the BGS to do a report on the Weald basin in southern England, because that basin has not been buried as deeply and is likely to be mostly liquids. In that case, we will probably come out with a shale oil estimate, and we might not go to the effort of doing a shale gas estimate.

**Lord Griffiths of Fforestfach:** And you have no initial idea of what that might be?

**Toni Harvey:** No, we are still doing the seismic mapping, log analysis and core rock evaluation. There is a lot of work to be done.

**Q23 Lord May of Oxford:** The next question is the one that you answered initially. It was to ask what the difference is between shale gas and what is normally called natural gas. Then there is a follow-up question that I think you also answered for somebody else a little further on: how does the estimate of volumes of shale gas in place compare with the likely amount of offshore gas recovered from fields in the North Sea? I would like to pursue that a little more because the estimates for the North Sea are, as I understand it, more generous than they might have been in earlier times: 101 TCFs, whatever those are. That is of course the estimate of the recoverable amount. I wonder if you could go into a bit more detail on the comparison that I imagine BGS must have made, whether or not it is in the public

domain. My note says it has made no estimate of how much shale gas can be recovered economically but I wondered if you have a view on that.

**Toni Harvey:** There is a different approach when we look at the “Yet to Find”. DECC publishes a number of estimates for offshore: the reserves we get from the companies, the PARs which are the Potential Additions to those Reserves that we work up with the BGS, and finally the “Yet to Find” that we work up with the BGS as well. What they do for conventional is that they look at every mapped prospect that has been either not been drilled or partially drilled and needs an appraisal well. That “Yet to Find” number is on closed geologic structures that are mapped in every case. With this unconventional contiguous reservoir you cannot put a closing contour for each prospect. They are very different and for that reason we have not added shale gas or oil to our “Yet to Find” DECC estimates.

**Q24 Baroness Blackstone:** The report that came out last July focused on shale resource in one area—a big area—and you have referred quite often in your responses this afternoon to the north of England. When can we expect work to be done on the rest of the UK, or certainly the rest of England and Wales? How soon will this be done? What is the timetable and what are factors that will determine that timetable for further work?

**Mike Stephenson:** The first thing to realise is that there are parts of Britain where there is no point in doing it because there is simply no shale. There are other areas where it is worth a look: the Weald is something that Toni mentioned. The south-east of England is being done at the moment. We expect the results of that about March next year. The intention is to look at the central lowlands of Scotland after that, so the area essentially between Edinburgh and Glasgow, the two bounding faults of the mountains in the north and the uplands in the south. That will be the third area.

**Toni Harvey:** But it is an incredibly time-consuming process to interpret all the seismic data. For the Bowland report, they looked at over 1,000 wells to come up with 60 that had any penetrations into shale. We did rock evaluation of 50 wells from outcrops, samples and cuttings. There is the geochemistry and basin modelling. It is not worth doing if you do not do it in a lot of detail so it takes time.

**Baroness Blackstone:** So what sort of timescale are we looking at before we have a complete picture for the UK?

**Mike Stephenson:** It depends on how realistic we think the prospects are. In the case of DECC and the BGS, we have to spend that money thoughtfully and carefully. It was a good decision to look at the north of England: that obviously has potential because in the United States there are similar rocks that have yielded shale gas. I think it is reasonable to look in the south-east of England and the lowlands of Scotland but we have to keep one eye on how likely the shale gas business is in the country rather than survey the whole country. That would be an enormous task, and complicated, long-winded and difficult. It is sensible to concentrate in the areas that have the most potential.

**Baroness Blackstone:** That obviously makes sense. Can you tell the committee how much it is costing to do the study you are doing at the moment on the south-east? How much will it cost approximately to do the central lowlands area of Scotland?

**Toni Harvey:** I honestly do not have those numbers. I have looked at them and we approved them but I do not know them.

**Baroness Blackstone:** Perhaps you could let us know.

**Toni Harvey:** Yes, I can provide that information.

**Mike Stephenson:** Can we tell them what the north of England one cost?

**Toni Harvey:** Yes, I think the Bowland one, by the time we were done, cost about £350,000.

**Baroness Blackstone:** How much?

**Toni Harvey:** £350,000.

**The Chairman:** That was for what, sorry?

**Toni Harvey:** The Bowland report.

**Q25 The Chairman:** Can I take it that the areas of the United Kingdom that you have not mentioned are likely to be those where there is not much potential? In other words, have you covered them all?

**Toni Harvey:** We will prioritise, that is all I can say. We want good value for money. We do not want to spend money researching things that do not have enough information to be a useable product.

**Lord Griffiths of Fforestfach:** But are you certain that there are some areas where there is no shale?

**Mike Stephenson:** Absolutely: the highlands of Scotland. We know where the shale is: that is done. It is all the other stuff that is difficult. Shale is a rock, shale gas is the gas in the rock but how do we know if the shale contains gas? That is the question. We know exactly where all the shale is and we have known for a century. The business of understanding how much gas is in it is much, much more difficult. That is where it costs money. There are certainly areas where there is no shale. For example, in the highlands of Scotland there is no shale.

**The Chairman:** Lord Rowe-Beddoe, ask him about Wales.

**Lord Rowe-Beddoe:** That is right. What about Wales?

**Mike Stephenson:** Wales is interesting because the black slate that you have probably been hiking on—I do not know if you know north Wales—is shale that has been cooked up, heated up and made a lot harder and turned into slate. It is, or was, shale. A few years ago if you had asked me or other geologists if we would ever get any gas out of that people would have shaken their heads and said “Absolutely not”. There are signs in the United States that some older, harder slates—shales that have been cooked and heated in the enormous furnace of the Earth’s crust—can yield gas. You cannot write that off but it is quite far off. It is not something that we consider at the moment.

**Lord Rowe-Beddoe:** What about the south Wales coal valleys?

**Toni Harvey:** I think there is prospectivity in south Wales.

**Mike Stephenson:** In south Wales, definitely.

**Toni Harvey:** But there is not a lot of data just yet, or well penetrations. Certainly, it would be wonderful from DECC’s point of view if we had some exploration drilling that we could study.

**Baroness Blackstone:** Can I just go back to the cost of the study that you have done so far? That does not seem to me to be so high as to decide not to continue with further

studies in the rest of the UK, given the possible potential of output that could be of enormous value in terms of our energy crisis.

**Toni Harvey:** I do not think we have said we will stop yet. We will continue to evaluate the prospectivity in a prioritised manner until the point that it is not worth doing. We want value for money.

**Mike Stephenson:** It is cheap in comparison to drilling a well. Drilling a single shale gas well takes millions.

**Lord May of Oxford:** I cannot help but remark upon the word “prospectivity”, which made its way into Baroness Blackstone’s question and which she very properly avoided uttering.

**Q26 Lord Lipsey:** Mr Stephenson, could you tell us what other work BGS is doing on shale, for example on methane concentrations?

**Mike Stephenson:** We do two kinds of work in general. One is looking at the resource: the size of the resource and where it is. The other is essentially looking at safety: the environmental impacts of possible exploitation of shale gas. Starting with that second kind of work, we are presently doing a methane groundwater study. We are looking at the natural amounts of methane in groundwater in parts of Britain. The reason we are doing that is so that we understand how much methane there is in groundwater naturally so that if there was ever a shale gas industry and something went wrong we would know. That is what we call a baseline study. We are also looking at seismic baselines, in other words natural earthquakes and how much natural earthquake activity there is. Again, that is for the same reason so that we know if there is something out of the ordinary. It is very much trying to understand what the natural environment is like. We are also doing studies of the distances between shale layers and water-bearing aquifers. We are looking at most of Britain for this and we are mapping out areas where there is a big difference and where there are small differences between possible shale layers and layers where we get water. It is not finished yet but that would be a very important way of essentially screening which parts of the country have aquifers close to shales and where aquifers are far away from them. That is a brief summary of the environmental impact area. In the resource area, this is obviously our most important piece of work because it illustrates the size of the resource. We are also in our laboratories looking at how methane moves through shale. We have experiments that operate at pressures and temperatures similar to the sub-surface and we test how methane moves. We would also like to simulate a frack in the laboratory and see how frack moves. We are also looking at something Toni mentioned that is very important: what is it about the organic matter in shale that makes it good for gas? We actually do not know at the moment. We know that there are different kinds of organic matter in shale. There are broadly two kinds: terrestrial, so pieces of wood and material from ancient forests that dumped their stuff into the lakes and the sea; and marine organic matter, which is phytoplankton—plankton components, essentially. We do not know which of these is best so we are trying to understand the original depositional environment of these shales, so what the environments were like 330 million years ago that produced these shales. In this area, we are trying to understand the shales because it could be that a lot of our shale is useless. That is possible. It could be that only thin layers are good. We need to understand that and also be able to predict where those layers are. In general, just to summarise, we are looking at the resource and trying to understand that in more detail than just how much there is, and also at possible environmental impacts including baselines studies of seismic and groundwater.

**Lord Lipsey:** The environmental impacts are quite an interesting case really. There are pressure groups hard at work, some of which claim that certain kinds of environmental impacts are terribly important or that it should all be stopped. Then there are the scientific facts of the matter, and, of course, Ministers are always looking for an answer to the certain kind of environmental pressure that they are under. I wonder how between DECC and BGS you reconcile one set of priorities that you might call the scientific priorities, with another set of priorities that you might call the political priorities.

**Mike Stephenson:** BGS is a science institution; we do not do politics. What we do is try to understand, as I said, the resource and the environmental implications of exploiting that resource, so our decisions about what we think the scientific priorities are will be related to what we think the biggest risk is. For example, at present we think that the biggest risk is a problem with the well and whether it leaks. The important thing is that those wells are completed and engineered properly, because that is the time when the gas is closest to the water-bearing lanes. Essentially, as scientists, we are trying to understand what the most important research questions are.

**Lord May of Oxford:** What you just said about the interplay between the vegetation that is there with, as it were, pre-shale was basically an amplification of the answer you gave me earlier. It was that sort of more finely grained analysis that I was after, so I very much welcome what you just said. Some of these potential themes might turn out to be really quite useless and others might be a really great idea, but we do not know much more than that.

**Mike Stephenson:** One interesting area is how much is absorbed and how much is free gas. We do not really know. That might affect how efficient the fracking process is.

**Lord May of Oxford:** That is what I had in mind with my earlier question. On the other hand, you said little about it so I did not pursue it, and I very much welcome what you just said.

**The Chairman:** How much does American experience and American research help you in this? Presumably a lot of similar work is being done there.

**Toni Harvey:** The experience from America is that every shale play is different and that it varies dramatically from basin to basin, so you really need to do the detailed analysis. There are certainly engineering optimisations and technologies in fracking that we could employ if we had a fully functional service industry, building on a commercial development, but the rock properties really will be different here and different in different parts of the UK.

**Q27 Lord Griffiths of Fforestfach:** In the States, who determines the budget of the scientists who are doing the equivalent in the BGS? How much of the resources going into finding out about what is there is private sector? And how would that compare to the UK's balance between the two?

**Toni Harvey:** I cannot answer that, but I suggest that you perhaps ask the Office of Unconventional Oil and Gas. They have people who regularly communicate with American colleagues.

**Mike Stephenson:** Geological surveys—I am a representative of one—were rather unusual kinds of organisations, but every country has one because there is a job to be done, which is to find out what the natural resources of a country are, to understand them scientifically and to recognise them either as a resource or not as a resource. The United States has a geological survey, the US Geological Survey, and most geological surveys know that they go

a certain distance in the business of understanding the resource and that there is a point where the commercial world takes over, if you like. It varies a little in different countries. Australia, for example, might take the process a little further. The geological survey of Australia might work up the prospects to a higher degree of understanding because they feel that that perhaps attracts the companies. We probably go a little less far, but essentially that boundary between where public science stops and commercial science starts is very similar the world over. There is a point where we think there is no point in spending public money on something which a commercial company ought to be doing. This is a very broad-brush look at geology and shale gas. We would not go as far deciding where a well would be drilled or doing an awful lot of detailed on a small area, because that is the company's job. That is the risk they take.

**Lord Griffiths of Fforestfach:** But that calculation would be critical in moving from a resource estimate to a reserve estimate.

**Mike Stephenson:** That is absolutely right.

**Q28 Lord Smith of Clifton:** First of all, a lot of your survey seemed to be sequential in nature rather than simultaneous. If DECC said, "We want you to look at the UK-wide position", would you have the staff resources and the scientific back-up to do that, or is the sequential nature of it because it is within your agency's abilities?

**Mike Stephenson:** I can answer that. The British Geological Survey has a lot of different jobs to do. We are looking at a great range of things to do with geology in the country, and if we diverted a lot of resources into shale gas, something would get smaller. We are operating in a period when there is not a lot of money around. It depends on how it would be done. I suspect it is the same for DECC. DECC might decide that it is not sensible to spend a very large sum of money on this.

**Toni Harvey:** We also do offshore studies that we publish on our website, and we do a promote effort every year to try to get new entrants to come and invest in the UK both onshore and offshore. The BGS helps us on that promote effort.

**Lord Shipley:** Who decides what research the BGS does? You have a budget of £45 million a year, half of which is publicly funded, so presumably the public body, DECC, will take a view as to what you should be doing. How do you decide on the priorities? Is it project by project that you are financed for, do you simply get a sum of money each year from DECC and you decide what to do, or do you do private work that might help to provide an evidence base for other work that DECC is interested in? How are those priorities assessed?

**Mike Stephenson:** I am a director of science and technology at BGS, so my role is strategy for BGS for the next decade. I am looking now at where we should be going broadly scientifically in the country. I would take advice from the scientists around me, and my predecessor would have done the same. We have scientists to advise us, but we also have an advisory committee that has a range of different stakeholders, including government, oil and gas companies and environmental groups. We essentially have a broad range of advisers who help us to decide where we should be going scientifically.

We are also part of the Natural Environment Research Council. Our funding comes through NERC and is around £18 million or £19 million. We, with NERC, decide on scientific priorities. So we are part of NERC, and our scientific strategy evolves as part of NERC and through discussion in NERC. DECC is obviously a very strong influence on what we do, because we want to listen to what the resource side of government is saying. Clearly, for

me, the future in science will be resources of this kind. We need to put money and investment into understanding resources of this kind, not just shale gas but cobalt methane and methane hydrates offshore for example.

To answer your question about companies, we do work with companies. We have always worked with commercial organisations. We feel that the commercial world sharpens us up. We know what we are doing and where the value is. We understand the value of what we do. We also understand more about the geology because we work with companies, so we are able for example to get access to data that we would not have got if we did not work with companies. Across the whole of BGS, we have worked for a very long time with lots of different commercial organisations: resource companies, oil and gas companies, environmental companies, water companies. So that is an income that we also have that we can use to plough back into our national capability research.

To answer your question, we try to develop strategy research through our stakeholders and through consulting among the scientific community and with other universities and higher education institutes. We will always work with NERC and with companies to develop and sharpen that up.

**Lord Shipley:** Can I just check? Is DECC happy with the set of priorities that have been devised for BGS?

**Toni Harvey:** Yes.

**Lord Shipley:** And you are fully involved?

**Toni Harvey:** I do not think that DECC gets involved too much in what their research priorities are, but when we commission them to do work for us they have never come back and said, “We do not have time”. They have always provided what we needed.

**Q29 Lord Smith of Clifton:** My main question really relates to what we have been talking about recently. When is commercial prospecting likely to begin, in your view? Is it being held up by any actions or inactions on the part of the Government? What stages need to be gone through first? What permissions are actually necessary?

**Mike Stephenson:** Commercial prospecting, as I think I hinted earlier, is really a matter for companies. We stop at a certain level, as I said.

**Lord Smith of Clifton:** But you must be reading their body language?

**Mike Stephenson:** Yes, we do. We have an idea of what they might be thinking, but essentially it is their decision and their risk. They are going to drill a well that might cost £500 million. It is their problem and their decision. I would not like to hazard a guess as to when people really get serious about it. I cannot see a huge rush of activity. I will stop there.

**Lord Smith of Clifton:** It is a bit like a bicycle race, is it not? No one wants to break through and then suddenly they will all go for it.

**Mike Stephenson:** Yes, possibly they are looking at each other to see who is going to take the first punt, if you like. It is very, very difficult for us to say. Given time, perhaps, we would be able to say better, but at the moment that is all we can say.

**Toni Harvey:** It is important to say, though, that it is the local authorities, the minimal planning authorities and their equivalents in Scotland that are the gatekeeper in some respects of what activity can happen. The companies need to get their planning permission before they can have any activity. Of course, they also have to get their relevant environmental permits and checks from HSE.



**Lord Smith of Clifton:** We heard in evidence last week that legislation was really fighting a lost war and we need to update our legislation on rights and royalties, and all that sort of thing. It involves a number of slow bicycle races, it seems to me, because the legislative side—looking at what new laws need to be introduced—is going at least as slowly as any other party involved in the exploitation of shale. Is that your impression? I know you do not want to get involved in politics, but do you read the body language that way?

**Toni Harvey:** I read your body language. I think that the Office of Unconventional Oil and Gas is trying to come up with ways to streamline the process, and I suggest that you get someone in from the office to talk to you.

**Mike Stephenson:** One thing to say is that it is important that we get it right. I thought that DECC had a very, very cautious approach after the problems of the two earthquakes. DECC asked for a report on how this could be done safely. The report was reviewed by some leaders in the field. It took over a year. Those things do need to take time, because they are important. It is important, too, for the public to be reassured, so you have to go at the right speed.

**Q30 The Chairman:** One area about which the public and certainly some environmental groups need to be reassured is water, which we have talked about briefly. It would be interesting to know what view geologists take of the possible impact of shale gas development on water supplies and the risk to water quality.

**Mike Stephenson:** I think the key is to remember that shale will be exploited or fracked pretty deep, so a long way from rocks that contain water. That is the principal barrier: the enormous thickness between where the shale is and where the water-bearing layer is. Most geologists find it very hard to imagine that contamination could occur in those circumstances. We think the major risk is where the well goes through the aquifer—the water-bearing layer—because that is where the gas is closest to our water. The key thing is the engineered quality of the well and making sure that that is good enough to protect our water, both during the activities and a long, long time afterwards when the well is abandoned.

**Lord May of Oxford:** That is a somewhat more anodyne response than BGS, who have recently produced an initial study. Its vague summary is quoted here. The report stresses that the large volume of water required could in some areas put pressure on groundwater resources, limiting its availability for other uses and potentially damaging groundwater-dependent ecosystems. This can partially be addressed by reusing suitably treated flowback water. So the issues are location-specific, as you said, but that conveys to me a less upbeat response than the one you just gave.

**Mike Stephenson:** That is different. You asked me about groundwater. I am talking about the protection of groundwater. I agree with you: there is an issue over the use of water for fracking where there is not enough water to go around. The overall usage is rather small—I can go away and get figures for you. The overall usage, even in quite a large fracking industry, is quite small but there are areas where you would perhaps not want to use water in that way because there is pressure on it. At that point, presumably the Environment Agency would not issue a licence to you to do it. It can be managed but you are right: water usage would have to be carefully looked at. It does use substantial amounts of water.

**Baroness Blackstone:** Since this is an issue and obviously one that concerns a lot of people, what evidence do we have from the United States?

**Mike Stephenson:** In some areas of the United States, they have had to truck water in—they have brought in water in trucks—because they have not had enough naturally available to frack with.

**Baroness Blackstone:** That is a different issue. Has the water supply been in any way either contaminated or reduced as a result of fracking anywhere in the US? Are there any conclusions we can draw from what has happened in the US?

**Toni Harvey:** I think you need to talk to someone from the Environment Agency or SEPA who have done quite a bit of research into that.

**Mike Stephenson:** I could answer that. There are peer-reviewed papers in the United States that have come out recently that show that there is evidence of fracking gas getting into water supplies. There is a paper by Jackson et al in the *Proceedings of the National Academy of Sciences*. That team attributed the problem to core well completions, so the well not being properly finished—in other words, leaking. There have been examples of fracking water getting into, for example, surface water. There are a small number of examples.

**Baroness Blackstone:** That suggests that when we actually move to prospecting, the quality of the wells will need to be rather carefully regulated.

**Mike Stephenson:** Absolutely.

**The Chairman:** It is more an impact of it not being properly done than it is a general problem. The lesson of the American experience is getting the wells right rather than saying there is a fundamental problem.

**Mike Stephenson:** Yes, I think the record of the United Kingdom in looking after wells is pretty good. Offshore, we have an awful lot of wells and we are pretty good at doing those and finishing them.

**Lord Smith of Clifton:** Except in the Gulf of Mexico.

**Mike Stephenson:** That is not the UK but you are right.

**Lord Smith of Clifton:** It is a UK company.

**Q31 The Chairman:** While we are talking about these environmental issues, could you say something about the risk of earthquakes?

**Toni Harvey:** Measures were announced last December, after careful consideration for almost 18 months. There will be a careful study done to see what the stress fields are and the historical seismicity, so that we know what stress faults might exist in the area. There then will be a detailed analysis of where they intend to frack to make sure that they are not intending to frack near an active fault. Finally they will have measures in place to run a traffic light system, where if they get a little earthquake they then listen to see if they get a bigger earthquake later. If they start to get a little one that is very tiny—only 0.5, which nobody would feel—they will stop for analysis. The last thing we agreed with the industry is that they will do a technique that will allow them to calculate how high the fractures grow, to again make sure that the fractures never get near any water supplies. Those measures together are probably the most stringent anywhere in the world for induced seismicity. The places that have had the most problems with earthquakes in North America are where they are disposing of the flowback fluid into a disposal well. They take flowback fluid from a number of wells and pump it into the sub-surface. That clearly causes earthquakes. We would not do that here in the UK.

**The Chairman:** We are getting close to the end. Lord Rowe-Beddoe and then one final question.

**Q32 Lord Rowe-Beddoe:** On environmental aspects, would either of you care to make a comment on radon?

**Mike Stephenson:** Shales are weakly radioactive: something like 10 parts per million, which is much less than you get in somewhere like Aberdeen or Cornwall. There are quite low levels of radioactivity but they are radioactive. Small amounts of radioactivity can get into flowback water and into gas. This is quite a well known phenomenon in the oil industry because oil and certainly gas sometimes contain radon. Methane gas contains radon. We do not regard it as a serious risk.

**Lord Shipley:** Could I just ask Mr Stephenson about the work you do for private clients? Are you doing anything for a private company on shale gas or tight oil in the UK?

**Mike Stephenson:** We are doing a small number of small contracts with oil and gas companies in the UK.

**Lord Shipley:** Are they going to be published?

**Mike Stephenson:** We cannot publish that data because it is in commercial confidence.

**Lord Shipley:** That could mean that BGS, which is half-funded by the public purse, does work for a private company that is not published. That could mean that that private company has information that DECC does not.

**Mike Stephenson:** That could not happen because the company is paying for us to do the work. It is not public money. We do this work because being close to the companies sharpens us up. We can see and get information that we would not otherwise get. For example, if a company drills a well we know about the geology if we do some work for that company. That is valuable.

Essentially, we see it as our role. It also enables us to understand more about the geology and make the money go further. Although we cannot publish the information, we know it and it helps us to understand the geology of the country better.

**Toni Harvey:** I have to say that for the Bowland report, the companies that had BGS do independent reports for them, when asked, shared those with us. Cuadrilla, IGas and Aurora shared their proprietary analyses, which we used in our report even though we did not publish any of the data in it. When the companies have been asked, they have shared that information with DECC.

**Lord Shipley:** Just to be really clear about this, is DECC concerned that it might be in the position where it might not have the information that would assist it in, say, allocating a licence while a private company did, it having been given to them by work done by BGS? Is there any conflict you can see in this?

**Toni Harvey:** No, because if they want the licence they will come to DECC. One of the criteria we award the licence on is the depth of their technical assessment. They will win more marks if they show us that they did more studies.

**The Chairman:** This has been a most fascinating and very helpful session to us. As I think you know, we are at the very early stages of our inquiry. We are very grateful to you for sharing your expertise with us. Thank you very much indeed.

## **Centre for Climate Change Economics and Policy (CCCEP) and Grantham Research Institute on Climate Change and the Environment—Written evidence**

**The Centre for Climate Change Economics and Policy (CCCEP)** was established in 2008 to advance public and private action on climate change through rigorous, innovative research. The Centre is hosted jointly by the University of Leeds and the London School of Economics and Political Science. It is funded by the UK Economic and Social Research Council and Munich Re. More information about the Centre for Climate Change Economics and Policy can be found at: <http://www.cccep.ac.uk>

**The Grantham Research Institute on Climate Change and the Environment** was established in 2008 at the London School of Economics and Political Science. The Institute brings together international expertise on economics, as well as finance, geography, the environment, international development and political economy to establish a world-leading centre for policy-relevant research, teaching and training in climate change and the environment. It is funded by the Grantham Foundation for the Protection of the Environment, which also funds the Grantham Institute for Climate Change at Imperial College London. More information about the Grantham Research Institute can be found at: <http://www.lse.ac.uk/grantham/>

This policy paper is intended to inform decision-makers in the public, private and third sectors. It has been reviewed by at least two internal referees before publication. The views expressed in this paper represent those of the author(s) and do not necessarily represent those of the host institutions or funders.

### **Introduction**

The Grantham Research Institute on Climate Change and the Environment (<http://www.lse.ac.uk/grantham>) and the Centre for Climate Change Economics and Policy (<http://www.cccep.ac.uk>) welcome the opportunity to respond to this call for evidence by the House of Lords Select Committee on Economic Affairs for its inquiry on ‘The economic impact on UK energy policy of shale gas and oil’.

This response is based on ‘A UK ‘dash’ for *smart gas*’, by Samuela Bassi, James Rydger, Sam Fankhauser and Bob Ward from the Grantham Research Institute on Climate Change and the Environment and the Centre for Climate Change Economics and Policy at the London School of Economics and Political Science, and Cheng Seong Khor and Neil Hirst from the Grantham Institute for Climate Change at Imperial College London. (<http://www3.imperial.ac.uk/climatechange>).

### **Response to select questions**

#### **Q1. How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?**

1.1 The Government’s Gas Generation Strategy states that between 19 and 37 gas-fired power stations will be built before 2030, suggesting that there is scope for shale gas to be used in the UK for power generation (DECC, 2012a). It should be noted, however, that new gas generation capacity at the upper end of this range would result in a carbon intensity

of 100g-200g CO<sub>2</sub>/kWh by 2030 for the power sector. This is far above the 50g CO<sub>2</sub>/kWh level recommended by the Committee on Climate Change (CCC, 2010). Investments in new gas-fired power stations will have to be carefully calibrated with domestic reduction objectives for greenhouse gas emissions, in order to avoid breaching the carbon budgets. Beyond 2030, the scope for gas, including shale gas, to be used in the UK, will depend on the rate at which carbon capture and storage technology can be commercially deployed.

1.2 The future price of natural gas will also be a key factor. The price will partly depend on how much of the shale gas resources available (or ‘in place’) in the UK and Europe can be commercially exploited (i.e. become ‘proven reserves’). It will also depend on whether the United States and China (which are currently estimated to have the largest shale gas resources) are able to trade natural gas on international markets. Both are uncertain.

### **Shale gas in the UK**

1.3 In the UK, the latest figures from the Department of Energy and Climate Change and British Geological Survey (DECC, 2013) suggest that the Bowland-Hodder Unit alone in northern England may have between 23.3 and 64.6 trillion cubic metres of shale gas in place, with a central estimate of 37.6 trillion. This compares with an estimate by the United States Energy Information Administration (EIA, 2013) that the volume of UK shale gas in place is 17.64 trillion cubic metres.

1.4 These numbers are large, but the volume of gas that is technically recoverable and can be demonstrated to be economically and legally producible under existing economic and operating conditions (known as the ‘proven reserve’) is likely to be much smaller than these resource estimates. The United States Energy Information Administration estimates that the UK has which 0.74 trillion cubic metres of “risked, technically recoverable shale resources”, which is approximately 4 per cent of the in place estimate. Applying this to the estimates by the Department of Energy and Climate Change and the British Geological Survey would suggest that the ‘proven reserve’ of shale gas in the Bowland-Hodder Unit would be 0.9 to 2.6 trillion cubic metres. The British Geological Survey and the Department of Energy and Climate Change have not published an estimate of proven reserves.

1.5 The key point is that UK shale gas resources could increase the UK’s energy security and create new jobs. But the information that is currently available does not indicate that UK proven reserves of shale gas will be sufficient to stop the UK being dependent on imports of natural gas.

### **Shale gas in Europe**

1.6 The UK currently imports approximately half of the natural gas it consumes from Europe and the Middle East (National Grid, 2012), so the extent to which shale gas resources in other European countries can be commercially exploited, as well as international prices for oil and liquid natural gas, will have a bearing on the future price of natural gas in the UK.

1.7 A number of European countries are known to have reserves of shale gas, particularly France and Poland. However, the European Commission’s Joint Research Centre (IRC, 2012) points out that predictions that shale gas will have a significant impact on the European Union are based on optimistic assumptions about production costs and reserves. So the impact that shale gas resources will have on the price of natural gas is unclear.

1.8 A shale gas ‘boom’, like that occurring in the United States, is very unlikely to be replicated in the UK and rest of Europe. The amount of technically recoverable gas in the United States is significantly higher and there are big differences in the population density, geology and regulatory framework.

### **Reserves of shale gas in the United States and China and the impact on international markets**

1.9 The natural gas industry is dominated by regionally segmented market structures, rather than globally integrated markets as there are for oil. This is due to high transportation and storage costs. As a result there is no global wholesale price and gas prices vary widely between regions.

1.10 It is very difficult to predict the price impact that future imports of natural from the United States and China (the countries with the largest reserves of shale gas) could have on the prices in the UK and Europe. There are signs that the market could become more integrated. For instance, Centrica this year signed a 20-year deal with United States energy company Cheniere Energy to purchase 2.5 billion cubic feet (70 million cubic metres) of natural gas a year (Financial Times, 2013) from 2015.

1.11 Nevertheless, the uncertainty is great and the evidence so far has not been sufficiently conclusive to allow a robust prediction that the price of natural gas will fall in the UK and Europe in the coming decades. The International Energy Agency (2011), for instance, assumes that natural gas prices will continue to rise worldwide up until 2035.

### **Q5. Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

5.1 The amount of natural gas (shale or otherwise) that the UK can use for electricity generation is constrained by the requirement set out in the Climate Change Act to reduce annual greenhouse gas emissions by at least 80 per cent below 1990 levels by 2050 (HM Government, 2008). To meet this target the UK power sector will need to be largely decarbonised by 2030 (CCC, 2010). This will require substantial investments in low-carbon power generation technologies. Natural gas could be used to balance out intermittent supply from renewable sources, such as wind. It is also likely to remain a significant source of fuel for heating, but its role will be gradually reduced as improvements in energy efficiency and the roll-out of low-carbon heat (like heat pumps) take over.

5.2 The opportunity to use natural gas for power generation will be greatly increased if carbon capture and storage technology can be developed and deployed commercially by 2030. However, more needs to be done by the European Union and UK to support the research and development on carbon capture and storage technology to make this a realistic expectation.

5.3 Beside environmental and technological constraints, a further barrier to the use of shale gas in electricity generation is the potential lack of a conducive investment environment. Notably, conflicting messages from the Government are creating uncertainty about the direction of future policy which could disincentivise investment. For example, the inconsistencies between the Gas Generation Strategy and UK decarbonisation ambition, combined with uncertainty about the outcome of the review of the fourth carbon budget in

2014, could be perceived by the private sector as a significant policy risk and could discourage investment in both gas-fired power plants and low-carbon energy sources.

## **7. What impact will shale gas and oil have on household energy bills?**

7.1 As noted above, large uncertainties remain about the amount of shale gas that could be technically and commercially extracted in the UK. Current estimates (e.g. EIA, 2011; Cuadrilla, 2011; DECC, 2012) suggest that shale gas may not be able to render the UK energy-independent and free from the need to import natural gas. Prices on the UK market are therefore likely to remain largely driven by wholesale prices charged by foreign suppliers. So, if the UK does successfully exploit its shale gas reserves, it will not automatically result in lower household fuel bills.

7.2 The Department of Energy and Climate Change has published two reports which come to different conclusions about the impact of shale gas on household bills. In its Fossil Fuel Projects (DECC, 2013b) report published in July 2013, the 'central scenario' indicates that gas prices are expected to settle at 73.8 pence per hundred cubic feet of gas (therm) in the 2020s, compared to 63.6 pence per therm now (see table 1).

**Table I**

**DECC 2013 Gas Price Projections**

All Prices are in 2013 pence per therm			
	Low	Central	High
2012	61.4	61.4	61.4
2013	54.1	63.6	73.2
2014	51.7	66.7	88.2
2015	49.3	69.7	90.6
2016	46.9	70.6	93.0
2017	44.6	72.2	95.4
2018	42.2	73.8	97.9
2019	42.2	73.8	100.5
2020	42.2	73.8	103.2
2021	42.2	73.8	105.4
2022	42.2	73.8	105.4
2023	42.2	73.8	105.4
2024	42.2	73.8	105.4
2025	42.2	73.8	105.4
2026	42.2	73.8	105.4
2027	42.2	73.8	105.4
2028	42.2	73.8	105.4
2029	42.2	73.8	105.4
2030	42.2	73.8	105.4

7.3 A second report, commissioned by DECC from consultancy Navigant (Rathbone & Bass, 2012), indicates in its ‘medium’ scenario that gas prices will decrease slightly between 2015 and 2030 to 65.7 pence per therm (see Table 2 below) - 20 per cent lower than suggested by the Fossil Fuel Projects (DECC, 2013b). For its ‘low’ scenario, the Navigant report predicts that gas prices will fall to 49.7 pence per therm.



**Table 2**

UK Gas Price Scenarios (in 2012 pence/therm)	Low	Medium	High
2015	59.0	67.8	69.9
2020	52.8	59.8	73.4
2025	51.3	62.0	77.2
2030	49.7	65.7	81.1

7.4 Forecasting gas prices that are lower than today requires some notable assumptions. The ‘medium’ scenario in the Navigant report envisages that shale gas production in the United States and China will continue to grow and that increasing natural gas exports, particularly from the United States, will bring the price down slightly on the UK/European market. The ‘low’ scenario makes the same assumption but also assumes significant investment in shale gas production in the UK and Europe. It also assumes a falling oil price. It should be noted that organisations such as the International Energy Agency (2011) predict that European gas prices will continue to increase through to 2035.

7.5 It is worth noting that, despite the drop in wholesale gas prices in the United States as a result of its shale gas ‘boom’, monitoring by the United States Energy Information Administration (2013) suggests that there has been relatively little impact on the average price of electricity for households, which increased by about 3.6 per cent in cash terms between 2008 and 2012. However, the effect on gas bills for residential consumers has been marked: the average residential retail price of gas decreased by about 48.6 per cent in cash terms between 2008 and 2012.

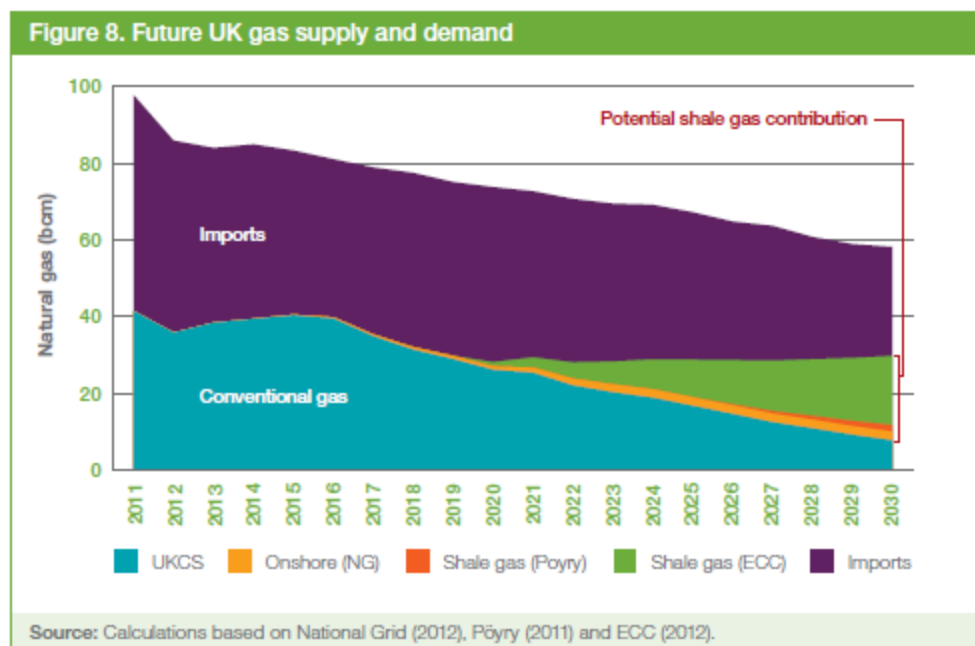
**Q8. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

8.1 Shifting from coal to natural gas (including shale gas) for electricity generation can help the UK power sector to decarbonise in the next two decades to 2030, as long as gas-fired power plants do not displace other low-carbon sources.

8.2 Beyond 2030, deeper emissions reductions will mean that natural gas should play a supporting role in the development of a low-carbon power sector, by providing essential backup for intermittent supply from renewables. It could play a bigger role if gas-fired power stations are fitted with carbon capture and storage technology.

**Q9. Will shale gas and oil increase UK energy security?**

9.1 If it can be extracted cost-effectively, shale gas has the potential to make the UK’s energy supplies more secure. However, it is unlikely to make the UK self-sufficient and the UK will continue to be a net-importer of natural gas. Figure 8 below provides more information on the potential contribute shale could make to UK supply.



(Bassi et al., 2013)

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September 2013

## Centrica—Written evidence

### Executive Summary

- The discovery of shale gas deposits in the UK presents an opportunity to explore a new source of gas to help meet growing UK gas demand.
- At this stage the size and commerciality of shale gas in the UK has not been fully determined - further exploration and appraisal activity is required to provide greater clarity.
- Centrica is the UK's largest energy supplier with substantial technical and project development expertise and has acquired a 25% stake in Cuadrilla's Bowland Basin exploration license (PEDL 165).
- We believe that the extraction of shale gas could deliver significant benefit to the UK and can be carried out safely with sensitivity to local communities and the local environment.
- But, we believe that the Government and Industry need to work together to maximise this opportunity and have provided key recommendations in this submission.

### I. Centrica Energy and Shale Gas

- 1.1. Centrica plc is a FTSE top 30 integrated energy company and the UK's largest energy supplier. Centrica companies are active at each stage of the energy lifecycle: from sourcing and generating energy at Centrica Energy through to processing and storing it at Centrica Storage. The downstream business, British Gas, provides energy and energy services to half the homes in Britain and over 1 million businesses.
- 1.2. In terms of sourcing energy, Centrica's focus is the development of a balanced and diverse portfolio to help support a balanced and secure UK energy mix. We believe gas will play a key role in securing this mix, particularly in meeting energy demand in the short and medium term.
- 1.3. This year we expect to invest around £1bn to secure supplies for the UK. We are one of the fastest growing entrants on the Norwegian continental shelf; we continue to maximise resources on the UK Continental Shelf and are a growing natural gas producer on the Western Canadian Sedimentary Basin. We have also entered into recent LNG contracts with QatarGas (2011) and Cheniere (2013) to secure gas supplies for the UK.
- 1.4. To date UK domestic gas supplies have been offshore, but shale gas represents a new source of gas and as the UK's largest energy supplier we believe it is right to fully assess this new opportunity.
- 1.5. In June 2013 Centrica plc acquired a 25% interest in the Bowland exploration licence (PEDL165) in Lancashire from Cuadrilla Resources Ltd (Cuadrilla) and AJ Lucas.
- 1.6. Cuadrilla is the operator of the Bowland exploration, but as a joint venture partner Centrica will work closely with them to bring our strong track record in safe and transparent project development to this exploration programme.
- 1.7. We will utilise our significant technical expertise in gas exploration and production, including offshore hydraulic fracturing, to assess the opportunity for UK shale gas and support its development.

## 2. The impact of shale gas on the UK energy market and economy

- 2.1. Initial data from a British Geological Survey study of Northern England suggests that there could be 1,300 trillion cubic feet (TCF) of shale gas in that sector<sup>2</sup> and Cuadrilla Resources have estimated that there is 200 TCF in the Bowland Basin.<sup>3</sup> This presents a sizeable opportunity to secure new gas resources for the UK.
- 2.2. At present it is difficult to determine the exact impact shale gas could play on UK energy as although there is a sizeable resource present, more information is required around the recoverability and commerciality of shale gas. Exploration and appraisal wells are needed to determine key factors such as the flow rates of shale gas.
- 2.3. Centrica is working hard with Cuadrilla, the operator, in Bowland to gain this additional information and the UK Government – particularly through DECC, DCLG the Office for Unconventional Gas and Oil, the Environment Agency and HSE – need to work with industry to ensure that the development of exploration and appraisal wells is able to take place in a timely and efficient manner.
- 2.4. The Office for Unconventional Gas and Oil has an important role to play in presenting the facts about shale to local communities and highlighting the UK's commitment to developing shale gas, as long as it is carried out safely and sensitively.
- 2.5. In terms of the impact of shale gas on UK energy prices, we note the report by Navigant that stated: “Our three scenarios give a wide range of potential gas prices by 2030, between 50p and 80p / therm at 2012 prices... In the second half of the period under review, the main factor determining the gas price in our view will be the extent to which US LNG exports and unconventional gas production are able to disrupt the current oil price indexed European gas markets.”<sup>4</sup>
- 2.6. But, we also recognise the comments of the Secretary of State for Energy, Rt Hon Ed Davey MP, when he said: “UK shale gas is unlikely to move global prices significantly”. He emphasised that “shale does have the potential to contribute significantly to the UK's energy security, to attract inward investment, to boost growth and jobs in certain areas, and to make a notable contribution to the Exchequer.”<sup>5</sup>
- 2.7. The House of Commons energy select committee inquiry also determined in April that it was “too early to say” whether domestic production of shale gas could result in cheaper gas prices in the UK. It said it was “unlikely” that the US shale revolution could be replicated in the UK, citing differences in “geology, public attitudes, regulations and technological uncertainties”.<sup>6</sup>

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<sup>2</sup> British Geological Survey, *The Carboniferous Bowland Shale gas study: geology and resource estimation*, 2013: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/226874/BGS\\_DECC\\_BowlandShaleGasReport\\_MAIN\\_REPORT.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226874/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf). Accessed August 2013.

<sup>3</sup> Cuadrilla Resources Website: <http://www.cuadrillaresources.com/what-we-do/about-natural-gas/>. Accessed August 2013.

<sup>4</sup> Navigant, *Unconventional Gas and the Potential Impact on UK Gas Prices*, July 2013: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223492/navigant\\_consulting\\_report.ppt](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223492/navigant_consulting_report.ppt). Accessed September 2013.

<sup>5</sup> The Rt Hon Ed Davey MP, Secretary of State for Energy and Climate Change, Office of Unconventional Oil and Gas Introductory Event, 11 March 2013. Found at: <https://www.gov.uk/government/speeches/office-of-unconventional-oil-and-gas-introductory-event>. Accessed August 2013.

<sup>6</sup> House of Commons Energy and Climate Change Committee, *7<sup>th</sup> Report: Impact of Shale Gas on Energy Markets*, 26<sup>th</sup> April 2013: <http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/785/78502.htm>. Accessed August 2013.

- 2.8. We believe that the development of natural gas from shale could have an important role to play in securing vital gas supplies for the UK as 80% of households are reliant upon gas for heating.<sup>7</sup>
- 2.9. The extraction of shale gas could also help reduce our reliance on gas imports and support substantial investment and employment. It is estimated that natural gas from shale could reduce the amount of gas the UK has to import in 2030 from 76% to 37%; nationwide investment could reach £3.7bn a year and 74,000 jobs could be supported across the industry and its supply chain.<sup>8</sup>
- 2.10. We also do not consider that investment in UK shale gas will displace investment in low-carbon generation. Investment in renewables in the US has increased by more than 400% during the last 7 years, at the same time that shale gas has grown dramatically.<sup>9</sup> Centrica has recently marked 10 years of investment in renewables with the opening of the Lincs Offshore Wind Farm in August and we believe that shale gas can play an important role in a balanced UK energy mix.

### 3. The impact of shale gas on the UK environment

- 3.1. Hydraulic fracturing of oil and gas reservoirs has been performed since 1949, with 2.5 million fracturing jobs having been performed worldwide, and 60% of all oil and gas wells now using fracturing techniques.<sup>10</sup> The technique is not new to the UK either, where 2,000 wells have been drilled onshore in the UK and 200 of these have been hydraulically fractured.<sup>11</sup>
- 3.2. The UK government has looked very closely at the impacts of onshore fracturing – including seismicity, impact on water supplies, air pollution and local impact – and is confident that it can be done in a safe and sensitive manner. There are very strict environmental regulations in place to cover all aspects of onshore fracturing and the Department for Energy and Climate Change, Environment Agency, Health and Safety Executive and Office for Unconventional Gas and Oil are working closely together to ensure the industry meets rigorous standards.
- 3.3. Centrica is committed to rigorous operational standards and although Cuadrilla is the operator, we have published a set of global operating principles, which will be applied to the Bowland project as well as to any future onshore natural gas exploration Centrica is involved in around the world. These principles cover all of the areas highlighted by operations to date in the US and are based on advice from industry experts, including the British Geological Survey, Royal Academy of Engineers, International Energy Agency, and the Centre for Sustainable Shale Development (CSSD) – a coalition of US shale companies and environmental groups.

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<sup>7</sup> DECC, *The Future of Heating: A strategic framework for low carbon heat in the UK*, March 2012: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48574/4805-future-heating-strategic-framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf). Accessed September 2013.

<sup>8</sup> Institute of Directors, *Infrastructure for Business: Getting Shale Gas Working*, May 2013: <http://www.iod.com/influencing/policy-papers/infrastructure/infrastructure-for-business-getting-shale-gas-working>. Accessed August 2013.

<sup>9</sup>*Ibid.*

<sup>10</sup>NSI Technologies, 'Hydraulic Fracturing', 2010: <http://www.spe.org/jpt/print/archives/2010/12/10Hydraulic.pdf>. Accessed August 2013.

<sup>11</sup> Institute of Directors, *Infrastructure for Business: Getting Shale Gas Working*. May 2013.

- 3.4. The Department for Energy and Climate Change recently published *About shale gas and hydraulic fracturing*,<sup>12</sup> which assesses and provides further details around the key issues associated with this process. Also, DECC's Chief Scientific Adviser, Professor David Mackay, also recently reported that "With the right safeguards in place, the net effect on UK GHG emissions from shale gas production in the UK will be relatively small." The report indicated that shale gas rated favourably to other sources of gas in terms of emissions.<sup>13</sup>
- 3.5. We recognise that there needs to be more information about shale gas and hydraulic fracturing and we call on the Office for Unconventional Gas and Oil to work with DECC, the Environment Agency and HSE to provide information and answer the questions being asked across the country about this industry.

#### 4. Community impact, engagement and benefits

- 4.1. We firmly believe that the most successful projects are developed through proactive engagement with communities and honest dialogue to address key issues. Centrica has worked on a number of large-scale onshore and offshore projects that required sensitive engagement with local communities and we will work in partnership with local communities and contribute towards sustainable, long-term benefits for the local area and economy through the development of jobs, skills and other initiatives that support local issues.
- 4.2. The UK Onshore Operators Group's (UKOOG), of which Cuadrilla is a member, will also play an important role in community outreach. They have developed a community engagement charter for their members, which has openness and transparency at its core and provides a robust framework for operators working alongside local communities in the extraction of natural gas from shale. This charter can be found on UKOOG's website.<sup>14</sup>
- 4.3. It is right that if hydraulic fracturing takes place in the Bowland Basin local communities should receive benefits for hosting these projects. Cuadrilla has already said that, should the project move to the production phase, a community fund would be established to ensure local community benefits from its operations. The UK Onshore Operators' Group (UKOOG) proposed benefits for local communities of £100,000 per well site at exploration/appraisal stage where hydraulic fracturing takes place and a share of proceeds at production stage of 1% of revenues, allocated approximately 2/3rd to the local community and 1/3rd at the county level.<sup>15</sup>
- 4.4. We do believe, however, that local community benefits must be accompanied by an efficient planning process and should be designed to deliver genuine, sustainable, benefits to the local community.

#### 5. Next Steps and Recommendations

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<sup>12</sup> Department for Energy and Climate Change, *About Shale Gas and Hydraulic Fracturing*, July 2013: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/225826/About\\_Shale\\_gas\\_and\\_hydraulic\\_fracking.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225826/About_Shale_gas_and_hydraulic_fracking.pdf). Accessed August 2013.

<sup>13</sup> Professor David Mackay, *Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use*, September 2013: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237330/MacKay\\_Stone\\_shale\\_study\\_report\\_09092013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf). Accessed September 2013.

<sup>14</sup> UK Onshore Operators' Group (UKOOG), *Community Engagement Charter*, June 2013: <http://www.ukoog.org.uk/elements/pdfs/communityengagementcharterversion6.pdf>. Accessed August 2013.

<sup>15</sup> UK Onshore Operators' Group (UKOOG), *Community Engagement Charter*, June 2013: <http://www.ukoog.org.uk/elements/pdfs/communityengagementcharterversion6.pdf>. Accessed August 2013.

- 5.1. Shale gas presents an exciting opportunity for the UK, but more information is required to determine the extent of this opportunity for the UK and the key priority is to develop exploration and appraisal wells that can provide further information and data on shale gas. To ensure this takes place we recommend that:
- 5.1.1. The Government work with industry to engage with local communities to provide the facts about shale gas; answer the questions that local people will have and build trust. OUGO should spearhead this work and support industry in the early shale sites where public acceptance will be more cautious.
  - 5.1.2. Government and Industry need to work with academics and the EA, OUGO, and DECC to present the scientific evidence on shale gas, which could help to assure the local community about the safety of shale exploration. This includes specific enquiries and focuses on key concerns for people, such as water.
  - 5.1.3. Government and Industry need to work to further map the jobs and skills that could be developed alongside shale gas in local communities.
  - 5.1.4. Government should implement a simple and supportive shale gas pad allowance, following HMT's recent consultation on the tax regime for shale gas.
  - 5.1.5. Government needs to support an efficient and effective planning regime for shale gas, to ensure projects are able to take place. DCLG recommendations over the summer were an important step towards this, but the development of secondary legislation in the autumn will also be critical.

*September 2013*



## **Chemical Industries Association (CIA)—Written evidence**

1. The Chemical Industries Association (CIA) is the trade association and employers federation for chemical and pharmaceutical businesses located throughout the UK. The chemical and pharmaceutical industry contributes £20 billion per year to the UK economy, provides direct and indirect employment for over half a million people and is the UK's number one manufacturing exporter. The chemical and pharmaceutical industry is energy intensive and is the largest industrial sub-sector by energy consumption (at 47TWh) in 2012.

2. As a major energy user, the UK chemical industry supports the development of 2 unconventional gas (including shale gas) while protecting the environment and ensuring that the public are both safeguarded and receive associated benefits. This is because indigenous sources of unconventional gas offer a secure and potentially competitive source of feedstock (raw material) as well as energy at a time when supplies from the North Sea are in decline. Development of unconventional gas will improve the business case for investment in UK chemical capacity. The therefore CIA welcomes recent Government initiatives to encourage the development of these resources in the UK

### **1. How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?**

3. The UK may prove to have significant shale gas reserves. If commercially viable, shale gas development could bring benefits - economic, energy security and environmental - to the UK, as it has in the U.S. We believe that shale gas could find a ready market for several decades, and that its use will be limited by its availability rather than demand. As an energy source, it is the same as the gas from the North Sea and elsewhere circulating in the UK gas grid. Shale derived methane could complement declining North Sea output and imported gas, and replace coal in power generation.

4. From a chemical industry perspective, the principal components of shale gas, ethane and methane, are both chemical feedstocks as well as a source of energy (in the case of methane). As supplies of ethane from the North Sea gradually run down, we need to source alternative supplies for the large chemical plants (ethylene crackers) which use it. Methane can be used both for manufacture of ammonia and nitrogen fertiliser. There is potential for cost effective supplies indigenously sourced of shale gas to not only sustain current operations but also to improve the business case for investment in UK chemical capacity. However, prerequisites for growth also include competitive and secure supplies of energy and a level playing field on climate policy related costs. In this respect, the level to which energy intensive businesses will be exempted from the impact of low carbon incentives on power costs (expected to be as high as 70% by 2020) is currently uncertain.

5. Shale oil will be readily absorbed in the global crude oil supply. The quantities being produced in the US are having a significant effect on trade patterns and might have helped to reduce prices were it not for the elevated risk to supplies caused by Middle Eastern instability.

6. While the development of shale gas and oil in the UK has an uncertain timeframe, we note that the UK Onshore Operators Group is predicting that 20-40 exploration wells will be drilled by the end of 2014. This could align with the chemical industries' new Strategy

for delivering chemistry-fuelled growth<sup>16</sup> which calls for further proof of commercial viability by the end of 2014 to enable commercial flows by 2017. Availability of exported US shale gas in quantity in the UK may also offer a nearer term prospect.

**2. How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

7. These are still early days for determining the costs of extracting UK shale gas in commercial quantities. While comparisons with the US should be made with caution, experience there suggests shale gas can be produced at relatively low cost, and certainly on a competitive basis with gas supplied from other sources such as imported liquefied natural gas (LNG). The British Geological Survey results<sup>17</sup> show the UK's Bowland reserves are 10 times thicker than any US shale reserves. This could help to reduce the cost of extraction.

8. While UK shale gas will not result in a US-style surplus and fall in general gas prices – because the effect will be diluted in the larger European market - it could reduce the risk of UK gas price spikes due to shortages and could also help to reduce prices in UK forward markets.

9. The UK is linked to mainland Europe by several gas pipelines, some of which can transport gas in either direction. Together with other pipeline networks in the North Sea, these offer flexibility in moving gas from Norway and the UK to and from different parts of Europe. The price of gas within this European network is also heavily influenced by contracts which are linked to the oil price. UK gas prices are mainly determined by such contracts and the general supply/demand balance in Europe as a whole.

10. However, at times of high demand, especially in the UK, the price will be set by the cost of marginal supply, usually LNG. In winter, the rest of Europe is also likely experience high demand, and the flow of gas by pipeline to the UK may be restricted, either for reasons of capacity, or because all available gas is needed for local customers in mainland Europe. This may lead to price spikes as UK suppliers are either forced to bid for such LNG cargoes as are available on the global market, and/or offer incentives for some customers to reduce their demand. Greater availability of indigenous UK gas, whether shale, coal-bed methane, or indeed new North Sea supplies, reduces the likelihood of such events.

11. Because US shale gas has displaced coal in US power generation, more US coal has become available on world markets. This has reduced coal prices in Europe, so that for power generation coal is currently the preferred fuel, even with current carbon charges. However, environmental constraints mean that many existing coal fired generators will close and gas fired power is cheaper than new nuclear or wind, even before taking into account the cost of back-up for days when the wind does not blow.

12. Environmentally, we believe the paper by DECC issued on 30 July About shale gas and about shale gas and hydraulic fracturing (fracking)<sup>18</sup> is a fair assessment of the environmental implications and should give confidence that environmental risks are well understood and can be safely controlled. The UK's long term carbon reduction targets will ultimately

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<sup>16</sup> <http://www.cia.org.uk/Portals/0/Documents/Growth%20Strategy%20FINAL.PDF>

<sup>17</sup> <https://www.gov.uk/government/publications/bowland-shale-gas-study>

<sup>18</sup> <https://www.gov.uk/government/publications/about-shale-gas-and-hydraulic-fracturing-fracking>

require the use of gas as a fuel to be combined with carbon capture and storage (CCS) technology and, preferably, usage technology. More support is needed for research into technically and economically viable CCSU options and revenues from shale gas could help to fund this.

### **3. What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

13. US experience has been that shale extraction has boosted the local economy, creating well paid jobs for local people and the instigation of a \$100bn boom in petrochemicals investment<sup>19</sup>. The successful development of shale extraction in the UK will create skilled jobs, directly increase GDP and help to reduce the country's trade deficit. It may bring downward pressure on energy prices, and lead to further gains in output in the rest of the economy

14. Shale gas producers will pay substantial taxes to Treasury on their production income and will also provide benefits to local communities. The IoD estimates<sup>20</sup> that investment in shale gas production could reach £3.7bn a year, supporting 74,000 new jobs. Locally producers will provide communities with financial benefits of £100,000 per well site during exploitation and 1% of production revenues. Shale gas could also help to sustain and grow the UK chemical industry which contributes £20 billion per year to the UK economy and provides direct and indirect employment for over half a million people throughout the economy with key production locations in the north west and north east of England, Humberside, and the east coast of Scotland.

### **4. What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

15. Coal is currently the cheapest generation fuel with gas acting as a more marginal fuel, setting the power price most of the time. "Old" nuclear has a lower marginal cost, but the "strike price" being discussed for electricity from new nuclear is much higher than the cost from gas fired plant. Wind, certainly the offshore variety, is more expensive still, even before the extra costs of bringing power from remote locations, and providing back-up for its unpredictable and unreliable output are taken into account. Gas usually provides the necessary back-up, because of its rapid response capability. However, investment in new gas fired generation plant is hard to justify because it must always make way for wind power when the latter is available. "Capacity payments" offer an incentive to provide such back-up, and the government is currently deliberating on what precise form they should take in the UK energy market.

### **5. Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

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<sup>19</sup> <http://www.businessweek.com/articles/2013-07-25/chemical-companies-rush-to-the-u-dot-s-dot-thanks-to-cheap-natural-gas>

<sup>20</sup> <http://www.iod.com/influencing/policy-papers/infrastructure/infrastructure-for-business-getting-shale-gas-working>

16. We see no problems, contractual or otherwise, with incorporating shale gas into electricity generation. Indeed, the more renewables are installed, the greater will be the need for gas fired capacity as back-up. The only other forms of generation which provide similar dependability are coal, nuclear and hydro, and none of these is likely to see aggregate capacity increased.

**6. Which forms of electricity generation is shale gas likely to displace and by how much?**

17. We foresee that coal fired power generation will continue to decline. Climate policy could eliminate coal entirely, although there would be security of supply benefits from retaining some operational coal fired capacity. Natural gas (shale or otherwise) is likely to fill the gap. Present nuclear capacity is also scheduled to be retired, and it appears unlikely to be replaced in time by new build. Only coal and gas can provide a reliable alternative, and of these gas is to be preferred because of its lower emissions intensity.

**7. What impact will shale gas and oil have on household energy bills?**

18. Shale gas could help to reduce household energy bills, although not dramatically. (See comments under Q3 and Q4). If shale gas comes to be seen as an acceptable alternative (at least in the interim) to more expensive renewables, the downward impact on household bills will be much greater. The recent report by Navigant consultants, commissioned by DECC<sup>21</sup>, provides an analysis of the likely impact on wholesale gas prices. This effect will be diluted in household gas bills, because the wholesale price of gas is only a part of the total. There may be a further indirect impact on electricity costs, because gas is likely to be the marginal fuel in power generation. Again, however, household energy bills contain many other components such as transmission costs, which have been increased by the need to connect remote wind locations to the grid, and the cost of more general subsidies to renewables operators.

**8. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

19. The recent report by DECC: Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use<sup>22</sup> concludes that, if adequately regulated, the overall carbon footprint of piped shale gas will be comparable to conventional pipeline gas and lower than that for imported liquefied natural gas.

20. Greater use of shale gas instead of coal will clearly reduce emissions, as has been witnessed in recent years in the US. Using more (shale or other) gas to back-up wind would probably have little effect on overall emissions, since gas used relatively inefficiently as a fill-in for fluctuating wind produces much the same aggregate emissions as gas used efficiently on a continuous basis. House of Commons paper #517, “The Economics of Wind Power” submitted to the Commons Energy and Climate Change Select Committee during its 2012-13 session, contains plausible calculations to this effect. The UK’s long term carbon reduction targets will ultimately require the use of gas as a fuel to be combined with carbon

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<sup>21</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223492/navigant\\_consulting\\_report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223492/navigant_consulting_report.pdf)

<sup>22</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237330/MacKay\\_Stone\\_shale\\_study\\_report\\_09092013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf)

capture and storage (CCS) technology and, preferably, usage technology. More support is needed for research into technically and economically viable CCSU options and revenues from shale gas could help to fund this.

21. Oil is unlikely to be used in power generation, and substituting shale oil for any other crude oil will make no difference to emissions from transport or domestic fuel oil heating. Any additional volume of UK shale oil would be insignificant in setting the global oil price and thereby affecting overall usage and associated emissions.

### **9. Will shale gas and oil increase UK energy security?**

22. Yes, certainly for gas. Although oil is a globally traded commodity with many sources, and gas is also fast approaching that status, from a security of supply perspective it is preferable to have readily available indigenous resources available wherever possible. In the same way that a “just in time” manufacturer prefers to have his key suppliers located close at hand, it is desirable to minimise dependency on major long range supply lines where single failures can have serious consequences: pipelines can fail, and LNG shipments can be diverted to other markets willing to pay a higher price.

23. As highlighted under Q1, from a chemical industry perspective, the principal components of shale gas, ethane and methane, are also chemical feedstocks and will continue to be important in terms of feedstock security. As supplies of feedstock from the North Sea decline, indigenously sourced supplies of shale gas have the potential not only to sustain current operations but also to improve the business case for investment in UK chemical capacity.

### **10. What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?**

24. Producers should benefit from the ease of delivering shale gas to the gas grid because of likely proximity to part of the existing comprehensive network of main gas pipes. Provision of pipeline connections to the gas grid, and connections for water and power supplies from the equivalent local sources, are the main infrastructure requirements, which we expect would largely be financed by the shale producers.

25. When it comes to ethane, which is a component of shale gas and of value as a feedstock to the chemical sector, there is potential to use the existing ethylene pipeline to ship supplies from the northwest of England to petrochemical plants on the east coast of Scotland and in the north east of England.

### **11. What changes to public policies are necessary to maximise the potential of any shale gas development?**

26. The past 12 months has seen a strong, concerted policy response from the Government regarding the potential for shale gas development in the UK. The Chancellor has proposed a reasonable taxation system which recognises the risks inherent in shale exploration and extraction. And the Office for Unconventional Gas and Oil is addressing the need to streamline permitting and that the government has issued guidance to streamline the

planning process. We hope these developments will support the expeditious and fair application of the planning process and operational regulations.

**12. Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

27. The development of shale gas will help further to diversify the UK's options to supply its future natural gas demand. While, as noted above, the UK is already part of a closely interconnected regional European gas market, the presence of a new, indigenous gas should benefit UK gas security.

**13. What lessons can be learnt from the US experience of shale gas and oil?**

28. The main lesson from the US experience – other than being able to adopt straight away some of the drilling techniques which have been perfected over several decades – is that most of the “scare” stories about hydraulic fracturing have been proved groundless. The sheer scale of US operations now provides reliable evidence that shale gas and oil extraction by the hydraulic fracturing process is a safe procedure.

29. A second lesson is that with a “can do” spirit, enormous economic benefits follow. The shale gas boom has sparked a huge wave in investment in chemical plants using ethane and methane, while the cheapness of US energy – both gas and electricity – is prompting a “reshoring” of much other manufacturing activity. A recent report from IHS<sup>23</sup>, a leading provider of market and economic analysis, estimates that already in 2012 the US shale boom had created over 2 million extra jobs, contributed \$285 billion to US GDP and generated almost \$75 billion in federal and state tax receipts. By 2020 the jobs total is projected to reach over 3 million, the annual GDP contribution to be \$468 billion and tax receipts to be \$125 billion. Net overseas trade will be boosted by \$160bn annually and the disposable income of the average US household will be increased by \$2500 a year.

30. Such impressive figures cannot be translated directly to the UK economy, for the various reasons already outlined above, but in the context of the smaller UK economy, the boost to activity could nevertheless be dramatic.

*October 2013*

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<sup>23</sup> [America's New Energy Future: The Unconventional Oil and Gas Revolution and the US Economy: Volume 3: A Manufacturing Renaissance \(September 2013\)](#)

## **Cuadrilla—Written evidence**

### **Introduction**

Cuadrilla has attracted much of the media focus on exploration of shale gas in the UK and is proud to be the first-mover in what could prove to be a very economically beneficial industry for the UK. In our view a UK shale gas industry could, if managed correctly, be instrumental in providing highly skilled jobs in areas which badly need them, in building energy security, in supplying tax revenues for the exchequer as North Sea revenues diminish, in meeting demand for energy for electricity, heating and industrial use, and in playing an important role in the UK's future energy mix.

Cuadrilla is a small, specialist, British SME with some of the foremost experts in geology and unconventional oil and gas engineering and drilling in Europe. We are in the vanguard of unconventional oil and gas exploration in Britain and likewise in Holland. Together with our partners Centrica and A.J. Lucas we hold a 1200 KM<sup>2</sup> licence in the Bowland basin in Lancashire. Cuadrilla plans to drill, hydraulically fracture and flow test a small number of exploratory wells to show how much of the huge quantity of natural gas in place in the Bowland shale (a resource recently assessed by the British Geological Survey as most likely to be 1,300 trillion cubic feet) is commercially recoverable.

### **The opportunity in the Bowland Basin**

Cuadrilla believes that the successful exploration and development of the Lancashire Bowland Basin - regarded as potentially one of the most significant ever UK gas discoveries - can be done safely, environmentally responsibly and, in conjunction with investment in renewables, provide the best possible pathway to a low carbon energy future for the UK.

It has been stated that the geology of shale in the UK is different from the United States and not conducive to successful and commercially significant shale gas production. In the view of our own expert geologists and other qualified experts who have viewed the available data this is not the case so far as the Bowland basin is concerned. In fact the shale layer in the Bowland is more than a mile thick and Cuadrilla and other expert assessment of the shale samples recovered from exploratory wells demonstrate that it can be successfully hydraulically fractured.

It is also frequently stated that the population density in the UK means that the shale revolution in the United States cannot be reproduced here. In that respect the nature of the Bowland geology is highly significant because the thickness of the shale layer in the Bowland basin (many times greater than typical US shale basins) could allow for gas to be produced from relatively fewer vertical wells with a much larger number of lateral wells radiating below the surface from each vertical. These lateral or horizontal wells would be effectively stacked one above another draining gas from multiple levels within the shale.

The Institute of Directors (IoD) report *Getting shale gas working*, authored by Corin Taylor, Senior Economic Adviser at the IoD, concluded that: "only a small amount of land is needed for shale gas development. One 2-hectare site could potentially support 40 horizontal wells and supply enough gas to power 747,000 homes at peak production. One hundred such

sites would take up just two square kilometres of land, and could supply around one third of our UK gas needs at peak”.

### Obstacles to Development of UK shale gas and oil

Unfortunately development of this potentially very positive economic scenario is hampered by a proliferation of scientifically unproven scare stories. Contrary to the views of a vocal minority there is a clear scientific and academic consensus, underlined here in the UK by the Royal Society and the Royal Academy of Engineering joint report (see joint report July 2012 <http://royalsociety.org/policy/projects/shale-gas-extraction/report/>), and by other prominent academic experts that unconventional oil and gas exploration and production can be carried out entirely safely in the UK. Concerns that have been raised around water and air contamination and seismicity can all be managed by strong regulation and industry best practice. The Government argues and we agree that the oil and gas regulatory process in the UK is already the strongest in the world.

Although there is clear evidence that public opinion favours continued exploration for shale gas (see Nottingham University – Public Perception of Shale Gas extraction in the UK: Increasing acceptance July 2013) it is also the case that scare stories are not immediately and decisively addressed by the relevant regulatory bodies who should be able to deal with the misinformation immediately and with credibility.

We believe there is a role for Government in ensuring that the views of independent academic experts are made available to the public in areas where exploration will take place. This committee is in a position to make clear how the UK should look at this opportunity, and to help focus policy makers on the job to be done. Our recommendation is that the Committee uses this opportunity to circumvent the extremist narrative, reassure the public that appropriately regulated exploration of this opportunity can and must take place in a timely fashion, and to recommend more work on community benefit structure and delivery.

### Scientific Consensus in Support of Safe and Environmentally Sustainable Exploration and Production

Additionally there is a growing scientific consensus that shale gas has a role to play in contributing to reduction of CO<sub>2</sub> in the UK. The report commissioned by the Department of Energy and Climate Change and led by the department’s Chief Scientist, Professor David Mackay, with Dr Timothy Stone, published on 9 September ([Potential greenhouse gas emissions associated with shale gas extraction and use: A study by Professor David J C MacKay FRS and Dr. Timothy J Stone CBE](#)) is very interesting in this regard. The report concluded that shale gas’s overall carbon footprint is comparable to gas extracted from conventional sources (e.g. the North Sea), lower than that of imported Liquefied Natural Gas and significantly (four to five times) lower than coal.

The debate on Britain’s energy needs almost invariably defaults to the supply of electricity, the need to decarbonise our electricity generation and the threat of the “lights going out”. In the context of this debate it is very important to note that some two thirds of UK gas demand has nothing to do with electricity generation and is in fact used for domestic heating, cooking and industry. Over 90% of UK homes use gas for heating. In the absence of a credible plan to replace this heating demand, then, irrespective of what happens in the electricity supply market, gas is going to have a major role to play in Britain’s energy supply



for the next thirty years or more. Given the decline in Britain's reserves of gas from the North Sea and increasing dependence on imported gas in the form of LNG from Qatar and pipeline gas from Russia and Norway the debate should really focus on not whether or not the UK will need gas but rather where will that gas be sourced from. UK shale gas offers the potential to significantly reduce reliance on imported gas with attendant benefits to UK balance of payments as well as the opportunity for improved energy security.

This need not be at the cost of a reduction of investment in renewables for as noted gas demand in the UK is likely to remain strong for several decades to come irrespective of the increased percentage share that renewables are forecast to secure in electricity generation.

### The Economic opportunity

There is clear evidence that a successful shale gas producing operation could have a major economic impact especially driving jobs and growth in areas such as the North West of England that badly need investment and jobs. The recent IoD report *Getting shale working* (see reference above) found that investment in shale gas could peak at £3.7 billion a year, supporting 74,000 jobs, not just in specialist areas such as geology and engineering but for construction workers, truck drivers and in local retail and service industries. Gas also provides essential feedstock for important industries such as chemical and fertilizer manufacture which are increasingly struggling to compete with the US where prices for feedstock and energy are some 30% lower. The IoD study supported the view that shale gas production in the UK could support jobs in the chemical industry and wider manufacturing, helping British industry to be more competitive.

Overall the IoD identified the potential opportunity in the North West of England for local communities to replicate the 'Aberdeen effect' and develop a local onshore gas and oil exploration and production expertise which could lead the development of these industries elsewhere in the UK and across Europe.

Community engagement is also a very important constituent part of sensible development and Cuadrilla has consistently advocated that local people should benefit from hosting shale exploration and development in their areas. Under the recently announced community benefit scheme local communities would receive, during the exploration phase, £100,000 per hydraulically fractured exploration well site. In addition during any subsequent production phase 1% of revenues from each hydraulically fractured well would be allocated to communities. Local people stand to benefit hugely. Work still needs to be done to detail exactly how this money would be administered, but we hope that this, along with other imaginative collaborative work with communities, will eventually create a public understanding of an inclusive industrial shale revolution providing long-term investment in communities associated with pride in British engineering and innovation.

### Conclusion

Cuadrilla is at the forefront of the UK shale exploration process. Since 2008 we have drilled three gas wells in Lancashire, partially fractured and flow tested one, and conducted a 3D seismic survey of 100 km<sup>2</sup> of our 1200 km<sup>2</sup> Lancashire license area. Our plan in the next two years is to drill, hydraulically fracture and flow test a relatively small number of further horizontal exploration wells in the shale. The data from these wells and in particular from the flow tests will begin to answer the very important question "how much of the huge

quantity of natural gas trapped in UK shale can be safely and sensibly produced”.

If the UK is to have a meaningful discussion about the economic opportunities, and attract investment to help develop that opportunity (should it wish to do so) it is vital that this exploration plan must be fulfilled in a safe and responsibly, but also in a timely manner.

### **Response to questions**

#### **1. *How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?***

1.1 We believe that there is huge scope for competitively priced domestic shale gas to substantially reduce our gas import dependency. Total UK gas demand is currently some 3 trillion cubic feet (tcf) per annum. The British Geological survey has estimated that in the North of England alone the Bowland shale contains, most likely, 1,300 tcf of gas. If just 10% of that gas could be recovered that represents over 40 years of domestic supply. By 2030, without shale gas, it is forecast by DECC that the UK will be importing some three quarters of its gas needs. Developing our own shale resources has we believe the potential to halve import dependency by 2030. However the full scope of this potential can only be properly addressed through a near term exploration and appraisal process.

1.2 There has been a lot of speculation, some well-informed, about the size of the resource and how much can be recovered.

1.3 Estimates for how much of gas and oil resources can be recovered have always been dependent on the technical ability, at time of estimate, to both make assessments of the size of the resource and what fraction of that resource can be recovered. While the resource itself remains the same, our ability to comprehend how much is there and what is viable to extract on economic grounds changes, and history tells us very often increases over time. So while a 10% recovery factor might be considered a reasonable estimate today, in 10 years' time that is likely to have increased. Oil and gas fields are never abandoned because they have run out of oil and gas. It becomes a question of the technology and economics of extracting the remaining reserve.

1.4 The technical limitations depend upon subsurface shale characteristics; the well deliverability, operational issues such as the pace of new drilling; and the industry's capacity to field rigs, fracturing equipment and crews. These factors in particular are what distinguish onshore shale gas extraction from the conventional deposits offshore. We will only know accurately how much is potentially available when we have more empirical data.

#### **2. *How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?***

2.1 The cost of exploration will to some extent depend on the ability of the planning and permitting authorities to work through a relatively small number of exploration well applications in a timely manner. It will also depend on aspects of the geology only understood in full once exploration is complete.

2.2 Cuadrilla is confident that development of a natural gas resource as huge as the Lancashire Bowland Basin will prove to be commercially viable but it requires support from

the office of unconventional oil and gas, the local planning authorities, regulators and communities to make this happen.

2.3 In any production phase costs are likely to be dominated by drilling and hydraulic fracturing. Industry experience is that these costs tend to be much higher at the start of activity in a new basin (such as Lancashire Bowland) and then fall dramatically over the first few years as the industry develops its knowledge of drilling and fracturing in the context of the local geology and with economies of scale as activity levels increase.

2.4 In the US breakeven costs for shale gas production are estimated to be approximately \$3 per thousand cubic feet (mcf). In the UK current wholesale gas prices average some \$12 to \$13 per mcf (i.e. over 4 times US levels). Thus whilst it is likely that UK costs will prove significantly higher than the US (particularly in the early stages), the economic potential is clear.

2.5 In relation to the environmental cost, we strongly believe that hydraulic fracturing of the Lancashire shale rock, over 6,000 feet below the surface, can be conducted with minimum cost to the surrounding environment. Water management is an important part of this. Despite some media reports to the contrary, there have been no proven cases of hydraulic fracturing fluid contaminating groundwater. Cuadrilla plans to use in Lancashire a fracturing fluid that will be non-hazardous to groundwater and contains few chemical additives any of which will require the prior approval of the Environment Agency and will be publically disclosed. The water that flows back to the surface from the shale rock with the produced gas has also been assessed as non-hazardous by the Environment Agency although it does contain very low levels of naturally occurring radioactivity. Initially this water will be taken for treatment at EA approved waste treatment facilities but over time we would expect to be able to recycle flow back water and re-use it for hydraulic fracturing.

2.6 Well integrity is vital, and much can be done at the design stage to ensure that a well is fit for purpose to prevent water contamination. Cuadrilla's wells are designed to the highest international standards. Each vertical well we drill has several layers of steel casing, the layers of which always extend beyond the depths at which the aquifer is found.

2.7 Our well designs are overseen by an independent well examiner, before being submitted to the HSE. Once the HSE has reviewed the design, and we have received all further planning applications and permissions, we are free to proceed with the construction of the well. We are confident about our well design.

2.8 The potential flaring of natural gas from shale is an area that has also been inaccurately reported on with descriptions of thousands of flares lighting up the countryside. Flaring is carried out in the exploration phase for a limited duration (typically 30 to 90 days), on a small number of exploration wells and with the volume to be flared per well restricted and regulated by both DECC and the Environment Agency. This is because in the exploration phase wells are not connected to the gas grid. During any subsequent production phase when a gas grid connection will have been established at each producing site then there should be no requirement to flare as wells are drilled and produced.

2.9 With regard to methane emissions and carbon footprint, as already noted the report by DECC's Chief Scientist, Professor David McKay, has concluded that the carbon footprint of UK shale gas extraction and use is likely to be comparable to gas extracted from

conventional North Sea sources, less than imported LNG and four to five times less than coal.

2.10 In short there will be environmental costs in relation to the industrial process, truck movements etc. These environmental impacts need to be viewed in context and not be exaggerated especially in relation to the possibility of water contamination, emissions or seismicity.

### **3. What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

3.1 The US evidence is that the economic impact on local communities is profound. Our own contribution to this has been to enable independent study. Of the four studies to date, the most all-encompassing was done by the Institute of Directors. This modelled US data, to show that at peak developing a significant shale discovery such as the Lancashire Bowland formation would create 76,000 direct and induced jobs in the UK. Our suggestion is that the Committee recommend a series of economic workshops so that affected Councils begin to have a better sense of this opportunity.

3.2 It is of course very difficult to accurately predict the long term impact of an industry still in its infancy. What is particularly hard to grasp is the ongoing nature of capex and opex investment. The US will invest more than \$40B this year in shale gas and oil production. And next year, and the year after that.

3.3 A productive rig can drill of the order of eight to ten wells per year (a combination of vertical and lateral). In doing so that rig will consume some £100M in capital and operating investment per year, which is of course deployed into the supply chain. Over its lifetime, a single rig could easily turn over £1B in investment.

3.4 The supply chain and skills needed to supply just 20 productive rigs would be very significant. Every single person working on a drill rig has some kind of certification, and many are required to have multiple badges from assessment. This is not an industry of “casual labour”. It requires and develops both artisanal and academic skills of the highest value. In this sense it is just like the offshore industry.

3.5 There is also the demand for technology. What will develop if shale is successfully produced in the UK are markets - for rigs, fracturing equipment, seismic kit, casing, cement, and hundreds of other components. We think that this has the potential to become a new regional industry. The important thing is to maximise the percentage of UK content. We see no reason why the industry could not aim for a 65% UK content goal.

3.6 We would welcome a committee recommendation for local authorities to jointly take actions to learn more about what a fully-fledged industry could represent. Further, it may be appropriate to look at an Enterprise Zone strategy for certain regions. Given all the energy businesses in Lancashire, renewables, nuclear and shale, there is no reason why the whole North West could not take the lead in establishing an energy enterprise zone.

### **4. What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

4.1 We would emphasise that gas produced from shale is identical to natural gas from other sources, and trades in the same market as all natural gas. Natural gas is a commodity and like all commodities its price is driven primarily by supply, demand and the distance / cost involved in transporting from the sources of supply to the centres of demand. Any increase in UK domestic gas supply close to UK domestic demand will exert a downward pressure on price. In the early years of shale gas that downward pressure may be modest. Over time however as production increases and in particular with other shale gas discoveries and production in the European market a more significant downward pressure on price could emerge.

4.2 The Committee also undoubtedly understands that intermittent renewables (wind and solar) need more network balancing and instant-on generation than persistent renewables (tidal). CCGT generation can play a significant role.

**5. *Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?***

5.1 We have no comment on this question.

**6. *Which forms of electricity generation is shale gas likely to displace and by how much?***

6.1 Others invited to give evidence will have more expertise in the market dynamics of energy supply.

**7. *What impact will shale gas and oil have on household energy bills?***

7.1 As mentioned, if shale gas can be produced in meaningful quantities it is likely to exert a downward influence on price. Whether that means primarily avoiding price increases or can be translated into price reductions remains to be seen.

**8. *What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?***

8.1 The relative carbon output from different sources of energy is well-documented, and other parties will speak more authoritatively on this. The study by Professor David Mackay released this month is insightful on this topic.

8.2 Natural gas, like other fossil fuels, is used for generating electricity, heating, cooking and transport, but when compared to coal, natural gas produces roughly half of the CO<sub>2</sub> when burned, therefore, has a smaller environmental footprint. Developing UK shale gas could help the UK use less coal according to the industry regulator Ofgem.

**9. *Will shale gas and oil increase UK energy security?***

9.1 Speaking only for the Bowland license area, even that resource alone has the potential to make an appreciable difference if it can be developed at scale. Pöyry Consulting, whom the Committee has invited to give testimony, did an analysis using Cuadrilla's exploration data

and showed a significant potential impact, up to 21% of UK supply by 2030, equalling the contribution from conventional indigenous production. This has a measurable impact on UK energy security.

9.2 The Institute of Directors report published in May 2013 indicated that 76% of the UK's gas is likely to be imported by 2030, costing £15.6 billion. In the IoD's central scenario, shale gas production could reduce gas imports to 37% in 2030, and the cost of imports could fall to £7.5 billion. This would assist with the UK's balance of payments and support energy security.

**10. What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?**

10.1 In terms of enabling investment, Lancashire is heavily networked with gas lines already in place. In the sites we have evaluated, the nearest connection point is usually only a few kilometres away. Water lines will have to be run to sites in some cases but again there is an extensive water grid in place and connection points are widespread throughout Lancashire. In this respect the UK is actually far better positioned than the US ever was to develop a shale gas industry.

10.2 The strategic investment involved should be considered in the context of the “gas is an essential transition fuel” message. There needs to be R&D devoted to development of a cost-effective low carbon energy system. This could incorporate the potential use of CCS, but also many other solutions that result in efficiency and demand reduction. This investment could be financed by ring-fencing a portion of tax receipts.

**11. What changes to public policies are necessary to maximise the potential of any shale gas development?**

11.1 Cuadrilla supports and seeks to reinforce the regulatory framework in the UK, although we are impatient with the pace of implementation, and as we have said, distressed by the inability of the regulators to get across a necessary message of environmental safety.

11.2 Cuadrilla is confident that shale gas exploration and subsequent development can be conducted safely and environmentally responsibly through robust regulation and this is supported by the scientific consensus amongst recognised and qualified expert opinion. It is crucial for the commercial future of the industry, however, that we are able to conduct our relatively modest exploration in a timely manner to provide the additional technical data essential for the scoping and assessment of potential development at scale.

**12. Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

12.1 Significant domestic shale gas production would evidently significantly reduce the need for imports from which ever source.

**13. What lessons can be learnt from the US experience of shale gas and oil?**

13.1 There are two lessons from the industry's experience in the States. One is that effective regulation is a collaborative and continuously developing process, not a fixed prescription. Contrary to popular view, American regulation in this sector is extremely experienced, intensive, and confident. American regulation has evolved in collaboration with industry, communities and environmental stakeholders. This multi-stakeholder approach has proved effective in dealing with issues as they arise. Regulatory agencies have done much to assuage public anxiety because their process has been inclusive and timely.

13.2 The second lesson is about technology and innovation. The shale gas industry is composed of people and companies who try new solutions. A cycle of continuous innovation makes its way into the industry. Collaborative regulators are able to see improvements, and build them into regulation process. Doing something new and different provided it is safe and environmentally responsible is not frowned upon.

13.3 There is of course a third observation from the States. This industry has the potential to re-energise a moribund economy, and provide a sense of self-determination and progress. We believe this is applicable here, although we understand that the pace and scale of development will be necessarily different.

*September 2013*

## Cuadrilla, IGas Energy and INEOS—Oral evidence (QQ 76-95)

TUESDAY 5 NOVEMBER 2013

*Evidence Session No. 7*

*Heard in Public*

*Questions 76 - 95*

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Skidelsky  
Lord Smith of Clifton

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### Witnesses

**Mr Francis Egan**, CEO, Cuadrilla, **Mr Andrew Austin**, CEO, IGas Energy, **Mr Tom Crotty**, Director, INEOS, and **Mr Andrew MacKenzie**, Gas Procurement Manager, INEOS

**Q76 The Chairman:** Welcome to the Economic Affairs Committee. This is the fifth public hearing of our inquiry into the economic impact on UK energy policy on shale, gas and oil. I ought to say at the outset that I understand that this hearing is being televised. I thank all four of you for coming, and I thank you, Mr Egan, for the written evidence on behalf of Cuadrilla and Mr MacKenzie for the written evidence from INEOS. We have also seen Mr Austin's interview in the *Daily Telegraph* on 13 September. I would be grateful if you would speak loud and clear for the webcast and the shorthand writer. When you are in agreement with whatever question is asked to which the first respondent has given the answer, just nod. Do not feel that you have to reply to each question; we leave that happily to you. Would anyone like to make an opening statement, or shall we go straight into questions? We are very grateful for your written evidence, which we have all absorbed. No? Then we will go straight into questions.

I begin by saying that we have had a lot of written evidence already, including your own, about the potential for shale gas in the UK. I do not really want to go over that ground today because we have pretty well had the evidence on it. One of the points that comes out clearly from it is that there is still considerable uncertainty about the potential until the drilling and all the experimental work has been done. How long do you think it will be before production of shale gas can commence in the UK?

**Andrew Austin:** You are absolutely right. Thank you very much for the opportunity to address the Committee today. The first thing is that we need to go through the stage of actually working out whether we can make gas flow at the right rate to make it economic. I



know that previous evidence has already come before this Committee from the British Geological Survey and others, which talks about how much gas is in place. We have a reasonable idea of that with a degree of certainty, so we know that there is an awful lot of gas there. We now need to establish whether we can technically recover it and at the right sort of prices that make it competitive as an energy source for the country. We need to go through that process, and as an industry that is in effect what we are asking the population for at the moment: the opportunity to work out whether we can make this work for Britain.

As to when shale gas can then start forming part of the energy mix, I think it will be a minimum of three to five years before you started seeing a material amount of production from shale gas contributing to the mix, on the assumption that we are able to make it flow. At the moment, we have only one data point on that—a Cuadrilla data point, which was positive—but we certainly need more data to work out whether it can make a difference for the country.

**Francis Egan:** Just to add to that, I think we are confident that there is a large volume of gas in the ground. As Andrew has said, we have tested a well and we know that it will flow from at least one well. I share the view entirely that we need further exploration wells. That distinction between exploration and exploitation or production is not particularly well understood. People want to know lots of answers to questions—about how many wells, how much gas, how much tax, how many jobs, et cetera—without actually drilling any wells, which is quite difficult. It is also not well understood that we probably need to drill only a relatively modest number of wells to begin to answer exactly those questions. I would say that with 10 to a dozen wells, certainly in the Bowland shale, you will have a pretty good understanding to take that forward. We do need to start. From 2008 to probably the end of this year, we will have drilled a grand total of three wells in the Bowland shale and partially fractured one. I would not call that an accelerated exploration programme.

**Tom Crotty:** If I could add one other point from the chemical industry's perspective, I think that Andrew MacKenzie and I are here representing two things. One is the energy-intensive users of shale gas—steel, aluminium and chemicals—and the other is the chemical industry. We have a specific issue, which is that this is not only an energy benefit for us; it is our basic building block or material—our feedstock. So we are keen to understand the content of that gas as well as the quantity, because that will determine how effective it is as a feedstock for the manufacture of chemicals, which is another key component of its economic benefit to the country.

**The Chairman:** Have there been any delays to your exploration schedule? What are the reasons for the delays, and why are you not drilling now?

**Francis Egan:** Physically, we could drill tomorrow. We have a rig and sites that we could drill. There have been well documented delays as a result of the seismic tremors near Blackpool, which shut down the industry for 18 months to two years. Currently, the long-lead time, the thing that takes the longest time, is the planning and permitting process. We need to work our way through that for exploration, and we will. It is very thorough, but certainly, if we move from exploration to exploitation, we will need—and by we, I mean the country—to streamline that without reducing its effectiveness but making it more efficient.

**Q77 Lord Lawson of Blaby:** May I ask you a supplementary? You talked about asking the population. I am not quite sure how you ask the population, but leaving that to one side, since you clearly want to get ahead with this exploration as soon as possible to find out what the facts are, is there any problem with the authorities in any way, either with the

department—DECC, with the Environment Agency or with any other authority in going ahead at the pace you would clearly like to find out what is there, given all the facts you mentioned?

**Andrew Austin:** It is fair to say that a level of scrutiny and consideration has probably been given by the Environment Agency in particular, and by DECC and the planning authorities to a lesser extent, which is over and above what we have seen for conventional oil and gas exploration. That is due to the heightened interest that there has been in shale gas exploration and fracking in particular. The level of consultation and engagement, and the time spent considering applications, has been considerably longer than what would otherwise have been looked at as industry best practice. We as an industry, and I am sure that I speak for Francis as well, want to make sure that the communities in which we are dealing are fully aware of everything that we are doing and that everyone has had a full level of time and opportunity to talk about the implications of what is happening. But clearly that has taken significantly longer than it would have done for conventional oil and gas, let us say three or four years ago, as a result of the heightened awareness of communities and the concerns that have been raised.

**The Chairman:** The BGS told us in oral evidence that a complete picture for the whole of the UK would be “an enormous task and complicated, long-winded and difficult”. It thought that it was probably sensible to concentrate in the areas that had the most. Looking beyond the Bowland shale, do you have a view of how long it will be before we have a clear view of the national potential?

**Francis Egan:** There is the study in the Weald basin, as I am sure they told you, which I understand they are due to report on in the first quarter of next year. But they have already confirmed their mid-case estimate for the Bowland Shale in Northern England. There is a lower and an upper band, and their mid-case is that there is 1,300 trillion cubic feet in the Bowland shale. So, frankly, there is more than enough to be getting on with in the Bowland shale and we would quite like to be getting on with it.

**The Chairman:** I see lots of nods. Lord Smith?

**Lord Smith of Clifton:** Which areas of the UK do you believe are the most prospective and prosperous for shale gas?

**Francis Egan:** The Bowland, certainly for gas, extends from Lancashire across the Midlands and Yorkshire. In effect, it extends down to Europe. We have licensed areas in Holland where we see the same geological formation. In the south-east, we will see what the British Geological Survey comes up with but the expectation is of a higher likelihood of oil there.

**Lord Smith of Clifton:** And also in the Scottish lowlands?

**Francis Egan:** We have not done an assessment of that, so I cannot comment on it.

**Lord Smith of Clifton:** Are there any specific areas in the UK where you would not drill for any reason, even if there were potential resources in place?

**Andrew Austin:** Anywhere we choose to drill or would look to drill would have to be with the acquiescence of the local community and in working with it. Frankly, if you do not have the social licence to operate with the acquiescence of the people you are with, when you are dealing with your neighbours that is going to be the constraint. It goes back to Lord Lawson’s question earlier about what the barriers are right now. They are getting local acceptance where we are trying to drill. We need to work with those communities, and it is the inability to manage that that would rule out any particular area.

**Q78 Lord Smith of Clifton:** Presumably, you would not seek to drill in heavily dense urban areas.

**Andrew Austin:** It would not be your first choice of area to go because of complications in engagement. If you can deal with a smaller amount of people, it is clearly easier to get the buy-in from that group. But we should not rule any areas out because, ultimately, energy security is something for the whole population.

**Francis Egan:** It is worth clarifying that when we say drilling, we mean that we establish a drilling site that is typically less than five acres. From there, we drill underground. At Wytch Farm in the south of England, they have drilled underground in a horizontal direction for 10 kilometres. In the Bowland shale this would typically be two kilometres or more deep underground and it is a six-inch diameter hole. Frankly, there is more disruption from British Telecom digging up outside your house than you are likely to see from a six-inch diameter hole two kilometres beneath it. They are going to drill deep geothermal wells in the centre of Manchester—I live near Manchester—a stone's throw away from Piccadilly train station, so we are already drilling in urban areas in the UK. Right now, I think that Andrew is absolutely right: we would not start there, but over time things may change.

**Andrew Austin:** There is also a history of getting the acquiescence of communities over time. We operate an oilfield in the Gainsborough area, right in the middle of a very densely populated area. The locals are aware of it and many of them are employed by our company as well. This feeds through into Tom's business in terms of local people being involved in the petrochemical industry with jobs being linked to that security of supply close to home, so there is a history of that.

**Tom Crotty:** Going back to Lord Smith's original question about the areas, he mentioned Scotland. It is just worth saying that while I know this is not an area where Andrew and Francis are directly involved, it is another area where I think there is significant potential. The shale deposit in central Scotland is very old and well known. Our site exists in Grangemouth because back in the 19th century, well before the North Sea work was even thought of, it was processing shale oil from those surface deposits. That deposit, which runs all the way from the coast into and past Glasgow, is another opportunity.

**Q79 Lord Rowe-Beddoe:** I noted that somebody mentioned the "acquiescence" of the population. Many of the Committee have received communications from the villagers of the Balcombe area. I have no idea as to whether what they say is accurate, but some 82% to 85% of the population are against Cuadrilla's drilling. If that be the case, it would appear that an extraordinary public relations exercise needs to be undertaken. Mr Egan, I understand that you are a small, "specialist" British SME, but surely you understand that if this is half true, or whatever it might be, it needs to be tackled. People need to understand what the scare stories are, if they are scare stories. It needs to be communicated and a major public relations exercise needs to be undertaken.

**Francis Egan:** You are absolutely right. Just to illustrate the scale of that, I am sure you are aware that most of those protests were against shale-gas fracking. Balcombe is not shale, it was not gas and we were not fracking. That will give you an indication of the challenge. I agree with you that there is a challenge.

**Lord Rowe-Beddoe:** Well, it is a challenge. Did the water turn green or not? I do not know.

**Francis Egan:** Again, the water turning green is a wonderful story. It was upstream of where we were drilling and after we had finished. It was investigated by the Environment

Agency and there was no trace of anything to do with drilling. It is most likely dye, I would think, but there you have it. It is a great story.

**Lord Rowe-Beddoe:** If I were in your position, I would be taking my public relations management very seriously and letting the world know what I was doing, why I was doing it and what the implications are both for and against. It would appear from this correspondence that this has not been gone through.

**Andrew Austin:** I think it is fair to say that all of us are aware that we have an uphill public relations challenge. It is an information challenge. Maybe I can say this in a way in which Cuadrilla cannot, but an open letter was written to a number of newspapers post the activities at Balcombe once Cuadrilla had gone off-site, which actually expressed support from a number of villagers and from the parish council. I cannot remember the percentage—

**Francis Egan:** Sixty people signed it, I think.

**Andrew Austin:** It was 60 of the villagers basically saying, in an open letter, that the demonstrations there were not about the activities that were happening. That was a testament to people realising post of that. As a company, we have taken this very much to heart in relation to our next activities, to make sure that we are communicating significantly in advance. We have had a number of public meetings and meetings of our community liaison groups. There have been site visits and a lot of liaison with the local police and the local council to ensure that everybody is fully informed up front as to what we are doing, that we are absolutely open as to what is happening and that any communication gaps, which you rightly identified, are as covered as they can be up front.

**Q80 The Chairman:** Mr Egan, can I ask you a question on this very point? You say in your written evidence that, “it is also the case that scare stories are not immediately and decisively addressed by the relevant regulatory bodies”—you draw attention to the regulatory bodies—“who should be able to deal with the misinformation immediately and with credibility”. How would you like to see that done better?

**Francis Egan:** I would like to see the regulatory bodies, particularly the Environment Agency, play a more active role in the early stages of consultation and communication to reassure members of the community when they are exposed to scare stories. I was at Balcombe, and I had people come to me who had been assured that they would get cancer from our drilling a well. I am pretty sure that when any incidence of cancer in Balcombe is recorded in years to come, there will be zero correlation between any incidence of cancer and the drilling of our well. If I say that, I am seen as having a vested interest, and I understand that, but someone from the Environment Agency could put the facts in front of them. In Lancashire, we are drilling through an aquifer that is some 40,000 parts per million salt, but people will still say that we are going to destroy the domestic drinking water supply of Lancashire. It is nonsense but, again, if I say it is nonsense, it does not carry the same credibility, and I am sure that the Environment Agency will say it much more diplomatically than that.

**Andrew Austin:** I welcome the response from Public Health England this week, which said that there were minimal if any risks from shale gas exploration. That starts to help inform that dialogue.

**Tom Crotty:** I think there is also some responsibility—duty may be the wrong word—on the part of the potential users also to stand up and be counted, which is one thing that we are trying to do. Energy-intensive users such as us, Tata Steel and companies like that are

trying to stand up and say positive things about the value that this will create for the economy and its importance to the ongoing security and survival of energy-intensive industries. We employ almost a quarter of a million people in this country, and I believe that without this sort of development we will no longer be able to do that in 10 or 15 years' time. We have a duty as well. The Chemical Industries Association has, as one, just published a brief note, *Shale Gas: The Facts*, which is trying to address some of these issues. I think we will see more of that happening downstream of these gentlemen.

**Q81 Lord Lipsey:** PR is no doubt important, but the most important thing is that you behave in a way that is beyond criticism. I quote from a letter that we have had from a Balcombe resident who does not appear to be any kind of extremist. She asks of your company, Mr Egan, "In what sort of organisation does it take five weeks to release a report on excessive drilling noise, causing weeks of sleepless nights and in the mean time forcing Balcombe residents to do their own monitoring to prove the breaches? The EA was present at a meeting on Sunday 8 September when, finally, Cuadrilla's independent acoustics expert asked for the drill to be shut down immediately because it was at 51 decibels, not 42. They spent the next 48 hours battling the drill". What explains that kind of behaviour?

**Francis Egan:** First of all, I would like to see the data supporting the "weeks of excessive noise activity". The incident in question happened over a weekend. The night-time limit was 42 decibels and the day-time limit was 55 decibels. As required at the start of the drilling operation, we had measured and we were in compliance with both. I got a report on a Saturday night that there was a complaint from one of our nearest neighbours. We sent somebody out there to measure it and he asked us to measure away from the stipulated noise monitoring point. We moved away and we measured 52 decibels. The difference between 48 and 52 decibels—four decibels—is in absolute terms probably less than a whisper<sup>24</sup>. If I whisper across the room at you now, that will likely be more than three or four decibels. To be clear we, not the Environment Agency or the Council planning department, immediately shut down the operation and it stayed shut down while we put in additional noise reduction measures around the rig. We cannot say this with certainty—it is certainly possible that it was the rig—but at about four decibels difference it is certainly possible that it was other sources of noise. We shut it down and put in additional noise reduction measures. We started up again and measured. It was beneath the limit and stayed beneath the limit. That is a mark of a responsible operator, and I do not know what anybody else would expect us to do. And I dispute the weeks of sleepless nights.

**Lord May of Oxford:** A responsible operator would not have exceeded the decibel levels in the first place.

**Francis Egan:** I agree it is best not to exceed, but if it is within four or five decibels it is marginal.

**Lord May of Oxford:** It is pushing the limits.

**Q82 Lord Hollick:** You make the point, which I am sure is valid, that communities are going to want an independent assessment of environmental risks—noise risks and all that sort of thing. You clearly engage with the Environment Agency, Public Health England and any other relevant agencies. Have you detected any reluctance on the part of those bodies

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<sup>24</sup> Mr Egan later made a correction: the night-time limit was 42 decibels, the day time limit was 55 decibels and the noise level measured, following a report, was "varying between 45 and 48 decibels with occasional short duration peaks to 51 decibels". He added: "Cuadrilla accepts that a 50Db noise level is louder than a whisper and noise at a level of 50Db has been compared to a "quiet suburb" or a "conversation at home")

to become engaged in the debate? Is the fact that they have not become engaged in it early because they have reservations about the accuracy of some of the information? Can you give us a sense of the dialogue that you have had with those agencies?

**Francis Egan:** I do not detect reluctance. The level of scrutiny that shale gas and onshore drilling have come under in the UK is unprecedented. The Environment Agency has not had to respond in that way before. I do not think that a well has been drilled onshore in the UK before where Sky TV was flying over it 24 hours a day. Two thousand wells have been drilled onshore in the UK, which is all pretty much the same. So I do not think it is a reluctance to become engaged; it is a fact of life that that level of engagement needs to be significantly greater than was probably historically the case. It is taking time to recognise that and to respond to it.

**Lord Hollick:** When you have made that point to the Environment Agency, what has been its response?

**Francis Egan:** They are willing to engage. They have attended a town hall meeting at Balcombe and they are proposing to attend meetings that we will hold in Lancashire. The individuals on the ground are very competent. I have a lot of respect for the Environment Agency and the work that they do.

**Lord May of Oxford:** I have had a bit of a look at the Public Health England report. Public Health England is an executive agency of the Department of Health and provides a nationwide integrated public health service, supporting people to make healthier choices. It gives what is basically a qualified, favourable review, and I am a little surprised that you did not mention it. It also alerts us to some things that need to be very conscientiously observed. It says: “The currently available evidence indicates that the potential risks to public health from exposure to the emissions associated with shale gas extraction are”, relatively, “low if the operations are properly run and regulated”. Then it sets out a bunch of bullet points that it hopes will be fully taken on board. I will just read you three of them and then I would like you to reassure me that, although you did not mention it—I would have mentioned it if I had been you—you are really fully on board with this.

First, it says that “Public Health England needs to continue to work with regulators to ensure that all aspects of shale gas extraction and related activities are properly risk assessed as part of the planning and permitting process”, and, secondly, that “Effective environmental monitoring”, which probably includes decibels, in the vicinity of shale gas extraction sites is needed throughout the lifetime of development, production and post-productions”. Thirdly, there is the thing that could on the whole be reassuring: “Evidence from the USA suggests that the maintenance of well integrity, including post-operations and the appropriate storage and management of fracking fluids and waste, are important factors in controlling risks and appropriate regulatory control is needed”. I would like to be reassured that you are really actively engaged with the regulators in this sense.

**Francis Egan:** We have engaged our consultant to do environmental impact assessments for all our upcoming operations in Lancashire, where we are proposing to drill, hydraulically fracture and flow-test wells. I hope that if you take the opportunity to review their assessment, you will see an extraordinarily thorough review of all the environmental issues associated with that process. Yes, I can reassure you that we will do that, including the monitoring of emissions. We did baseline monitoring at Balcombe, where the groundwater has high levels of methane in it. That has not polluted the water supply of West Sussex but it is there. We will do the same in Lancashire and we will have ongoing monitoring before, during and after the operations.

**Lord May of Oxford:** If I were you, I would cultivate a close relationship with the outstandingly good and very stropky woman who is the Chief Medical Officer.

**Andrew Austin:** May I add to that? This is something that as a country we need to be quite proud of: that we have regulators who are very capable in all the areas you talked about. Prior to planning thorough risk assessments are undertaken, and there is baseline monitoring, as Francis has said, which we have carried out at various sites. Older sites that have been around for 10 or 20 years often have water monitoring boreholes around them, which are regularly monitored by the Environment Agency and us to ensure that there is no contamination going through. Also, the real key to this in dealing with water and questions about aquifers is well integrity. Again, the UK has gold standards throughout the North Sea, which we have adopted for 30 or 40 years and which are the same standards that are applied onshore. So this is not us policing ourselves but a well established regulatory system that is being applied to an established industry, and a new angle on that industry in shale gas is being executed. That should give a degree of confidence that it is not us policing ourselves: rather, that the public can rely on the quality of the regulators.

**Baroness Blackstone:** Were you surprised by the very high level of scrutiny that you described just now? If so, what do you think the reasons for it are?

**Francis Egan:** On the first question, the answer is probably yes. The reasons for it are that in that instance it became a touchstone for shale gas fracturing when it was not shale gas or fracturing. If you look at the bare facts, the protests were not against what was actually happening; they were about what people were concerned might happen.

**Baroness Blackstone:** Do you think that people are misinformed in some way about what might happen, and if so how?

**Francis Egan:** In some ways, yes. I will give you an example. I have frequently read and heard that we use hundreds of toxic chemicals in our fracturing fluid. We propose to use one chemical, which is non-toxic, in our fracturing fluid. The Environment Agency will review it and approve it, and if our proposed fracturing fluid is declared hazardous to groundwater we will not use it.

**Baroness Blackstone:** Coming back to the PR point that was raised before, have you publicised that?

**Francis Egan:** Yes. It is on our website. People frequently say to me, “You don't say what is in your fracturing fluid”, and I say, “It's been on our website for the last three years and if you go on to the Environment Agency website, it is on there”. We say that frequently.

**Lord Lipsey:** You have talked about gas so far. Can you tell us what you think the prospects for tight oil are in this country?

**Francis Egan:** In the oil industry, tight oil is not necessarily shale. As you probably know, it can be a conventional reservoir. That in fact is what we were drilling for in Balcombe. As I said, it was not shale and not gas. There is oil there. We cannot say without testing the well whether it is likely to be commercial. There are not a lot of data points for it yet, so I cannot really answer other than with that.

**Q83 Lord May of Oxford:** We had written evidence that told us that the costs were much higher at the start of drilling and hydraulic activity, then fall dramatically over the first few years as the industry develops its knowledge of the local geology and economies of scale. Do you have a view of what the potential cost of developing shale gas in the UK is likely to be?

**Andrew Austin:** The simple answer is no but I would like to try to add a little context to that. A lot of the cost of developing it is about the rate at which you are able to make it flow. That is the biggest variable in any equation that we are looking at. You rightly point to the cost of the supply chain in the process. Clearly, there is not the same depth of supply chain for onshore oil and gas in the UK as there is in the United States, although there is a supply chain. So it is realistic to expect that the cost of execution here would be of the order of 150% to 200% in the first instance of what it would be in the United States, because of having high levels of environmental monitoring and less depth in the supply chain.

The biggest determinant is actually down to the flow rates. Even with US-typical flow rates and those increased costs, given the way gas prices are in the UK this still has the possibility of being a very economic business for the country. But we need to get past this point of understanding where the flow rates are first before we are able to make any real predictions.

**Lord May of Oxford:** I have three short follow-ups. First, does that comparison with gas prices still stand up if you allow for what some would regard as the deliberate, semi-criminal overpricing of gas at the moment?

**Andrew Austin:** I think that we are talking about the wholesale price of gas rather than the price at which it is delivered to households.

**Lord May of Oxford:** Very good. I should have realised that. In its written evidence, Cuadrilla said that UK production costs will probably be higher than in the US. I wondered whether you agreed and what the reasons were.

**Francis Egan:** They will certainly be higher at the start but, first, to step back and distinguish again between the exploration and exploitation phases, costs are invariably much higher in the exploration phase. What drives the cost of shale gas development primarily is the wells. As Andrew said, flow rate dictates how many wells you require and the cost of the well is the biggest single input to the overall capital cost of the project. In the exploration phase, you do a lot more analysis with the well. You take many more samples out of the well and you take a lot longer, because you are learning from the well. In the production phase, it is much more of a factory process and you are drilling wells purely to produce, not to learn about the subsurface, because you have by and large learnt those lessons. So typically in the production phase, you would expect at least a 50% reduction over time in the cost of the wells.

People argue about the break-even costs in the US—I have seen various reports—but it is around \$3 per unit. It does not matter what the unit is. For the equivalent wholesale gas price in the UK, it is \$12 to \$14 per unit. If costs were to double, there would still be a significant margin from where we sit today in wholesale gas prices versus the break-even costs in the UK. If costs were to treble, we would be getting closer to break-even prices, but there is certainly scope, as Andrew has said, to develop an industry. But that takes time. You need to get to an economy of scale. At the rate they are drilling in the US, by the time we have finished this conversation they will have drilled half a dozen wells. We are drilling three wells in four years. It takes time to build an economy of scale. That is the key to it.

**Andrew Austin:** I go back to the point about knowing what those flow rates are. If that flow rate is half the typical rate in the US, the economics are linearly affected.

**Tom Crotty:** Could I make a slight addition to that? When we are doing these comparisons, we operate extensively in the US, and we are operating on shale gas ethane on our chemical plants. One of the other key differences between the US and the UK is that the UK's gas



infrastructure is infinitely better than the gas infrastructure that the US had and even today still has. Once you get to the production point, our ability to capitalise and utilise that gas is significantly better than the US's. People sometimes forget that.

**Lord May of Oxford:** That is a good point. Lastly, one of the earlier witnesses, Professor Robert Muller, suggested that, in the US, shale gas business and technology are advancing rapidly, which prompts the question: might not these events be applicable here in ways that can reduce your costs?

**Francis Egan:** Undoubtedly. One of the key things in Lancashire, for example, is the thickness of the shale. In its order of magnitude it is thicker than anything that has certainly been exploited in the US to date. That opens up the possibility of drilling horizontal wells at multiple levels—a little like floors in a building, as I think we said in our written evidence—so the surface impact is significantly less. For one vertical well at the surface, you can have multiple horizontals. That technology is moving ahead and will continue to move ahead. That is just one example. The recycling of flowback water is another example. The use and reduction in chemicals is another. The technology will continue to advance.

**Q84 Lord Hollick:** I wonder whether we could move from the cost of developing shale gas to what the cost of the gas that is going to be produced is likely to be. In your business plans, you must have made some assumptions, which clearly need to be tested by drilling, about the likely cost of the gas that you will produce and its sale price. You have decided on balance that that looks to be a profitable project. You made the point, Mr Austin, in your *Telegraph* interview that if you can get to a place where shale gas can displace 50% of our import dependency, it will definitely make an impact on gas prices. That is perhaps rather at the top end of estimates, but I do not know; you might like to tell us. What is your current expectation of the cost of gas that you are going to produce and therefore its impact on pricing throughout the United Kingdom?

**Andrew Austin:** Unfortunately, I do not have a crystal ball as to where the overall price of commodities will be in three to five years' time, but I can see a direct link, as I said in the article in the *Telegraph* that you referred to, between the materiality of the exploitation of shale gas in the UK and its effect on prices. At the limit, if we have maybe one or two sites and we are unable to go any further than that, then for whatever reason, either flow-rate related or public acceptance-related, clearly it is only going to have a negligible effect on the gas prices that are experienced at a wholesale level across the country. The greater the level that that industry is able to get to to be able to displace imported gas from other places, the more chance it has of having an effect that I would say is positive but negative in the sense of price and the impact on gas markets in the UK. The more certainty that we have about the amount of gas that we have and can deliver within our borders, much as the North Sea gave people the ability and the confidence to invest, the more confidence people will be given to invest. That might seem a long-winded answer, but it is linear to the size of the exploitation. If we can make a material difference, it will start having a material effect, but if there are only one or two sites and people say that gas prices have not gone down as a consequence, it will not, because the bulk of gas will still be coming at the margin in an imported form.

**Lord Hollick:** Mr Egan, when you make a presentation to your investors, what price of gas do you assume in your model?

**Francis Egan:** Again, we need to distinguish between the exploration phase and the exploitation phase. Typically in an exploration phase, because you have not yet drilled and, as has already been discussed, you have not established a flow rate for a while, the level of

investment is materially less, and frankly the exploration companies are not deciding exploration programmes on the long-term price of oil or gas; they are deciding in development programmes on the long-term future of oil or gas.

Moving to your question, I have worked in oil and gas all my working life and I have never seen an accurate oil and gas price forecast. You can look back at them. I remember when North Sea oil fell to \$10 and the industry was considered to be dead, but it is still going pretty strongly today. All you can do in oil and gas is control your costs. You do not control the price of a commodity. What controls the price of a commodity is supply and demand. You will see, and I think you will have seen in any commodity, that over time it gets more efficient and it drives down costs. That is our job: to do it safely, to do it effectively and to drive down cost. That is how we make money. We will model what the price is now and we will model lower prices than that, because we will want to make money if the price goes down. If the price goes up, the price goes up, but we will control our costs so that we can make money if the price goes down.

**Andrew MacKenzie:** I absolutely agree with Andrew that it is very difficult to assess what prices are actually going to do. In the most simplistic economic argument more supply is likely to have a downward effect on prices, but to some extent—certainly from the large users' point of view—the concern is not so much about absolute price but about the competitiveness of price and the differential between Europe and the UK versus the US – and at the moment it is clearly very high. You only have to turn the clock back about three years to pre-Fukushima, so not very far. Fukushima changed the global gas demand balance when the UK and the US prices were pretty well correlated with each other because liquefied natural gas was balancing the two markets, and it did not take an awful lot to make that change. That just illustrates that predicting what prices do is tricky.

**Q85 Lord Hollick:** If the United States decides to export shale gas in substantial quantities, would that alter your enthusiasm to continue to drill and explore in this country?

**Francis Egan:** To drill and explore? No. By the time that happens in the US, if we have not drilled and explored a few wells we will be doing something else. When it comes to an investment decision for long-term development, shale is not like conventional oil and gas where you decide up front and you invest significant sums of money, potentially billions of pounds or dollars, in a single asset such as the Forties field in the North Sea. Shale is an incremental series of production sites that can carry on for 20, 30 or 40 years, so it involves a series of relatively modest capital investment decisions. It is not as though you come to the start of it and say, “Am I going to do all of this?”. You develop it incrementally over time, so in some ways it is an easier investment proposition.

I do not think that, separately, US shale gas exports are going to fundamentally alter the gas price, but if China exploits its shale gas reserves, as it will, that could be interesting.

**Lord Hollick:** In what way?

**Francis Egan:** If it successfully exploits what people think is there, that could have a significant downward impact on gas prices.

**Tom Crotty:** Just on your point, just to bring this into reality, we as a company are in the process of making plans to import US shale-based ethane into Europe as we speak, because we have to. The gas supply that we rely on from the North Sea is now diminished to the extent that we can only run our major petrochemical complex at half rate, so we have to find another way of doing that. We have long-term contracts in the US to bring ethane in. We are having dedicated tankers built for us to do that. It will give you some feel for the

price differential that we can do all that and still make a profitable entry into our European plants. We see that very much as a stop gap, because I guarantee that if we go back in 15 years' time to those US suppliers and say, "Can we have some more, please?", the chances are that they will say, "No, sorry, we are using it all ourselves". For us this is a stop-gap way of maintaining our business competitiveness over the next 15 or 20 years while indigenous supplies are developed.

**Q86 Baroness Blackstone:** Turning from costs and pricing questions, can you put your hands on your hearts and say that fracking is completely safe? And in answering that question, could you indicate the main risks and how you will manage them?

**Francis Egan:** If you want me physically to do it, the answer is yes. We would not do it if we did not think it was safe to do it. We live in this country. Our children drink the water in this country. We are not living on a different planet. The risks have been well documented. Water is talked about a lot, and I talked a little about it today. We will use non-hazardous to groundwater fracturing fluid. As Andrew has said, we will construct our wells meeting all the requirements of the UK regulatory system. We will put in an exhaustive seismic monitoring array around each well site and, as we are currently doing, we will have a top-class engineering firm, Arup in this case, complete an environmental impact assessment, and it will tell us—it is not us doing it—if there is something unacceptable there. If there is, irrespective of Cuadrilla, Arup will not put its name to it as part of a planning application. The European Union has asked for environmental impact assessments, but we have already said that we will do it. It is not strictly a legislative requirement, but we are doing it for exploration wells that are being hydraulically fractured. If there are more requirements, we will meet those.

**Andrew Austin:** In terms of putting one's hand on one's heart, we already operate a number of wells across the country that have been hydraulically fractured in the past and produce oil and gas from those wells now. We do so in a safe way. Again, I go back to Francis's point about us being here for the long term. We work in the communities, our employees are in those communities, and we live in the same communities. We are not going to do this if we are going to harm the environment, because that is just too short term. As much as anything else, it is just not good business. Added to that, we are dealing with world-class regulators who can work with us in making sure that it can be done safely. So to answer the question directly, yes, hand on heart, we feel that we can do this safely.

**Baroness Blackstone:** We had evidence last week from Professor Robert Mair, who said, "The jury is still out on the precise quantities of methane emissions" caused by fracking. Would you like to comment on that, and on what steps you might take to do all this?

**Francis Egan:** In the US, I think it is recognised that the largest source of methane emissions comes from the practice of water flowing back with the gas being stored in open pits on the well sites. That water contains some methane entrained in it and that is vented off to atmosphere. All the studies relating to methane emissions out of the US will show that that area alone is the largest percentage contributor to methane emissions. That practice will not happen in the UK. In the UK, all the water that flows back is separated in a closed tank system, and the water is tankered off the site and taken to an Environment Agency-approved treatment plant. In the exploration phase the natural gas is flared but in the production phase it will be transported into the gas transportation system or will generate electricity, or whatever the usage is. If you take that single step alone (eliminating open pit storage of flow-back water), you take the majority of methane emissions out of shale gas.

The other sources are probably no different than they are for conventional gas: typically compressors, seals, pipelines, ditto. A good maintenance programme will address most of those. I do not think that anyone can ever say that you will have zero emissions. I am sure that Transco transporting gas through the UK network has some emissions. DECC's chief scientist produced a study that concluded that the emissions in the UK should be less than LNG imports, comparable to conventional pipeline gas, and three or four to five times less than CO<sub>2</sub> from coal. It is possible to manage them, and they are being managed. That is the regulation in the UK; it is quite different. In fact, in the US that practice has by and large stopped now in any event.

**Baroness Blackstone:** Have you learnt anything else from the US experience that might lead to different practices here in the UK?

**Francis Egan:** Again, in seismicity—this is probably more the UK's experience—the degree of monitoring and what is called the traffic light system to control that in the fracturing process is order of magnitude ahead of anything that has been done in the US, or in fact for geothermal projects or any other projects in Europe. That is another example of UK regulation being significantly more stringent.

**The Chairman:** Mr Crotty, for the sake of the transcript, you have been nodding vigorously through the last two answers. Is there anything you want to add?

**Tom Crotty:** No. I think we have clamped our hands to our hearts, along with the producers here, in that we have done a lot of analysis on the risks. We run high-hazard operations in the chemical industry, so we are used to analysis of hazards, and we believe that there are no hazards here that cannot be very, very safely managed. That is a key part going forward.

**Q87 Lord Skidelsky:** In the written submission, PHE concluded that, “The currently available evidence indicates that the potential risks to public health”—from exposure to the emissions—“in the vicinity of shale gas extraction sites are low if shale gas extraction is properly run and regulated”. Presumably the purpose of regulation is to reinforce the hand to the heart to make sure that the organisations are efficiently managed. Do you believe that the necessary regulations are in place to allow you to proceed? If not, what do you believe is needed? In particular, do you think that there is a delay in regulation because of waiting for the European Union to produce its own set of regulations?

**Andrew Austin:** I do not think there is any immediate delay in waiting for the European Union, because again, as I have said before, there is a long history of successful oil and gas production in this country. That is a dynamic process as well. It is not just stuck in one moment in time. This picks up on what Lord Hollick was saying a moment ago about the US experience. As technologies evolve and as people can do things in a cleaner way, et cetera et cetera, those get fed back into the regulatory process.

Also, the industry as a whole is looking for best practice, so whether best practice is represented by IGas, Cuadrilla, Centrica, EDF or whoever it may be, that best practice will be fed back into each of those operators because it will be reinforced first by the regulator and secondly by our own licence to operate. There is a virtuous circle in that. In terms of delays, we need to ensure, as was said earlier, that we keep informing the public about the quality of that regulation and that it is seen to be being done, as well as being in place behind the scenes.

**Lord Skidelsky:** So the purpose of regulation in part is to reassure the public?

**Andrew Austin:** The purpose of regulation is to reassure the public that the environment is being protected, not just to reassure the public for its own sake.

**Lord Skidelsky:** The public would not trust the companies to do it themselves?

**Andrew Austin:** It is better for both the companies and the public that there is someone independently looking at that.

**Francis Egan:** That is not uncommon for most industries. On regulation, there is effective regulation and there is efficient regulation. You asked about effectiveness. I think it is effective, but I think we have a way to go, certainly in the production phase, to make it efficient. Again, we need to understand the distinction between exploration and production. If it is to be produced, the pace of activity will have to pick up significantly. That includes effective regulation that happens more quickly.

**Q88 Baroness Noakes:** We talked a little earlier about the experience at Balcombe, where we saw a conjunction between a local set of reactions and a national one based on beliefs about the decarbonisation of electricity. Do you believe that we can get past both that local and that national opposition so that you can get to a stage where you have sufficient support from both the local community and the national community to allow you to do exploration and then production, or do you think that the level of opposition that you experienced there is going to have a fundamental impact on the way in which you operate?

**Francis Egan:** We believe that we can or we would not continue to do what we are doing, clearly. Going back to an earlier question, we do not underestimate the scale of the challenge. It is interesting that you mentioned decarbonisation, because that is at the root of a lot of the NGO position and it sometimes gets mixed up with water and seismicity, but when you say, “We can deal with that and we can deal with that”, it comes down a lot to the impact on CO<sub>2</sub>. Invariably when you get to that position, the conversation turns to electricity and lights going out, and away you go. Electricity is 20% of our energy demand, and the other 80% is never talked about. What heats our homes? What fuels our businesses? We will be using natural gas in this country for decades to come, so it is really a question of whether we are going to export our CO<sub>2</sub> emissions to Russia and Qatar, or whether we are going to monitor and measure them here.

**Baroness Noakes:** I understand the arguments. The question is whether you think that you can get this opinion to turn? You clearly cannot operate on the basis that you have that level of opposition every time you try to do a bit of exploration, let alone production, so my question was really about how you get to the other side.

**Francis Egan:** I am sorry for repeating myself. I would say yes, but we need a lot of support to do that. Again, rehashing some of the earlier conversations, it cannot just be Cuadrilla or IGas saying this, because people say that we have a vested interest, and of course we do; we are explorers and we want to make it a success. So we need regulators, independent academics, customers and communities ultimately to say, “Yes, this can be done”.

**Baroness Noakes:** Do you think the system of payments that is being proposed for communities will help? Are they at a sufficient level? How do you see this playing out?

**Francis Egan:** Again, it is early days. We are in the exploration phase, and the industry has said that it will give £100,000 per fractured site, and 1% of production revenues when we get to that phase. The proof of the pudding is also in the eating. We have to find a way of making a material impact in communities, and it is certainly possible to do that.

**Andrew Austin:** Can I add to that on the community point? Direct community benefits in the form of cash are one of probably four parts of a contribution that an industry can make and should be seen as part of a portfolio of local benefits, not the sole panacea in that mix. Having them as the sole panacea creates the danger that people will feel that you are bribing people in local communities and are saying, “If we pay them enough money, they will allow it to happen in this area”. I do not think that is the way we should be going as an industry and as a country, but they are part of it.

Clearly we also need to look at whatever disruption is caused and whatever implications for the local community there are that are directly on the negative side, but there are also significant benefits in jobs locally. The IoD has talked about 74,000 direct jobs across the country. I can look at my own business and talk about the number of apprentices, the length of time that people are typically employed against those assets, and the quality of those jobs. That does change the local communities’ attitudes to what is going on.

Another very important area is the indirect jobs and the ability to give other industries the security to invest using that gas infrastructure and the products that are produced. That is also an important part of it.

Fourthly, it is the ability to use local services such as local fabrication and local scaffolders, down to the level of drilling where you have crews staying in local hotels and eating at local burger vans. It is literally at that level. You do see that as a direct impact in that locality, and over time that will come through. That part of the picture needs to be demonstrated by action. I do not think that this is just about paying money into community funds. That is definitely a part of it, and an important part, but it is part of package.

**Tom Crotty:** I would just add from the user side that we must not underestimate the impact downstream on jobs in particular. As I said, the energy-intensive industries in this country employ a quarter of a million people, and indirectly that is probably about three-quarters of a million, according to the IoD. Those jobs are currently at risk because of the lack of competitiveness in UK energy markets. Only a week ago, we saw Tata Steel losing 500 jobs, clearly classified as being because of energy problems. BASF closed a chemical factory up in Scotland about two weeks ago and 140 jobs were lost, again because of energy competitiveness. These are real current issues where an improvement in the energy mix in this country will make a substantial difference. Those are difficult issues to explain to people, and they take a long time to explain, but there are real none the less.

**Q89 Lord Rowe-Beddoe:** Before I deal with the next question I would like to take you back for one moment to the set of questions that Lord Hollick raised about price. In your written statement for INEOS, Mr Crotty and Mr MacKenzie, you say something that is the statement of the obvious, I suppose, in current circumstances: “Energy prices in the UK are already uncompetitive and this is set to worsen drastically”. Could you in one line tell us why?

**Tom Crotty:** Either of us can answer that. Fundamentally, we have to sell our products globally. Today, the cost of energy in the UK is three times that in the US and three times that in the Middle East. They are our two major competitors for the manufacture of petrochemicals.

**Lord Rowe-Beddoe:** And the reasons why they are so uncompetitive?

**Tom Crotty:** There is a clear supply/demand issue with gas in particular. That is what has transformed the US energy markets, and clearly that is why Middle East energy costs are so much lower.

**Lord Rowe-Beddoe:** Thank you. Sorry to make you go back, but I just wanted to flesh that out. Professor Stevens wrote to the Committee in evidence that, “The state of the service industry in the UK to undertake onshore shale operations is very weak with few drilling rigs and even fewer units that can hydraulically fracture”. He states that in the United States in one particular shale play in 2008 there were 199 rigs, and that in 2010 there were apparently only 34 rigs in the whole of western Europe. The question, therefore, is: do we have a satisfactory supply chain that is ready, willing and able to deal with hopefully the success of your drilling operations?

**Francis Egan:** No, because supply chains do not hang around waiting for wells that may or may not be drilled. We have sufficient capacity to drill the wells that we need for the exploration phase, and if that phase is successful the capacity will arrive. The North Sea is a classic example of that. There was no capacity in Aberdeen, as you are well aware, when North Sea oil and gas started. If there is a market, people will supply it. It takes 18 months or so to build a rig. It is not that technically complicated; this is not the deep-water Gulf of Mexico that we are talking about here.

**Baroness Noakes:** So what will the lead times be to get the supply industry ready to supply you with what you need for the development phase?

**Francis Egan:** It will depend on what pace that grows at, because as I said it will get developed side by side. So you will start with a handful of sites, maybe just two production sites, and then you will increment. What drives the pace of growth is the number of rigs, which is exactly the stat that you just quoted. We have said that at peak you could have somewhere between 10 and 20 rigs operating just in Lancashire. You could get 10 rigs in one fell swoop, but that is unlikely. You will probably increment two, four, eight, 10.

**Andrew Austin:** Maybe to answer what is at the bottom of the question whether this is going to be an impediment to the growth of the industry, I would echo what Francis has said: that we can get through the phase of the appraisal phase with the existing supply chain but that through that process we need techniques and technology that are usually held in people’s heads and on laptops that can fly around the world. Going back to the comment earlier on about the speed at which things have happened in the United States and the speed at which new shale plays have opened up, the half life associated with opening those up has shortened significantly. Over time people have learnt techniques, which is why Francis said earlier on that maybe 10 or 15 rigs in Lancashire will give us enough information to know whether this is material. If you go back to Barnett, you would have been looking at maybe 100 wells before you had the same level of information, so it has moved forward. We can get through that stage. In conversations that I and I am sure others have had into the development stage, the service companies are ready to provide that kit and those people. They need to know that they have a market. So I do not think that this Committee should look at that as being an impediment. It is clearly something that we have to go through, but if we can give them the confidence from early results we will get the supply chain to follow. They will want to be based locally and close to where the operations are. That gives rise to the opportunity to create a new onshore version of Aberdeen somewhere in the UK, probably in the north-west, which is a centre of excellence. The UK is at the forefront of that for Europe, given that at the moment it is probably the most attractive place to look at for shale gas exploitation.

**Francis Egan:** That is the bigger prize, because there will not be multiple service centres if this takes off in every country in Europe. There will be a first-mover advantage.

**Lord Rowe-Beddoe:** So clearly this is not a concern.

**Andrew Austin:** It is an opportunity.

**Francis Egan:** Yes, it is exactly that.

**Tom Crotty:** I would like to underpin this first-mover advantage for the UK. Again, being selfish and talking about the chemical industry for a moment, the reason why this is so important for us is that among the large petrochemical units—the crackers that make basic petrochemicals—of which there are about 40 in Europe, only four are actually gas-based. The rest are oil-based and two of those four are in the UK, so our opportunity to exploit this is infinitely better than that of any other part of Europe. The other two are, logically, on the other side of the North Sea in Sweden and Norway. That is another reason for pressing ahead.

**Q90 Lord Lawson of Blaby:** As a Committee, we are obviously interested in the economics of the production of gas and, to a lesser extent, oil from shale. Clearly, looking at the United States, there is a presumption that there might be a huge economic benefit from this, not least in getting cheaper gas than would otherwise be the case. Of course it is only a presumption and, as you have pointed out, until the exploration can really get under way, one will not know whether that presumption is a reality. It seems to me that not much more can be said at this point about the economics.

However, we in the Committee are also interested in public policy, so I ask all of you: is there anything in public policy that you would like to see done that is not being done, or not done that is being done? When I talk about public policy, it is in particular about the Environment Agency—the speed at which it operates, and so on—and the Government.

**Andrew Austin:** I think we have seen from the Government a sterling attempt, under the establishment of the Office of Unconventional Gas and Oil, to get different parts of government joined up. We have actually seen that very practically in meetings where we have all variously been present. When you go into a meeting to talk about taxation policy, you will have representatives from DCLG, DECC, the Environment Agency et cetera in the room, and vice versa when you are talking about other issues. What the Government have done in that sense has been very positive.

We would like to ensure that we can get a streamlined, fit for purpose regulation regime with the Environment Agency in particular. At the moment, different pieces of policy that were constructed for other uses are being applied there but in some cases slightly outside their original remit. I am not asking for a short-cut environmental consultation situation at all. It is absolutely imperative that a high level of consultation is engaged in with every stakeholder involved. If we do not do that, and efficiently, we will lose the social licence to operate that I spoke about earlier. We need clarity in the policies and rules that we are going towards, and applicability in those—taking into regard everything that has happened in the historical best practice of the industry, et cetera—rather than trying to find other regulations that we can apply in some way to an industry that is here.

**Lord Lawson of Blaby:** Would Mr Egan or anybody else like to add anything to what you have said?

**Francis Egan:** I have already commented on having effective but efficient regulation. If we are to move into a production phase—and you are quite right that the exploration needs to be done and the answers bought forward from that—it will require a step change in the pace and scale of operation. That needs to be prepared for.



My perception of the general policy is that we spend a lot of time talking about electricity, which is vital, but as I say it is 20% of our energy supply and we need to think about the other 80% as well.

**Lord Lawson of Blaby:** I do not know whether anybody else wants to add anything, but I am still slightly puzzled, because what you spend your time talking about is, to a considerable extent, up to you. Consultation with the local population is largely up to you. I know that you are walking on eggshells and do not want to upset Ministers and apparatchiks of one kind or another, but it is important for the Committee to know whether there anything which you think the Government or the Environment Agency could be doing better than they are at present.

**Andrew Austin:** Giving absolute clarity about the nature of the rules that we are expected to work with and the way in which they are applied.

**Lord Lawson of Blaby:** Is it not clear at the moment?

**Andrew Austin:** There are points when you feel that you have overcome certain barriers in dealing with things, but then other obstacles are put in your way, with further levels of disclosure, requirements or legislation. Legislation fit for this purpose would really help, as would giving local councils clarity, for instance, when they are looking at the planning process and the things they need to be involved in and the things for which other competent authorities are assuming those responsibilities on their behalf. For instance, does a local council need to understand the entire fracking process and its implication for local groundwater? No. A resolute answer has been laid out by the DCLG in planning guidelines, which say that the competent authority to deal with the integrity of aquifers and well integrity is the Environment Agency. That kind of clarity makes our job easier when taking things forward. That is absolutely not about appealing for a short cut in consultation; it is about making sure that we are clear about which regulations we are and are not working with.

**Francis Egan:** The other thing to make clear again is this distinction between exploration and production. Most of what we are asked to respond to is about production: how many jobs, how much water, what level of emissions and, depending on who you are talking to, how many thousands or millions of wells. What we really want to do, as I said at the start, is to drill half a dozen to 10 wells. There needs to be a refocusing. Let us drill that half a dozen to 10 exploration wells and assess the risks associated with those.

**Lord Lawson of Blaby:** What is stopping you?

**Francis Egan:** As I said, we could start drilling tomorrow. Primarily, we need to get the planning approvals and the environmental permits to do that. Some of the questions that come out of that process are not strictly related to drilling 10 wells but 4,000 wells.

**Lord Lawson of Blaby:** So where you would like to see better performance in having greater clarity and common sense, and all that? Is it from the Environment Agency, the Government or both?

**Francis Egan:** I think the sense of focus on having 10 or 12 wells versus questions on having 4,000 is across the piece.

**Q91 Lord Lawson of Blaby:** One last point, unless anybody else wants to add anything. Earlier on, Mr Egan, you suggested that people who object are objecting on the basis of claims that are manifestly false, but that if you say this nobody believes you. Were you suggesting, therefore, that some impartial authority that does not have a financial interest,

such as the Environment Agency or some direct form of government, should be informing the public of the facts and the truth, because they do not believe you? Is that what you would like to see?

**Francis Egan:** Yes, that would be beneficial.

**Tom Crotty:** Just to reinforce that point and maybe to loop back to your earlier question, Lord Lawson, I personally believe that there is an enhanced role for government in getting the imperative explained in the public domain. I do not yet believe that there is any understanding in this country of the crisis that we are facing in energy supply. That is something that the Government need to expand on more clearly and consistently because people should understand how critical it is, particularly from where we are sitting in the energy-intensive sectors. We will not have energy-intensive industries in this country 20 years from now unless we do something about it, and that is not coming across clearly enough.

**The Chairman:** I would like to hear you say more about the risks of not going ahead and the scale of the benefits that you see in moving beyond the exploration phase and looking further ahead.

**Tom Crotty:** One good way to start on that is to look at what has happened in the United States in just the last four years. There has been no new investment in the petrochemical industry in the United States for 25 years. There are now 11 major facilities under construction and another seven in the planning phase, and by major facilities I am talking about individual spends of between \$500 million and \$1 billion. That transformation in the industry has been brought about by the development of shale gas. There is both an opportunity for us to look at and copy that and a huge threat if we fail. I guarantee that the outcome for the UK chemical industry, and indeed the European chemical industry, will be that we will be supplied by imported materials 20 years from now, if we do not do anything about this—

**Francis Egan:** That is a threat.

**Tom Crotty:** —and the result is that it will have a massively negative impact not only on our economic performance but on our environmental performance, which makes no sense to me.

**Francis Egan:** I have heard it said that we can satisfy our energy needs from renewables and energy efficiency. Maybe we can, but that is not going to happen quickly. I keep going back to this: if we could do that in electricity alone, that would be a huge and probably welcome step. Electricity is 20% of our energy demand but 40% of our energy demand is heating, almost all of which is supplied by gas. We will import all our gas. That will be the inevitable outcome of this, and we will lose billions of dollars of tax revenue and pay the security prices associated with that. The opportunity is to explore and drill a dozen wells. If it is not there, it is not there, but will we just walk away from it?

**Andrew Austin:** That is the point. The country deserves to find out whether this can make the difference. It goes through to really old-fashioned things such as the balance of payments, in terms of the energy-intensive users and the effect of having to import bulk chemicals, oil and gas. It is much better if we can do that for ourselves.

**Q92 Lord Hollick:** Following on from Lord Lawson's question, you have put forward a number of issues—some fundamental to the strength of the UK economy—that clearly need to be taken into account. Do you think that the Government and the relevant

Ministers are sufficiently engaged in the process of, first, informing the public about all the issues and, secondly, helping to bring the debate to a conclusion?

**Tom Crotty:** No. I believe that there is no consistency on that yet, either across government or time. This message needs to be repeated consistently and over time, which is currently still lacking. We are getting it in parts but not totally.

**Lord Hollick:** So there are mixed messages?

**Tom Crotty:** I believe there are still mixed messages, yes.

**Lord Skidelsky:** Could you just say a word about the job creation potential of fracking? The IEA suggests that the production phase of shale gas could support 74,000 jobs. AMEC's prediction was that 15,900 to 24,300 jobs would be created at peak construction. Is that the difference that you were talking about earlier, Mr Egan, between the construction and production phases? Is there a discrepancy or not, and if there is, why?

**Francis Egan:** I was smiling at the fact that they got it down to 300. Perhaps the forecasting ability on jobs is better than that on oil and gas prices. To forecast it at that level is quite something. I have seen 25,000 through to 100,000, and the IoD was at 74,000. It will depend pretty much on how many rigs are operating in the country and how many sites are running in parallel. I would not attempt to put it even at 1,000, let alone 3,000, but it will be tens of thousands of jobs. It certainly has that potential if it can be developed at the scale that we believe it could be if the exploration phase is successful.

The second thing I would say about this is that when we say this we often hear it said that this is going to destroy jobs and renewables. It is as though people cannot have two energy industries alive at the same time. I just do not understand that at all. Why cannot we have both?

**Q93 Lord McFall of Alcluith:** Can I get back to the issue of the message? I think you have set yourselves a very high barrier here. For example, in the INEOS submission you talk about “£100,000 to the community” and other benefits that could include “new jobs, local economic growth, revenues for the community, and lower energy bills”. There does not seem to be any clarity in that. If I was looking at that, I would be quite concerned. Andrew, you made the point earlier that you need local acceptance and that an inability to manage that would rule out going ahead. That is a big barrier in itself.

I noticed from the clippings, Andrew, that your favourite film is “Local Hero”, which is about oil and gas exploration in the west coast of Scotland. Burt Lancaster, aka Felix Happer, goes there but concerns himself more with looking at the northern lights than with his oil company, so I suppose you will differ in that respect. The local community there was for it because there was big money in it, but Fulton Mackay's old man put an oyster in it by saying, “Wait a minute, who will look after the beach when you go away?”. There is the issue, if you use this as a metaphor today, of who will look after the beach. I am interested in what you are going to do in the terms of that message. For example, do you have any idea what should be done with the £100,000 that you are giving at the moment if the well has been drilled? I have experience of this in my past representative life. If you give that money, who is it going to be handed to? Who is going to monitor it? What influence do you or your proxy have over that? If there is no strategic view on that, and if there is no clarity, this could end up a mess.

**Andrew Austin:** Okay. Starting with “Local Hero”, it was the soundtrack as much anything else which I appreciated in that movie. The points that are made are important. Actually,

there is a read across in that the local community could see the benefit in jobs, local fabrication and local services coming through, but with that came a degree of environmental responsibility, as you rightly pointed out.

**Lord McFall of Alcluth:** What I am saying is that the points that you are making at the moment are hypothetical, and I want to put some flesh on them.

**Andrew Austin:** The basis of what we do every day as a business is not hypothetical. We operate over 100 sites across the country right now. Where we produce oil and gas we deal with the Environment Agency and we produce water, which we reinject. There is a whole business going on out there right now.

**Lord McFall of Alcluth:** Yes, but you are giving £100,000 to communities. That is a big thing.

**Andrew Austin:** We have been running a community fund for a series of years through which we put money back into the local community, and that is independently matched. As an industry we have talked about formalising a number of informal schemes which a number of individual operators have had in the past. We have an independently managed fund which we put an amount of money into each year. That fund is made up of local parish councillors in areas where we have operations and they determine, on the basis of bids received from local community projects that are scored against their local content, their applicability to the people immediately around sites and their ability to add to the value of other grant money that is coming in to make things happen. They are typically things like education projects, play areas, speeding schemes, defibrillators in village halls across Lincolnshire, a community swimming pool, heating projects—that kind of project. There is some real experience in doing that. There is also a lot of experience in restoring the environment. Going back to your point about who is going to look after the beach post us, we have a responsibility to return that land to where it was when we have finished our operation, and we do. There are remediation schemes in place at the point of permitting that we are monitored on through that process.

**Lord McFall of Alcluth:** Francis, do you have any points?

**Francis Egan:** Just to reinforce that point, the model that we envisage is a locally run community benefit, be it by members of the parish council or other members of the community, and they will decide how that £100,000 will be allocated, not Cuadrilla, IGas or another company. We are working with experts in that field—I will not say more because it is a work in progress—to help us to structure that. That is the model that we envisage for how that will be spent. The community itself will dictate.

**Andrew Austin:** We were already on board with that: that that has to be seen to be independent of our activities.

**Lord McFall of Alcluth:** Does INEOS want to add anything?

**Tom Crotty:** Not really. We have said from day one that it is very important that there is a methodology that allows benefits to be channelled back into these communities. If I was in the community, I would expect to see that. That is all I want to state.

**Q94 Lord McFall of Alcluth:** On the issue of the tax regime, the Government launched their consultation document in July this year, and the paper outlines a proposal for a pad allowance that will reduce the tax in a portion of the companies' production income from 62% to 30% at current rates. Do you believe that shale gas business in the UK requires a distinct tax regime to stimulate activity?

**Francis Egan:** I believe that it does require a regime that reflects the staged development that I talked about earlier. The pad allowance is actually not that distinct. It is modelled on the small-field allowance that exists and has existed for some time in the North Sea and has been applied to the west Shetlands and other new frontiers where typically the development costs up front are very high. Yes, it has been described as a tax subsidy but it is not a tax subsidy. Not a penny of the exploration funds comes from the Government. The companies take all the exploration risk. It is a sliding scale from 30% through to 62%, and that reflects the fact that at the start, as we discussed earlier, the economies of scale just are not there and those early pads will probably be economically quite challenged.

**Lord McFall of Alcluith:** So do you think there is further work for the Government to do on the tax regime?

**Francis Egan:** They are doing it. A consultation is under way.

**Lord McFall of Alcluith:** But are you happy with the progress the Government are making on that?

**Francis Egan:** Yes.

**The Chairman:** I think you are all nodding in agreement.

**Tom Crotty:** Absolutely, and one of the benefits of the fact that the Government have responded on this goes back to what we were saying earlier on: that it is a public statement of commitment to the development of this industry, which I think is very important.

**Q95 The Chairman:** One last question. Do you think that shale gas can stimulate additional industrial development to utilise the gas locally, as has occurred in the United States?

**Tom Crotty:** I believe so, yes. We are, by dint of history, fortunate in that our major chemical operations happen to be in the Firth of Forth and in the north-west of England and so are sitting more or less on top of the two major deposit areas. So we would be hopeful that you could get quite a lot of local downstream growth as a result of that, which would lead to further downstream investment.

**Francis Egan:** Wood Group in Aberdeen started off as a small naval fishing company, and now it is one of the largest service companies not just in the UK but globally. There is no reason why that cannot be replicated in shale, for Europe at least.

**The Chairman:** Mr Crotty, I understand that the Scottish Government have proposed a restrictive planning process, which has been presented as severely limiting the likelihood of shale gas exploration or production in Scotland, not least in Grangemouth. Have you something to say on that?

**Tom Crotty:** It is something that we are talking to the Scottish Government about. We do not believe that it is helpful for future growth.

**The Chairman:** Gentlemen, have you any final comments that you would like to make? No. Then can I thank you all very much indeed for coming and for giving such clear answers? Thank you very much indeed.

## **Cuadrilla—Supplementary correspondence with Committee Clerk**

Dear Mr Egan,

### **Economic Affairs Committee: Inquiry into *The Economic Impact on UK Energy Policy of Shale gas and Oil***

Since you gave evidence on 5 November the Committee has heard more witnesses and is nearing the end of oral evidence-taking in this inquiry.

One main theme common to most witnesses is that no-one can know what the UK's economically recoverable reserves of shale gas or oil might be until exploratory drilling takes place.

Industry witnesses indicated that they were keen to go ahead with exploratory drilling but that regulatory constraints impeded progress.

Witnesses from the regulators indicated on 3 December that regulatory requirements were clear and known to the industry and that responses to applications for the various permits were normally quite speedy. But, according to Tony Grayling of the Environment Agency, no application to drill by hydraulic fracturing had come in since the moratorium was lifted in December 2012.

Can you add anything to your evidence to help the Committee understand why an industry eager to get exploratory drilling under way is apparently not pursuing the necessary permits?

It would be helpful if you could reply by 16 January, in part to inform the Committee's questioning of forthcoming witnesses.

Yours sincerely

Bill Sinton

(W B Sinton)

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Dear Mr Sinton,

Thank you for your letter of 9 January.

You ask about the efforts of the industry in applying for necessary permits for exploratory drilling.

In answering this question I would like to firstly clarify that to make an assessment of the UK's economically recoverable reserves of shale gas or oil, we need exploratory drilling in the shale, as your letter states, but we also need to **hydraulically fracture and test the**

**rate of gas or oil flow** from some of those exploratory wells. I emphasise the latter because to date while a number of exploratory shale wells have been drilled and indeed continue to be drilled, only a single exploratory shale well in the UK has been hydraulically fractured (partially) and flow tested. That is the Preese Hall, Lancashire shale exploration well which Cuadrilla drilled, partially fractured and flowed in 2011.

With regard to the assertion that the industry is not pursuing the necessary permits, I attach as a reference Table 1 which outlines the key steps and associated dates related to Cuadrilla's applications to the Environment Agency for permits required to hydraulically fracture and flow test exploration wells at three separate exploratory sites in Lancashire (Anna's Road, Grange Hill and Beconsall). You will note from this table that permit applications were submitted by Cuadrilla on 15<sup>th</sup> August 2012. After two separate periods of public consultation on those permit applications and numerous discussions between Cuadrilla and the EA, the EA wrote to Cuadrilla on 31<sup>st</sup> May 2013 requesting that the permit determination date be extended to 31<sup>st</sup> December 2013. Cuadrilla agreed to that request.

The above and the attached I trust confirm that Cuadrilla and the EA are indeed working hard on the environmental permits required for drilling, hydraulic fracturing and flow testing an exploration well. Clearly the timescale involved in delivering these very first permits of their kind in the UK has been very lengthy. That is perhaps not wholly unsurprising and in the period between permit submission in August 2012 and December 2013 there have been two separate public consultations run by the EA and a huge amount of debate and development of environmental permit requirements for shale, not least in respect of application of various European Union Directives, for example the Mining Waste Directive.

I share the view expressed in your letter that we as an industry and the regulators, having worked through this in some considerable detail over a lengthy period, now do have a clear and shared understanding of the various environmental permits required.

Given that and in view of the time elapsed since permit applications were originally submitted by Cuadrilla in March 2012, we have decided that rather than re-work our original permit applications we will submit a new set of permit applications to the EA in the near future. These new applications will also address a number of proposed new exploration sites. I trust that the response to these applications will indeed be "quite speedy" as regulators have advised the Committee.

I do hope that the above and the attached answer the Committee's questions on this matter.

Yours sincerely

Francis Egan  
Chief Executive Officer

**Table I – Cuadrilla Environmental Permit Applications – Sequence of Events**

<b>Date</b>	<b>Event</b>	<b>Comment</b>
15 <sup>th</sup> August 2012	Permit applications submitted by Cuadrilla to the EA for environmental permits required to fracture exploration wells at three Lancashire sites (i) Grange Hill, (ii) Anna’s Road, (iii) Becconsall.	Permit applications covered (i) Mining Waste Directive (MWD) and (ii) Radiological Substance Regulations
16 <sup>th</sup> August 2012	Permit applications acknowledged by EA	
September 2012	EA and Cuadrilla correspondence on the permit applications	
4 <sup>th</sup> October 2012	EA launches first public consultation on permits	Sites classified as “High Public Interest” meaning 2 periods of consultation required
29 <sup>th</sup> October 2012	First period of public consultation ends	
Nov / Dec 2012	Ongoing discussions with EA on permit requirements	
9 <sup>th</sup> / 10 <sup>th</sup> Jan 2013	Draft permits issued to Cuadrilla	
16 <sup>th</sup> Jan 2013	Second (“Minded to grant”) public consultation on permits launched by EA	
13 <sup>th</sup> Feb 2013	Minded to grant public consultation finishes	
March / April 2013	Further permit changes /additions proposed post second public consultation period.	Cuadrilla advises EA that it will complete an Environmental Impact Assessment (EIA) as part of the Planning Application for exploration sites where hydraulic fracturing is proposed
17 <sup>th</sup> May 2013	Meeting with EA to discuss potential requirement for a 3 <sup>rd</sup> public consultation period in light of changes / additions made to permits following consultations 1 and 2.	
30 <sup>th</sup> May 2013	EA advise that 3 <sup>rd</sup> period of public consultation required	
31 <sup>st</sup> May 2013	EA requests until end Dec. 2013 to determine permits. Cuadrilla agrees to request.	Will allow permits and EIA to be considered collectively by EA

January 2014



## Department for Communities and Local Government—Written evidence

Thank you for your e-mail of 4 December 2013 to Peter Schofield with the Committee's request for a note on the planning process governing proposed drilling of onshore wells for shale gas and oil by hydraulic fracturing.

Perhaps I can start by giving you a brief overview of the extraction process and its interaction with the planning system and other regulatory regimes. In July 2013, we published planning practice guidance on onshore oil and gas, the main purpose of which was to clarify the relationship between the planning system and other regulatory regimes. This guidance may be found at: <http://tinyurl.com/n2gv2rb>. We are making arrangements to integrate this guidance with the rest of the planning practice guidance being prepared by DCLG, to avoid needless duplication. However, the main points set out below will remain.

In brief, there are three phases to onshore hydrocarbon extraction (including shale): exploration, appraisal (testing) and production. Each stage is explained in further detail in paragraphs 9-20 of the guidance. The exploratory phase seeks to acquire geological data to establish whether hydrocarbons are present. It may involve seismic surveys, exploratory drilling and, in the case of shale gas, hydraulic fracturing. However, it does not have to involve hydraulic fracturing – indeed we understand that some companies with an interest in shale extraction are simply taking core samples for the time-being.

Appraisal stage takes place following exploration when the existence of oil or gas has been proved, but the operator needs further information about the extent of the deposit or its production characteristics to establish whether it can be economically exploited. Hydraulic fracturing for shale will almost certainly take place at this stage, followed by flow testing to establish the strength of the resource and its potential productive life. As you might expect, hydraulic fracturing takes place in any further or additional wells drilled at the production stage.

Planning permission is required for each phase of extraction, although it is possible to apply for more than one phase as part of the same planning application.

Shale gas operations are subject to more than one regulatory regime, and no extraction may take place without compliance with each regime. A flowchart setting out the process and the interaction of the various regimes is attached at Annex B to the practice guidance and was explained by Duarte Figueira when he appeared before the Committee on 3 December 2013. The Department of Energy and Climate Change also published a Regulatory Roadmap on 17 December which provides a helpful and detailed explanation of all the steps that an operator must take before exploratory work may take place. This roadmap, which explains the regulatory regime for each part of the United Kingdom, may be found at: <http://tinyurl.com/mmzj8gb>.

Broadly speaking, the planning permission decides if the proposed land is suitable for its intended use and also deals with wider implications for e.g., traffic movements, whilst the environmental permit and health and safety regulations seek to ensure that the actual extraction process is carried out safely and without pollution of the environment or

unacceptable effects on water. In line with the National Planning Policy Framework, we expect planning authorities to assume that other regulatory regimes will work effectively, but the guidance makes it clear that planning authorities must still be satisfied that such issues can or will be adequately addressed by taking the advice from the relevant regulatory body.

You specifically ask how the various bodies work together. The approach to planning permission for oil and gas development is similar to that for other types of development. As the guidance demonstrates, all regulatory bodies play an important role at the planning stage. Although it is not compulsory in respect of shale gas, the Government encourages early discussions between the applicant, the planning authority and other interested parties before a detailed application is made. In our view such discussions provide prospective operators with an opportunity to share information that may be relevant to obtain licences and permits, and for all parties to provide advice to the minerals operator on the acceptability of the proposal.

Furthermore, once an application is made, other regulatory bodies that are statutory consultees in the planning process have an opportunity to comment on the proposals. The types of development which will require consultation with statutory consultees is set out in Schedule 5 of the Town and Country Planning (Development Management Procedure) Order 2010. The Environment Agency, the Health and Safety Executive, the Highways Agency, and Natural England, amongst other bodies, are statutory consultees and must be consulted on relevant planning applications where required under the Order. One such example is that the Environment Agency must be consulted on all planning applications that involve mining operations.

By virtue of the 2010 Order, statutory consultees are required to provide a substantive response to the local planning authority determining the application. This response should be sent within 21 days of the receipt of consultation documents (or as otherwise agreed in writing between the statutory consultee and local planning authority). For the purpose of the Order, a substantive response is a response in which the consultee has no comment; the consultee is content with the development; the consultee refers to standing advice on the subject of the consultation; or the consultee provides advice to the local planning authority.

The Government is keen to ensure that planning authorities take high quality and timely decisions on planning applications. Legislation sets out statutory periods for dealing with planning applications and all applications for shale gas will be classed as major applications, subject to a period of 13 weeks for determination or where the application is subject to Environmental Impact Assessment, the deadline is 16 weeks. The Government's 'Plan for Growth', published in March 2011, put in place the planning guarantee to promote timely decisions on planning applications to ensure that applicants fully understand when they can expect to receive a decision. This provides certainty by setting a one year limit on the time that any planning application should spend with decision-makers; so in practice no more than 26 weeks to decide an application, and no more than 26 weeks to decide any appeal that follows a decision on the application.

We have further strengthened this by underpinning the guarantee with a refund of the application fee where a planning authority fails to determine the application within 26 weeks from the date a valid application is received, subject to a very few exceptions. .

As a Government we ask for regular reports on the number of applications made, and the time taken to decide them. We do not collect data specifically on how long it takes to deal with oil and gas operations, but an indication on the overall performance of local authorities determining minerals and waste applications may be found at: <http://tinyurl.com/bxpn2fv>. Tables PI44A, I46 and I47 are most relevant in this context. Although we are not aware of many applications since 2012 for shale gas extraction involving hydraulic fracturing, it is worth noting that the moratorium on shale gas was only lifted in December 2012 and it will take time to prepare an application that properly addresses the issues involved and complies with all relevant requirements. This is especially true for the first several such applications; over time we would anticipate operators finding it quicker to produce these as their expertise develops. We understand that several companies have been in pre-application discussions with regulators, in line with best practice guidelines, and we expect to see these coming forward in the early part of this year.

The Committee raises questions about how the planning system deals with large scale horizontal drilling from a pad on one property extending beneath other properties. Under planning legislation the applicant is required to clearly set out on a location plan the land to which the application relates. This includes the possible extent of underground as well as surface working, and we will be providing further guidance on this in due course. Furthermore, before an application is submitted, the applicant is expected to notify each landowner or tenant of development that may take place on their land.

In December 2013 the Government laid legislation to amend the form of notification for landowners and tenants. These new arrangements come into effect on 13 January 2014. In practical terms, in place of the existing blanket notification, the changes mean that applicants who are applying for planning permission for on-shore oil and gas projects will now be required to publish a notice in a local newspaper and put up site displays in local parishes. In addition, a new requirement has been introduced for a site display to be set up in every local authority ward where no parish exists, or where the parish only covers part of the ward. We consider that these measures strike the right balance between the need to notify land owners and tenants, while ensuring the implementation for applicant is proportionate and pragmatic in the unique circumstances of onshore oil and gas development.

Critically, these measures do not affect or alter any voluntary pre-application consultation between the applicant and local communities (including landowners), and are in addition to the requirements for Local Authorities to publicise applications for public consultation.

Finally, the Committee asks about whether the planning system is geared up to deal with the increase in planning applications. At this stage we consider that mineral planning authorities are able to cope with an increase in applications for shale gas at whatever phase, and we are monitoring the situation. If the Department identifies any issues we will look at how these may be addressed. For example, this might include engaging the services of the Planning Advisory Service to support local planning authorities to provide effective and efficient planning services, to drive improvement in those services and to respond to and deliver changes in the planning system.

I hope you find this useful. Please feel free to get in touch should you wish for any further information.

*January 2014*

Department of Energy and Climate Change and British Geological Society—Oral evidence (QQ 17-32)

**Department of Energy and Climate Change and British Geological Society—Oral evidence (QQ 17-32)**

Transcript to be found under [British Geological Society and Department of Energy and Climate Change—Oral evidence \(QQ17-32\)](#)

**Department of Energy and Climate Change, Environment Agency and Health and Safety Executive—Oral evidence (QQ 153-184)**

TUESDAY 3 DECEMBER 2013

*Evidence Session No. 12.*

*Heard in Public.*

*Questions 153 - 184*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord McFall of Alcluith  
Lord May of Oxford  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witnesses**

**Duarte Figueira**, Director, Office of Unconventional Gas & Oil, Department of Energy and Climate Change, **Rt Hon Lord Smith of Finsbury**, Chairman, Environment Agency, **Dr Tony Grayling**, Head of Climate Change and Communities, Environment Agency, and **Peter Baker**, Acting Director, Hazardous Installations Directorate, Health and Safety Executive

**Q153 The Chairman:** Mr Baker, Mr Figueira, Lord Smith and Dr Grayling, thank you very much indeed for coming. This is the ninth public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. I would be grateful if those of you who have not appeared before a Select Committee before would speak loudly and clearly for the benefit of the webcast and the shorthand writer. Also, although our questions are to all of you, if you agree with what has been said by whoever speaks first or second, simply nod and I will record that for the transcript; that is fine. Do not feel you have to answer every question. Thank you very much indeed for coming, and thank you in particular to you, Mr Figueira, for your written evidence, which has been very helpful. Would anyone like to make an opening statement, or shall we go straight on? Well, perhaps I can begin by saying that the background for this particular session is that everyone that we have had evidence from so far has agreed that stringent tests need to be carried out on all the various aspects of risk, including environmental. Some have assured us that the UK has a good—indeed, some said it was one of the most stringent—regulatory system, and we would like to probe that with you today. This is the background for this session, which we regard as a very important session for us, and it is these issues we wish to explore with you. Can I begin with a fairly straightforward question, just to set the scene? Could each of you outline the

regulatory framework under which shale gas exploration and development takes place in the UK, and in particular refer to your respective roles?

**Duarte Figueira:** What I would like to do is to first of all lead off for DECC and explain what DECC does in the process, because, in a sense, DECC starts the process off. I will also cover the planning aspect, because we do not have anybody here from DCLG, who lead on planning policy for England.

**The Chairman:** We are having the Secretary of State in due course.

**Duarte Figueira:** Okay, but I will incorporate that into the overall description of the process, and then I will say a little bit about DECC, because DECC comes back into the process at the end, when the final drilling consent is given. Then I will invite my colleagues from EA and HSE to detail their parts of the process.

The process for obtaining a consent to drill a well is the same whether or not it is a conventional or an unconventional target. That is the first point to make. What happens is that DECC issues licences in competitive offerings—in licence rounds—that grant exclusivity to operators in a particular licence area, but they do not give any rights, or consents, to drill per se. This is not done, in any case, by OUGO; it is done by the licensing part of DECC. When an operator wishes to drill an exploration well, their first step, therefore, once they have got the licence, is to negotiate access with the landowner, and they must also obtain permission from the Coal Authority if their proposed exploration is going to encroach on a coal seam. The next step for the operator is to seek planning permission from the mineral planning authority, which in England is largely done by county councils or unitary authorities, and they will determine whether or not an environmental impact assessment is required. That is based on various thresholds that have to be met—whether or not the exploration will have a significant environmental impact. That is the first stage of the process: we issue a licence and, after a negotiation with the landowner, the company approaches the mineral planning authority. At this point, I will pass over to my colleagues from the Environment Agency and HSE.

**Lord Smith of Finsbury:** Thank you. We are the environmental regulator. That means that we look at those aspects of any drilling operation for mineral extraction that have an impact on the environment. In relation to shale gas exploration, we manage the use of water, the protection of ground and surface waters, and the management of wastes such as drilling muds, flowback fluid, gases and naturally occurring radioactive materials. If a significant or actual risk becomes apparent, we have the authority to stop the activity, but we would make a very clear assessment of the protections that the drilling company has in place, and, on the basis of those protections, we would issue permits. The range of permits required will vary from site to site. There will be some sites, for example, where there is no danger whatever of an impact on groundwater, so a groundwater permit might not be required. The range of permits that would be potentially required includes environmental permits for mining-waste activity, for radioactive-substances activity, potentially for groundwater activity, potentially for water-discharge activity, and potentially for industrial emissions. There would also be water abstraction consents required, because at the time of fracking a substantial quantity of water is required. Depending on location, there might be a flood-defence consent required as well. All of those are very specifically potential environmental impacts.

**Peter Baker:** The Health and Safety Executive is the health and safety regulator in Great Britain for work-related activities. That includes activities involving shale gas. Our role is principally to make sure that employers and operators of shale gas activities are adequately

managing and controlling safety risks associated with those activities, which may affect the workers on the shale gas site, contractors working on the site, and also members of the public who may be affected by those work activities. For shale gas operations, our focus is on ensuring that the shale gas wells are properly designed, constructed, operated, maintained and, ultimately, decommissioned. The principal process safety hazard associated with shale gas is an uncontrolled release of pressurised hydrocarbon gas and other pressurised fluids involved in the process, so the regulatory regime around that hazard is focused on containing the pressurised gas and other materials within the well itself.

On top of the Health and Safety at Work etc Act, which is of general application, there are two specific sets of regulations that are aimed at controlling well design, well controls and well operations. One is the Borehole Sites and Operations Regulations, which date back to 1995, which require operators of sites to notify the HSE of a proposed well operation. The other is the Offshore Installations and Wells (Design and Construction etc) Regulations 1996, which set out specific requirements for the standards associated with wells and also inspection regimes that are necessary throughout the lifecycle of the well operation.

HSE's role is principally in two broad areas. One is more generally engaging with the industry, with colleagues from DECC, the Environment Agency and other agencies, in encouraging and supporting the development of technical guidance and technical approaches that underpin the statutory requirements. The other is independently inspecting and regulating the well operations themselves. We receive the well notifications, which will include the operator's safety assessments and emergency arrangements, and we will assess those before the operations take place. Once the operations are up and running, we will conduct inspections: initially, before the operations take place, and then throughout the lifecycle of the well operations. Operators are also required to send us weekly operations reports on how the operations are going in accordance with their original design specifications, which we then scrutinise and can take action on as appropriate.

**Duarte Figueira:** Perhaps I can just conclude, Chair, by saying that DECC will then check that the Environment Agency—or the devolved equivalents, SEPA and the NRW—and HSE have no objections before consenting to drilling operations ourselves. If hydraulic fracturing is intended, then DECC will require a fracturing plan to address the risk of induced seismicity, and this will be submitted and reviewed before the operations are permitted. If the operator wishes to drill an appraisal well following exploration or to do production, then they will start again through the process that has been described to you by the witnesses.

I should say that all of this is done from the licensing side of DECC, and I would just like to say a very few words about the Office of Unconventional Gas and Oil. The Government announced that the office was established last December, and the office was up and running at the end of March, in order to help develop the shale gas industry in the UK and to ensure that it is environmentally safe, and also safe in the normal sense of the word. The office works very closely with the regulators, the relevant government departments and the industry to ensure the regulatory regime is as clear and simple as possible while safeguarding safety and protecting the environment. That is our role.

**Q154 The Chairman:** You partly answered the question I am about to ask in your last comments, but, as you know, in June 2012 the Royal Society and the Royal Academy of Engineering produced a report on shale, in which they emphasised the importance of co-ordination and said that co-ordination of the numerous bodies “should be maintained” and recommended that “a single body should take the lead”. That was in 2012. In October of



this year, giving evidence to us, Professor Robert Mair, who led the working group behind that report, was asked how these recommendations were going on, and replied: “The Royal Society and the Royal Academy of Engineering have had subsequent follow-up discussions with DECC, and I think ... it is acting on our recommendations”. Can you bring us up to date?

**Duarte Figueira:** As I said, we set up the office at the end of March. We have had contact with the Royal Society subsequently. We set up the office to provide exactly the sort of co-ordinated approach that was recommended in the Royal Society report, so there was clarity on the roles and responsibilities of different regulators and we had mechanisms to support that. We have set up a shale gas strategy group, which involves the bodies represented at this table but also other government departments and other stakeholders, like the Planning Officers Society and so on, which meets regularly and talks about the regulatory environment for exploration and then, subsequently, for production, and has been working on various bits of work. For example, DCLG produced planning guidance in July, part of which sets out very clearly how local planning officers should view their own work and the work of the regulators, to ensure that it is as streamlined as possible. That is one of the things that has emerged from the work that we have done as a co-ordinated body.

**Lord Smith of Finsbury:** Within the Environment Agency we have focused all our shale gas work in relation to all the different aspects in one place. It comes under Tony Grayling’s team. That team, which works to Tony, works very closely with both DECC and the HSE.

**Peter Baker:** There is also a memorandum of understanding between ourselves and the Environment Agency, which sets out a broad framework for how we both work together and plan our interventions, both in terms of longer-term strategy with the operators and how we conduct operations at individual site level. This reflects arrangements we have between EA and HSE across a whole range of other major-hazard industries, which have worked particularly well over a number of years.

**Q155 Lord Smith of Clifton:** Gentlemen, would you please explain to us in more detail how the planning process and the issuing of permits works for shale gas development? In particular—because you have gone into some detail on this—is it desirable to make the current process quicker? Some of the witnesses who have come before us have said that, while you have got to maintain these safeguards, the edifice you have constructed makes speedy decision-making difficult.

**Duarte Figueira:** I have mentioned that mineral planning authorities are responsible for planning permission and, effectively, ensuring that the use of the land is acceptable. Very briefly, the planning process involves a number of stages. There are usually pre-application discussions between the operator and the mineral planning authority, and, indeed, the industry has now committed publicly to doing pre-application engagement in advance of putting planning applications in. The planning authority normally screens to identify whether there is a need for an environmental impact assessment, and there is subsequently a submission of the planning application by the operator, with or without an environmental statement, depending on whether an environmental impact assessment is required.

**Lord Smith of Clifton:** When you talk about pre-application procedures, is that aimed at speeding the thing up? What does it actually involve?

**Duarte Figueira:** It is encouraged by the planning system, but the industry has adopted it to make sure that the local community fully understands what is proposed before the planning application is submitted. At the point at which the planning application is submitted, the

mineral planning authority will validate it and advertise it, and there will be a consultation on it so that the views of statutory consultees—such as the Environment Agency—and communities can be taken into account. Then the decision will be made by the planning authority, which may or may not set some conditions.

On the point about speeding up, I mentioned the fact that the guidance produced by DCLG in July specifically advised that planning authorities should assume that the regimes that exist already—the regulatory regimes run by HSE and the Environment Agency—will operate effectively, and while these issues may be put before the mineral planning authorities by consultees, they should not need to carry out their own assessment but could rely on the assessment of the regulatory bodies. So, planning authorities would need to be satisfied that these issues were being dealt with by the regulators, but they would not need to revisit them. That was a way of streamlining the process.

**Lord Smith of Clifton:** Do you think, as more applications are made and we get going on this, the various agencies will themselves be able to streamline with experience the processes that have to be undergone?

**Lord Smith of Finsbury:** The broad answer to that is yes. We already encourage applicants to parallel-track their application for planning permission with their application for environmental permits. We aim to issue the environmental permit within a 13-week period. That, however, has to include a period for public consultation. If it is a matter of high public interest, the consultation period might have to be a slightly extended one, which might push the timetable a bit beyond the 13-week period, but we try wherever possible to meet the 13-week deadline. In terms of gradually getting quicker at this, the answer is that we would certainly hope to do that, and in the new year we will be consulting on the potential for having standard rules permits, where, unless there is something that is very out of the ordinary, it can fit within a standard pattern, and that would enable things to happen much more quickly.

**Lord Smith of Clifton:** When there is a considerable increase in the volume of applications, are you ready to proceed without undue delay?

**Lord Smith of Finsbury:** We would certainly hope so, but we do have to get it right. That means that we would need to prepare the standard rules permit proposal well; we would need to consult very extensively on it; and then we would need to come to a determination on it.

**Q156 Lord Lipsey:** What you have said confirms what many of our witnesses have said—that we have got as strong a regulatory process as any in the world. But some of us worry about a situation where we have 4,000 wells. This is only an environmentally satisfactory fuel in a transitional phase—at least according to the conventional wisdom—to help us to get rid of coal quicker, until we move to whatever is going to be the long-term energy source. Are you really sure that this is not going to stop development occurring at the kind of pace it is necessary for it to occur to be a national asset?

**Duarte Figueira:** The industry says—or claims—that they expect 20 to 40 exploration wells to be put forward in the next two to three years, and that will give us an idea of how much of the resource that has been identified through the studies DECC has carried out—on the Bowland shale, for example—may be turned into technically and economically recoverable reserves. We are happy—all the bodies here would say—that for the exploratory phase of the process we have the right regulatory system in place and we have the resources to enable that exploratory phase to proceed. Our answer would be that we

certainly have the capability and the regulatory structure in place to enable the exploratory phase to proceed in line with industry expectations.

**Lord Lipsey:** Going beyond that, what is the first date on which you can imagine commercial exploitation of shale gas coming on stream?

**Duarte Figueira:** The industry talks in terms of the exploratory phase taking two to three years, and then there will normally be an appraisal phase, when the flow rate from the exploratory wells is analysed, and then production starts some time after that. They would certainly expect production to start before the end of the decade, but to be at scale in the early 2020s.

**Q157 Lord Lawson of Blaby:** May I follow up on what Lord Lipsey was saying? It does seem to many of us that a distinction needs to be drawn between the exploratory drilling and the production drilling, and that it is very important to be getting ahead with the exploratory drilling as soon as possible so that we know whether the vast amount of shale that there is in the United Kingdom—which has been established, indeed, in the north of England alone, and no doubt elsewhere—will produce commercially exploitable reserves on a very large scale, only on a very small scale, or somewhere in between. With exploratory drilling, a lot of the things that have been mentioned really do not apply. The quantity of water, for example, used in exploratory drilling is miniscule. It is puzzling for us, and I think it is puzzling for some in the industry, that it is taking so long. In the United States, where the Environmental Protection Agency is alive and well—an effective organisation—it all happens much faster. Why are you so slow?

**Lord Smith of Finsbury:** That question is directed primarily at us. First of all, it is worth gently pointing out that the United States did start rather a large number of years before us on this, but I would argue that we are not—in inverted commas—“so slow”. The ability to determine permits within 13 weeks seems to me to be quite expeditious given the circumstances. We would certainly hope to do better than that as more applications start to come through and as we get the standard permit rules very firmly in place.

**Q158 Lord Hollick:** I wonder if we can just look a little bit more closely at the length of the process. Various stages have been mentioned. Some may be concurrent; some may be sequential—I do not know. Pre-application discussions: is that a process that takes place?

**Duarte Figueira:** That is a process that the company would undertake, and be encouraged to undertake, and it is really up to them how long that would take.

**Lord Hollick:** That is a matter of a few weeks, is it?

**Duarte Figueira:** It would be purely a matter for the company to determine whether it wanted to engage in local discussions, hire parish halls and have meetings with local communities and so on. That is purely a matter for them.

**Lord Hollick:** Then the Environment Agency takes 13 weeks. Maybe more, maybe less, but that is what they are currently.

**Lord Smith of Finsbury:** Simultaneously with a planning application that has gone in. All of these things happen in parallel.

**Lord Hollick:** Right. Is the HSE also happening simultaneously with that?

**Peter Baker:** Yes. The HSE role, before the operations start, is not a permissioning or permitting role. All the operator does is notify us at least 21 days before the operation starts and we carry out our assessment within that 21 days.

**Lord Hollick:** Is it the case that the environmental permit does not really commence until the owner has signalled his or her agreement to this?

**Duarte Figueira:** Normally, getting permission from the landowner would be the first stage. That would take as long as the commercial negotiation took for the company.

**Lord Hollick:** Then that is the slowest ship in the fleet, maybe: the planning process itself.

**Duarte Figueira:** The planning process will depend to some extent on whether or not an environmental impact assessment is required, and that will require a period of work by the company to pull it together. Once the submission is made by the company of the planning application, together with the environmental statement that reflects the environmental impact assessment, the mineral planning authority would normally validate it, place an advert and consult for usually around 21 days, and then the planning permission would normally take 16 weeks if it involved an environmental impact assessment, and, if it did not, around 13 weeks. These are indicative dates that are part of the planning system. As Lord Smith said, the environmental aspects can go along in parallel to that.

**Lord Hollick:** Is it the case that if you were drilling half a dozen exploratory wells within pretty much the same area—maybe a mile or so apart—this could be done as a group application, or does each one have to be done singly?

**Duarte Figueira:** This is a planning question and I will double-check it, but my understanding is that normally a planning application would refer to a specific development, or a pad. Normally, another pad with a well on it—if you are talking about exploration—would be a different development elsewhere, and it would not normally be very close; it might be a couple of miles, or further, away.

**The Chairman:** So far, very little drilling has taken place. Why?

**Duarte Figueira:** Essentially because the companies have been looking at the licences that were issued by DECC in the last licensing round in 2008 and preparing themselves through doing various activities, including seismic work and speaking to local communities. As in the case of Cuadrilla in Lancashire, they have carried out some activity. There was a period after the seismic event when there was a moratorium on hydraulic fracturing, which was lifted in December 2012, but since then the companies have started to take forward their work and we have seen commercial activity, including investments by other companies in those licence-holders.

**Q159 Lord Griffiths of Fforestfach:** Can I ask how many licences, or permits, have so far been given?

**Duarte Figueira:** DECC issued approximately 176 licences for activities under the last licensing round in 2008, and we intend to have another licensing round next year.

**Lord Griffiths of Fforestfach:** Do you know the average length of time it took for those to be issued? You mentioned 13 weeks.

**Duarte Figueira:** The licensing process is a separate process. Under European law, to carry out a licensing round, we have to do what is called a strategic environmental assessment of a plan or a programme, which is what we are doing at the moment for the next licensing round. Once that process is complete, once it has been consulted upon and once Ministers have decided what size the round is going to be, a commercial competitive approach is taken to this, and those licensing rounds are normally done in 90 days.

**Lord Griffiths of Fforestfach:** Given that the companies have been objecting and saying this could have been faster, do you have any idea of what their experience has been in relation to what you would like the norm to be?

**Dr Grayling:** If I might come in here on the issue of environmental permits, since the Government gave permission for hydraulic fracturing in principle to resume, we, the Environment Agency, have not yet received any permit applications to undertake hydraulic fracturing. The applications we have received have been for conventional activities—for example, the exploratory well at Balcombe, which was looking for oil; and, more recently, an application from IGas to drill and take core samples from a well at Barton Moss, Irlam, near Manchester—but not involving hydraulic fracturing. In both of those cases, we issued our permits well within the 13-week deadline. I think we did it in six weeks in the case of the well at Balcombe and nine weeks in the case of the well at Irlam.

**Lord Lawson of Blaby:** Are you in discussions about permits for hydraulic fracturing with any operator?

**Dr Grayling:** Yes. We are in discussions with a number of operators who are considering bringing forward proposals next year for hydraulic fracturing, notably Cuadrilla. We are expecting that they will come forward in the new year with a number of permit applications, alongside seeking planning permission.

**Q160 Baroness Blackstone:** Could I ask what the reasons were for your rejection of those two applications that you have just mentioned?

**Dr Grayling:** Rejections?

**Baroness Blackstone:** You said there were two that you rejected.

**Dr Grayling:** No, we granted the mining-waste permits within, respectively, six and nine weeks. In the case of Balcombe, we also issued a radioactive-substances permit.

**Baroness Blackstone:** Sorry, I misunderstood. So you have not rejected a single application for a licence for exploratory drilling so far?

**Dr Grayling:** No, there are some circumstances in which we would.

**Baroness Blackstone:** Or have?

**Dr Grayling:** We have not so far, because nobody has yet come forward with a proposal that we consider objectionable.

**Baroness Blackstone:** What are the reasons that you would adduce for a rejection?

**Dr Grayling:** Particularly if there were proposals to drill in a location that was particularly important for supplies of drinking water—what we would call source protection, zone 1. We would object to developments in those areas.

**Baroness Blackstone:** Because of the risk of water contamination?

**Dr Grayling:** Because of the heightened risk of water contamination.

**Q161 Lord May of Oxford:** By whom and how will the shale gas operations be monitored for environmental and public-health impacts in both the exploration and the production phases—which, as Lord Lawson emphasised, are rather distinct? Who is going to carry it out and what engagement and oversight will the regulators have?

**Dr Grayling:** The Environment Agency will require monitoring, including baseline monitoring before operations start, as part of the conditions of our environmental permits, notably the mining-waste permit that is a requirement for all drilling activities, and we will ourselves examine the results of that monitoring to ensure that the operator is complying with their permit conditions. In addition, we may also carry out our own monitoring, which we do on a risk basis or if we think that an activity is being undertaken that is novel and contentious. For example, in relation to the well at Preese Hall, which is the only one where there has been some hydraulic fracturing so far, we took our own samples of the waste fracking fluids and analysed the contents of that waste, and we published the results of our analysis on our website.

**Lord May of Oxford:** You will be aware that the Royal Society report highlighted five main areas of risk, and I would add a sixth. The notes I have in front of me for the question go on for a page and a half and I will try to go through them quickly, but I would like to have some specificity on each of these six topics: groundwater contamination; treatment of waste water; methane emissions; well integrity; fracture propagation-induced seismicity; and air quality. First of all, groundwater contamination. I should declare a non-interest, in that I had nothing to do with the Royal Society report. The Royal Society recommended that the UK environmental regulators work with the British Geological Survey to carry out national baseline surveys of methane and other contaminants in groundwater. What is the standing of that?

**Dr Grayling:** We are indeed carrying out joint work with the British Geological Survey, in particular on assessing groundwater levels of methane as a baseline. In addition, in relation to its specific developments, we will require the operator to do that. For example, we required Cuadrilla to carry out baseline monitoring from a sampling borehole on their Balcombe site.

**Lord Smith of Finsbury:** It is probably fair to say that groundwater contamination is the biggest environmental risk in this activity, so we do have to be pretty careful about it. At Preese Hall, which is the one site where fracking has taken place thus far, there were no groundwater aquifers anywhere near the drilling location, as far as I recall.

**Dr Grayling:** The only groundwater nearby was saline and would not be suitable for potable use.

**Q162 Lord May of Oxford:** On the question of well integrity, the 1996 regulations apparently require that the design and construction of onshore wells be examined by an “independent and competent person (well examiner)”. The well examiner—if I believe this—is currently commissioned and paid for by the operator, and it is true that the 1996 regulations state that the examiner “might be someone employed by the well operator’s organisation”, but Robert Mair, the person who chaired the Royal Society thing, regarded that as a very undesirable thing to do and recommended that these guidelines be clarified so that one is really ensuring the independence of the person. I would welcome responses to that.

**Peter Baker:** The guidance that goes with the independent-examiner requirements under the regulations sets out very clearly how to ensure independence. It is right that operators have the option of using someone that they directly employ.

**Lord May of Oxford:** Do you not find that inherently contradictory? I do.

**Peter Baker:** In the majority of cases they do not; they use external operators.

**Lord May of Oxford:** What are they doing in this case?

**Peter Baker:** In the majority of cases they use independent contractors. This is not unusual in major-hazard industries. The offshore industry uses third-party verification for a number of significant integrity issues to do with offshore installations. Our assessment and evidence indicate—and the Select Committee inquiry into deepwater drilling following Deepwater Horizon also indicated—that it does not necessarily follow that having your own people do third-party verification is a bad thing.

**Lord May of Oxford:** Do you not draw a distinction between the wells being in the midst of a community and something being in the ocean?

**Peter Baker:** There is a difference, clearly.

**Lord May of Oxford:** There is a difference, and it makes it more sensitive. Even if there are not conflicts of interest, you should be avoiding the appearance of them.

**Peter Baker:** But similarly, on an offshore installation, a lack of well integrity can have very serious consequences as well, as we all know. The well examiner is in addition, though, to the independent regulation by us as HSE; it is not the sole assurance that the operations will get. They will get the independent inspection by HSE well specialists, and, as part of our inspection system, we do concentrate on how the operators ensure both the efficiency and integrity of their well-examination scheme, and, where they use their own employees—which is quite rare—they maintain that necessary level of independence. It is an important barrier in the well-integrity control system.

**Q163 Lord May of Oxford:** Ticking the next box, the Royal Society report recommended an appropriate body carry out national surveys to characterise stresses and identify faults in UK shales: site-specific surveys. I take it that is before, during and after fracking. I take it that is in hand.

**Duarte Figueira:** DECC has already published various bits of work outlining the tectonic history of many areas that are prospective for shale, but we commissioned the BGS to complete a Bowland shale regional mapping project, which was published in June this year. We have a further study to map the Jurassic shale gas potential in various areas of prospectivity. In terms of our specific requirements within DECC, as I mentioned at the outset, one of the things that we require if fracking is contemplated in a particular project is a fracturing plan from the company to address the risk of induced seismicity, related to the licence. We will review that plan before any operations are permitted.

That involves a series of stages. First of all, the operators have to review the available information on faults in the area. Secondly, there has to be background seismicity monitoring carried out for a period to provide a baseline. Then the actual hydraulic-fracture programme has to be completed and submitted by the company to DECC, which is essentially a risk assessment. That should be designed to use only the amount of fluid required to fracture the rock sufficiently to allow the gas to flow, and the pressure should be quickly reduced thereafter. We have introduced a traffic-light system for when fracking actually occurs. You may have heard of it. That essentially involves operations being halted in the case of a seismic event of more than 0.5 being registered. The reason we do that is because, when we had the seismic events at Preese Hall, which were 1.5 and 2.3 on the Richter scale, they were preceded by some seismic events that could have potentially led to anticipation of the later ones. Once the fracking and the flowback are completed, the monitoring continues for at least 24 hours after, to identify any abnormal events post-frack. In addition, we have a requirement for equipment—tiltmeters and seismometers—to be

installed to determine the penetration of the frack into the rock, just to make sure that is consistent with what the company said it would be. There is quite a detailed process that is required when fracking resumes.

**Q164 Lord May of Oxford:** I will take the next two boxes together, because they should be more straightforward: monitoring potential leakages of methane or other emissions before, during and after operations and submitting them to the regulator; and also minimising the use of waste water and recycling and reusing it. I take it that is all in hand.

**Dr Grayling:** Again, we require monitoring of methane as a condition of our mining-waste permit before and during operations, and we expect complete containment.

**Lord May of Oxford:** Good. The last thing comes back to the question of how confident one can be that well examiners and other people involved are truly independent of the operators who have appointed them. We have one anecdote here. You will understand that it comes indirectly, via some of the people who live around there. Cuadrilla has appointed Ground Gas Solutions (GGS) independently to monitor the air quality for the duration of its activity at Balcombe. One of the residents rang GGS just to find out how independent they were, and she was told that it was none of their business, and that, “All requests for information are to be directed to Cuadrilla’s enquiries contact address”. I see this as at best a failure of tact, and I hope it is no worse than that. Could someone reassure me?

**Dr Grayling:** That is possibly one for the companies involved to answer rather than ourselves, but we would take air quality seriously. For that reason, for example, we would require very stringent standards to be applied to the flaring of any waste gas on the site, although at Balcombe they have not yet got to that stage.

**Duarte Figueira:** There are a couple of other bodies involved in air quality. Mineral planning authorities have a role in ensuring that the air quality impacts are acceptable. That can include, for example, issues like dust rising from the construction. That is particularly important in an area where there might be poor air quality. They can set planning conditions and they can also have Section 106 agreements as a result of their planning permission. In addition, within DECC we have a very strong policy on minimising the release of gases as a condition of the licence. For example, we would allow venting as part of the licence conditions only in the case of a safety requirement. In the case of flaring, we would seek to minimise it to the technical and economic minimum. That would be at exploration, and at production we would certainly expect there to be much more of a green-completions approach going forward.

**Lord May of Oxford:** I did have a last question, but I am not going to ask it, because we have had a statement about it.

**Q165 The Chairman:** I think it is worth asking. It is the question about the concern that has been expressed by Professor Richard Davies from Durham University over how well wells will be monitored once they have stopped producing. Are there regulations in place to deal with abandoned wells?

**Duarte Figueira:** The position from the licensing point of view is that the operator remains liable for the well, essentially. The liability stops with the operator and, if there were a difficulty with the well, we would expect to ask the operator to remedy it going forward.

**The Chairman:** There is no independent monitoring.

**Duarte Figueira:** I am not aware of independent monitoring



**Lord Smith of Finsbury:** We would expect, as part of the monitoring of the operation of the well while it was happening, that the plans to ensure that anything was properly contained subsequently were very firmly in place, and we would be making sure that that happened. In relation to what happened subsequently, we would, I imagine, in the same way as we do for abandoned coal mines, from time to time need to monitor and regulate if a problem were to arise—but we would want to make sure that problems did not arise in the first place.

**Q166 Lord Hollick:** I will just start with a follow-up to a comment that you made, Dr Grayling, about saline water. One of our witnesses, Professor Muller from Berkeley University, told us that the hydraulic fracking technology had improved dramatically, to the point where substantially all of the water that would be used would be saline water. Are you familiar with these developments?

**Dr Grayling:** I would not claim to be a particular expert in that area, but we would encourage operators to look at ways of managing their use of water to reduce the impact on the environment, and one of the options would be the use of non-potable water—water that would not be suitable for drinking purposes. We would also encourage the recycling of fracking fluids to reduce the amount of further water you need to take from the environment. It is very important to understand that if you want to take large amounts of water from the environment, you require a licence from the Environment Agency or our sister bodies in other parts of the United Kingdom, and we would not license levels of abstraction beyond that which would be environmentally safe. We undertake a catchment assessment to make an assessment of what level of water abstraction is sustainable.

**Lord Hollick:** It would be well worthwhile following that up with Professor Muller.

**Duarte Figueira:** Perhaps I could just add to that. I did recently visit the Eagle Ford Shale in Texas and I had a number of discussions with individuals around the possibilities of using non-potable water. The general picture that we got back was that yes, it is certainly possible to start moving in that direction, but it will take some time and the technology is not completely there yet. There are certainly possibilities in that direction at the moment.

**Q167 Lord Hollick:** We heard from Balcombe residents about cancer concerns. They referred us to a report from the Colorado School of Public Health, which the Royal Society also referenced, which suggested that there are higher cancer risks for residents living within half a mile of a well than for those living further away. Would you like to comment on that?

**Dr Grayling:** We certainly take the risks of emissions of pollutants, including carcinogenic pollutants, extremely seriously. I am not personally familiar with the Colorado study, but it is important to note that there are practices permitted in the United States—or at least certain states—that we would not permit in England or, indeed, in other parts of the UK. For example, we would not permit the use of venting of gas, as Duarte has already outlined, which can result in toxic pollutants getting into the atmosphere. We would not allow waste fracking fluids to be stored in open pits or lagoons, which are sometimes used in the United States and which can mean that you also get pollutants getting into the atmosphere. We take our responsibilities on this front very seriously. For example, we would also not allow the use of substances in fracking fluid that we consider to be hazardous to groundwater in the first place. In many ways, we have a tighter regulatory regime than is the case in some states in America.

In addition, the industry is at a much earlier stage of development in the UK, and I suspect that part of the air-quality issue that has been identified in Colorado will be because they are at the production stage, where you have got a higher density of operations, including probably the use of diesel engines and other sources of pollutants on sites. We will certainly need to be mindful of the cumulative risk that you might get when operations scale up, and we will adapt our regulatory approach accordingly to ensure that you do not get unacceptable levels of pollutants going into the atmosphere.

**Duarte Figueira:** Can I just say a couple of quick things? One is that I had the pleasure of speaking to Balcombe parish councillors and reading the report—it was one of the first things I read when I started the job—and they did an enormous amount of work to identify the potential risks, which is incredibly helpful for the local people. Just briefly, though, the work that I think is being referred to in that quote was analysed as part of a document that was published in October by Public Health England, which was an analysis of all the various chemical and radiological risks that may occur as a result of shale, and that study is possibly something that your specialist adviser is aware of. That referred to a study in Colorado by McKenzie et al, and it did suggest a higher risk of adverse health effects, but it pointed out that the results were preliminary and needed more research and that, indeed, the methodology was not recommended by UK authorities. Public Health England's overall summary was that, on current evidence, the impact of individual shale-gas wells on local air quality was likely to be low in the UK if operations were properly run and regulated, that any failures were largely down to management failures, and that the regulatory environment in the UK would not allow such risks.

**Lord Hollick:** Do you think further research is required? Clearly, the CEO of Cuadrilla does not feel that, because he said when we were discussing this with him that there is “zero correlation between any incidence of cancer and the drilling of our well”. He was referring to Balcombe.

**Duarte Figueira:** What I am saying is that the PHE report suggested that the risks arising were low if things were properly managed and regulated. Whether additional research is required is really a matter for PHE to consider as part of their ongoing work.

**Lord Smith of Finsbury:** The key principle for us here is to contain very securely any environmental arisings that might have a hazardous or toxic nature, and that would be particularly in relation to any fluids or gases. We would make sure in issuing any permit that there was proper containment in place.

**The Chairman:** If there is anything you would like to send us on that particular incident in a further note, please do so.

**Q168 Lord Lipsey:** I am sorry to raise Balcombe again, but the local Balcombe pressure groups have been very assiduous in keeping this Committee informed as to their concerns, and we are grateful for that even if we do not share them all. One of the main ones they raise is about noise. Here, the difference between the company and the residents is enormous. The residents speak of months of sleepless nights; the head of Cuadrilla, on the other hand, described a breaching of the limits laid down by the authorities for noise as “less than a whisper”. I do not think there is any doubt that he was being economical with the truth; I cannot say whether the residents were economical with the truth when they described the sleepless nights. It would be very helpful to hear from you what the regulations are and how you make sure that they are adhered to and not just broken when it suits the company.

**Lord Smith of Finsbury:** Noise requirements are put in place as part both of the planning approval from the local authority and of the environmental permit that we issue. At Balcombe, during the drilling process, both we and West Sussex County Council received a number of complaints about noise. When we investigated and assessed it, Cuadrilla turned off their equipment and fitted noise-abatement measures to it, because that was required in order to meet the conditions that they were supposed to meet. After the equipment and the barriers had been put up, no further complaints were received by us.

**Q169 Lord Skidelsky:** In our notes, Mr Figueira, you are quoted as saying that the UK Government “is engaging with communities to explain the benefits of shale gas development”, and that “industry also needs to do that”. Presumably you would want the Government to explain the risks as well as the benefits.

**Duarte Figueira:** I do not know where that is quoted from. The position that we have is quite clearly that we believe that early engagement by companies with local communities is critical, and we have been encouraging the industry very strongly to make that happen so that they can explain their projects and the implications of them. Our role within OUGO, which is set out in our published objectives, is to support public engagement—including ensuring there is access to evidence-based information—so we can address the questions that they raise. For example, on the gov.uk website we have an extensive list of—I think 70—questions and answers on various aspects of shale, the majority of which are based on scientific information that tries to explain what the different aspects are, whether it is seismic or water or air quality, and so on. We are planning to increase over time the accessibility of that information and its use, so that it is public-facing and scientifically objective. We are shortly planning to publish a regulatory road map, which will set out, not just for planners and for companies but also for people in localities, what the various aspects of the regulatory process are, not just in England but in Scotland, Wales and Northern Ireland. It will make it very clear what the regulatory requirements are.

Certainly, part of our role is explaining the Government’s policy on energy, including shale’s role within that and within the gas strategy, but a lot of our work is essentially trying to make sure there is explanation at both the national and the local level of what the regulatory system is and how it applies. For example, in Lancashire, we, the Environment Agency, HSE and the local mineral planning authority presented to local county councillors and district councillors the full range of the regulatory process and allowed questions and answers on that. I did a similar event with the Environment Agency and a well-known scientist in the area at the South Downs National Park Authority, which was attended by members of the public. Members of my team have been in Lancashire and other parts of the country, explaining to local communities what the science is, and essentially making sure that people understand what the regulatory process is. We are not being proponents for shale in that sense; we are explaining how shale fits into energy policy.

**Lord Skidelsky:** I am trying to visualise this. There is a meeting in the town hall and the operators say, “Look, this will bring wonderful benefits to the community because of a, b, c, d” and so on. Then Lord Smith turns up from the Environment Agency and says, “Wait a minute. There are these things you have to consider, too.” Is that how it is going to go? Shoving reams of paper onto websites is not going to engage the local community at all in the debate, really. It might engage a few councillors. I thought there was something a bit more interactive being suggested here.

**Q170 Lord Shipley:** Can I add to that question and just ask who you think is responsible for leading consultation? We have applicants, we have local councils, we have government

departments in Whitehall, and we have government agencies represented here. I am not clear from the evidence you have given so far as to who leads a local consultation. Are you clear about that?

**Duarte Figueira:** Yes. When companies explain their projects to local people, they may ask us and the Environment Agency to be present and may ask us to explain what the Government's policy is on energy, and the Environment Agency to explain what the regulation is. Those are events the companies may put on, which are explaining their projects to local people. However, if we are engaging with local communities, normally we would expect the parish council, the county council or the district council to ask us to put on an event—as we did in Lancashire and we did in the Weald—where the range of the science and the regulation is explained objectively to people. What we are trying to do is to enable people to be well informed about the regulation and the facts about shale and the facts of the geology. We would take the lead in helping organise that with the parish council, or local council. We would have colleagues from HSE and EA present with us to give us the full range, because within OUGO we are not experts on well regulation, for example, if a question came up in that area. We would regard ourselves as being in the lead with, say, the district council in an area that is likely to have an application.

**Lord Smith of Finsbury:** On the whole, I would expect the local authority to take the lead in arranging and fostering any local consultation process.

**Lord Shipley:** To be clear, it is the planning authority, as opposed to a parish council, which is a consultee.

**Lord Smith of Finsbury:** It will depend on the circumstances, but I would envisage that it probably would be the planning authority, because they would need to be consulted in any case in relation to the planning permission. We would have the formal consultation process where we put out the documents relating to the permitting, but in terms of public meetings, discussions and helping people with information, the organisation of that I would anticipate being done by the local authority. We would very willingly come along. It would not be our place to argue for or against shale gas; it is our place to inform people about what the environmental regulations are and how they could be met.

**Q171 Lord Skidelsky:** Thank you. I would like to ask one more follow-up, please. It is a question on inducements. The UK Onshore Operators Group has proposed that local communities receive from extractors—that is, operators—£100,000 per well site at the exploratory stage and then a 1% share of proceeds at the production stage. Is that based on a well worked-out premium for the risk that the communities would be running, or is it simply a bribe?

**Duarte Figueira:** You must remember this is an offer from the industry. The industry has brought forward its community-benefits offer and it has all been wrapped up in their community engagement charter. The Government has welcomed that, and we have done that at a very early stage. At the moment, we have got to remember that we are still in a position where we do not know how much of the resource that exists can be translated into technically and economically recoverable reserves. At a very early stage, the industry has come forward, largely on the basis of not really knowing how much is going to be produced, and made an initial offer. They have said in their community engagement charter that they will keep the matter under review.

**Lord Skidelsky:** So is it a negotiating position, as it is with a landlord?

**Duarte Figueira:** It is what they have offered the local communities at present.

**Lord Skidelsky:** It is not based on any serious cost-benefit analysis of rights being traded?

**Duarte Figueira:** It is very difficult for the industry to know exactly how to make that calculation in the absence of the explorations going forward.

**Q172 The Chairman:** Can I ask you one question on the issue of information? In your note to us, Mr Figueira, you say that your office “is now developing plans for engaging the public in a well informed debate on shale”. You have tended to concentrate on the regulatory process, procedures and so on in your answers so far, but are you intending—as the industry I think would like to see—to put more of the case for the benefits and contributions of shale to the wider population, if the exploratory wells prove that it is right?

**Duarte Figueira:** What we have done is a mixture of national and local. It is absolutely true to say that in the first six months of our existence, our focus has been very much on making sure that the regulatory position is clear. That included the DCLG’s work on its guidance, the Environment Agency’s own consultation on guidance and our own regulatory road map that we plan to publish shortly. Our focus now has shifted and we have started to do a lot more both local and national engagement.

When we say we want to inform the public, it has two dimensions. One is that there is very clearly a need to make sure that people understand fully the specific dimensions they may have concerns about. We have tried to make sure that issues are well understood through national publications and reports, such as, in terms of health, the Public Health England report; and, in terms of emissions, Professor MacKay’s study. In the case of Professor MacKay’s report, we made sure that we had a launch at the Science Media Centre, which was attended by journalists so that they could report it properly, and that the presentations on the science were given by scientists. We had a similar event in the House, sponsored by the APPG, for MPs and Lords.

At local level, we respond to requests from local bodies, whether they be county councils or lower levels of administration, to give presentations that outline the regulatory process and address any concerns they may have through questions and answers. They explain how shale fits into the Government’s energy policy—I would normally do that sort of presentation—and they also outline the potential benefits of it if the resource can be translated into reserves. Those would be improved security of supply, tax revenues, and the like. That is part of our mission, and that is very much part of our work going forward.

**Lord Smith of Finsbury:** We have said at national level on quite a number of occasions that it is our view that shale potentially has a useful part to play in the energy mix for the UK, provided that it is done and extracted safely, and it is our job to make sure that that happens.

**Q173 Baroness Blackstone:** Turning from the local to the transnational, we gather that the European Commission is considering publishing proposals for an EU-wide framework for unconventional fossil-fuel extraction that they want to harmonise across all member states. Do you know what these proposals are likely to be, and do you agree with them?

**Duarte Figueira:** The Commission is currently reviewing the European legislative framework for unconventional hydrocarbon extraction, including shale gas. We expect them to publish proposals in the new year, so we will not know until then what they propose. We are talking to them, because that is the way you influence things in Brussels—by making sure you get in early—and we will have to negotiate more formally when the proposals are published. In terms of what we think the need for EU action is, we can see the value in

developing guidance across the Union that would provide clarity and ensure that the directives are applied uniformly across member states, but we do not believe there is any need to legislate further. We must ensure that EU action is proportionate and does not result in new regulation in the industry that is not required. In addition, the uncertainty that would be involved in the timeframes for legislation would also be an issue for concern, given the fact that we think the existing directives cover the risks that need to be addressed, and we want to get the exploration phase away as soon as possible, in the way that has been described. We should also say that, in terms of discussions with the Commission, we have been sharing best practice with them—that is something perhaps the EA might say something about—and we have in the UK over 50 years' experience of onshore regulation in oil and gas to draw on in doing that.

**Baroness Blackstone:** Are you saying that you do not envisage a great deal of change being necessary to the UK's regime once these are brought into force, or not? I do not quite follow.

**Duarte Figueira:** We do not believe there is a need for legislation. We believe that there might be a benefit in having some guidance across the European Union on how the directives should be applied.

**Lord Smith of Finsbury:** Our view, likewise, is that the current suite of directives that apply to these operations is entirely sufficient to secure environmental protection.

**Q174 Baroness Noakes:** I want to turn to the potential for shale gas in the UK. We have recently had the British Geographical Survey assessment of the Bowland-Hodder shale, and they told us that they were going to produce a report on the Weald early next year. Do you believe that these studies are proceeding at a fast enough pace, or does there need to be some more energy put into the programme? There are other areas in the UK that remain unlooked-at by BGS.

**Duarte Figueira:** You had evidence from my colleague, Toni Harvey, early on, on the work that is being done in this area. I should say we have also started work on a study of the Midland Valley of Scotland—I am not quite sure whether that was mentioned by Toni—and that will cover various bits of work related to that. In general terms, the studies bring together a whole set of separate analyses, so many of these cannot be done in parallel, I am told by the geologists. The Weald study is proceeding faster because the study area is quite small and structurally less complex. The studies do take time to get right and, at BGS and across the UK industry—because the UK industry has been helpful in this respect, as Toni outlined—the expertise is in fairly short supply. It is not as if any geoscientist can do the work, so throwing more people at the problem will not necessarily speed it up. We are trying to do this work as quickly as possible.

**Baroness Noakes:** Were DECC late to the party?

**Duarte Figueira:** No, I do not think so. The work is being carried out in line with the programme that was agreed some time ago. It just takes time to do the studies.

**Baroness Noakes:** So the constraint is the lack of people with expertise. Could they not be brought in from America?

**Duarte Figueira:** The constraint is simply the complexity of the work. The BGS already has the basic raw materials, but it takes a long time to process it. It also involves the use of external reviewers, who need time to peer-review, and these experts do this on top of their

day jobs. It just takes time to include their contributions in the process. No, I do not think that the work has been done slowly; it is all proceeding at a reasonable pace.

**Baroness Noakes:** You mentioned three areas that have been done, or will be done. What other areas in the UK are planned to be covered by these surveys? Are there any no-go areas in terms of potential shale exploration?

**Duarte Figueira:** There are some areas of the UK that are regarded as not being highly prospective for shale. Toni may have mentioned the Scottish Highlands as being one such area. There is prospectivity, for example, in parts of Wales, and there will be further work done by the department in due course. If the Committee would like, I could ask my colleagues on the licensing side to do a note on the plan for those studies.

**Q175 Lord Griffiths of Fforestfach:** Do you think the development of shale in the UK requires a special tax regime?

**Duarte Figueira:** That is a difficult one for me particularly to deal with, because tax is a matter for the Treasury. They are planning to respond shortly to the fiscal proposals that they consulted on in any instance, and certainly within the timescale of your inquiry. In general terms, in the offshore sector these targeted field allowances—which were consulted on in respect of onshore—are very similar, and they have contributed to record levels of investment. That type of incentive has worked in that way.

**Q176 Lord Rowe-Beddoe:** Let us turn now to the economic implications for the country, both in terms of employment and of use of this. There are, confusingly, some quite disparate figures here. We have from the IoD's publication, *All Hail Shale*, information that the production phase of shale gas could support 74,000 jobs. The Prime Minister himself used this figure, I understand, in the *Daily Telegraph*. On the other hand, AMEC—I believe it was stated in a private meeting with DECC—used a figure of 15,900 to 24,300. Those are not very precise figures, I must say, but there we are. We understand that they base this on different assumptions about the speed at which wells are drilled. However, with such a wide range of potential economic impact with regard to jobs and job creation, what are your opinions on this?

**Duarte Figueira:** To be honest, the economic impact of shale, whether it is jobs or other elements of economic activity, will very much depend on the level of production and, indeed, production costs—which, again, we do not know yet.

**Lord Rowe-Beddoe:** And the speed?

**Duarte Figueira:** And the speed. The IoD figures were hailed at the time because, in many ways, that was the only report that was around when it was published in May. It is a scenario of 74,000 jobs. They talk about £3.7 billion of capex. We will need to see. We are doing some work. DECC consultants are finalising the environmental report to be published as part of the consultation for the strategic environmental assessment for the next licensing round, which I have mentioned, and this will present some high and low-level scenarios for future development of the industry and the potential employment implications of that. That is another set of figures that will appear shortly, and I think it will appear within a timescale that means you can take it into account in your inquiry.

I should mention that as well as the community benefits that I have mentioned already, there are some other benefits that will arise from growth locally, including the Government's reform of the business rates retention scheme, which will allow a higher proportion of rates to be retained locally where there is local growth. So, if there are shale developments

locally, there will be a benefit to that once production takes place. There will be other aspects to take into account as well.

**Lord Rowe-Beddoe:** AMEC are now being commissioned to carry out the strategic environment assessment.

**Duarte Figueira:** They are our consultants to carry out the environmental report, yes.

**Q177 Lord Rowe-Beddoe:** In his evidence to this Committee, Professor Dieter Helm said it is “hard to make a case” that the UK and Europe will have energy-intensive industries in the future. The reason that I bring this up is because we have heard evidence that if we had much more competitive energy prices, it would greatly impact on our ability to attract energy-intensive industries. Professor Helm says he believes that the US gas price will continue to be “amazingly competitive” when compared to European prices. Do you agree with this analysis?

**Duarte Figueira:** It is worth bearing in mind that we have not yet had the exploration phase and, as a result, we do not know how much shale will be produced economically; we do not know what its production costs will be and how they will compare. It is important to keep reminding yourself of that when you are making assessments of this type. We had a piece of work carried out via a company called Navigant, which was published in the middle of this year. I do not know if the Committee is aware of that piece of work, but we are very happy to make it available; it is public on our website. That has a number of scenarios, and it does talk about a scenario where it is possible that there will be a decrease in energy prices. It relies on production in the US being exported; it talks about production of shale in China; and it talks about production of shale in Europe, not just in the UK. There are some scenarios that you could analyse that result in lower prices. Certainly from the point of view of the department, we would say that large-scale shale production would undoubtedly have a downward pressure on prices; we cannot rule out a price effect, but we take a cautious view of any estimates of what that price will be. That is our position: we take a fairly cautious view on what the price impact might be.

**Lord Rowe-Beddoe:** US gas prices are about 25% of what we are currently paying. Is that right?

**Duarte Figueira:** I understand they are in that range.

**Lord Rowe-Beddoe:** \$3 to \$4 per million BTUs.

**Duarte Figueira:** \$3 to \$4, yes.

**Lord Rowe-Beddoe:** And we are somewhere around \$10 to \$12.

**Duarte Figueira:** Yes. You have to take into account the transport costs.

**Lord Rowe-Beddoe:** You could transport an awful lot for \$9 across the Atlantic.

**Q178 The Chairman:** We have taken a lot of evidence on the economic impact, and we had a very graphic description of the effects on some parts of the United States last week, when Mr McAleer described the tremendous benefits at great length. In your well informed debate on shale, do you regard it as your responsibility—or the Government’s responsibility—to emphasise some of the economic benefits as well as all the security arguments, all the safeguards and so on?

**Duarte Figueira:** The important thing is, when we are talking to the public, we make statements that can be objectively backed up and are scientifically proven. In terms of the



sort of discussion we have just had on price, for example, we would set out our analysis on it and we would make it very clear, if we were asked, what that was. We would certainly make the point that if shale was developed in the UK at scale, it would have positive impacts in terms of security of supply, which is important, and it would have tax-revenue benefits and other economic benefits, including job benefits.

**The Chairman:** For energy-intensive industries, for example, and so on.

**Duarte Figueira:** Yes, potentially so.

**Lord Smith of Finsbury:** One side-effect of what has been happening in the United States in terms of the gas price is that the United States has been selling coal very cheaply on the global market. Our use of coal here in the UK for power production has gone up to its highest level for many years as a direct result of that.

**Q179 Lord Shipley:** Could I ask a very specific question, first to Mr Figueira? You spoke at the *Financial Times* Global Shale Energy Summit in October, and you said, as it has been reported, that shale gas “is a transition fuel to 2030”. Is it a transition fuel, given that we do not quite know how much there is?

**Duarte Figueira:** Certainly from the point of view of energy policy, we have a gas-generation strategy that makes it very clear that gas will continue to play a very important role in the electricity mix in the coming decades. Certainly in terms of decarbonising the electricity system—we normally talk in terms of 2030—there will be a continued need for gas in the decarbonisation efforts. I also said—I do not know if it was reported—that it is potentially a destination fuel if we can get CCS working as we expect, in which case we can also have gas well beyond that. Of course, gas will be required for heat well beyond 2030. It is not purely a transitional fuel, but it is certainly part of the energy mix to 2030.

**Lord Shipley:** How quickly might we have carbon capture and storage?

**Duarte Figueira:** That is a matter that the Government has invested a good deal of effort in, in terms of our work, both in the R&D phase and in contracting, but I cannot give a specific date on that.

**Q180 Lord Shipley:** More generally, for everybody: does the advent of shale gas alter the Government’s energy policy? Is it likely to have to be adjusted in the years ahead?

**Duarte Figueira:** In terms of unconventional gas from shale, it is purely a matter for us whether it is domestically produced or whether it is imported. Gas will continue to play a part in the energy mix even beyond 2030, for various reasons and for various purposes, so the reality is that what we are talking about here is purely whether or not we can produce it domestically at a cost that makes it economic. It does not have an impact on our gas-generation strategy, except that it improves our security of supply to some extent.

**Lord Shipley:** And it has no impact on our climate-change targets—or does it?

**Duarte Figueira:** The study that was carried out by Professor MacKay in this respect set out that the emissions impact of unconventional gas produced in the UK would certainly be lower than the impact from coal, and probably lower than the impact from conventionally produced gas from outside Europe—so its emissions impact was likely to be low compared to the normal case, if you like.

**Lord May of Oxford:** Can I just clarify that? My understanding of that—I am a member of the Committee on Climate Change—is that the trajectory to 2030 is one in which we are

still putting fossil carbon back into the atmosphere, and we will put less if we do it with gas than if we do it with coal.

**Duarte Figueira:** Yes, of course.

**Lord May of Oxford:** That is a good thing, but that is not the only aspect.

**Q181 Lord Lawson of Blaby:** Baroness Blackstone referred to the European activity on the environmental front, which I must say I find rather puzzling, because the sort of things we have been talking about today on the environmental front are supremely local issues. It does seem very puzzling that this is not a matter par excellence where the subsidiarity doctrine would apply. That aside, another thing puzzling me is that Lord Smith said—I think I took it down correctly—that he considered groundwater contamination to be the biggest environmental risk, yet we heard evidence that in the United States, over many years, with hundreds of thousands of wells drilled, there has been not a single authenticated case of groundwater contamination. I am puzzled, Lord Smith, why you consider that to be the biggest risk.

**Lord Smith of Finsbury:** I would simply say that, provided that drilling takes place in the right place and provided that it is properly regulated by the suite of European regulations that happens to exist, there should be no risk to groundwater. If a well were to be drilled in a location that was directly adjacent to a drinking-water source, for example, there could potentially be problems. That is why there needs to be proper environmental regulation in place to make sure that it is safely and properly done.

**Lord Lawson of Blaby:** I entirely accept that you need to keep your eye on it—that is absolutely right—but, as I say, the evidence from the United States is very clear. It is not surprising, because the aquifers that are used for drinking water tend to be at very shallow depths, whereas, characteristically, fracking and the drilling for shale is very deep down—something like a mile down, or sometimes more. Therefore, although I agree that you have to monitor it, that must greatly reduce the likelihood of any groundwater contamination, must it not?

**Lord Smith of Finsbury:** Yes, but some of the chemicals do come back up to the surface through the well.

**Lord Lawson of Blaby:** Nowadays it is 95% water and a tiny amount of chemicals, is it not?

**Lord Smith of Finsbury:** And they need to be properly contained when they get to the surface. Tony, do you want to add to that?

**Dr Grayling:** That is absolutely right. Where there have been problems, in a small minority of cases of wells in the United States, they have been to do with the poor sealing of the well nearer the surface, and that can apply to wells that are used for hydraulic fracturing as well as those that are using conventional extraction techniques. It is particularly critical from the point of view of environmental protection that the well is properly constructed and sealed in the first place. It is our responsibility to ensure, along with the Health and Safety Executive, that those regulations are properly applied.

**Q182 The Chairman:** To sum up, because you are dealing with all the environmental and other impacts and risks of the shale oil and gas development, is it your view that we have, and will have, a sufficiently robust regulatory regime to deal with all the risks that we have discussed and that are part of the public debate?

**Lord Smith of Finsbury:** Yes. That is partly because onshore drilling for minerals is not a new process. Some 2,000 wells have been drilled onshore in the UK over the past 100 years or so. There are currently 120 operating sites and around 300 operating wells. They produce in excess of 20,000 barrels of oil each year. Each of those is regulated for their environmental impact. They have to have environmental permits. Yes, there are some new aspects that come into the equation with fracking, but it is not an impossible process; it is something we are very familiar with.

**Peter Baker:** From a health and safety perspective as well, it is worth remembering that the current regime was introduced in the mid-1990s, on the back of Lord Cullen's recommendations following Piper Alpha, which introduced a series of important barriers in the control of wells risks both on and offshore. There is a very strong evidence base for the efficacy of the regulatory regime onshore, which has been shown to be fairly robust.

**Duarte Figueira:** I have two quick things to add to that. People sometimes talk about the fact that we are adjusting the onshore regime from the offshore regime. In fact, originally, the regulatory regime was constructed for onshore; it was taken offshore in the 1960s and now the focus is back on onshore. There is that point to pick up. More generally, what we have been talking about for much of the discussion has been the regime that applies to exploration. We are not complacent about it; we have done quite a lot of work in the last six months to make sure that it is robust for exploration, and I think that all colleagues in the regulatory sphere agree that it is robust for exploration. Part of our role within OUGO is to start thinking now, two or three years ahead, to make sure that the regulatory regime is fine for production as well. There will be some impacts that will be different at production scale from those at exploration. That is a focus for the office's work, alongside the public engagement work that I talked about earlier.

**Q183 Lord Hollick:** In the light of what Lord Smith said about the adequacy of the current regulations and guidelines set down from Europe, do you fear that there is a danger that the European Union will simply gold-plate existing regulation and make it more cumbersome?

**Duarte Figueira:** Part of what I said before was essentially about ensuring that that does not happen. The position we have adopted on regulation is essentially that we can see that there is a case for making sure that different member states apply the suite of directives that already exists, which Lord Smith referred to, in a consistent manner, and we can see that there might be concerns about making sure that does happen—but we do not see the need to go beyond that and to gold-plate in the way that you have described.

**Q184 The Chairman:** Gentlemen, there were a couple of points on which you said you would send us a note, and we will look forward to those. Meanwhile, thank you very much indeed for coming this afternoon.

**Duarte Figueira:** Thank you for the opportunity.

**The Chairman:** Thank you.

## **Durham Energy Institute, Durham University—Written evidence**

### **1.0 Durham Energy Institute, Durham University**

1.1 Durham Energy Institute (DEI) covers the spectrum of energy research but the areas in which we excel are those which lie at the boundaries between the traditional technical disciplines and the social sciences and humanities. In terms of this call for evidence we have world-leading experts in the geoscience of shale gas and also in power engineering.

1.2 ReFINE (Researching Fracking in Europe) is a pan-European research consortium led by DEI. The researcher group to date are Durham, Keele, Newcastle and Heriot Watt universities. The advisor-stakeholder group includes the European Commission's Joint Research Centre, the UK's Environment Agency and the UK's Department of Energy and Climate Change. Supporting organizations are the Geological Society of Bulgaria and The Geological Society, London. Funders are NERC, Chevron, Shell and Total.

### **2.0 Potential Scale of Shale Gas in the UK**

2.1 The UK is at a very early stage in shale gas exploitation – known as the exploration phase. During this phase drilling activity is limited to a small number of exploration wells. After which there will be a better understanding of whether the gas can be produced at economic rates and quantities. It is possible that results will be disappointing. If the results are promising then there would be a significant increase in the number of wells drilled to develop and produce the resource.

2.2 Analysis on the gas resources estimated by the BGS (BGS, 2013) for Northern England indicate that the potential is significant and that the UK may have sufficient shale gas to meet UK demand for many years to come.

2.3 The number of wells that could be drilled to exploit shale gas in the UK depends on a number of factors including social acceptance and economics.

2.4 Using data from producing shale gas wells from 5 shale provinces in the USA, the ultimately recovery (EUR) from a shale well varies from between 1.4 BCF (Billion Cubic Feet) to 5.9 BCF. We estimate that on average a conventional gas well in the Southern North Sea (UK) produces between 8 and 33 times more gas in its lifetime. Therefore as a rule of thumb a shale gas well produces a fraction of the gas that a conventional gas well produces.

2.5 If one assumes that development takes place mainly unhindered by factors such as social acceptance, then one can use this range in EURs of 1.4-5.9 BCF as a guide to the number of wells that would be required for every 1 TCF (trillion cubic feet) of total production in the UK. We estimate that every 1 TCF of production would need between 169 and 714 wells. This statistic hides the fact that much of the production comes from the first couple of years of life of the shale gas well. There is normally a rapid decline in production after that. In 2012 the UK imported about 1.8 TCF of gas.

### **3.0 Lessons learnt from USA shale gas and oil**

3.1 At least two million hydrocarbon wells have been drilled in the USA.

3.2 Just 2,152 hydrocarbon wells that have been drilled onshore in the UK already since 1902, targeting conventional reservoirs. By way of comparison there are 250,000 abandoned mine shafts in the UK the locations of which are unknown. We estimate that 1138 of the 2152 wells in the UK are what the American's would term 'orphaned' – they have no clear ownership because the company that drilled the well no longer exists.

3.3 If shale gas takes off in the UK unhindered by economics or acceptability then the UK could drill more wells than we have in our last 111 years. It is very likely to be the biggest increase in drilling activity onshore since the 1940s.

3.4 Several wells (e.g. based on the USA around 12) could be drilled from a well pad.

3.5 There is no easy way to find out how many of the existing onshore UK wells are leaking.

3.6 Our research indicates that many wells in the UK cannot be effectively monitored as they have been buried by subsequent land use, such as farming and housing developments.

3.7 There are examples of best practice on well monitoring in Pennsylvania where an online database on well infringements exists as well as some sort of investment which provides insurance for well repairs after the company has left or gone out of business.

#### **4.0 Role in the Energy Mix**

4.1 Gas plays, and is likely to play, a very considerable role in the UK energy mix. While gas's share of generation fell from 40% in 2011 to 28% in 2012 (DUKES, 2013), it was due to coal being relatively cheaper than gas as the result of shale gas replacing coal for electricity generation in the USA and therefore USA dumping cheap coal on world markets. However this trend may be reversed in future as the ratio between gas and coal changes.

4.2 Cheap coal means that more coal has been burned in the UK (increase from 30% in 2011 to 39% in 2012) with the resulting detrimental effect on CO<sub>2</sub> emissions (burning coal releases approximately twice as much CO<sub>2</sub> than burning gas per unit of electricity produced). However the EC regulations (Large Combustion Plant Directive) limit the number of hours a coal plant can operate unless it has equipment limiting emissions of sulphur dioxide, nitrogen oxides and dust. Due to availability of cheap coal such plant have been closing earlier than expected, with only 1GW currently operating (out of the original 9GW of coal plant without emission-limiting equipment in 2008), half of which should close by 2014/15. On the other hand UK regulations prevent building new coal plants that are not ready to accept Carbon Capture and Sequestration (CCS) equipment. All this means that the role of coal is likely to be limited in the future UK supply mix.

4.3 Shale gas is a fossil fuel, therefore burning it add greenhouse gases to the atmosphere, but it is cleaner than coal – as stated earlier burning coal releases approximately twice as much CO<sub>2</sub> than burning gas per unit of electricity produced. If cheap shale gas becomes available in the future, it is likely to replace coal with a relatively positive environmental effect. The extent to which cheap shale gas could displace wind generation depends on the appropriate subsidy/tax regime reflecting impact of gas and wind on the environment. Such

displacement is unlikely to happen if the current generous subsidy regime for wind continues in the future when shale gas becomes available.

4.4 It is not widely appreciated that gas plays a significant role in supporting wind generation. Wind intermittency (i.e. relatively rapid changes of generation when wind speed changes) requires a back-up from other sources of generation. The main source of such balancing is gas generation due to a relatively fast speed with which gas plants can change their output. Coal plants, and especially nuclear plants, are quite inflexible. This means that significant amounts of wind generation will require a significant support from gas generation.

4.5 A balancing service for intermittency of wind (point 4.4 above) could also be provided by energy storage, customer response or via interconnection with other countries thus limiting the importance of gas. However energy storage is still, and likely to remain, prohibitively expensive, interconnectors have limited capacity and it is not clear at all at the moment to what extent one will be able to rely on the customer response balancing intermittency of wind. Hence the role of gas in supporting wind, while perhaps diminishing in the future, is likely to remain quite significant.

4.6 Regarding security of supply, Ofgem expects (Electricity Capacity Assessment Report 2013) that generation capacity margins “will decrease to potentially historically low levels in the middle of the decade and that the risk of electricity customer disconnections will appreciably increase, albeit from near-zero levels”. However it is unlikely that UK’s shale gas will help in filling the generation gap due to a significant time lag (at least 5-10 years) before the UK’s shale gas becomes available (due to the time required for exploration and supply chain development). Hence it is expected that shale gas is unlikely to play a significant role in the security of supply in the short- to medium-term.

4.7 In summary, the availability of cheap and abundant shale gas would support expansion of wind generation while reducing CO<sub>2</sub> emissions by replacing coal, improving security of supply in the long-term and reducing energy bills. The evidence from USA is that shale gas has reduced dramatically gas prices thus reducing energy costs (<http://www.eia.gov/dnav/ng/hist/n9190us3m.htm>). The extent to which cheap shale gas could displace wind generation depends on the appropriate subsidy/tax regime reflecting impact of gas and wind on the environment.

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*September 2013*

**Durham Energy Institute and Oxford Institute for Energy Studies—  
Oral evidence (QQ 127-133)**

TUESDAY 19 NOVEMBER 2013

*Evidence Session No. 10*

*Heard in Public*

*Questions 127 - 133*

Members present

Lord Lipsey (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Baroness Noakes  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witnesses**

**Professor Richard Davies**, Durham Energy Institute, and **Mr Howard Rogers**, Oxford Institute for Energy Studies

**Q127 The Chairman:** Professor Davies, Mr Rogers, welcome to the Committee. Thank you, Professor Davies, for the Durham Energy Institute's written evidence. Can you start by telling us a bit about the ReFINE project?

**Professor Richard Davies:** I would be delighted. ReFINE it is the acronym for Researching Fracking in Europe. It is a project that was officially launched on 7 November this year. It is funded jointly by the Government and through research councils and industry: three companies—Shell, Total and Chevron. Our mission is to carry out totally unbiased, independent research on the concerns that people have raised around Europe and elsewhere about the environmental risks associated with fracking technology.

**The Chairman:** Thank you very much indeed. I think that you are more up in geology than an economist, so could you start off by summarising your view of the possible scale of the UK's resource of shale gas? The British Geological Survey is still looking at three areas. When you see those, do you think that you will have a full picture of how much gas we have, and even some idea of how much of it might be exploitable?

**Professor Richard Davies:** Just to summarise, the BGS presented a number of numbers on the Bowland shale in northern England. The number that is most easily quoted is the 1,300 trillion cubic feet of resources, which means that it is theoretically underground. There is a big difference between resources and reserves that are proven and can be brought to the surface economically. Ten per cent of 1,300 trillion cubic feet is 130 trillion cubic feet, which is more significant than production from the North Sea to date. The issue with those numbers is not that they are valid or otherwise, based on the data that is available. The

average shale gas well in the United States produces between 1.4 billion and 5.9 billion cubic feet of gas. That is in the evidence I have provided to the Committee. That means that you need a lot of wells to produce that volume of gas. Those volumes may be there. Whether they are ever produced is dependent on the economics of drilling that number of wells and the social acceptability of drilling a large number of wells. Really, the key consideration is how many wells can be drilled, to a large extent, because unless our shales are very different, and they could be, the volume of gas produced is quite low. The one difference with UK shale gas is that the thickness of the shale is considerable, much thicker than US shales, so perhaps we will see that some of the UK wells produce more gas than the ones in the United States.

**The Chairman:** Perhaps I should say that you should not feel that you have to come in if one of you has answered a question. Nodding will do very well, but if you shake your head, you had better say something.

**Q128 Lord Hollick:** I wonder whether you can give us an idea of the timescale for development. How long will it take to get a reasonably accurate assessment of the commercial potential? Beyond that, when are we likely to see significant production?

**Professor Richard Davies:** I think it will take several years, based upon the fact that the first well that was fractured in shale was in 2011, and we are now in 2013. It will take several wells to assess whether the rocks are there, whether they have the organic content that is required and, perhaps most importantly, whether they fracture in the way the companies hope they will. All those factors determine the productivity from the well and the well flow rates. It will take years to drill enough wells to establish those things.

**Lord Hollick:** You said several years, and then you said years. Could you give us a timeframe?

**Professor Richard Davies:** I would expect five to 10 years before you get to the point of producing any significant volumes of gas. It could take a lot longer than that. To be frank, I do not think we really know whether this is going to be a cottage industry or something more significant, because there is only one well and every shale is different. Nature means that every shale is different. You do not know until you have drilled more wells.

**Lord Hollick:** Would it be fair to say, then, that we are going to be well into the 2020s before this is, if it is exploitable in sufficient quantity, likely to have any impact on the supply of gas in the UK?

**Professor Richard Davies:** I would have thought so, mainly because you are going to have to drill quite a few wells. You need a decent supply chain in place to be able to drill a number of wells. We have a slow rate of drilling wells at the moment, and very little supply chain to allow the quantities of wells you require to produce significant gas, as you say, to have an impact. On the supply chain, we do not have the number of rigs that were available in the US. They had hundreds of rigs that could be refitted and moved to Pennsylvania quite quickly. They had small companies that could innovate quickly. They had different mineral ownership rights; you must know all these things. All those reasons meant that they could develop this quite quickly. The rate at which we are drilling wells is quite slow. We do not have a supply chain to drill hundreds per year.

**Lord Smith of Clifton:** Can you estimate how many wells will have to be drilled to provide a clear view of the commercial potential?



**Professor Richard Davies:** As I said in response to the previous question, unfortunately every shale is different. What people do not know is whether the shale has the right organic content and whether it will fracture well enough for it to produce sufficient gas. So many tens of wells will be required to refine the numbers that the BGS has provided for the Bowland shale. For the Weald Basin in south-east England the same evaluation will be required. Several wells, perhaps a few tens of wells, will be required to understand whether the resource can actually be developed and produced.

**The Chairman:** That was the point that you made in your written evidence: that over a trillion cubic feet of production would need between 169 and 714 wells, after the initial process of the exploratory wells has been completed.

**Professor Richard Davies:** Correct, exactly. Once the exploration phase has been completed, or is well advanced, wells can be drilled for development and producing the gas. We know from the US that each well produces a small amount of gas. If, and it is a big if, those numbers are valid in the UK, you need a lot of shale gas wells to produce the volumes of gas that the UK would need to reduce our need for imports.

**The Chairman:** I think we were also exploring how many were needed initially. Obviously, given the environmental opposition to local drilling, a number of small wells experimenting is very significant.

**Professor Richard Davies:** That is difficult to say, but several tens of wells may be required to understand whether there is a significant resource there to be developed and for that investment to take place.

**Lord Lawson of Blaby:** Before I ask the question I was going to ask, I would like to follow up on your remark about the problem of our not having the supply chain and all that. Obviously we do not have a supply chain because there is no need for it, because there is no exploratory drilling going on. Only when there is exploratory drilling will we find out whether there are commercial quantities of gas. I would have thought that this is not rocket science, and that if it were discovered—it may or may not be; I have no idea—that there were seriously commercial quantities of shale gas in the United Kingdom, the supply chain would be created very quickly indeed. All the evidence is there. So really the delay is not due to the supply chain. It is because so far there has been no permission to drill.

**Professor Richard Davies:** As you know, in the US they are producing significant volumes of shale gas, but they are drilling 25,000 to 30,000 wells a year. That is quite a significant supply chain. In the UK, we do not have the number of rigs available that could be easily deployed.

**Lord Lawson of Blaby:** But there is no problem.

**Professor Richard Davies:** I am not saying that it cannot be done.

**Lord Lawson of Blaby:** Is it not the case that the delay is the delay in being able to discover whether or not we have commercially exploitable shale gas on a significant scale?

**Professor Richard Davies:** It is the first and most important step.

**Q129 Lord Lawson of Blaby:** The other aspect is the environment, which is probably the main reason for the delay in getting permission to do this exploratory work. Assuming that there is adequate environmental regulation, which one must assume because everybody agrees that there would be, do you believe that there are any real environmental problems

that should prevent the development of the UK shale gas resource, if it is commercially there, any more than there are in the United States?

**The Chairman:** Perhaps Mr Rogers can have the first go on this one.

**Howard Rogers:** I think there are three main areas of focus to answer this question. The first is the much publicised, although I am not sure that it has ever been proved, issue of gas leaking into drinking water aquifers in the US. I know that there has been a study in the UK by Professor Davies's institute, which sets a limit of 600 metres as the vertical separation required to be sure that fractures are not moving from the well bore all the way up to the drinking water aquifer. On drinking water aquifers themselves, as long as the well is completed with the appropriate integrity, as it passes through the aquifer, that is not an issue. The last area specific to shale gas production is the issue of fugitive methane, when the liquids are flowed back out of the well after fracturing. At that point the liquids have small bubbles of entrained methane within them, but, as the IEA has commented, if that liquid is put through the right separation equipment, there should be no fugitive methane. As a professional engineer, I am clear in my mind that the environmental risks associated with shale gas are easily manageable.

**Professor Richard Davies:** Can I provide a very short comment? We have done some recent research on this. As you know, the UK has around 2,100 wells onshore already, drilled from 1902 to the present day. We have gone looking for the wells, and you cannot physically put your hands on about 65% of them. That means that they would be difficult to monitor. If you look at 65% of wells over the past 111 years—you can look at them on Google—you can see where they are meant to be but you could not physically put your hands on them. The UK government has some responsibility here, given the well count, to make sure that wells can be efficiently monitored going forward. I have raised that before. Given the well numbers, it would be prudent to make sure that wells can be monitored in the very long term, after the company has finished its operations.

**Lord Lawson of Blaby:** I am sure that is right, but equally there is no problem with ensuring that they can be monitored, is there?

**Professor Richard Davies:** Well, 65% of the wells drilled so far—

**Lord Lawson of Blaby:** But that was the past, when people were less concerned about environmental problems than they are, maybe quite rightly, today. If you are concerned about this, you can surely secure that there is the capacity to monitor them. What happens in the United States? What does the US Environmental Protection Agency think about all this?

**Professor Richard Davies:** It is very variable from state to state in the United States. Pennsylvania, for example, has an online database which you can check yourself to see whether a well has any infringements. In Canada, a study of 316,000 wells drilled since 1904 showed that 4.6% had leaked, so well leak is an issue. It is not that we do not have the technology, but cement breaks down and cracks, and steel corrodes. I do not think it is a huge issue for the UK, because there are 2,152 wells and this is not reported very often. However, if there was a significant industry with many wells in the future, it could perhaps be improved upon so that the wells can be properly monitored in the future.

**Lord Lawson of Blaby:** But they can be?

**Professor Richard Davies:** There is nothing stopping that. There is no technological reason for not being able to monitor them, but 65% of the wells drilled to date are buried.

**Lord Lawson of Blaby:** But that is going back a long, long way.

**Professor Richard Davies:** No, some of these wells have been drilled in the past five or 10 years. These are wells drilled over the past 111 years—

**Lord Lawson of Blaby:** Exactly.

**Professor Richard Davies:** Yes, but a lot of them were drilled in the recent past.

**Q130 Lord Hollick:** The emeritus professor of geophysics at the University of Glasgow, David Smythe, has written that the UK shale basins are heavily faulted, from the shale layer right to surface, in contrast to those in the USA. He says that pre-existing faults provide a potential fast-track pathway for fracking fluid and produced gas to escape upwards. His view is that fracking for oil and gas should be banned in areas of complex, faulted geology. Would you like to comment on that?

**Professor Richard Davies:** That is a good question. There are well over a million fracking operations in America. Many of the successions are faulted. There is not yet any hard evidence to show that contamination has occurred in the water supply due to fracking operations. The study that we published in 2012 showed that fractures tend not to move past about 600 metres, and those are very unusual. The separation distance between the shale gas and the aquifer is usually significantly more than that. To get fluid to travel all the way up a fault from three kilometres is quite difficult. You are going to have to pump a lot of fluid underground, and you are going to have to do it for some time. It can be done if you set out to actually make that happen. There is evidence that if you pump for days and days, with enough fluid, you will get the fluid to go from a depth of three kilometres to the surface. But the pumping times for fracking operations are usually one to two hours, and the volumes are quite modest. I do not think that it is feasible, given the pumping times and the volume, to make that happen.

**Lord Griffiths of Fforestfach:** Some of the witnesses we have heard from have suggested that the development of shale gas in the UK will be at a higher cost than in the US. I have two questions. First, do you agree with that? Secondly, if you do, to what extent is that due to our structure of mineral rights, or to the regulatory environment which we have at present, or to the intrinsic difficulty of the geology?

**Howard Rogers:** On a like for like basis—a well of the same depth or horizontal distance—I would expect the US costs to be lower than those of the UK, purely because of the existence of a large, dynamic and very competitive service industry. The UK, especially the start-up mode, is inherently disadvantaged in that. I would expect, however, unit costs in the UK to come down with time. This is purely about well depths, horizontal bore distances to be drilled and how competitive the service industry is.

**Q131 Lord Shipley:** I want to ask you about the implication of significant shale gas development in terms of what it would displace. I want to be clear on what you both think about its potential for displacement of imported gas or coal, or renewables or nuclear.

**Howard Rogers:** Clearly, if UK shale gas production is economically viable, development is undertaken and that volume grows, it will displace gas that would otherwise be imported into the UK. It is important to set in context, however, that over the past 10 years the UK's domestic gas production has dropped by about 50%, so the underlying decline rate is quite steep. I am relatively pessimistic about the scale of future shale gas production. Therefore, I think it would at best have a modest impact on the overall decline rate of UK production. I

do not think that it will have any impact on other fuels. That would be down to government policy and carbon markets.

**Professor Richard Davies:** That is not an area of expertise of mine, but the evidence we provided include evidence from Professor Janusz Bialek, who is an expert in this area. He tells me that gas provides a good balance with renewables because it can be brought on stream quickly to balance the variability of renewables. However, of course, the shale gas will not be coming on stream for many years to come, as we have already discussed. It could fit well with renewables, because of the variability of renewables and the fact that electricity production through gas can be turned on quickly. I refer you to the evidence that Professor Bialek provided.

**Lord Shipley:** But to be clear, then, about subsidised renewables, previous witnesses have indicated to us that significant development of shale would not displace subsidised renewables. Do you agree with that?

**Howard Rogers:** I agree with that, yes. The future growth of installed renewables capacities, to my mind, is entirely down to government programmes and the scale of feed-in tariffs and such payments.

**Q132 Baroness Noakes:** Can we shift on to prices and ask what you think the impact of US shale gas production will have? We have seen that US gas prices have come down. As they now shift to being able to export some of their gas, what will the impact of that be on world energy prices?

**Howard Rogers:** From the advent of serious shale gas production in the US up to about 2015 and 2016, the US has had no export markets other than Mexico, where there are pipeline bottlenecks. With production outstripping demand growth, that has depressed US prices, in my view well below the long-run marginal cost of dry shale gas production, hence some companies are making a loss. To date, we have had the US Administration granting non-free trade agreement permissions to export some thing like 63 billion cubic metres per year of LNG from the US. It is likely that more projects will be given that category of approval. This comes at a very interesting time for the global gas market. 2015 is when the new Australian LNG projects come on stream. Towards the end of the decade, you will have east Africa, maybe some Russian projects and probably some west-coast Canadian projects. We are potentially looking at the next supply wave of LNG into the market. What will be interesting for Europe is that the excess LNG left over after Chinese and Asian requirements will end up in Europe. It will compete with the swing supplier of the European market, which is Russia. If Russia continues to defend its current strategy of ceding market share but maintaining prices, that could lead to an interesting loss of market share for Russia. At some point it would respond by holding firm and causing a price reduction in the European market in an attempt to slow down the rate at which gas in America is being produced because arbitrage there would lower prices there as well. There is a huge capacity for US LNG exports to impact not just the European market but the Asian LNG spot market.

**Baroness Noakes:** In the context of those global forces, do you think that production of shale gas in the UK will have any impact on prices?

**Howard Rogers:** I fear not. Let me try to encapsulate it. If we take the average shale gas well production profile from the Texas Barnett shale and assume that we drill 300 of those a year in the UK, after 10 years we get up to a production rate of 8 billion cubic metres a year, which is equivalent to 10% of the UK's demand. There is a huge question of whether

the UK public would be happy with 300 wells a year. They could be drilled 12 per pad, but that sounds like a very intensive drilling activity to produce quite a modest level of production. With that kind of lead time, I would not think that that would have a discernable impact on prices, linked as the UK is not just to the European continental gas market but to the global LNG supply market as well.

**Baroness Noakes:** So we would never produce enough to—

**Howard Rogers:** I would be very surprised if we did. Even if we did, the price impact would be arbitrated away on the European traded hubs, and it would impact LNG trade flow patterns as well. If it was very large, ultimately you would see some energy projects being delayed, maybe in Australia, later in the decade. The market dynamic response would make it very difficult to discern a price impact.

**The Chairman:** Can I just check that that is a shared view?

**Professor Richard Davies:** Yes, I think Howard has the wealth of knowledge there. I am happy to follow him on that.

**Baroness Blackstone:** Do you think that the current UK fiscal regime needs to change to encourage the exploration and development of shale gas or not?

**Howard Rogers:** It has been a long time since I have studied the UK oil and gas tax regime in some detail. My understanding is that a special pad allowance has been granted for prospective shale gas drilling such that the special petroleum duty, I think it is, would not apply until a certain production level had been met, so the marginal tax on shale gas production would, I understand, be about 30%. There would be accelerated capital allowance reliefs for the up-front investment. That does not sound very different from ordinary corporate taxation. If we are in the fortunate position of finding that UK shale gas is economically viable, there may be a case for fine-tuning the regime, but as we stand today the more relevant uncertainties are well-flow rates, the predictability of shale gas performance and, indeed, whether there is any prospect of liquid co-production in shales. Those uncertainties by far overwhelm any need to really consider optimising the fiscal regime, which would come further down the road.

**Baroness Blackstone:** In that case, why do you think that the Chancellor of the Exchequer is promising the most generous tax regime in the world in order to encourage this development? What would that consist of? Why is he doing it in the first place? It is a bit puzzling in light of what you have just said.

**Howard Rogers:** I would imagine that potential investors may be discouraged if they looked at the full marginal rate of UK offshore oil and gas taxation, which I believe is in the range of 65% to 80%. I do not know the exact figure. A 30% rate, which I would imagine is more in line with US corporation tax, or federal and state tax rates, would enhance the competitive appeal of UK shale gas drilling. It has to be remembered that most small offshore fields would be exempt from the higher rate of tax in any case. I would be surprised if the current regime for shale gas, as proposed, were very different to that for small, offshore fields in the UK.

**Lord Hollick:** INEOS, when it appeared before us, said that locally produced shale gas could provide quite a significant boost to the energy-intensive industries here. Obviously INEOS is involved in petrochemicals, so it would know first hand. You said today that significant quantities of shale gas, if they do flow, are unlikely to flow until well into the 2020s. You, and indeed others, have made the point that because we are part of a European market, it is unlikely to have very much impact on pricing. Is there a prospect of a significant

rejuvenation in energy-intensive industries, which is what has happened in the United States? Or is that a pipe-dream here?

**Howard Rogers:** I think there is a distinction, and obviously I have not heard INEOS's statements, but what has rejuvenated the petrochemical industry in the US is not so much the natural gas, the methane, but the co-production of ethane, propane, butane and the higher alkanes, which are the traditional feedstock components for petrochemicals. An issue for the Grangemouth petrochemical complex is that its traditional feedstock of ethane and other alkanes from the North Sea is in long-term decline. Therefore, I would imagine that they would look with some hope at the prospect of those components being sourced within the UK, if shale gas is viable and if NGLs, natural gas liquids, are present as co-products.

**Q133 The Chairman:** Just to finish, a lot of the evidence that we have heard speaks of gas as a transitional fuel towards a lower-carbon economy, rather than a long-term fuel. If we do get a large and lasting supply of shale gas, is this going to make it harder to reach the UK's carbon target for 2050, which I think is 80% lower than the 1990 baseline, or is it going to make it easier? Or is the target unobtainable anyway?

**Howard Rogers:** As we discussed earlier, if UK shale gas production is viable and grows, I find it difficult to see how that in itself would materially change the UK's energy mix. The dynamic I would foresee is that that increase or slight slowdown in decline of domestic gas production merely reduces the level of imports. So the fuel mix is driven by government policy. At one time it was to be hoped that the CO<sub>2</sub> trading system in Europe would influence the fuel mix. That, alas, has not happened.

On the issue of the concept of locking in gas in the UK because of intensive investment in shale gas production, I think the very nature of shale gas militates against that. The wells decline very quickly. If you invested quite a lot of money in wells for five years and then stopped you would find that that production declined quite quickly, so I think the degree of lock-in is not really an issue to be too concerned about.

**Professor Richard Davies:** I think we are all aware that shale gas production in the US has displaced coal, and that we are burning more coal, as are the Germans. At the moment, it is having a somewhat detrimental effect because the price of coal has gone down, but that is in the UK.

**The Chairman:** Gentlemen, thank you very much indeed for your clear and concise answers. You have helped us a lot this afternoon. Thank you for coming and talking to us.

**Professor Richard Davies:** Thank you very much.

**Howard Rogers:** Thank you.

## Électricité de France (EDF) Energy—Written evidence

### Key Points

- EDF Energy is committed to delivering affordable, secure, and low carbon supplies based on a diverse energy mix. As part of this, we believe that unabated gas fired generation, including that from shale gas, will play an important role in the transition towards a decarbonised power sector in the 2030s by providing the firm backup generation required for balancing the electricity system.
- However, further investment in any unabated gas generation plant, beyond the minimum that is required to bridge the gap to the transition to low carbon technologies, would introduce significant challenges in meeting the UK's legally-binding climate change objectives. Such investment substantially increases the risk that the UK's long term emissions reduction targets will not be met, or at least be met in a cost-effective manner. This is either because the carbon emissions from these new assets will be 'locked in' or, alternatively, because it increases the risk of stranded assets.
- We support the steps that the Government has taken so far to develop shale gas in the UK, and its ambition to ensure that any debate is supported by evidence-based information. The environmental risks from drilling and hydraulic fracturing must continue to be managed effectively. This will require the Government to establish a strong regulatory regime with the aim of reducing risk to as low a level as reasonably practicable to assuage public concerns over the environmental and safety aspects of shale gas operations.
- Based on the currently available evidence, we agree with the conclusion of the House of Commons Energy and Climate Change Select Committee from its May 2011 report that shale gas is unlikely to be a "game changer" for the UK, and that we are unlikely to replicate the production experience of the USA.
- European shale gas production costs are likely to be higher than those in the USA. Reasons include differences in regulatory, fiscal, labour and environmental regimes, as well as land and resource access issues pertaining to geology and population density.
- Although the volume of gas available worldwide may be increasing, once the cost of LNG transportation (and re-gasification) to Europe is taken into account, this may only curb the extent of price rises in the longer-term rather than drive prices down from current levels. In addition, it is likely that LNG cargoes diverted from the USA will be used to meet growing demand in Asia rather than go to Europe.
- We welcome the Secretary of State for Energy and Climate Change's recent announcement that "we must not and will not allow shale gas production to compromise our focus on boosting renewables, nuclear and other low carbon technologies"<sup>25</sup>. Shale gas should be considered as a complement, and not an alternative, to low carbon technologies such as renewables and nuclear.

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<sup>25</sup> 'Davey: UK shale gas development will not be at expense of climate change targets', DECC Press Release, 9 September 2013, <http://tinyurl.com/nvrcsr4>

- It is imperative that the Government maintains its continued momentum on Electricity Market Reform (EMR). The Government's proposals will provide the investment framework that is crucial for the low carbon investment that the country needs to deliver its energy policy objectives, and will keep costs down for consumers.

## About EDF Energy

EDF Energy is one of the UK's largest energy companies with activities throughout the energy chain. We provide 50% of the UK's low carbon generation. Our interests include nuclear, coal and gas-fired electricity generation, renewables, and energy supply to end users. We have over five million electricity and gas customer accounts in the UK, including both residential and business users.

## EDF Energy's response to your questions

### 1. How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?

1. The UK has historically been self-sufficient in gas as UK Continental Shelf (UKCS) production has been able to meet all of the UK's annual heating and gas-to-power demand. However, over the past decade domestic production has declined with imports making up the shortfall. This has come from a diverse range of sources including Norway, Continental Europe and globally sourced liquefied natural gas (LNG). In 2011, imports exceeded production for the first time and comprised 53% of the UK's gas supply<sup>26</sup>. This trend is likely to continue with the UK forecast to import at close to 70% of its gas consumption by 2025<sup>27</sup>.
2. Shale gas is similar in chemical composition to conventional gas and so in this respect there is nothing inherently unique about it. We believe that it should therefore be considered as an additional source of gas rather than a new fuel per se as is often portrayed. The impact of shale gas and oil on the UK will largely depend on how much can be produced and what the production costs will be.
3. In terms of potential shale resource and production volumes, the most recent estimates indicate shale gas volumes in place in the UK to be substantial, ranging from 18 trillion cubic metres (tcm)<sup>28</sup> to 38 tcm<sup>29</sup>. However, estimates of technically recoverable resources are much lower, ranging from 150 billion cubic metres (bcm)<sup>30</sup> to 740 bcm<sup>31</sup>. This represents 2-9 years of UK gas demand in 2012<sup>32</sup>. It is important to treat these figures with caution because as the Government acknowledges "little drilling or testing has taken place [and so] it is not at this stage

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<sup>26</sup> 'Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use', D. MacKay & T. Stone, 2013

<sup>27</sup> 'The Myths and Realities of Shale Gas Exploration', E. Davey speech, 9 September, <http://tinyurl.com/pdoaeoa>

<sup>28</sup> 'Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States', US Energy Information Administration, 2013

<sup>29</sup> 'The Carboniferous Bowland Shale gas study: geology and resource estimation', British Geological Survey, 2013

<sup>30</sup> 'The Unconventional Hydrocarbon Resources of Britain's Onshore Basins - Shale Gas', British Geological Survey, 2010

<sup>31</sup> 'Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States', US Energy Information Administration, 2013

<sup>32</sup> UK Future Energy Scenarios', National Grid, 2013 states 2012 UK gas demand was 77.3 bcm



possible to make meaningful estimates of how much shale gas may be practically and commercially recoverable”<sup>33</sup>.

4. Estimates of UK shale oil resources are more limited due to the absence of detailed geotechnical data<sup>34</sup>. The US Energy Information Agency estimated the UK possessed 54 billion barrels<sup>35</sup> of shale oil resource in place, of which technically recoverable resource amounts to 690 million barrels<sup>36</sup>.
5. In Europe, estimates for the volume of shale gas are also significant with potential volumes up to 139 tcm<sup>37</sup> and technically recoverable resources ranging 17<sup>38</sup> to 25 tcm<sup>39</sup>. Within Europe the most attractive potential markets are Russia, Poland, France and Ukraine. However, we note that to date Polish shale gas exploration has been less successful than anticipated<sup>40</sup>. Russia, which already possesses large resources of conventional gas, and France, which currently has a hydraulic fracturing moratorium in place, will likely be slower to develop their shale resources in the short to mid-term. European shale gas is expected to be imported to the UK through existing or new continental interconnectors.
6. As the most mature market in the world, the US is the only country with proven reserves of shale gas amounting to 2.7 tcm in 2011<sup>41</sup>. Unproven resources are estimated to be 15.4 tcm leading to total technically recoverable resources of 18.0 tcm<sup>42</sup>. However, the true size of potentially extractable shale gas resources remains uncertain and is still being discovered. Today shale gas accounts for around 35% of total US natural gas production<sup>43</sup> with the US going from being one of the world’s largest gas importers to one of the largest exporters. Due to the relatively isolated nature of the US gas market, shale gas will be shipped globally after being converted to LNG (the UK has existing LNG annual import capacity of c.50 bcm). The US has minimal existing LNG export capacity but several large projects are under construction and expected to be operational by the second half of the decade. Two LNG export licences<sup>44</sup> have been granted to date with a further 13 applications being assessed<sup>45</sup>.
7. In terms of production costs, the literature we have reviewed indicates that European shale gas production costs are likely to be higher than those in the US, with predictions between 50<sup>46</sup> and 100 per cent higher<sup>47</sup>. Reasons include differences in regulatory, fiscal, labour and environmental regimes, supply chain maturity and

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<sup>33</sup> ‘About shale gas and hydraulic fracturing (fracking)’, DECC, 30 July 2013

<sup>34</sup> Stated in ‘The Carboniferous Bowland Shale gas study: geology and resource estimation’, British Geological Survey, 2013

<sup>35</sup> ‘Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States’, US Energy Information Administration, 2013

<sup>36</sup> *Ibid.*

<sup>37</sup> *Ibid.*

<sup>38</sup> ‘Breaking with Convention’, IHS CERA, 2010

<sup>39</sup> ‘Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States’, US Energy Information Administration, 2013

<sup>40</sup> *Ibid.*

<sup>41</sup> ‘Assumptions to the Annual Energy Outlook 2013’, US Energy Information Administration, 2013

<sup>42</sup> *Ibid.*

<sup>43</sup> ‘The Great, Global Shale-Gas Development Race’, Boston Consulting Group, 2013

<sup>44</sup> *Ibid.*

<sup>45</sup> According to Office of Energy Projects, US Federal Energy Regulatory Commission, 2013

<sup>46</sup> ‘The Impact of Unconventional Gas on Europe’, Pöyry, 2010

<sup>47</sup> ‘Unconventional Gas, The Potential Impact on UK Gas Prices’, Navigant Consulting, 2012

detailed knowledge of the underlying geology. Public support, and ultimately social acceptability, may also prove a significant hurdle to replicating US production costs.

8. It is also important to highlight that the low gas price in the US (c.25 p/therm versus c.65 p/therm in the UK) is due to current overproduction and oversupply, and partly driven by the fact that shale gas is being extracted as a by-product from shale oil production which can attract a greater margin due to the higher price of oil. The current price is perceived by several market analysts to be below break-even and unsustainable for dry (i.e. non-oil associated) shale production and this has likely contributed to over \$10bn of asset impairments in 2012. The US price is expected to rise as shale gas becomes available for export and the oversupply condition is re-balanced.
9. In the future, imported LNG will continue to play a role in offsetting the decline of UK indigenous production. Some of this volume could include exports of US LNG derived from shale. LNG conversion processes (liquefaction and regasification) and shipping contribute to significant transportation cost of delivering US gas to the UK market. The mark-up of transportation to Europe has been indicated to be up to 100% of the US wholesale gas price<sup>48</sup>. These costs mean US gas prices are not so different from UK prices once transportation is taken into account. This gap could narrow further as US gas prices rise as a result of rebalancing of the US market away from its current oversupplied condition, considering, of course, some uncertainty over the future range of gas prices. We would also highlight that demand from Asia will also play a role in determining whether US LNG can have a major impact on the European market since currently Asia sets the global premium price for LNG.

## **2. What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

10. As is common with investment in other forms of large-scale energy infrastructure, shale gas and oil has the potential to create jobs and drive growth for communities that host such projects. For example, it has been estimated a multi-well shale gas pad could create a peak of around 400 direct, indirect and induced jobs during the initial construction and drilling stage and around 50 total jobs per year during the remainder of the pad's operational life<sup>49</sup>. However, due to the infancy of the industry in the UK, these estimates are likely to be revised as the shale gas industry gains further exploration and drilling experience.
11. As a counter to the benefit of creating jobs and supporting related industries, shale gas development is likely to have some adverse impact on local communities. It has been estimated a typical 10 well shale gas pad would require up to 8,000 truck movements<sup>50</sup> over its operating life, of which the majority would occur during the early drilling and construction phase. Access road and export pipelines may require construction depending on existing infrastructure at well sites. These, and other activities, could prove disruptive and so it is important that the industry fulfils its

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<sup>48</sup> 'Unconventional Gas, The Potential Impact on UK Gas Prices', Navigant Consulting, 2012

<sup>49</sup> 'Infrastructure for Business, Getting Shale Gas Working', Institute of Directors, 2013

<sup>50</sup> *Ibid.*

commitment to early engagement with local communities to identify and mitigate local concerns in a proactive way.

12. EDF Energy supports the principle of local communities receiving direct benefits for hosting vital energy projects, and with these being distributed across the Local Authority according to the geography of the impacts from the development.
13. We note that the United Kingdom Onshore Operators Group (UKOOG), the representative body for UK onshore oil and gas companies, has published a 'Community Engagement Charter'<sup>51</sup>. As part of this, the industry has committed to provide community benefits at the exploration/appraisal stage of £100,000 per well site where hydraulic fracturing takes place. In addition, it will provide 1% of revenues at the production stage (split approximately 2:1 between the local community and county level).

**3. What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

14. Shale gas is no different to the gas currently used in Combined Cycle Gas Turbine (CCGT) plant. The operating characteristics of such plant are defined by low fixed costs and high variable costs, the major contribution to which are operational costs associated with fuel and carbon.
15. The Government regularly publishes fossil fuel price projections and estimates prices rising from the current level of around 65p/therm to around 74p/therm by 2020 in its central scenario<sup>52</sup>. The current consensus indicates shale gas is unlikely to have a significantly impact on UK gas prices, even if significant production volumes can be achieved<sup>53</sup>. This means that the introduction of native or imported shale gas will have a limited impact on gas prices and the cost of generation of gas-fired plant. Please see our response to Question 5 for further detail on the issue of impact on energy costs.
16. Electricity produced from CCGT is around half as carbon intensive as electricity produced from coal-fired plant. Therefore an increasing carbon price will improve the economics of gas-fired generation relative to coal.
17. DECC publishes estimates of electricity generation costs for new build renewable and non-renewable technologies on an annual basis. Due to the interaction of a number of dynamic factors (including wholesale fuel costs, carbon costs, technology maturity, cost of financing) levelised lifecycle generation costs for different technologies can evolve significantly over time. Chart 1 illustrates DECC's most recent forecast for the evolution of the cost of generation for selected power plant technologies.
18. The cost of generation from existing power plant will vary significantly depending on plant efficiencies, operating regime, site specific factors amongst other parameters.

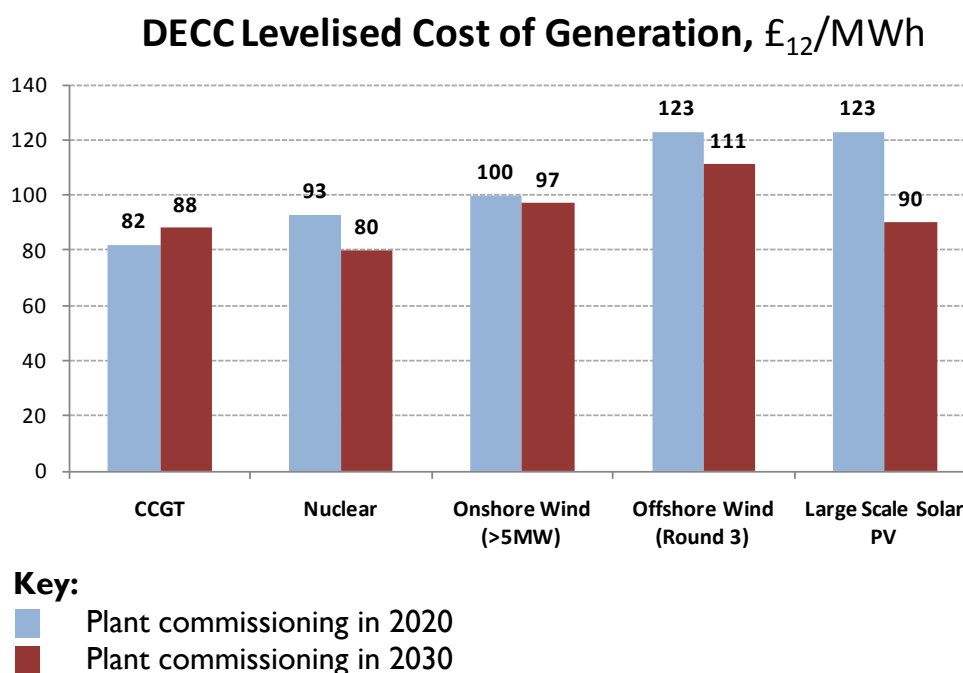
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<sup>51</sup> <http://www.ukoog.org.uk/elements/pdfs/communityengagementcharterversion6.pdf>

<sup>52</sup> 'Fossil Fuel Price Projections', DECC, 2013

<sup>53</sup> 'Pöyry Point of View: Shaping the Next Future, How will Lancashire Shale Gas Impact the GB Energy Market?', Pöyry, 2012

**Chart I: DECC estimates for the levelised cost of generation by technology for power plant commissioning in 2020 and 2030<sup>54</sup>**



**4. Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

19. EDF Energy does not anticipate there being any major barriers with respect to the future incorporation of shale gas in the electricity market. We currently purchase our gas on a three year or less horizon, and it is our understanding that only a small proportion of UK gas demand is covered by long-term gas contracts. We therefore believe that there is not a material risk that long-term gas contracts with ‘take or pay’ clauses would prevent generators from using shale gas.

20. It should be noted that the UK’s current gas quality standards are based on the quality of gas sourced from the UKCS<sup>55</sup>. Shale gas will only be allowed in the National Transmission System (NTS) if it meets the required gas specifications. It is possible that shale gas may require processing to reach this specification. For example, nitrogen injection (to reduce gas quality) or propane injection (to increase gas quality) could be needed, and this will therefore incur additional processing costs compared to existing indigenous sources of gas.

**5. What impact will shale gas and oil have on household energy bills?**

21. The impact of shale gas on the wholesale gas market price will largely depend on the volume of gas which can be produced at a competitive price compared to alternative sources. In the short term, due to the lack of onshore drilling supply chain

<sup>54</sup> Table 6, central scenario from ‘Electricity Generation Costs 2013’, DECC, 2013

<sup>55</sup> Ofgem, <https://www.ofgem.gov.uk/gas/wholesale-market/gas-quality>

experience, European well costs will be considerably higher. However, these initial costs could be expected to reduce as European demand increases the availability of onshore drilling equipment and experienced operators.

22. Recent studies have highlighted the limited likelihood of shale gas contributing to significant reductions in consumer gas and electricity bills. Pöyry estimates that Lancashire shale gas could reduce UK gas prices by 2-4% based on an optimistic production of 12-20 bcm per year<sup>56</sup> from 2020 to 2030. However, our analysis calculates this would only correspond to a 2% reduction on a typical consumer's gas bill, and 1% reduction on a typical consumer's electricity bill. These reductions are not significant compared to the uncertainties surrounding future commodity prices.

## **6. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

23. Gas-fired generation (whether fuelled by conventional or shale gas) will play an important role in the transition towards a decarbonised power sector in the 2030s by providing the firm backup generation required for balancing the electricity system.
24. However, further investment in any unabated gas generation plant (whether fuelled by conventional or shale gas), beyond the minimum required to bridge the gap to the transition to low carbon technologies, would introduce significant challenges in meeting the UK's legally binding climate change objectives (as set out in the Climate Change Act 2008). While gas-fired generation has lower carbon dioxide emissions than old coal-fired generation, without carbon capture and storage (CCS) technology it is still a significant source of carbon emissions in its own right.
25. Such additional investment in unabated gas generation plant substantially increases the risk that the UK's long-term emissions reduction targets will not be met, or at least not be met in a cost efficient manner. This is either because the carbon emissions from these new assets will be 'locked in' for the duration of their operational life or, alternatively, because it increases the risk of stranded assets.
26. We welcome the Secretary of State for Energy and Climate Change's recent announcement that "we must not and will not allow shale gas production to compromise our focus on boosting renewables, nuclear and other low carbon technologies"<sup>57</sup>. Shale gas should be considered as a complement, and not an alternative, to low carbon technologies such as renewables and nuclear
27. It is imperative that the Government maintains its continued momentum on Electricity Market Reform (EMR). Reform of the existing electricity market arrangements is necessary to ensure the market is capable of delivering the reliable diverse energy mix required to deliver the UK's energy policy objectives. The Government's proposals will provide the investment framework that is crucial for the low carbon investment that the country needs, and will keep costs down for consumers.

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<sup>56</sup> 'Pöyry Point of View: Shaping the Next Future, How will Lancashire Shale Gas Impact the GB Energy Market?', Pöyry, 2012

<sup>57</sup> 'Davey: UK shale gas development will not be at expense of climate change targets', DECC Press Release, 9 September 2013, <http://tinyurl.com/nvrcsr4>

28. There is general agreement within both industry and the Government that power sector decarbonisation by 2030, or soon thereafter, is necessary to meet the UK's statutory requirement of an 80% reduction in greenhouse gas emissions by 2050. This is because low carbon electricity generation is likely to be a key driver in the decarbonisation of the residential heat and surface transport sectors. We would highlight that a number of analyses, including the Government's 2050 Pathways Analysis, show that new nuclear will be a vital component of any pathway compatible with the 2050 objective. This is because it is the most internationally competitive and lowest cost option for firm low carbon electricity supplies (as illustrated in Chart 1 above) and can make a significant contribution to providing safe, secure and affordable low carbon energy in the UK.
29. As recognised by the House of Commons Energy and Climate Change Select Committee<sup>58</sup>, we note that there continues to be a divergence in opinion with regard to the lifecycle greenhouse gas footprint of shale gas (including direct and indirect emissions of both carbon dioxide and methane), and the issue of leakage during extraction will need to be studied further. Recent estimates for the greenhouse gas emissions intensity for shale gas, when used for electricity generation, are likely to be in the range 423-535gCO<sub>2</sub>e/kWh<sup>59</sup>. This range is higher than that of conventional gas but lower than LNG life-cycle emissions.
30. The potential emergence of significant volumes of shale gas reinforces the need to establish a credible and enduring carbon price signal so that investors can make informed investment decisions. Currently the EU Emissions Trading System (ETS) price is unable to provide sufficient long-term signals to ensure relevant investments in low carbon generation. The introduction of the carbon price floor in the UK should help restore the long-term price signal that the EU ETS was expected to achieve. However, it does not remove the need to continue to expedite reform of the EU ETS at the European level.

## **7. What changes to public policies are necessary to maximise the potential of any shale gas development?**

31. EDF Energy supports the steps that the Government has taken so far to develop shale gas in the UK and its ambition to ensure that any debate is supported by evidence-based information. We welcome the establishment of the Office of Unconventional Gas and Oil (OUGO) and in particular its role in working with regulators and industry to ensure that the regulatory regime is clear, robust and protects the local environment. It is imperative that the environmental risks from drilling and hydraulic fracturing continue to be effectively managed. This will require the Government to establish a strong regulatory regime with the aim of reducing risk to as low a level as reasonably practicable to assuage public concerns over the environmental and safety aspects of shale gas operations.

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<sup>58</sup> 'Shale Gas, Fifth Report of Session 2010-12, Volume II', House of Commons Energy and Climate Change Committee, 2011

<sup>59</sup> 'Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use', D. MacKay & T. Stone, 2013

32. It is important that the concerns of the public are adequately addressed through open and transparent communication between policy makers, operators and the general public. This is necessary as part of the ongoing initiatives to inform the public of the need for the transition to new safe, secure and affordable low-carbon energy infrastructure. This will help promote greater transparency and build trust between the different stakeholders involved.
33. Engaging communities during the development of proposals helps to improve people's understanding of the infrastructure, its impacts and any mitigation measures required, as well as fostering a sense of trust. Building constructive relationships with neighbours and key stakeholders throughout the planning process also helps to ensure constructive relationships later during operation and beyond.
34. We believe that both local and central Government have a number of responsibilities in relation to the public understanding of risk, not only just in relation to shale gas, but energy projects in general. This includes consulting on and defining national policy; ensuring that the public has access to clear and reliable information; and providing resources for world class research and for authoritative independent agencies.
35. We welcome the Government's commitment to work with the relevant regulators, including the Environment Agency in England and the Health and Safety Executive, to monitor and control the environmental and health and safety aspects of shale gas operations as appropriate. It is important that these agencies work together in a co-ordinated and consistent manner to help foster public trust.
36. We support the Government's decision to accept the recommendations of the Royal Society and the Royal Academy of Engineering, as set out in their review of hydraulic fracturing<sup>60</sup>. In particular, we note that they recommend that "monitoring should be carried out before, during and after shale gas operations to inform risk assessments"<sup>61</sup>. Adopting the recommendations will help improve the credibility of the steps being taken to develop shale gas. We also believe that the regular publication and promotion of information (e.g. Q&As), that addresses key areas of public concern such as safety, air pollution, seismicity and water use and contamination, will also be useful in helping to increase public acceptance.

## **8. What lessons can be learnt from the US experience of shale gas and oil?**

37. The commercialisation of shale gas extraction in the US took place slowly over 30 years. This included significant Government sponsorship through R&D programmes, suitable fiscal policies and market deregulation which introduced pricing signals incentivising shale development. Today operators have access to better technology and shale gas know-how than US pioneers but innovation will be required to adapt to areas where geology, access to required resources and local regulation is significantly different from the US.

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<sup>60</sup> Royal Society and the Royal Academy of Engineering, Shale gas extraction in the UK: a review of hydraulic fracturing, June 2013.

<sup>61</sup> *Ibid.*, p4

38. Technological innovation has been the key driver of increasing shale gas production and commercialisation. Improvements such as 3D micro-seismic mapping, horizontal drilling, multi-stage fracturing and reduction in requirement for proppant (sand or ceramic materials which help to keep fractures open) and fracturing fluid volumes have all contributed to a significant reduction in the costs of production.
39. However, it is likely exploration and production in the UK will face new, country-specific challenges. These will only be able to be overcome if the UK's shale development potential can be confirmed through further exploration and geological mapping. If sufficient commercial incentives are in place, including gas price signals and a suitable fiscal framework, companies will be able to commit to research and development to overcome anticipated technical challenges.
40. Independent operators were the first to develop shale gas plays in the US but the increasing capital costs of “factory drilling”, amounting to around \$32 billion capital expenditure in 2012<sup>62</sup>, has led to significant consolidation of the US industry. It is likely that the UK will follow a similar path of independents being first to develop resources with larger oil and gas companies, who have more attractive short-term investment opportunities in conventional oil and gas, entering the market once shale gas play resources are confirmed and investment becomes de-risked.
41. For the UK, a particular challenge will be overcoming environmental and local community opposition. This is in contrast to the US where generally, due to sparser population density, landowners possessing mineral rights, a history of large scale onshore oil and gas production and the creation of strong employment opportunities in the industry, social and environmental acceptance has been more easily achieved. We believe that the UK has a world class regulatory regime for high-risk energy production industries which can be adapted to suit the specific risks of shale gas extraction. However, overcoming public opposition will require both industry and the Government addressing concerns in a transparent way and ensuring host communities are compensated in a reasonable and fair manner.

*September 2013*

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<sup>62</sup> 'Infrastructure for Business, Getting Shale Gas Working', Institute of Directors, 2013



Environment Agency, Health and Safety Executive and Department of Energy and Climate Change—Oral evidence (QQ 153-184)

**Environment Agency, Health and Safety Executive and Department of Energy and Climate Change—Oral evidence (QQ 153-184)**

Transcript to be found under [Department of Energy and Climate Change, Environment Agency and Health and Safety Executive—Oral evidence \(QQ 153-184\)](#)

## **Environment Agency—Supplementary correspondence with Committee Clerk**

Dear Dr Grayling,

### **Economic Affairs Committee: Inquiry into *The Economic Impact on UK Energy Policy of Shale gas and Oil***

I enclose an exchange of letters between me and Francis Egan, CEO of Cuadrilla, about permits to explore for shale gas.

It was prompted by the apparent contrast between the impression given by industry evidence that they were keen to press on with exploratory drilling but delayed by regulatory requirements and the Environment Agency's evidence that responses to applications for permits to drill were quite speedy (around 13 weeks) and that in any case no applications for permits to drill by hydraulic fracturing had been received since you permitted it in principle to resume.

Mr Egan's reply seems to indicate a much lengthier process still under way.

Is there anything you can add to help the Committee understand more fully how matters stand?

Yours sincerely

Bill Sinton

(W B Sinton)

Clerk to the Committee

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There is no disagreement between Cuadrilla and the Environment Agency on this matter. The accusation has sometimes been thrown at the Environment Agency that our permitting is delaying the development of the industry but this is not the case. There have been no new permit applications for hydraulic fracturing since the Government announced that in principle fracking could be approved with additional controls on seismic activity. As Francis Egan's letter states, decisions on a couple of pre-existing environmental permit applications have been delayed by agreement because the company is undertaking an Environmental Impact Assessment, which is part of the planning process but may reveal issues material to our permitting decisions; and in any case Cuadrilla is likely to withdraw these applications and submit new ones. Permitting need not delay operations if operators make sure that they align their permit applications with their planning applications. We have said that we will seek to determine bespoke permits within 13 weeks of deeming applications duly made, though that is challenging if extended public consultation is required for a site of high public interest. At this early stage of the industry's development it is likely that proposals for hydraulic fracturing for shale gas will be deemed of high public interest. It is in the hands of

the operator to ensure that they supply us with the information we need to determine a permit in a timely way. That is not least of the reasons for the very active and constructive pre-application discussions we are having with a number of operators, including Cuadrilla. The point remains that environmental permitting has not been the limiting factor.

Yours sincerely

Tony Grayling  
Head of Climate Change and Communities

## **E.ON—Written evidence**

### **Summary of key points**

- i. E.ON is one of the largest suppliers of gas and electricity in the UK. We own and operate various fossil and renewable power stations and a gas storage facility in the UK. We also have an Exploration and Production business with a regional focus in gas and oil production in the North Sea, Russia and Algeria.
- ii. E.ON is not involved in any unconventional gas production activities in Europe or elsewhere.
- iii. We do not expect shale gas to have a significant impact on gas prices in the short to medium term, so would caution against assumptions that shale gas will dramatically reduce energy bills. However, provided the regulatory regime is sufficiently robust, we do believe that opportunities can be explored in a sustainable way.
- iv. We do not believe significant quantities of shale gas will be produced and marketed within Europe in the next decade at least.
- v. The UK is part of a well connected, liquid and established European gas market; any cost benefit following a discovery of cheaper gas in the UK (whether shale or not) would therefore be smeared across the wider European and global gas markets. This means that, taken with our expectations of the scale of shale gas exploitation in the UK, any impact of domestic shale gas would be limited.
- vi. We recognise that neither the UK nor Europe is likely to be able to produce shale gas on a scale which leaves them self-sufficient. This means that the UK and Europe are likely to continue to need to import gas from outside Europe and so wholesale prices will reach the levels where this occurs regardless of domestic shale gas production.
- vii. Our understanding is that environmental concerns associated with shale gas extraction need not be any greater than those from other forms of gas (or mineral) extraction and that, whilst extraction techniques may be different, the risks associated with shale gas extraction can be managed without causing undue harm to the environment.

We have focused our response on questions where we feel most able to comment.

### **How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?**

- I. Gas is likely to play a role in our energy market for some time to come. In its latest report (Next Steps on Electricity Market Reform<sup>63</sup>) the Committee on Climate Change sets out a number of scenarios for a future low carbon electricity generation mix in 2030. In the most ambitious of these, which achieve a CO<sub>2</sub> intensity of 50g CO<sub>2</sub>/kWh, the CCC still expects around 40-45TWh of electricity to be generated from gas in 2030 (down from 86.3TWh in 2012). Generation mix scenarios that reflect a higher cost of

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<sup>63</sup> <http://www.theccc.org.uk/publication/next-steps-on-electricity-market-reform-23-may-2013/>

low carbon generation, but are still consistent with the UK's climate change goals (achieving 100g CO<sub>2</sub>/kWh), see up to 125TWh of electricity generated from gas in 2030. It is likely that the demand for gas for heating will reduce over this period as UK consumers replace gas fired boilers with electric heat pumps (indeed, the CCC's analysis assumes an increase in demand for electricity for precisely this purpose).

2. It is clear, therefore, that there is a continued role for gas, from whatever source, as part of a low carbon energy system. However, as we outline below, the extent to which shale gas is used in the UK is likely to be limited, at least in the short to medium term, by the economic benefits it brings.

**What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

3. The UK gas market is well connected to the wider European gas markets and has the capability to import gas from outside of Europe. Any cost benefit following a discovery of cheaper gas in the UK (whether shale or not) would therefore be smeared across the wider European and global gas markets, reflecting the prevailing price in those markets. Therefore we do not expect to see a significant change in the cost of power generation as a result of the quantities of economically viable shale gas we expect to be recovered in the UK.
4. Based on the experience of North Sea Oil and Gas and how that market has evolved since the 1960s, we do not expect significant quantities of shale gas to be produced within Europe in the next decade. If significant quantities were subsequently produced, their impact on price is unclear due to the uncertainty associated with the cost of extraction and the price of other sources of gas. We would therefore caution against assumptions that discovery and extraction of shale gas will reduce energy prices in the foreseeable future.
5. Changes in wider global energy markets and national and international regulatory frameworks are more likely to impact the cost of generation in the UK going forward. For example, the extensive use of shale gas in the US has actually reduced the cost of coal in the UK (and the rest of the world) due to the reduced demand for coal in the US as it is replaced by gas. This meant that in 2012 coal-fired generation produced 39% of the UK's electricity, up from 29% in 2011<sup>64</sup>, increasing UK CO<sub>2</sub> emissions as a result.
6. Any increase in the accessible (importable) supply of gas globally is likely to put downward pressure on gas prices and therefore reduce the cost of gas-fired power generation from what it would otherwise have been. However, with a rising European carbon price, which is a fundamental and necessary element of the EU's climate change package, gas could remain an expensive form of generation in the long term when compared to low carbon generation, even if gas prices were to fall in real terms.
7. When comparing the cost of gas generation to other forms of generation it is important to consider the scope for cost reductions based on the maturity of each technology. Gas, coal and nuclear generation technologies are relatively mature; therefore fixed or capital costs of these technologies are unlikely to reduce significantly in future. Renewable technologies such as wind (particularly off-shore) or solar are relatively

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<sup>64</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/225045/statistics\\_press\\_notice\\_2013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225045/statistics_press_notice_2013.pdf)

immature and so there is greater scope for cost reductions as these technologies become increasingly industrialised. The rate and scale of these costs reductions will be crucial in any cost comparison with gas generation.

8. Cheaper gas prices would favour gas generation over coal generation, particularly when combined with a rising carbon price (as coal generation produces around twice as much CO<sub>2</sub>/kWh than gas). However, given the UK's carbon price floor policy, European environmental regulations such as the Industrial Emissions Directive, the potential for a new global climate deal in 2015 and further strengthening of the EU's Emissions Trading System, it is in any event unclear how much coal generation will remain on the system in the UK by the time shale gas could be entering the global market in significant quantities.

**Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

9. As described above, the UK's gas market is part of an established, liquid and well connected European gas market. The UK market uses a virtual trading location known as the National Balancing Point (NBP) where gas is exchanged between buyers and sellers. To the extent that shale gas has an impact on price, we would expect this to be reflected in NBP prices. Many gas contracts are indexed to NBP and therefore even long term contracts should reflect any impact of shale gas.
10. From a physical perspective, shale gas would need to be treated to ensure it met the relevant quality standards before introducing it to the gas network or for use in power stations, although this would be true of any other source of gas.
11. Should shale gas offer economic benefits in future, we expect the UK electricity market to be able to incorporate it relatively easily.

**Which forms of electricity generation is shale gas likely to displace and by how much?**

12. As described above, we do not expect domestic (UK) shale gas to have a significant impact on the cost of gas in the immediate future. Therefore, we do not expect domestic shale gas to significantly alter the generation mix in the UK. Similarly, domestic shale gas is not expected to significantly reduce the cost of gas fired heat when compared to electrical heat.
13. Assuming the UK and EU remain committed to their climate change goals, and given our expectation that the price of gas will be largely unaffected, shale gas is highly unlikely to replace low carbon forms of generation.
14. To the extent that it has any impact on price, shale gas could displace coal generation; although, as noted above, it is likely that coal generation would have already been severely reduced by carbon prices and environmental regulations by the time this happens. There may however be a greater impact in terms of replacement of coal generation in other countries where coal is otherwise expected to be a greater part of the future generation mix going forward (e.g. China, India).

### **What impact will shale gas and oil have on household energy bills?**

15. We do not expect significant quantities of shale gas to be produced and marketed within Europe for the next decade. The UK market is also well connected to the European and wider global gas markets, and so we would caution against assumptions that shale gas will reduce energy bills in the near future. We do not expect a significant impact on the wholesale price of gas in the UK as a result of domestic shale gas in the short or medium term.
16. Discovery and extraction of shale gas would further diversify the UK's sources of energy and therefore could provide security of supply benefits in the longer term, reducing reliance on other sources of gas. However, we note that, as the UK is already part of a well connected and liquid gas market, it is already relatively insulated from supply side shocks.
17. Assuming the UK and EU remain committed to action on climate change, it is likely that, by the time shale gas and oil have any impact on household energy prices (whether for electricity, heat or transport), cheaper, lower carbon sources of energy will be available. This is due to the likely reduction in cost of low carbon energy as technology matures and the impact of higher carbon prices on fossil fuels (especially in the UK through the carbon price floor).

### **What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

18. Carbon emissions from shale gas and oil can be considered in two parts:
  1. Emissions when burning the fuel; and
  2. Emissions when extracting/transporting/processing the fuel.
19. Emissions when burning the fuel are no different to any other form of gas or oil (although precise emissions will depend on the quality of the fuel which may vary depending on its source).
20. A material reduction in the cost of gas generation relative to coal generation could reduce UK carbon emissions by displacing coal in the power sector. However, as we note above, we do not expect any impact from UK shale within the next decade, at which point coal power generation is likely to be very limited anyway as a result of high carbon prices and European environmental regulations.
21. We are not best placed to comment on emissions from extracting/transporting or processing shale gas or oil. However, we would note that transport emissions would be lower when using domestic sources of gas or oil rather than LNG/oil imports.

### **Will shale gas and oil increase UK energy security?**

22. New domestic sources of gas or oil will undoubtedly improve UK energy security by diversifying our energy sources further. However, we do not expect shale gas to be produced at such a scale to make the UK (or Europe) self-sufficient in gas. Therefore the UK will continue to rely on imports of gas from the wider global market.
23. The UK is already part of a well connected European gas market and has access to global LNG supplies, so we consider the risks to gas security to be relatively low today.

Last year for example, we saw an unusually prolonged and cold winter, leading to an inevitable tightening of the gas market. The market responded as expected by providing the right price signals to gas shippers and the gas flowed.

**What changes to public policies are necessary to maximise the potential of any shale gas development?**

24. As described above, whilst we believe the potential for shale gas should be explored in the UK, we would caution against premature assumptions that shale gas will result in lower energy bills for customers. Any change to public policy should reflect this uncertainty along with the importance of reducing CO<sub>2</sub> emissions in the UK in order to meet our legally binding climate change targets.
25. The fundamental geology in the UK cannot be changed, therefore if Government wishes to promote and encourage shale gas development it can only do so by affecting 'above ground' factors. The key above ground challenges to shale gas development appear to be financial (giving companies the incentive to explore given the uncertainty involved), regulatory and public perception. To overcome these challenges, it is important that any fiscal regime (such as the proposal published in July 2013) is accompanied by consistent, coherent and robust regulatory regimes that are appropriate for the risks posed by shale gas extraction along with strategies for public engagement at both local and national levels.
26. We note that recent developments have polarised the debate into extremes, with some parties claiming shale gas will significantly reduce energy bills whilst others are stating that the environmental costs are too great.
27. We take a more balanced view: we are sceptical that shale gas will significantly affect gas prices in the UK but believe that provided the regulatory regime is sufficiently robust, opportunities can be explored in a sustainable way.

**Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

28. See answer to Q9 above. Discovery and extraction of UK shale gas and oil will increase energy security by diversifying supply although we believe the UK gas market is already well insulated from specific supply issues from certain regions.
29. Imported gas is likely to remain a key part of the UK's energy mix in future so imports from regions such as the Middle East and Russia, where a considerable amount of global gas reserves are located, are still likely.

**What lessons can be learnt from the US experience of shale gas and oil?**

30. Whilst E.ON has not explored shale gas opportunities to date, we would caution against using the US as an example of what can be achieved with shale gas. Differences in geology, licensing regimes and environmental regulation mean that lessons from the US experience have limited relevance in the UK and elsewhere in Europe.
31. The US is also currently a more isolated market without significant export capacity relative to the amount of domestic gas now available. This means changes in domestic reserves have a greater impact on price. As described above, the UK has benefitted



E.ON—Written evidence

from a liquid and well connected European market which brings more stable prices and increased energy security. This does mean that the price impacts of shale gas will be less extreme than those witnessed in the US thus far.

*September 2013*

**Rt Hon Michael Fallon MP and Duarte Figueira—Oral evidence (QQ 251-267)**

TUESDAY 21 JANUARY 2014

*Evidence Session No. 17*

*Heard in Public*

*Questions 251 - 267*

Members present

Lord MacGregor of Pulham Market (Chairman)

Lord Griffiths of Fforestfach

Lord Lawson of Blaby

Lord Lipsey

Lord May of Oxford

Lord McFall of Alcluith

Lord Rowe-Beddoe

Lord Shipley

Lord Smith of Clifton

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**Witnesses**

**Rt Hon Michael Fallon MP**, Minister for Energy, and **Duarte Figueira**, Head, Office of Unconventional Gas and Oil, Department of Energy and Climate Change

**Q251 The Chairman:** It is normal for the Committee, as we get to the end of our inquiries—and we are coming towards the end of this particular one—to invite the relevant Secretary of State and, indeed, we have the Secretary of State for the Environment coming next week as our concluding witness on this subject. We well understand why there are exceptional reasons why the Secretary of State cannot come at the moment and we fully accept that. However, I would equally like to say that we welcome you, Mr Fallon, because you cover this subject in two departments and are highly appropriate for giving us evidence on behalf of these departments as a Minister. I understand that you have a vote at 4 pm.

**Michael Fallon MP:** Yes; I must apologise, Lord Chairman; we have a vote at 4 pm so I may have to sprint down the corridor and return in five minutes flat.

**The Chairman:** I may have to apologise, because in return we may have votes too, so we will also have to sprint. That is quite understood and I hope that you will be able to stay despite that. I also welcome Mr Figueira. I will begin by asking you this question. The Prime Minister said last week that the UK is “going all out for shale” and that this will mean “economic security for the country”. What does “going all out for shale” entail, and—although we have had a lot of evidence on this—could you give us your own slant on “economic security”?

**Michael Fallon MP:** Thank you, and thank you for the invitation. Going all out for shale is getting the investment climate absolutely right and attractive in this country. It means that those who we want to encourage to explore for shale are absolutely clear as to the regulatory requirements here, that there are fiscal incentives in place so that they are clear

about the way in which their revenues will be taxed, and that they have sufficient opportunity, which we will confirm—we are currently consulting on a potential 14th round to widen the licence area. So going all out is about clarifying the regulatory structure so that there is no misunderstanding or uncertainty about it, putting the fiscal incentives in place to drive the exploration and widening the search beyond the licences that were issued before shale was really prospected back in the 13th round with the 14th round, which we hope to run this summer. On economic security, yes, we were a net exporter of gas until around 2003. We now import half of the gas we need and we will be importing 70% of the gas we need within a few years, so it is extremely important to us that we maximise home-grown energy of all kinds. That means reactivating the nuclear programme, encouraging renewables and making sure that, if the shale gas is there to add to the mix, we do everything possible to get it out.

**Q252 The Chairman:** We will come to a number of issues in more detail in a moment. That same press release said that we already knew that the development of shale gas could bring growth, jobs and energy security to the country. Leaving aside energy security for the moment, on what scale do you see the scale of growth and of jobs? We have had quite a lot of evidence—we will come on to this in detail—about the slow pace at which things are happening at the moment. When do you envisage that these effects will start to come through?

**Michael Fallon MP:** So far as the jobs are concerned there have been a number of estimates. The Institute of Directors estimated some 70,000 jobs; we put a figure in the strategic environment assessment, which of course only shows the jobs that might be created under the new 14th round and does not refer to the jobs that are already there. That was an estimate of between 16,000 and 32,000 jobs. So there are some varying job estimates. However, I am very clear, from the experience in the United States and having discussed it over there and met Governor Perry from Texas, that there are huge growth opportunities here in jobs, in the development of new businesses and in the opportunities for some of our offshore companies to get involved by using the techniques that they have developed sub-sea.

I think the second part of your question was: why is it taking so long to get going? We are at the very initial stage of this. We have a dozen or so companies out there exploring. I think they have been using the last few months to get familiar with the regulatory framework and to start preparing their planning and permit applications. They have been doing a lot of the geological analysis that is necessary. That is very much a preliminary step to seeing the next stage, which is the drilling of, I believe they estimate, some 20 to 40 exploratory wells over the next couple of years. There is therefore no delay in this process; on the contrary, we have been doing everything we can to encourage it and to make sure that it happens here. Some of these operators have opportunities elsewhere, in central Europe, for example, and we need to make sure that they commit to here. We have the right investment and regulatory framework to do that.

**Q253 Lord Lawson of Blaby:** Your determination to get going on shale gas is very clear and I think that many of us entirely support that. But something has gone seriously wrong, has it not, because we have not got going. Virtually no exploratory wells or very few have been drilled. There are no plans to drill exploratory wells in the immediate future that I am aware of. What has gone wrong and what are you going to do about it?

**Michael Fallon MP:** I certainly thank you for what you said about our determination. The main thing we know about shale gas is that there is an awful lot more of it than was

originally thought. We know that from the northern survey and we will publish the southern survey in a few weeks' time, which may well tell us the same thing. The scale of the opportunity only really became apparent in the middle of last year, when we published that very authoritative survey of the northern basin. Of course, we had the moratorium on hydraulic fracturing, which lasted until December last year. Last year we had about half a dozen wells drilled; we are going to see a number more applications this year, and then it will get going. I think you are suggesting that it has not got going but, with respect, Lord Lawson, it took time to get going in the United States. It took a few years there for the momentum to build up and I am in no doubt that it will here. What encourages me is that at a much earlier stage than in the US we see some of the majors coming in. We have seen Centrica, GDF and just last week a £30 million investment from Total coming in at a much earlier stage than the majors came in in the United States. That encourages me.

**Lord Lawson of Blaby:** Of course, you would expect us to go even faster than the United States now because they were pioneers. We have the benefit of the learning process which they had to go through. So it is very disappointing and puzzling. Anyhow, can you say, to follow that up in practical terms, how many exploratory wells you expect to be drilled in this country over the next 12 months?

**Michael Fallon MP:** No, we rely on the industry's estimates, and they have given us a figure of 20 to 40—which I accept is a rather wide range—that will be drilled in the next two to three years. That is the industry's figure that we rely on.

**Lord Lawson of Blaby:** But you do not think that there may be very many in the next 12 months, let alone the next two to three years.

**Michael Fallon MP:** Yes, it is very difficult to be accurate about these forecasts. We talk to the companies all the time, they tell us of their plans, and their plans then change. We know that a number of them are considering putting in planning applications, but the exact timetable is frustratingly hard to predict. But the industry estimate is 20 to 40 wells over the next two to three years, and production would then hopefully flow from that.

**Q254 Lord Lawson of Blaby:** I have just two quick supplementaries. First, I think the Prime Minister said recently that the objections to the drilling of shale gas were irrational, or words to that effect. Is that the case?

**Michael Fallon MP:** Certainly some of them are. One has to distinguish between some legitimate concerns about the environment or the use of water and—

**Lord Lawson of Blaby:** Sorry—I was going to ask you: what are you, the Government, going to do to set at rest the unnecessary fears which many people have?

**Michael Fallon MP:** Where they are legitimate concerns, we have tackled them one by one. There was a concern over methane emissions; we have published a very authoritative study on that by our Chief Scientist, who said that there is no significant increase in the risk of methane emissions. Public Health England published a study saying that there is no significant increase in risk from shale gas. The water industry published a study saying that the water issue is manageable by negotiation with the water companies. So where there are legitimate concerns we have been tackling them. We continue to put information up on our public website and to encourage the academic bodies, such as the Royal Society, to disseminate the information that they have. It is more difficult to tackle some of the myths about shale gas—that it gives you cancer, or whatever. However, where there are legitimate concerns, we have been tackling them.

**Lord Lawson of Blaby:** It seems to me that you are relying on other people to set people's minds at rest. I feel that government has a role to play and that the industry feels that government has a role to play. Finally, how many applications to drill are under consideration at the present time?

**Michael Fallon MP:** On the first point, I accept your admonishment on using third parties. I am afraid that it is a fact of modern life—it may have changed since your day—that Ministers are not always believed when they go out and say that things are absolutely safe. We think it important that scientific and other bodies are involved in this as well. How many wells do we know of—half a dozen?

**Duarte Figueira:** As the Minister has said, half a dozen wells have been drilled in the past 12 months in various parts of the country, and a number of applications are either in or about to go in from various companies. Of course, the information about applications that have not yet been submitted is commercially confidential, so we—

**Lord Lawson of Blaby:** I am not asking you to name the companies, which is commercially confidential information. I am asking you, quite simply, how many planning applications to drill are under consideration at the present time as we speak.

**Duarte Figueira:** I am aware of one at the moment.

**Lord Lawson of Blaby:** Just one. That is rather pathetic, is it not?

**Duarte Figueira:** The applications to drill are only part of the whole process. Discussions will go on with various local authorities and with the environment agencies, and so on, and all that has to be taken as a holistic picture. So the application is only part of the process; there will be pre-application engagement with local communities, and so on. A number of companies are doing a number of things in different parts of the country.

**Q255 Lord Shipley:** Can I pursue this discussion? The Environment Agency told us in December that it had not received any applications for permits to hydraulically fracture since the Government's moratorium was lifted 12 months previously in December 2012. Are you surprised by that?

**Michael Fallon MP:** No, I am not wholly surprised. In the first instance, you will find drilling without hydraulically fracturing as more of this exploration activity that precedes fracturing and production takes place. So that does not wholly surprise me. I do not think that it will be long before we have the first application for fracturing, so I am not wholly surprised.

**Duarte Figueira:** Can I just add to that? It is worth bearing in mind that a number of the companies are planning to do non-hydraulic fracturing exploration prior to hydraulic frack. The Environment Agency—Tony Grayling—said in its evidence that it was in discussions with a number of companies around hydraulic fracturing permits.

**Lord Shipley:** We understand from Cuadrilla that it applied to the Environment Agency for permits to hydraulically fracture three test exploration wells in August 2012. But the eventual permit determination date was 31 December 2013—that is, some 15 months later. What insight do you have into why it took so long?

**Duarte Figueira:** In the case of Cuadrilla in Lancashire, the company itself decided to carry out quite an extensive environmental impact assessment, including a lot of local consultation. So this is not a reflection on the period in which the Environment Agency has taken to consider this matter but a reflection of the fact that Cuadrilla wanted to do things

very properly and carry out an environmental impact assessment. I think you got the evidence from the Environment Agency that they have considered all their applications within their 13-week period—they gave evidence to that effect to this Committee.

**Lord Shipley:** So your expectation is that in 2014 it will be better if people put in a planning and a permit application at the same time rather than doing them sequentially, which seems to have happened in this case.

**Michael Fallon MP:** I think it is more likely now that we have published the regulatory road map and the companies are clearer about which pieces of European legislation bite on them and which do not.

**Lord Shipley:** Lord Lawson asked you how many are pending now, but given that operators seem to have much better idea as to how the processes involved work, do you have any forecast of how many there will be in 2014, this calendar year?

**Michael Fallon MP:** The number of fracturing applications?

**Lord Shipley:** Planning and permitting applications, so all categories.

**Duarte Figueira:** The industry has said to us, and I discussed it with them as recently as today, that they expect a number of companies to bring forward applications during the course of this year and expect the pace of those applications to ramp up over the next few years. They might in some cases do exploratory wells this year, which may not involve hydraulic fracking, or they may go through the process of applying for a hydraulic frack planning application or environmental permits, and then the pace will pick up over the next couple of years. That is what the industry is saying now.

**Q256 Lord Rowe-Beddoe:** Minister, last week a US shale gas entrepreneur gave us evidence. We asked him if he would consider investing in the United Kingdom if there were “rigorous” and “crisp and clear” regulations. He said that he did not believe that at the moment the regulations are crisp and clear. Do you believe that the current regulatory regime in the UK for development is crisp and clear and, if it is not, what can we do about it?

**The Chairman:** He actually said, “not right now”.

**Lord Rowe-Beddoe:** Yes, that is what he said—I apologise.

**Michael Fallon MP:** He may not have caught up with our publication of the regulatory road map in December. We think that the system is now crisp and clear, and other operators have not expressed any doubts about it. As I have said, we have seen this quite significant investment coming in from Total, so that has not been our experience. I have addressed a number of investor conferences, including a lot of entrepreneurs from the United States, and they have not made that criticism. They may have made that a year ago, but not now. I think that the position is very clear. In this country we have a very well established regulatory framework from onshore drilling, and we have had that for a very long period.

**Lord Rowe-Beddoe:** I suggest that he did know what he was talking about, because obviously he has had quite a lot of success in North Dakota and he was very keen to invest here if he thought that it was right. However, in the evidence we have heard in this Committee over the past period, a lack of a co-ordinated approach comes through all the time, and there is a lot of misunderstanding among the public—misperceptions and so on. It is a big task. But if it has the economic consequences that the Prime Minister and the

Government say it does, why is there not some task force out there, leading the UK world to understand what we are doing, why we are doing it and how necessary it is that it is done. How can we allay people's fears? With everybody who has mentioned fears, experts have told us, "Those fears are unfounded", or, "It can be handled this way". So there is an enormous amount of not just transparency but public relations that needs to be steamrollered.

**Michael Fallon MP:** I accept that. It is quite hard to steamroller public relations, but I accept that there is a lot of work to be done. We do it through Duarte's office, through the website, through engagement with those areas of the country where there is likely to be drilling—a whole series of meetings have been held with councils where it is likely to take place. Where we can engage, we do. So far as Whitehall is concerned, we have streamlined the machinery. I am the Minister responsible and I am in no doubt that all of my colleagues who have interests in other departments are absolutely behind the need to encourage exploration. If there is anything that your Committee or the industry feel is lacking from our current framework or incentives, I will be very happy to look at it.

**Lord Rowe-Beddoe:** Would it be helpful, Minister, if all these various regulations were consolidated into one set of regulations? Is that something you could look at?

**Michael Fallon MP:** That is why we publish the road map, which brings all the guidance together and makes it absolutely clear to developers what steps they have to go through. However, certainly we can always improve so far as the regulations are concerned and whether they can be brought together in one place. But with great respect I do not think that that is the issue that is now holding things up. They are preparing their plans, getting their finance in place and doing the geological work—the survey work—that they need to do and they are planning where they are likely to have the best prospects of drilling. The survey of the northern basin was published only at the end of June, so an awful lot of work flows from that in enabling the companies to pin down where they are most likely to have success.

**Q257 Lord Griffiths of Fforestfach:** Minister, you mentioned the publication of the document in the summer on the potential of the Bowland shale field—if only a tenth of it was to be recovered, it would meet our current gas needs for more than 30 years. In the press and on the radio you have been very bullish about what the potential is. The Prime Minister has talked about "driving energy prices down". My first question is: what do you think the potential impact will be if it gets going in the UK? What would be the effect on household bills and energy prices?

**Michael Fallon MP:** I have spoken publicly about the potential effect, because we have clearly seen a transformational effect in the United States, both on industry's costs and on domestic household bills. There has been a very significant effect on their economy, which poses a challenge for us here and right across western Europe in terms of competitiveness. So there has been a huge effect there. It is possible that we will see a similar effect here, but we cannot be sure of that until we see more exploration and until we know, geologically, whether with the thicker shale here recovery is possible to the extent that it has been done in the States, and at the cost-effectiveness with which it has been done in the States. We do not yet know the answer to those two questions. What we know is that there is a lot more shale gas underneath us than was previously thought. You have seen the estimate, which I think is a median estimate of 1,300 trillion cubic feet in the northern basin. We will know by the end of March what the prospects are in the southern basin, and a couple of other studies are proceeding as well. So we know that there is a lot more of it down there than

we thought, but we do not know whether it can be extracted to the same volume and at the same cost as it has been extracted in the States. That is why we need to get on and encourage the industry to drill.

**Lord Griffiths of Fforestfach:** Have you and the department become more cautious in what you think the effect on prices should be? I say that because in your recent *Sun on Sunday* article you cautioned that prices would come down, and so on, but only if, as you said, “our boldness is matched by others in Europe”. Mr Figueira said that the potential would not be for 50 years’ consumption but for just over 30 years. As one reads this, one wonders whether, in a way, you are a little more hesitant than you were about what the potential for falling energy prices in the UK really is.

**The Chairman:** I think you have time to think about that because there is a Division in the Commons.

3.59 pm

*Sitting suspended for a Division in the Commons*

**The Chairman:** Thank you very much indeed for coming back so quickly, breathless no doubt. I hope that you can remember the question.

**Michael Fallon MP:** Indeed, and I have exempted myself from the follow-on Division, so I hope that there will not be any more interruptions.

I do not think that I have modified my language—I have always talked about the potential. There are some fairly stark differences between the gas market in the United States and that in Europe, in that the former is more hermetically sealed and they do not have the LNG export capacity. Here, like it or not, we are increasingly enmeshed in a European gas market. We have a couple of interconnectors—three altogether, I think. It may be more difficult to read across the direct parallel in the huge reductions there have been in gas prices to what would happen in the European marketplace. But, as I am sure you have discovered, very active exploration is going on in the centre of Europe—in Hungary, Romania, Poland and other countries there. We still have to regard it as potentially a huge gain, but it is not possible to be clearer than that.

**Q258 The Chairman:** The *Sun on Sunday* article was mentioned. You said there, in relation to families, that the cost of power for families and businesses could be driven down if “our boldness is matched by others in Europe”. What exactly did you mean by that?

**Michael Fallon MP:** What I meant by that is that member states should be free to pursue shale gas exploration in their own way, and should resist, at the European level, the need for any further legislation or other interference by the Commission. I meant that the other member states should feel equally free to get on and encourage exploration in their countries without referring back to the Commission.

**The Chairman:** In the same article you said that by speeding up regulation “we aim to handle environmental permits in two weeks rather than the current 13”. What impact do you think that would have on the pace of exploration?

**Michael Fallon MP:** There has been concern from some of the operators that because this activity was relatively new the Environment Agency was taking too bureaucratic an approach, so that permitting reduction, which we hope to achieve during this calendar year, will be a significant improvement. We are always looking to see, in the regulatory process, where there is the possibility to reduce intervals and to streamline and avoid



overduplication—for example, in responding to consultation sequentially rather than at the same time, and the information that is provided to the various agencies that could be shared more easily.

**Q259 Lord Lipsey:** Are the Government wise to hang their hat on possible price reductions in this field? As you say, it depends very much on the rest of Europe also going for fracking. We have also seen a major downgrading of the prospects from Poland and it may be that Europe cannot do all this. However, whether or not we get large European production, the simple fact is that it will do enormous good to our balance of payments if we do not have to buy all this gas from Europe, but serious worry about the economy, not our balance of payments, is in the background. Should we not be selling the advantages of this gas for that, as well as the possible advantages for prices?

**Michael Fallon MP:** Yes, I agree with that—and the huge advantages for our industry. We have here in the United Kingdom two of the very few crackers—cracking plants—that are equipped to handle shale gas. At the moment they are considering importing it at Grangemouth, for example. However, both the cracker at Grangemouth and the one at Mossmorran are ideally placed to take advantage of shale gas as a cheaper feedstock for the chemical and petrochemical industries. So again, there is a huge opportunity there, as well as the more obvious sales opportunity to the rest of Europe.

**Lord McFall of Alcluith:** Can I just clarify what Lord Griffiths has said about a shift to shale. Are you of the opinion that it will eventually cut domestic gas prices?

**Michael Fallon MP:** It could—that is the word I am afraid I keep using. It has the potential to do that given what we have seen in the United States. It has the potential quite dramatically to reduce costs for our industry and for our domestic consumers.

**Lord McFall of Alcluith:** In your *Sun on Sunday* article you said that the new regime makes Britain “the most attractive place in the world for new shale gas investment”. What advantage does the UK have over America?

**Michael Fallon MP:** The industry in America has been running for 10 to 15 years now. The advantages here are the fiscal incentives that we have set out, which provide a very clear encouragement for companies to come here. That explains the involvement of companies such as Total. It was a fairly concisely written newspaper article. I probably meant the most exciting new place to explore for shale

**Lord McFall of Alcluith:** So it is a bit of hyperbole.

**Michael Fallon MP:** Not hyperbole; I probably meant that of the new places to come to drill for shale, this is one of the most attractive. That is why we are now seeing investment from these French companies, for example, which are denied the opportunity to search for shale in France, coming over to Britain. That is a sign that we have the right climate in terms of regulation and fiscal incentives.

**Lord McFall of Alcluith:** Lord Rowe-Beddoe mentioned the situation regarding a plethora of regulations and that it was monitored by multiple, often obscure authorities. We received that in evidence. On the issue of the establishment of a designated administrative body for shale gas with a single set of production guidelines, do you not think that the Government should move on that, particularly to assuage community concerns about shale gas, for which the Government has a big responsibility here?

**Michael Fallon MP:** We have two bodies that are relatively independent of government: the Environment Agency and the Health and Safety Executive. My concern with setting up

another body is not just the time that it would take to set it up, but that people might feel that it was completely pro any kind of development. It is important that communities are reassured that the Environment Agency is taking the necessary steps to protect the environment and the water supply and that the Health and Safety Executive, which has a great deal of experience in this area and in the North Sea, is doing everything it can to make sure that the method of fracturing is safe for those who are those who are doing it and safe for the local community. So I am not persuaded that setting up a new body all over again would necessarily make it easier.

**Lord McFall of Alcluth:** Lastly, a report by the House of Commons Environmental Audit Committee concluded last month that fracking “does not warrant subsidy through a favourable tax treatment”. Why do the Government think that it does?

**Michael Fallon MP:** I do not accept that it is a subsidy. Oil and gas companies pay a higher rate of tax than they pay in corporation tax. The allowance that we have put forward relieves a portion of the company’s profits from the 32% supplementary charge, but they will still be paying ring-fence corporation tax at 30%, which is a lot higher than the mainstream corporation tax rate of 21%. For profits that are not covered by the allowance, they will pay tax at 62%, which is three times the mainstream corporation tax. So I cannot accept—and I tried, probably unsuccessfully, to convince the Environmental Audit Committee of this—that it is a subsidy. They will be paying more tax than other forms of industrial and commercial activity.

**The Chairman:** I think that a number of us would accept that it is not a “subsidy”—although that is in quotes, not from the Committee.

**Lord Griffiths of Fforestfach:** In our last session, Lord May asked Chris Wright, the American entrepreneur, “Why do you think it is that so few of the bigger companies have been involved in UK?” The answer was, “for the same reason that they are not really involved in the US. It is not a big company game. It is not a thing you can plan 10 years in advance. It is a thing where you look at the geology, you pick what you think is the best place, you drill a few wells, you find out that you were wrong, then you find out which way you think you were wrong, and then you try something different”. He pointed out the fact that Shell was exiting the US and that Exxon in North Dakota was one of the low-quality producers. He concluded by saying—and I must say that I think it was a surprise for the whole Committee—that the business model was different from that of the large companies: “It has been driven by private, faster moving or public but smaller entrepreneurial, fast-moving companies”. What is your comment on that fascinating observation?

**Michael Fallon MP:** I think it is fascinating and true. This is very much an entrepreneurial activity. The dozen or so companies that are out there at the moment are relatively small and are risking their investors’ capital in this search for shale. The nature of oil and gas exploration is that there is still a huge amount of serendipity in the way in which you prospect and your percentage chance of your drilling operation actually hitting the gas and oil that you want to extract. However, some majors have started—there has been more concentration in the States in the past couple of years. Some of them have been mergers between the smaller companies and so on. The only point I made was that it is encouraging that relatively strong companies with big balance sheets like Centrica and Total are getting involved at such an early stage.

**Q260 Lord May of Oxford:** I want to ask a question that reveals an embarrassing ignorance on my part, but it also relates to the question on the agenda that I was going to

come to in a moment. I was unaware that fracking was not allowed in France. Is that what you said?

**Michael Fallon MP:** Yes, rather as we did, they have a moratorium on fracking.

**Lord May of Oxford:** Can you tell me the essence of the difference between decisions that the French came to which led them to put that in place and the decisions that we have come to that have led us to be keen to go ahead with it?

**Michael Fallon MP:** We had a similar moratorium when we had unusual seismic activity at a couple of sites in Lancashire, but we did not waste the years of the moratorium. We got on and we have introduced new seismic controls to ensure that there is a traffic light system whereby if there is any seismic activity beyond a certain measure—Duarte will remind me—

**Duarte Figueira:** It is 0.5.

**Michael Fallon MP:**—the operation is stopped and a series of further steps have to be taken by DECC if you go beyond that. So we have responded to the issue and we have put in place—

**Lord May of Oxford:** They have actually gone further and stopped you doing things which you then have to have safety measures about. That is interesting.

**Michael Fallon MP:** Indeed. As I understand the situation in France, it was near or close to the election period that the French decided to terminate the study that I think they were doing. They were doing some kind of study.

**Duarte Figueira:** They drilled one exploration well, which was possibly unfortunately placed, and which resulted in it becoming a political issue, and then they closed it.

**Lord May of Oxford:** That was by way of a preamble to the more general question I have. The European Commission is expected to make an announcement on its initiative on “unconventional hydrocarbon extraction” this week. Apparently there is speculation that they have decided against legislation. What is your reading of this, what are you expecting and what do you think the issues might be?

**Michael Fallon MP:** We certainly hope that that will be the result. I do not have any definite information to give the Committee because we have to wait for the actual publication. We have been arguing very strongly that there is no need for further European legislation in this area and that any EU action must be proportionate and should not lead to any overt regulation. Where we agree with the Commission is that there is perhaps a case for further guidance as to which bits of which European environmental directives actually apply, and so on. I think that the industry would welcome that. However, we are absolutely opposed to further regulation in this particular area and I hope that our lobbying on that will be successful. We do not want to see the delays that might be involved in any formal piece of legislation from Brussels, which might in itself take two or three years to wend its way through the legislative process.

**Lord May of Oxford:** You previously described the UK as having a “world class safety and environmental regime”. How do you see the EU relating to that? The legal basis for our current situation, as I understand it, derives ultimately from several EU directives: the groundwater directive, and so on. If the EU is disposed to take a somewhat more strict view, am I right in understanding that there is then the opportunity—and would one wish to invoke that opportunity—of having a blocking minority that overrode the EU’s feelings?

**Michael Fallon MP:** I will make two points. First, there is already well accepted and understood European legislation on the environmental side about the use of water and methane emissions, and so on. So there is already a European regulatory framework, which everybody in all the member states has to comply with, and our industry here has to comply with it too. We do not see the case for any further, new legislation on top of that. It is too early to speculate about what we will do if that is proposed. We hope that all our lobbying efforts in Brussels will have been successful and that the Commission will not proceed to further legislation. The Prime Minister has written to President Barroso to express his concerns about the damage that any new legislation would cause and the delays that it is likely to cause in the investment that we need. I hope that all those efforts will bear fruit, but we will have to see the final text of the Commission's proposal.

**Lord May of Oxford:** As I understand it, the Treaty of the European Union is such that it is the right of individual member states to make choices among energy sources. If indeed there were feelings based on a less sanguine appraisal of the issues, do you think that there are actors within the EU who would like to try to invoke environmental legislation to undercut the rule that individual countries can more or less make their own choices about energy?

**Michael Fallon MP:** I think that there are other member states who for various ideological reasons want to try to prevent others from constructing the energy mix of their own making. We have seen a little bit of that on the nuclear side and there may be a little bit of it on the shale side. I believe very firmly that it is for member states not only to be free to decarbonise now at their own pace but to have an energy mix of their own making. That is a fundamental competence that should remain at the national state level.

**Lord Lawson of Blaby:** May I ask a supplementary on that? You mentioned that of course there is a whole lot of binding European environmental regulations at present. Even if you are successful, as I hope you will be, in blocking any further environmental regulation directed at shale in particular, do you think that there is a risk that the existing regulations, which have the force of law, might be used to delay the development of our shale gas resources in the way that you would like to see?

**Michael Fallon MP:** That is certainly possible. It is possible for those bodies that are actively opposed to shale gas exploration for environmental reasons and are completely against extracting any more fossil fuels from beneath us. It is certainly possible that they may try to invoke various pieces of European legislation, but we think that at the moment the framework is pretty clear and that the industry knows which bits of European legislation it has to comply with and which bits it does not. There may be a case for more guidance from the Commission on that. Anyway, there is certainly no case for further regulation. I take the point that we will obviously have to keep the existing regulation under fairly firm review.

**The Chairman:** That is very clear.

**Q261 Lord May of Oxford:** Coming from a different direction, you just addressed, quite sensibly, issues of decarbonising, and so on. How, in your view, does the encouragement of this fit together with the fact that at least in principle we have primary legislation—the Climate Change Act—and an agreement that the trajectory towards our end aim has us decarbonising electricity by 2030? Do you think that this development of shale gas is beneficial on the route to that and consistent with it no longer being used past 2030, or do you just have a cynical view about the whole Climate Change Act?

**Michael Fallon MP:** I certainly do not. That is an obligation that Parliament has entered into.

**Lord May of Oxford:** I declare an interest, of course.

**Michael Fallon MP:** New gas is consistent with the decarbonisation of the power sector and it will help us to meet some of these targets. These are targets. The only point I was making in my comment to Lord Lawson was that I firmly believe that member states should be free to reach those targets in their own way and not be bullied into imposing unnecessary or premature costs on either their industry or their consumers.

**Q262 Lord Smith of Clifton:** Minister, the industry launched a pilot scheme that will see local communities receive a one-off payment of £100,000 once exploratory drilling has begun. It is also consulting on a proposal for communities to receive a 1% share of revenue once a production has started. Do you support these measures? In particular, do you believe that 1% of revenue is sufficient?

**Michael Fallon MP:** I certainly welcome the offer, which comes from the industry itself. I certainly welcome it. I think that £100,000 for a fractured well will go some way towards compensating the very immediate local residents from some of the disruption involved over the period of the actual fracturing before gas starts to flow. One per cent of the revenues per well site could amount to around between £5 and £10 million. It could end up as a formidable sum of money which could be used for the benefit not simply of the local residents but of the slightly wider community around the well-head. It is a pretty generous offer.

**Lord May of Oxford:** Which unit of local government do you contemplate that it will be: parish councils, district councils or county councils?

**Michael Fallon MP:** I am not so sure that these two parts of the offer should go to any of the councils involved. In the first instance they should go to local residents, those who immediately surround the well site, and the form that it takes should be for local residents to choose. It should be clear to local residents that they could opt for a reduction in their bills. That amount should be made clear to them. However, it may be that they would want the £100,000 to be devoted to a particular facility. So far as the £10 million is concerned, the danger in allocating it to one of the councils is that sooner or later the Chancellor will notice that those councils are getting formidable amounts of money and their grants and so on may be reduced. I would rather see it go either to some community or to a local charitable foundation that is working in the area and not see it sucked into the local government finance system.

**The Chairman:** I fear that it is now our time to vote. We will be back as quickly as we can. I hope that that will work for you, because we have a few more questions that we would like to ask.

*Sitting suspended for a Division in the House*

**The Chairman:** We will resume.

**Q263 Lord Lipsey:** Minister, I thought we might explore the nature of the public opposition and what the Government can do about it. I will refer to the interesting interview Lord Deben gave to the *Guardian* today in which he distinguished sharply between persuadable people and those who are pursuing a Trotskyist agenda—I think he used those words—which is to say that they are using their opposition to shale to express very much

wider political positions, and who are therefore not convincible. Do you accept that there is that distinction, and do you think that that should condition where you aim your fire when you try to dispel unreasonable fears?

**Michael Fallon MP:** I am sorry to say that I have not yet caught up with the *Guardian* today, so I have not read Lord Deben's interview.

**Lord Lawson of Blaby:** He would be horrified that you have not read the *Guardian*.

**Michael Fallon MP:** So much to read. Nor have I seen a breakdown of who attends the various protest camps and so on, so it would not be right for me to speculate. Earlier I drew the Committee's attention to the need to distinguish between quite legitimate concerns about the disruption involved—such as the noise or the lorry movements, or whatever, where indeed the planning authorities have the power to impose conditions, and the potential use of water in areas where water may be in shorter supply than others—and people who simply want to leave everything in the ground. In all our work we have to try to deal with concerns that are legitimate.

**The Chairman:** In some of our earlier sessions a number of our witnesses, particularly from the industry, felt somewhat frustrated because they felt that the Government were not doing enough to promote the positive case for shale oil and gas. I know that you have been trying to make some efforts, but how would you respond to that?

**Michael Fallon MP:** We have been making some efforts. Senior Ministers have been out there, and the Prime Minister visited a site in Lincolnshire last week. You will see other senior Ministers out there making the case. It is obviously difficult for Ministers to interfere with particular planning applications, because that is strictly a matter for the planning authority and Ministers would not want to prejudice its handling of those applications. However, I hope that you will see more Ministers making the case for getting on with this exploration, and I hope that there will be renewed interest from the other surveys of other areas of the country that are now being done.

**Q264 Lord Lipsey:** In America it is accepted locally, largely because people can see the jobs and the boom that is created by fracking, although we would not want to see as little regulation as they have there. Is there not a danger that the small minority with very strong feelings, who may or may not be politically motivated, are being allowed by the authorities effectively to veto the development? The fact is that Cuadrilla had to pack up at Balcombe, I believe because the police were not prepared to protect them against the demonstrators. Should you not be taking a tougher as well as a carefully argued line?

**Michael Fallon MP:** I do not want to criticise our *Guardian* reader who wants to see us cut the ability to protest, and so on. There is a well established tradition here of protesting. I am not sure what you mean by "taking a tougher line", whether that means you expect the constabulary to crack heads or whatever. We have been quite clear that these are legitimate industrial activities, and we will make sure that companies that have the necessary authorisations and that go ahead with their drilling are protected in so doing.

**Lord Lawson of Blaby:** May I follow that up? I asked you in effect at an earlier stage of this session why the Government, or some Minister or another—I am not saying which Minister it should be; maybe it should not be you, but that is not the point—are not doing more to allay the unfounded fears that have been stirred up, for whatever reason, among the public, and why you are leaving it to others. You answered that it is because politicians are not believed any more. However, is there not a danger first of all that if you do not point out that these fears are unfounded, given the proper regulation that we have in this

country on contamination of groundwater for example, that will only lead to suspicions that you think there may be some grounds for them. If you do not address the specific concerns that some people have—which are unfounded, but they have them—you are limited to generalisations that carry even less conviction than specific points well made.

**Michael Fallon MP:** There is that danger, of course. I accept that. But I have told you how we have tackled some of the immediate concerns about methane emissions, water use and risk to public health—not simply by having Ministers say that they believe it to be safe, but by using authoritative third-party people who have looked at those issues and have published studies, and so on, and ensuring that their authority is deployed. Of course there is more that we can do there, and probably more that we should be doing. I was simply making the point that I do not think that Ministers going on television and saying, “This is safe”, necessarily convinces these days. That is why we have to tackle this in conjunction with the various agencies and authoritative bodies, and indeed with the academic community.

**Duarte Figueira:** Can I add to that? I think you had evidence from David MacKay on the work that he has been doing to get a number of scientists—I think it is up to about 20 now—who are prepared, in the right sort of fora, to give scientific evidence on various aspects of the science that applies, whether that is geology, water, or other aspects. We have therefore been active in making sure that the scientists are also employed in this area, not just in terms of individual meetings at national level; we have seen them involved in activities that we as OUGO have organised in places like the South Downs National Park Authority. We had a recent event there at which scientists, regulators, the Environment Agency and DECC explained the case for shale in terms of energy. They explained that both to the South Downs National Park Authority, which is a planning authority, and to members of the public who were present. So we have been producing materials at the national level, and at the same time we published the regulatory road map we published a public-facing *Facts about ‘Fracking’* document, which is much shorter than the very large question and answer session and tackles the very details that you have talked about.

We have also been doing that sort of thing at the local level. As we see the activity go forward in the next couple of years we will be engaging locally in the relevant areas. In fact, some of my team have already been engaging, for example, in Lancashire, at Cuadrilla events, and we plan to do more work in the near future in Lancashire as well. So it is a point well taken that we can do more, but it is important that we do that in a way that is respected by the local community because it is scientifically based and objective. Where the risks are identified, the regulators explain how they are mitigating those risks.

**Lord Lawson of Blaby:** But with the greatest of respect, the way in which you speak to the great mass of the British people is through the media. The media may be very foolish, but it is a fact of life that senior Ministers are likely to get much more coverage in the media than groups of scientists or officials. It may be very stupid of the press and the television to take that view, but that is the view they take. Therefore if Ministers are not prepared to go up front, and they shelter behind officials and scientists, they will not make the impact that they would like to make.

**Michael Fallon MP:** I accept that, but we are not sheltering behind public bodies. You have quoted from articles I have written, and statements and speeches that I have made, but you will find more senior Ministers assisting the charge in the way that you have suggested, and I hope that you will see a pattern of more senior Ministers engaging in this throughout the early months of this year.

**Q265 The Chairman:** I will come back to a point you made very early on, which is that a number of our witnesses from the United States told us how the development of shale gas there has led to what they describe as a renaissance in the energy-intensive and petrochemical industries. I fully understand that some of the circumstances in North Dakota and elsewhere are a bit different from circumstances here. Nevertheless, do you think that shale gas development in the UK could lead perhaps not to a similar renaissance but at least to a substantial development of the energy-intensive and petrochemical industries?

**Michael Fallon MP:** Yes, that is certainly possible. It is possible that by importing shale gas there may be a reduction in costs anyway. Even before we begin to develop our own industry, the importation of shale gas into facilities like Grangemouth may itself bring about a reduction in costs. Also, we have the opportunity, given the plants we have and the proximity of shale gas to some of our petrochemical industry on Teesside and in the north-west, to see the industrial application of shale in a way that perhaps has not had the attention, which has focused largely on household bills. So there is an opportunity there, and in any case our own chemical and petrochemical industries will have to respond to the challenge of much lower costs in the United States. So I do not think that this is a challenge we can duck.

**Lord Lawson of Blaby:** Given the snail's pace which you told us about earlier this year, when you thought that about seven exploratory wells might be drilled a year over the next three years, when do you think we will ever see or could see significant production of shale gas in this country?

**Michael Fallon MP:** Let me try to answer both those points. First, on the snail's pace, there was no successful demonstration of the fracking of shale in the United States until the early 1990s. It took another 10 years after that for production to hit anything like commercial scale. In the United States it is still true, even with the advantages of a much bigger area than we have here and the differences in mineral rights, that a new basin or a new prospect will need some two or three years of experimentation and exploration before it moves into commercial production. So I caution the Committee against an easy assumption that all this is being done far too slowly. It has taken time to get going in the United States. I do not expect to see shale gas production here until we have completed the exploration phase, so I do not expect to see it for two to three years. But even that would be much faster than the stage that it reached in the United States.

Of course, I accept Lord Lawson's earlier point that there are lessons that we should and could be learning from the States, which ought to speed up that timetable, but I do not accept that we are proceeding at a snail's pace. We are at the very beginning of this industry.

**Q266 Lord May of Oxford:** I find it a little peculiar that the people in this industry, not the people around the table, do not give more attention to the parallel need for developing carbon capture and storage. Just to pick one of many possibilities, recently the Tyndall Centre for Climate Change Research, in written evidence, said that the idea of a golden age of gas "may turn out to be a gilded cage, locking the UK into a high carbon future". For example, emissions for the grid in 2030 could be six times higher than the target level that the Committee on Climate Change has called for unless there was a 95% or better deployment of carbon capture and storage. I would just welcome your thoughts on how research on carbon capture and storage is going, and to what extent, for the long term interests of the industry, you think proper attention has been given to it.



**Michael Fallon MP:** Yes. I have ministerial responsibility for carbon capture and storage, among other things, and we have set aside £1 billion over the spending review period for the commercial development of carbon capture and storage. We ran a competition and the two successful bidders were the Drax operation in Yorkshire and the Peterhead operation up in Scotland. We have now signed the initial contract with Drax and we expect to sign on Peterhead in the next two weeks, so those two projects, which will consume an awful lot of public money, are now going ahead.

In addition, we are now looking at some of the industrial applications of CCS, and as part of the City Deal for Teesside I have authorised some modest expenditure there on a pilot study as to how the existing pipeline network that lies across Teesside might be deployed in carbon capture and storage. It is not, however, until we have seen the success or otherwise of the big two projects at Drax and Peterhead that we will be able to answer the critical question as to whether this technology is scalable and whether it can be applied on the scale that we need to make a significant difference.

**Lord May of Oxford:** My opinion is that it would be very helpful to you and to the industry if it put more emphasis on this point.

**Michael Fallon MP:** It would. There is a Carbon Capture and Storage Association, chaired, I think, by the noble Lord, Lord Oxburgh.

**Lord May of Oxford:** With whom I was just talking.

**Michael Fallon MP:** He is the champion of carbon capture and storage. However, as I say, we are not neglecting it. On the contrary, we are driving it forward in this country, and I think we are only second behind the work that has been done on this in Canada.

**Lord Lawson of Blaby:** If I may come back to the snail's pace, I was very glad to hear that you say that you thought that there might be significant production for shale gas in three years' time but not before, but I am puzzled as to how that can happen in three years' time at the pace you are going. You also said that over these three years only between 20 and 40 exploratory wells will be drilled. If one looks at the American experience, which you quoted on a number of occasions, and one looks at the nature of the beast, it will take many more than 20 to 40 exploratory wells to be drilled before you can have significant production.

**Michael Fallon MP:** I think I actually said that there would not be significant shale production within two to three years, or for at least three years. I am not sure that it will follow exactly three years. It is the industry's estimate that 20 to 40 wells are likely to be drilled over the next two to three years. Of course, at the moment we only have the authoritative study of the northern basin. We have not yet finalised the study that is being done by the British Geological Survey of the southern basin—the Weald Basin—and other studies are being done in both Wales and Scotland. So the most accurate information the industry has at the moment is limited to those northern counties that were covered by the study last July, and to existing information from earlier licensing rounds of where oil reserves in particular are likely to lie outside those areas. We are at the start of this process, but I am confident that in the fullness of time that it will lead to substantial production. But it is impossible to say with any definition that that will definitely occur in year three, year four or year five. It took time in the United States.

**Lord Lawson of Blaby:** But you would like to see considerably more than 40 exploratory wells drilled over the next three years.

**Michael Fallon MP:** Absolutely. This is a huge opportunity. Given the scale of the resource, we need urgently to establish whether it could be transmuted into a reserve. I

shall certainly do everything I can to step up the pace of exploration. Where barriers and hurdles are brought to my attention, with the encouragement of senior colleagues in the Government we go out and tackle them. The fiscal regime we have put in place is now attracting significant international investment from these other companies—we have got that right. However it is, I am afraid—I have to keep saying this—relatively early days. We are just at the very start of this industry, and it is not wholly reasonable to talk of our response being feeble or at a snail's pace when we are only a few months into something that took 10 years in the United States.

**Q267 Lord Shipley:** The British Geological Survey, which you referred to, has a very important role here. You referred to the publication of the Weald report. Can you tell the Committee when that is likely to be published, and then comment on whether you think the process is going quickly enough, or whether the geological survey could work more quickly?

**Michael Fallon MP:** The Weald study is proceeding more rapidly than the study of the larger Bowland-Hodder shale last year because the study area is slightly smaller and structurally less complex. We hope to publish that study before Easter. The Committee might like to know that a study is also being done of what is geologically known as the Midland Valley of Scotland, which I think in real money means the central belt of Scotland. That is at a much earlier stage. They are still collecting information, and I do not have a definite estimate as to when that will be completed. The Welsh Government have separately commissioned the British Geological Survey to look at prospects in Wales, which as I understand it are largely in south Wales, around the coal mining and to some extent up in the north, where north Wales abuts Cheshire.

**Lord Lawson of Blaby:** For completeness, what about the shallow waters offshore, where geologists think there is a lot of potential?

**Michael Fallon MP:** I have not seen any survey and I do not think we are surveying that, but that would come under North Sea or other exploration.

**Duarte Figueira:** We have not planned anything offshore. In general terms, we have previously given evidence to the Committees that the costs of offshore shale development are of an order of magnitude significantly above those onshore. That has generally been the reason why we have not pursued that as a priority.

**The Chairman:** Minister, we have covered a lot of ground, but in conclusion are there any points or comments that you would like to make?

**Michael Fallon MP:** No. I am grateful, Lord Chairman. I have tried to make the points that I wanted to make.

**The Chairman:** We will shortly come to considering our report, so I cannot make any comments today on the direction or substance of what it would be. I thank you very much indeed for giving us your evidence. We have covered all the points we wanted to make, we are very grateful for your responses, and we thank you for the time you have given.

**Michael Fallon MP:** Thank you.

**Duarte Figueira:** Thank you.

Duarte Figueira and Rt Hon Michael Fallon MP —Oral evidence (QQ 251-267)

**Duarte Figueira and Rt Hon Michael Fallon MP —Oral evidence (QQ 251-267)**

Transcript to be found under [Rt Hon Michael Fallon MP and Duarte Figueira—Oral evidence \(QQ 251-267\)](#)

## **Frack Free Balcombe Residents Association—Written evidence**

### **The rational anti-fracking movement of Balcombe**

Some politicians label us 'irrational'. But we in Balcombe have been soberly studying fracking for the past two years, sometimes to the exclusion of our day jobs. We have attended conferences and debates, established links with academics and engineers, corresponded with councils, MPs and government agencies, and sat in on your sessions, wishing we could give our own evidence in person. Our concerns are based on solid research, on peer-reviewed science, on our experience of Cuadrilla operating in our village, and on personal contact with North Americans and Australians whose land and lives have been severely damaged by this industry. We are teachers and academics, plumbers, accountants, joiners, journalists, artists, farmers, engineers, lawyers...

Balcombe village polls have shown over 80% of our community to be against Cuadrilla. The company has no social licence to be in our village.

### **Balcombe – a sacrificial guinea pig**

In mid-January, 2014, Nick Boles (Planning Minister) said at the All Parliamentary Group on Unconventional Gas and Oil: 'Every energy source brings social costs. We have to balance national needs with community needs. Individual communities cannot be allowed a veto.' But no attention is being paid to our needs. We are guinea-pigs in a dangerous experiment being promoted by the government.

### **Balcombe and beyond**

The views we hold here are spreading rapidly across the country. Groups opposed to fracking are springing up and sharing their research. We and community groups from Lancashire are now seeing the rest of Britain waking up and reacting. Every time a new planning application is mooted, or a new licence application is made, a new community protest group emerges.

### **Our environment and health are not for sale**

The Government are now losing the argument. Fracking must be bad if they and the industry need to bribe us! Communities will not accept sweeteners. The potential costs to our health, environment and livelihood are too great.

The money would not go very far in any case. US road-mending statistics show that costs of improving and repairing roads typically exceed any compensation. Arkansas received \$182m compensation from shale gas since 2009 but had to spend \$450m on roads. Pennsylvania received \$1.3billion in 2012 but spent \$7billion. Locals comment that the incentive seemed to suffice, nevertheless, to corrupt the planning process.

### **Why fracking makes no economic sense**

Time is against the fracking industry – and this is the strongest economic argument. Analysts agree that shale gas would not come seriously on tap until the mid-2020s at very earliest - just when we are committed to being well on our way out of fossil fuels. Shale gas and all its new infrastructure will be stranded assets. The claim that greenhouse gas emissions from shale gas and other fossil fuels will be dealt with by carbon capture and storage (CCS) is hollow. Britain has already fallen years behind timetable on CCS and it is unlikely that CCS will ever work safely or at a cost we can afford.

Already there are indications in the US that shale reserves have been overvalued, and that prices do not cover costs. The German newspaper, *Süddeutsche Zeitung*, on January 9th 2014 reported:

‘Investment in shale gas halved in the US in 2013 compared with 2012 (figures from consultants IHS Herold). Oil and gas companies and their investors spent more money on land, equipment and exploration than they earned from sales of gas and oil. Less capital outlay means fewer wells drilled and lower production – and that could spell the end of the era of low energy prices. The bubble will burst. “I wouldn’t be surprised if it burst this year,” says Werner Zittel, chief executive of independent analysts the Ludwig-Bölkow Foundation.’

The US Energy Information Administration (EIA) is no more encouraging where we are concerned: ‘Compared with North America, the shale geology of the UK is considerably more complex, while drilling and completion costs for shale wells are substantially higher... faults are numerous, geologic data control is weak, and shale wells are more costly to drill.’

How much shale gas will cost to extract in the UK is still anyone’s guess. Bloomberg comes up with its own estimate, that UK costs will be 40% to 100% more than in the USA. The International Energy Agency (IEA) and Ernst & Young also predict higher costs than in the USA, and costs that will be higher than those of conventional gas development in Britain. If that is the case, UK shale gas operations could be loss-making. Where will our 1% community cut be then? Gone, along with the taxes the government hopes to raise.

Whatever the production costs, gas prices will not drop this side of the Atlantic for industry and hard-working families. Virtually all the experts are now agreed on this, but the government still repeats this myth. We are part of the European regional gas market, and any local extraction will have minimal impact. When Lord Browne (chair of Cuadrilla, former chair of BP and lead ‘non-executive’ across government) declared in a speech at the LSE in late 2013 that shale gas would not mean lower prices in the UK, the Government story briefly wavered – no, John Redwood explained, prices wouldn’t drop, but the Government would use all those shale gas taxes to subsidise prices (Spectator debate, Dec 2013). Days later, the Prime Minister was back to ‘lower prices’. Does he think our memories are so short?

We should not ignore longer-term costs. Wells once drilled will be there forever. But there is powerful evidence from the USA that around half of all wells will fail or leak within a few years. How long will Cuadrilla’s insurance be valid? Even now, we worry. The latest available accounts show the current net worth of the Cuadrilla subsidiary Cuadrilla Balcombe Ltd to be a negative number, -£401,689 (<http://companycheck.co.uk/company/06811588>).

Meanwhile, job figures have been hyped. A Cuadrilla-sponsored study based on off-shore statistics promised 74,000 jobs, but DECC and Amec later predicted a maximum of 32,000. Most will be specialised, few for locals. Yet government and industry still quote Cuadrilla’s figure.

### **Industrialisation of the British countryside**

The pursuit of gas locked in shale and coal will, as US Energy Secretary Ernest Moniz confirmed in January 2014, ‘result in unavoidable changes to the countryside’. We are threatened with thousands of wells. In the long term, Bloomberg estimate there will be 10,000 wells radiating from 1,000 pads, with 1,000 new wells added per year at peak production. AMEC’s report suggests a possible 2,880 wells on 120 pads. All this will require hundreds of new access roads, many pipe networks, plus compressor stations, dehydrators and power stations.

Oil or gas flow declines sharply in shale wells, possibly by 70% over the first year. New sections of wells must be fracked, or new wells drilled and fracked, to keep up the flow. That spells years of disruption for communities, heavy traffic, growing health and environmental concerns. Jobs will be lost in tourism, small businesses and the hospitality industry, and farming impacted. In Balcombe, within an Area of Outstanding Natural Beauty, Cuadrilla has signed a 30-year lease.

### **The UK's inadequate on-shore regulation**

Our aim is a ban on fracking, nationwide. We have come to believe that adequate regulation is impossible for on-shore shale gas exploration. Our experience in Balcombe has been that government agencies and advisors are inexperienced and naïve. They cannot even provide us with remotely similar definitions of fracking.

The Environment Agency (EA) is increasingly understaffed and underfinanced. It has clearly not made any real attempt to assess the case we made objecting to Cuadrilla's mining waste application for Balcombe. Nearly 900 objections were lodged within the prescribed timeframe. Yet only three days after the final date for submission the EA issued a permit.

Last summer, Cuadrilla were allowed to self-monitor, self-report, and self-regulate. We know of only one inspection visit by the EA that was not made at our request. Cuadrilla were permitted simply to monitor their own operations, and to send an email to the relevant authorities each Friday afternoon to assure them that all was well. That seriously undermines the government's repeated claim that our UK environmental regulation is 'robust'. The Chartered Institution of Water and Environmental Management (CIWEM, Jan 2014) has issued its own warning. 'It is important that the public are reassured that this regulation is fit for purpose and that transparency is displayed on all levels in order to establish trust. There appears to be scope for improvement on these fronts at the present time. Whilst a profitable shale gas industry may be attractive to the Treasury, this must not be achieved via light touch regulation at the expense of critical environmental resources.'

The government is now caught in a conflict between its reassurances about what it claims is a 'robust regulatory regime' and its promise to industry of 'clear, streamlined regulations'. To us, 'streamlined' carries the implication that dissenting voices will be ignored and that evidence pointing to dangers of grave environmental damage will be sidelined. Years of legislation protecting peoples' health and environmental safety will also be sidelined. Such weak regulation will have little or no chance of preventing the kind of well-documented accidents, toxic spills and water pollution that have blighted homes and farms in numerous American states. UK ministers, when asked about such pollution, have relied on bland and blanket reassurances from senior US officials. America's notoriously weak and pliant Environment Protection Agency has already suspended its own investigations into water pollution attributed to shale gas development in three states, to the reported dismay of some of its own staff.

### **Cuadrilla's poor performance**

In Lancashire, because of inadequate seismic testing, Cuadrilla fracked into a fault near Preese Hall, and caused earthquakes that damaged their well casing over several hundred feet. Damaged well casings are the main conduit for contaminants from oil and gas wells. Yet they continued to frack this well, and they informed the authorities only six months later. At their Anna's Road site they flagrantly continued drilling two weeks beyond the permit period, despite the arrival of protected overwintering birds.

In Balcombe, Cuadrilla failed to apply for permits for mining waste and naturally occurring radioactive materials. During drilling, they exceeded noise limits, disturbing our sleep. We had to buy our own sound testing equipment before they admitted infringing the limits. Villagers were plagued by heavy traffic, sometimes outside agreed hours. Cuadrilla lorries passed the school at drop-off/pick-up times, sometimes faster than agreed, sometimes with no labels to show if their contents were toxic.

Base line testing of air and water has been shown to be vital in North America and Australia, when it comes to proving cases of pollution. As a community, we looked into doing our own, but quickly discovered this would be extremely expensive. Cuadrilla sub-contracted testing to Ground Gas Solutions. We question whether their air and water testing has been at adequate distances in time and space, and whether they tested for the right chemicals. We know that Cuadrilla accidentally removed upwind air sampling stations when they took down fencing. Another set of air sampling devices, also within the compound, were tampered with at the pre drilling-stage. Of five surface water monitoring points, only the two furthest from the site had results for the post-drilling report. So we believe the quality of Cuadrilla's baseline information is poor, and both they and their sub-contractors have been reluctant to share it with us.  
<http://www.cuadrillaresources.com/wp-content/uploads/2013/11/Drill-Phase.pdf>.

Neither Cuadrilla nor West Sussex County Council appear to have plans for dealing with accidents and emergencies, other than calling the ordinary emergency services. Emergency plans do not feature in planning applications.

Cuadrilla's engagement with our community has been lamentable – there was indeed no communication for the first 18 months until we invited them to a public meeting. When trying to raise issues with them we are directed to a public relations company, and it can take two weeks to receive what is usually an inadequate reply.

### **Unhealthy relationships, misinformation**

Two years ago, many of us in Balcombe were politically naïve. Now we have been made aware of the power of oil and gas industry money to influence the democratic process. Our concerns include the funding of all party parliamentary groups at Westminster, industry funding for research projects (including a study released by the Institute of Directors) and conflicts of interest within government departments, where industry or ex-industry executives are advisors.

We have learned that planning staff at West Sussex County Council have been trained by industry members in how to process planning applications. Our parish council has held what we see as cosy meetings with Cuadrilla. Responses to our concerns from council officials, ministers, and the Prime Minister's office have usually been dismissive. We feel unrepresented.

### **High volume hydraulic fracturing is new**

This kind of fracking is new. Conventional, vertical wells have been low-volume-fracked since the 40s. High-volume fracking in long, horizontal wells was developed in the USA little more than a decade ago.

Modern fracking has happened only once in the UK. The Department of Energy and Climate Change (DECC) confirmed this in an email to Balcombe residents on August 20th, 2013: 'Cuadrilla is the only operator in the UK to so far use high volume hydraulic fracturing – this technique was used on the Preese Hall well in Lancashire in 2011. DECC has not at this stage

received any applications from other operators to carry out hydraulic fracturing for shale gas onshore in the UK and therefore no such consents have been issued.'

For engineer and fracking expert Mike Hill, comparing old fracking to modern fracking is like comparing a corner shop to a hypermarket. It's a question of scale – modern fracking uses higher pressures, more water, more chemicals. Yet the 'fact' that fracking has been going on since the 1940s has been used by government and industry in an attempt to sooth and silence opposition.

### **Fugitive methane could make shale gas worse than coal**

Peer-reviewed scientific papers published recently in the USA provide powerful evidence of extremely high levels of methane emissions in the air around gas sites. Principal amongst them is a study from the University of Harvard in collaboration with four other top academic bodies and a federal agency, the US National Oceanic and Atmospheric Administration. Further studies from Austin, Texas, Colorado and Cornell University put losses to the atmosphere from venting and leaks at up to 8% of all the shale gas they get out of the rocks.

<http://link.springer.com/article/10.1007/s10584-011-0061-5#page-2>

Levels this high would undermine any claims that shale gas could result in lower greenhouse gas emissions if gas were to replace coal. (There is no guarantee than gas will be used instead of rather than as well as coal.) Burning methane produces less CO<sub>2</sub> than coal, but methane escaping unburnt to the atmosphere is 86 times more potent a greenhouse gas than carbon dioxide over a 20 year time scale, and about 35 times more potent even over 100 years, according to latest figures from the Intergovernmental Panel on Climate Change (IPCC).

Such evidence threatens the main justification for shale gas development, namely that it is a useful 'transitional' fuel that can quickly lower greenhouse gas emissions in the short to medium term, while investment takes place to build up low carbon generation from renewables. The growing US evidence on fugitive methane emissions was completely ignored in a recent paper on shale gas and the greenhouse effect, co-authored by the DECC chief scientific advisor.

### **Fracking waste – why it is 'nasty stuff'**

We in Balcombe are opposed to any drilling, testing and oil or gas extraction, conventional or unconventional, so close to our village. In Australia, legislation now prohibits oil or gas wells closer than 2km from houses and schools. The Balcombe school is 1.5km from Cuadrilla's well, while some houses are 600m downwind. Drilling muds, vented methane and air-borne pollution from the flare are all concerns for local health and environment, even before we get to fracking. Lord Lipsey asked a recent community panel of witnesses from Lancashire at the EAC to say why fracking fluid should be regarded as 'nasty stuff'. This is our answer.

Oil and gas companies in the USA have opposed public disclosure of the chemicals used in hydraulic fracturing. But according to American environmental investigators and a US House of Representatives Document (April 2011), well over 600 chemicals have so far been used in fracking fluid across more than a dozen states, including lubricants and biocides. The most widely used chemical is methanol (a hazardous air pollutant), along with isopropyl alcohol, 2-butoxyethanol and ethylene glycol, benzene, toluene, xylene and ethyl benzene. All of these are hazardous air and drinking water pollutants. Benzene is a known human carcinogen. Carcinogens in frack fluid also include naphthalene, formaldehyde, sulphuric acid, thiourea, benzyl chloride, acrylamide, acetaldehyde, ethylene oxide, lead compounds and propylene oxide. Many chemicals that have been used are proprietary and 'trade secret chemicals', making assessment of their health impact difficult. Two such were rejected by the EA from Cuadrilla's list of chemicals



destined for use at the Balcombe site. The EA told us Cuadrilla could not explain what was in them. In the impending Balcombe ‘test flow’, Cuadrilla intend to use, amongst other chemicals, 9.99% solution of hydrochloric acid. Originally they wanted to use a 15% solution, until the EA told them anything over 10% will be considered toxic.

Around half the fracking fluid comes back up to the surface through the well. More fluid (or gas) can emerge elsewhere at unpredictable times and locations, posing serious health risks to farm animals, to humans, and to drinking water supplies, streams and rivers. Balcombe’s well is particularly shallow at 823 metres, compared to the ‘depths greater than 1500m’ from which the British Geological Survey (BGS) claims ‘mobilisation of solutes and methane is unlikely’.

Emeritus Professor of Geophysics at Glasgow University, David Smythe, questions the BGS, and is very concerned about rock faults acting as conduits to take such hazardous material back up to our immediate environment. He writes: ‘A leaky fault is a fast-track back to shallow groundwater and to the surface for methane and other gases, as well as (perhaps) for the contamination of water resources by fracking chemicals. Juxtaposed against this, the question of earthquake triggering is but a sideshow. In France fracking has been banned partly because of this risk, which was pointed out in 2011 by [geologists from the University of Montpellier](#).’

With the fracking fluid comes NORM – naturally occurring radioactive material - and other noxious substances from thousands of feet below the earth’s surface. The Amec report predicts that the UK will have to find a way to dispose of up to 108 billion litres of toxic waste fluid for fracking operations. Currently there is no safe way of treating and disposing of this material, and it is deemed to be nasty enough that there is no waste facility in Britain equipped to treat it. This is a serious gap in the British Government’s environmental planning.

In the USA, fracking waste fluid is often held in open lagoons (currently illegal in Britain). In America it has also been sprayed onto fields by drought-stricken farmers, or onto roads as anti-freeze. Much of it is ‘re injected’ – that is to say disposed of down old mines and wells, where it can cause earthquakes by stressing and lubricating existing faults. It has also been discharged into the sea or into waterways, sometimes after minimal treatment. Recent reports have revealed ‘elevated levels of radio-activity, salts and metals’ downstream from US water treatment plants that have dealt with the flowback from fracking operations. According to Avner Vengosh, Professor of Geochemistry and Water Quality at the Nicholas School of the Environment, at Duke University, ‘Years of disposal of oil and gas wastewater with high radioactivity has created potential environmental risks for thousands of years to come.’

*January 2014*

## **Friends of the Earth England, Wales and Northern Ireland, Greenpeace UK and World Wildlife Fund (WWF-UK)—Written evidence**

### **Summary**

1. This joint response from WWF-UK, Greenpeace UK and Friends of the Earth England, Wales and Northern Ireland focuses on UK shale gas.
2. While there might be some sizeable reserves of shale gas in the UK, evidence suggests that it is highly unlikely that these reserves could be available fast enough, cheaply enough and in enough volume to offset the price-setting role of imported gas in the UK. Given the very distinct circumstances applicable in the UK compared to the US and the fact that the UK is an integral part of the European gas market, it is highly unlikely that a UK shale gas boom could significantly reduce the price of gas in the UK, let alone offset the UK's increased dependency on gas imports (see questions 1, 2 and 4).
3. Even in the event of substantial exploratory drilling going ahead, it will not be possible for a number of years to know the size, if any, of the UK's economically extractable shale gas reserve. However, highly optimistic claims on the future potential of shale gas create the risk of incentivising the construction of an excessive reliance on new gas infrastructure in the UK. This would cement even further the UK's dependence on imports of gas, would increase its vulnerability to the international gas price and would result in the UK being locked into a gas heavy system that is incompatible with its goal of reducing its emissions of greenhouse gases by at least 80% by 2050 in the Climate Change Act 2008.
4. Thus, it is important on economic, energy security and environmental grounds that the prospect of future gas extraction in the UK does not lead to policies encouraging an increase in gas usage in the power or other sectors. It would be similar to an argument that enhanced extraction of North Sea oil should affect policy on consumption of petrol and diesel (see question 9).
5. The UK is not faced with a false choice between burning lots of coal – as it is currently doing given the low prices of both coal and carbon - or burning lots of shale gas instead to meet its energy needs. As clearly demonstrated in recent evidence from the Committee on Climate Change<sup>65</sup> and major institutions such as the International Energy Agency<sup>66</sup>, the World Bank<sup>67</sup> and the United Nations Environment Programme<sup>68</sup>, the answer to the long-term decarbonisation, affordability and energy security challenges faced by countries like the UK is to make

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<sup>65</sup> *Next Steps on Electricity Market Reform*, the Committee on Climate Change, 23 May 2012:

<http://www.theccc.org.uk/publication/next-steps-on-electricity-market-reform-23-may-2013>

<sup>66</sup> *World Energy Outlook 2012*, the International Energy Agency, November 2012:

<http://iea.org/publications/freepublications/publication/English.pdf>

<sup>67</sup> *Turn Down the Heat: Why a Warmer 4°C World Must Be Avoided*, the World Bank, November 2012:

[http://climatechange.worldbank.org/sites/default/files/Turn\\_Down\\_the\\_heat\\_Why\\_a\\_4\\_degree\\_centrigrade\\_warmer\\_world\\_must\\_be\\_avoided.pdf](http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf)

<sup>68</sup> *The Emissions Gap Report 2012*, United Nations Environment Programme, November 2012:

<http://www.unep.org/publications/ebooks/emissionsgap2012/>

an early and decisive move towards an efficient and low-carbon energy system. This would significantly reduce the UK's demand for gas (and other fossil fuels) in the next twenty years (see questions 8 and 9).

6. A recent report from Cambridge Econometrics showed, for example, that compared to a dash for gas generation, policies enabling a continued deployment of offshore wind farms in the UK to 2030 would increase UK GDP by £20bn/ year by 2030, create 70,000 more jobs by then, reduce gas imports by some £8bn/ year and produce emissions in the power sector that would be three times lower, with only minimum impact on UK electricity prices. Importantly, these conclusions remain valid under a wide range of assumptions on the future price of gas and the economic benefits remain the same with or without UK shale gas exploration<sup>69</sup>.
7. To put the UK on such a path, UK energy policy should be strengthened through the adoption of a commitment to decarbonise the UK's power sector in the Energy Bill currently going through the House of Lords and by the Government's clear endorsement of the Fourth Carbon Budget recommendations from the Committee on Climate Change during the review expected in spring 2014.
8. Further, the recent *Redrawing the Climate and Energy Map* report from the International Energy Agency suggests that meeting the internationally agreed limit of 2 degrees centigrade of warming would mean that just under half of all 'currently proven gas reserves' (i.e. discovered volumes having a 90% probability that they can be extracted profitably) must go unexploited by 2050<sup>70</sup>. The IEA, Ernst and Young<sup>71</sup> and Bloomberg<sup>72</sup> have forecast that UK/EU shale gas production will be relatively expensive (by comparison to conventional extraction and US shale gas). This means that encouraging a "new shale gas revolution" in the UK could either contribute towards the world burning more gas than is compatible with tackling dangerous levels of climate change or result in there being simply no market for UK shale gas. Thus, there is a significant risk that UK shale gas extraction could lead to stranded assets (see questions 6, 8 and 9).

## Introduction

1. This submission is made on behalf of WWF-UK, Greenpeace UK and Friends of the Earth England, Wales and Northern Ireland. In line with the latest scientific findings of the Intergovernmental Panel on Climate Change<sup>73</sup>, our organisations are strongly committed to helping prevent the worst environmental, societal and economic impacts of climate change and in particular preventing global average temperatures from rising above 2°C compared to pre-industrial levels.

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<sup>69</sup> A study into the Economics of Gas and Offshore Wind, Cambridge Econometrics, November 2012:

[http://www.wwf.org.uk/wwf\\_articles.cfm?unewsid=6342](http://www.wwf.org.uk/wwf_articles.cfm?unewsid=6342)

<sup>70</sup> *Redrawing the Climate and Energy Map*, International Energy Agency, June 2013, page 98-99 & figure 3.5:

<http://www.worldenergyoutlook.org/media/weowebsite/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf>

<sup>71</sup> [http://www.shalegas-europe.eu/en/docs/E&Y\\_Shale-gas-in-Europe\\_revolution-or-evolution.pdf](http://www.shalegas-europe.eu/en/docs/E&Y_Shale-gas-in-Europe_revolution-or-evolution.pdf)

<sup>72</sup> "Is UK Shale Gas all it's fracked up to be?", Bloomberg New Energy Finance, 7 February 2013.

<sup>73</sup> *Fifth Assessment Report - Summary for Policy Makers*, Intergovernmental Panel on Climate Change, 27 September 2013: [http://www.climatechange2013.org/images/uploads/WGIAR5-SPM\\_Approved27Sep2013.pdf](http://www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf)

2. We believe that an increased deployment of renewable energy technologies<sup>74</sup> coupled with a greater focus on improving energy efficiency and increasing the UK's interconnection with European grids and other demand management/response techniques are the most viable options to deliver a successful and cost-effective decarbonisation of the UK's and the EU's power sector by 2030, with gas playing a limited role as a transitional and system balancing fuel.

3. This is supported by a substantial body of analysis showing that renewable energy, energy efficiency and greater regional interconnection can form the bedrock of the decarbonisation of the EU and the UK's power sectors. This includes Poyry's work for the Committee on Climate Change's *Renewable Energy Review*<sup>75</sup>, research from DECC, the Crown Estate and industry supporting the UK's *Offshore Valuation Report*<sup>76</sup>, research from Imperial College and Kema supporting the European Climate Foundation's *Roadmap 2050* report<sup>77</sup>, research from Garrad Hassan underlying WWF-UK's *Positive Energy* report<sup>78</sup> and recent cross-industry research supporting Carbon Connect's *Power from Renewables* report<sup>79</sup>.

4. We are strongly of the view that rapidly decarbonising the UK's energy system makes economic as well as environmental sense. A recent report from Cambridge Econometrics showed for example that compared to another dash for gas generation, policies enabling a continued deployment of offshore wind farms in the UK over the next 20 years would increase UK GDP by £20bn/ year by 2030, create 70,000 more jobs by then, reduce gas imports by some £8bn/ year and produce emissions in the power sector that would be 3 times lower, with only minimum impact on UK electricity prices. Importantly, these conclusions remain valid under a wide range of assumptions on the future price of gas and the economic benefits remain the same with or without UK shale gas exploration<sup>80</sup>.

### **Question 1: How much scope is there for shale gas and oil – from domestic and overseas sources – to be used in the UK? Over what timeframe?**

5. The question of how much shale gas can be made available for the UK market depends on the following critical questions: (i) how much shale gas is there in the UK; (ii) what is the realistic flow of production for UK shale gas; (iii) how much gas can be used going forwards in the UK given its legally binding commitments in other areas such as those under the Climate Change Act 2008; (iv) how much gas will be used globally if international action to tackle climate change reaches agreed ambition; and (v) over what timeframe?

(i) *How much shale gas is there in the UK?*

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<sup>74</sup> We would urge the Committee to review the conclusions of the Crown Estate Offshore Wind Cost Reduction project, released on 13 June 2012  
<http://www.thecrownestate.co.uk/media/305094/Offshore%20wind%20cost%20reduction%20pathways%20study.pdf>

<sup>75</sup> *Renewable Energy Review*, Committee on Climate Change, May 2011: <http://www.theccc.org.uk/reports/renewable-energy-review>

<sup>76</sup> *The Offshore Valuation Report*, DECC / Crown Estate / Industry, July 2010: [www.offshorevaluation.org](http://www.offshorevaluation.org)

<sup>77</sup> *Roadmap 2050*, European Climate Foundation, September 2010: <http://www.roadmap2050.eu/>. See also the *Power Perspectives 2030* report, November 2011: <http://www.roadmap2050.eu/project/power-perspective-2030>

<sup>78</sup> *Positive Energy: How renewable electricity could transform the UK by 2030*, WWF-UK, October 2011:

[www.wwf.org.uk/positiveenergy](http://www.wwf.org.uk/positiveenergy). The underlying technical analysis carried out by Garrad Hassan is also available on the same page.

<sup>79</sup> *Power From Renewables*, Carbon Connect, September 2013: <http://www.policyconnect.org.uk/cc/research/report-future-electricity-series-part-2-power-renewables>

<sup>80</sup> *A study into the Economics of Gas and Offshore Wind*, Cambridge Econometrics, November 2012: [http://www.wwf.org.uk/wwf\\_articles.cfm?newsid=6342](http://www.wwf.org.uk/wwf_articles.cfm?newsid=6342)

6. The recent British Geological Survey (BGS) report estimated that the Bowland shale in Lancashire and Yorkshire may contain 1300 trillion cubic feet (tcf) of gas. The BGS stressed that this is a highly uncertain estimate and also included high and low estimates at 2281 tcf and 822 tcf respectively. It stressed that these numbers are not indicators of the volume of gas likely to be extracted, which will depend on economic, technological and environmental factors. The estimate often used for the percentage of gas which can actually be recovered is 10%, although actual recovery figures appear to be more like 6.5%<sup>81</sup>. If 10% of the 1300tcf of gas were extracted, then this would be equivalent to about 41 years of UK current gas consumption. However a study by the US Environmental Information Agency<sup>82</sup> (EIA) concluded that once risks are factored in only around 4% of the UK's resource was likely to be technically recoverable.

7. The Bowland shale has an upper and lower layer. There is some evidence that the upper layer resembles some North American shales such as the Barnett. The lower layer, in which the majority of the gas can be found (1065tcf of the 1300tcf estimated to be present), is less well understood and estimates of gas in place in the lower layer have a far higher degree of uncertainty<sup>83</sup>.

(ii) *What is the realistic flow of production for UK shale gas?*

8. While the BGS has recently revised upwards its estimate of shale gas reserves in the UK, evidence suggests that it is unlikely that the UK will witness similar rates of production and downward impacts of gas prices (see response to question 2) than those observed in the United States.

9. Analysis provided in a recent report from Bloomberg New Energy Finance found for instance that “UK shale gas will not be available fast enough, cheaply enough or in enough volume to take over the price-setting role from imported gas”<sup>84</sup>. This is in part due to a set of circumstances that are very different to those in the United States, in terms of geology, property rights (with UK landowners not having the right to mineral resources under their land), the lack of midstream infrastructure (such as gathering pipes transporting raw gas to processing facilities) and the lack of an onshore drilling services market.

10. Based on analysis comparing production flow rates from comparable shale gas basins in the United States, the report concluded that “UK shale gas production would need to rise to 4.0-4.5Bcfd to offset declines from the UK continental shelf and eliminate the need for imports. Even if test fracking demonstrates high flow rates, this would require around 50 rigs drilling almost 1,000 wells in the English countryside each year at the peak of activity.” Given the higher population density in the UK and the wave of recent protests at shale gas exploration sites, shale gas developments of that scale seem unlikely to happen.

(iii) *How much gas is compatible with the UK's other legally binding obligations?*

11. The UK has a legally binding obligation under the Climate Change Act to reduce greenhouse gas emissions by at least 80% on 1990 levels by 2050. The Committee on Climate Change provides advice on how to achieve this goal including recommendations on interim milestones, one of which is that the UK power sector should be largely

<sup>81</sup> [http://www.foeeurope.org/sites/default/files/publications/foee\\_unconventional\\_unfounded\\_may2013\\_1.pdf](http://www.foeeurope.org/sites/default/files/publications/foee_unconventional_unfounded_may2013_1.pdf)

<sup>82</sup> <http://www.eia.gov/analysis/studies/worldshalegas/>

<sup>83</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/209021/BGS\\_DECC\\_BowlandShaleGasReport\\_MAIN\\_REPORT.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209021/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf)

<sup>84</sup> Bloomberg New Energy Finance, 7 February 2013, “Is UK Shale Gas all it's fracked up to be?”

decarbonised by 2030. The level of decarbonisation which the Committee has recommended is 50gCO<sub>2</sub>/kWh by this date. Whilst this leaves some space for unabated gas-fired generation in the electricity mix, any use of unabated gas in the power sector would have to be limited by 2030 to providing flexibility as opposed to baseload power. A statement from the CCC's David Kennedy made this very clear: "*the role for unabated gas fired power generation should be limited to balancing the system in 2030, by which time the share of unabated gas generation in the total should be no more than 10%, compared to 40% today*"<sup>85</sup>.

12. The picture is the same with respect to heat, where gas provided 80% of the UK's heating needs in 2011. The Government's own Carbon Plan published in 2011 and advice from the Committee on Climate Change on the carbon budgets clearly state that emissions from buildings need to be reduced to almost zero by 2050, while industry must reduce their emissions by up to 70% over the same period. Much of this reduction will come from replacing fossil fuels, including gas, with low carbon heat supplies alongside the decarbonisation of the power sector. By 2030, 34% of heat demand from domestic properties and 74% from non-residential buildings will need to be met by low carbon heat<sup>86</sup> via the electrification of heat and the deployment of district heating schemes. Industry will also rely heavily on the decarbonisation of the power sector, as it replaces gas as the largest supplier of industrial energy demand by 2030<sup>87</sup>.

13. Planning a major expansion of unconstrained gas infrastructure (such as through the construction of a large fleet of new gas power stations envisaged in some scenarios contained in the Government's Gas Strategy and EMR Delivery Plan) fuelled by hopes of high rates of domestic shale gas production would therefore be incompatible with the UK's legally binding obligations under the Climate Change Act (see question 9 for more details). If one assumes that the UK Government takes these obligations seriously, the market for shale gas is therefore limited going forwards and a dash for gas-dependent infrastructure could therefore lead to a risk of stranded assets.

*(iv) How much gas will be used globally if international action to tackle climate change reaches agreed ambition?*

14. Assuming the world takes action to tackle climate change, this means UK shale gas will come on stream just as the [IEA predicts](#)<sup>88</sup> that the world's already proven supplies of gas will begin to push down prices (over 60% of proven supplies go unused by 2035). Indeed, the IEA predicts that gas use for the power sector will have peaked world-wide before 2030.

15. The IEA has published [new EU gas price forecasts](#)<sup>89</sup> assuming global action to tackle climate change. These suggest wholesale gas prices may be below the UK cost of shale gas extraction as forecast by Ernst and Young, leaving shale gas assets in the UK either stranded

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<sup>85</sup> Committee on Climate Change, Letter from David Kennedy, 24 May 2012, <http://www.theccc.org.uk/news/latest-news/1186-unabated-gas-fired-generation-24-may-2012>

<sup>86</sup> Committee on Climate Change, The Fourth Carbon Budget, December 2010, [http://archive.theccc.org.uk/aws2/4th%20Budget/CCC-4th-Budget-Book\\_interactive\\_singles.pdf](http://archive.theccc.org.uk/aws2/4th%20Budget/CCC-4th-Budget-Book_interactive_singles.pdf)

<sup>87</sup> DECC, 2012, The future of heating, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48574/4805-future-heating-strategic-framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf)

<sup>88</sup> <http://www.worldenergyoutlook.org/media/weowebiste/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf>

<sup>89</sup> <http://www.worldenergyoutlook.org/media/weowebiste/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf> Table I.1, p. 40

or in need of financial support (the IEA predicts prices of 63p/therm by 2035 below the top end of EY's range at 78p/therm).

16. **Navigant, in its report for DECC**<sup>90</sup>, which does not assume a 2 degrees pathway, forecast gas prices remaining at their current levels through to 2030, or rising if global unconventional gas extraction fails to deliver. In either scenario, shale gas extraction in the UK may struggle economically.

17. As the IEA warns, “countries vulnerability to this risk [of stranded assets] may be greater if their asset base is more heavily weighted towards [fields] that are not yet developed and towards those that have the highest marginal production cost”. UK shale fits both of those criteria.

18. In short, allowing unchecked shale gas exploration could leave the UK economy over-dependent on fossil fuel extraction and over-exposed to the economic impacts on the fossil fuel industry of global action to tackle climate change. The situation in Poland, where an industry has already moved into reverse simply because Polish gas is not economic at current prices is a warning of the economic risk of UK shale.

(v) *Over what timeframe?*

19. There are considerable uncertainties over the speed of development of any shale gas industry in the UK. A report by Poyry for Cuadrilla<sup>91</sup> indicated a scenario where gas starts to flow significantly in early/mid 2020s, peaks in 2030 and declines thereafter. This indicates that shale gas offers no short-term fix to any perceived energy security problem. Indeed, it rather suggests that UK shale gas production would be peaking just as the UK would have made significant improvement in energy efficiency in buildings and is likely to substantially decarbonise the power sector.

## **Question 2: How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

### *Projected breakeven price of UK shale gas*

20. Despite the BGS' upwards revisions of potential UK shale gas reserves, it is highly unlikely that the breakeven price for shale gas production in the UK and the rest of EU will be anywhere near as low as what has been observed of late in the United States.

21. At the EU level, the International Energy Agency (IEA) published the indicative costs of shale gas developments in Europe and suggested that the costs will be up to three times higher per unit of gas than in the US and similar to those of conventional gas<sup>92</sup>. This was followed by analysis from Deutsche Bank in early 2013, which argued that the “development of shale-gas resources in Europe, the Middle East and Africa are considerably more expensive” and that “given current estimates, it appears to be a far stretch to expect that shale-gas production could bring about an equalisation of global gas prices towards the US level.”<sup>93</sup>

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<sup>90</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/223492/navigant\\_consulting\\_report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223492/navigant_consulting_report.pdf)

<sup>91</sup> [http://www.poyry.com/sites/default/files/imce/files/shale\\_gas\\_point\\_of\\_view\\_small.pdf](http://www.poyry.com/sites/default/files/imce/files/shale_gas_point_of_view_small.pdf)

<sup>92</sup> IEA, 2012, “Golden rules for a Golden Age of Gas”, <http://www.worldenergyoutlook.org/goldenrules/>

<sup>93</sup> Deutsche Bank, 25 January 2013, “European Gas: The Changing Landscape for Shale Gas”, <http://www.commodities-now.com/reports/power-and-energy/13677-the-changing-landscape-for-shale-gas.html>

22. Given the different set of circumstances applying to shale gas extraction in the United States and the UK (see answer to question 1 for more detail), Bloomberg New Energy Finance “estimate the cost of shale gas extraction in the UK – including allowance for the cost of capital – at between \$7 and \$12/MMBtu, against comparable costs for (dry) US plays of \$5-6/MMBtu.”<sup>94</sup> Importantly, the predicted range for UK shale gas prices “is close to the \$8-11/MMBtu range in which spot UK gas prices have traded over the past two years” at a time where UK gas prices and energy bills have been particularly high.

23. It is important to note here that one of the additional reasons why expected UK shale gas prices are significantly above some of the lowest prices observed in the US (which has seen gas prices fluctuating between \$1.80 and \$3.50/MMBtu during the course of 2012) is that UK shale gas is unlikely to be extracted as a by-product of shale oil as it has been in several locations in the United States<sup>95</sup>.

*A note of caution on US gas prices*

24. When comparing the gas price in the UK to that in the US, the Committee should note that the low prices in the US – which fell to lows of \$1.80/MMBtu during parts of 2012 (compared to an EU price fluctuating between \$8 and \$12/MMBtu) – are unlikely to continue for a long period of time going forwards as they are particularly uneconomic for shale gas operators, as well demonstrated in an intervention in 2012 from the Chief Executive of Exxon Mobile<sup>96</sup>. In fact, the price of gas in the US has increased markedly in 2012 and was at around \$3.40 in early 2013. As observed by Bloomberg, there are various reasons why operators have been forced to continue to produce shale gas at times of very low gas prices, including the existence of ‘Held By Production’ leases, which result in operators losing their lease if they stop drilling. Half of the drilling activity of one major US driller, Chesapeake, was reportedly simply to keep their licences alive and keep valuable assets on the balance sheet<sup>97</sup>.

*Costs on the local environment*

25. In addition to our main concern relating to greenhouse gas emissions and climate change set out in answer to question 8, evidence available to date suggests that the most significant local environmental risks linked to shale gas production are the following:

- *Surface and groundwater contamination:* according to an EC study<sup>98</sup>, there is a high risk of surface and groundwater contamination at various stages of the well construction, hydraulic fracturing and gas production processes, and after well abandonment. Academic studies have suggested that the issue of well integrity, meaning the effective sealing of the well from the surrounding environment, which may include groundwater zones, is of significant concern. Studies have shown that well integrity issues may affect around 5% or more of wells drilled<sup>99</sup>. Poor well design

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<sup>94</sup> Bloomberg New Energy Finance, 7 February 2013, “Is UK Shale Gas all it’s fracked up to be?”

<sup>95</sup> Professor Paul Ekins, University College London, UKERC Current Event Blogs, “The Fracking Battle: No way to conduct energy policy”, August 2013: <http://ukerc.wordpress.com/>

<sup>96</sup> Exxon CEO: ‘Losing our shirts’ on natural gas price <http://www.marketwatch.com/story/exxon-ceo-losing-our-shirts-on-natural-gas-price-2012-06-27>

<sup>97</sup> Club de Nice 5 décembre 2012 « Point de vue d’un géologue pétrolier »

Jean Laherrère président ASPO France [http://aspofrance.viabloga.com/files/JL\\_2012\\_NICE-gazrochemere.pdf](http://aspofrance.viabloga.com/files/JL_2012_NICE-gazrochemere.pdf)

<sup>98</sup> EC study on shale gas environmental impacts

<http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf>

<sup>99</sup> Watson and Bachu. Evaluation of the Potential for Gas and CO<sub>2</sub> Leakage Along Wellbores. *SPE Drilling and Completion*, March 2009. Society of Petroleum Engineers.



or construction can lead to subsurface groundwater contamination arising from aquifer penetration by the well, the flow of fluids into, or from rock formations, or the migration of combustible natural gas to water supplies.

During the drilling stage, contamination can arise as a result of ineffective site management, well blowout or component failure. Further, runoff and erosion during early site construction, particularly from storm water, may lead to silt accumulation in surface waters and contaminants entering water bodies, streams and groundwater. This is a problem common to all large-scale mining and extraction activities. However, unconventional gas extraction carries a higher risk because it requires high-volume processes per installation and the risks increase with multiple installations.

- *Freshwater availability:* According to the IEA, “in areas of water scarcity, the extraction of water for drilling and hydraulic fracturing . . . . .can have broad and serious environmental effects. It can lower the water table, affect biodiversity and harm the local ecosystem. It can also reduce the availability of water for use by local communities and . . . . .in agriculture”<sup>100</sup>, an issue that should be considered seriously in those regions of the UK such as the South-East that can be prone to periods of water scarcity.
- There are also concerns around disposal of flow back fluids<sup>101</sup> and air pollution.<sup>102</sup>

#### **Question 4: What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generations including coal, nuclear and renewables?**

##### *Impact of shale gas on the cost of gas-fired electricity*

26. There is significant uncertainty on the future impact of shale gas on the cost of electricity generated by gas plants. However, the evidence published to date on the projected breakeven price for UK shale gas (see response to question 2) suggests that UK shale gas production will only have a limited impact on reducing the future price of gas in the UK or no such impact at all. Indeed, the Energy Secretary has admitted as much, saying “we can’t expect UK shale production alone to have any effect [on UK gas prices]”<sup>103</sup>

27. Most forecasts agree that the EU breakeven price for shale gas will be higher than in the US and that there are considerable question marks as to whether gas prices will be lower with domestic shale gas production than they would have otherwise been, an issue that came out clearly in a recent interview with Lord Nicholas Stern<sup>104</sup>. A key issue that is often forgotten when some commentators argue that the price of gas would fall dramatically in the UK with strong domestic shale gas production is that the UK gas market is an integral part of the wider European gas market. It is therefore the overall balance of demand and supply of gas in the European market as a whole which will ultimately set the price of gas.

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<sup>100</sup> IEA, Golden rules for a Golden Age of Gas, 2012

<sup>101</sup> <http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf> p56

<sup>102</sup> <http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf>

<sup>103</sup> <https://www.gov.uk/government/speeches/the-myths-and-realities-of-shale-gas-exploration>

<sup>104</sup> The Independent, 4 September 2013, “Baseless Economics: Lord Stern on the claims that UK fracking boom can bring down the cost of gas”: <http://www.independent.co.uk/news/uk/politics/baseless-economics-lord-stern-on-david-camerons-claims-that-a-uk-fracking-boom-can-bring-down-price-of-gas-8796758.html>

28. Even under scenarios with ambitious shale gas production in the EU, in the absence of demand constraints such as vigorous carbon emissions abatement, gas prices across the EU are forecast to rise to 2035. The IEA projects a slightly increasing gas price in the EU out to 2035 under optimistic assumptions about the future supply of shale gas in the EU, with higher gas price increases being forecast under less optimistic assumptions about shale gas production<sup>105 106</sup>. DECC's central gas price scenario for the UK is similar to the IEA's optimistic case, whilst its high scenario assumes future gas prices that are above the IEA's less optimistic case. This is of course against the backdrop that future gas forecasts can never be relied upon and that failing to reduce the UK's overall reliance on gas on the assumption that gas prices will be low is a highly risky strategy.

*The economic case for rapidly decarbonising the UK power sector is strong with or without shale gas*

**29. Importantly and regardless of where the UK may get its gas from to meet future demand, the economic case for rapidly decarbonising the power sector remains a strong one.** A recent report from Cambridge Econometrics showed for example that compared to another dash for gas generation, policies enabling a continued deployment of offshore wind farms in the UK over the next 20 years would increase UK GDP by £20bn/ year by 2030, create 70,000 more jobs by then, reduce gas imports by some £8bn/ year and produce emissions in the power sector that would be 3 times lower, with only minimum impact on UK electricity prices (in the order of 1% by 2030). Importantly, these conclusions remain valid under a wide range of assumptions on the future price of gas and the economic benefits remain the same with or without UK shale gas exploration<sup>107</sup>.

30. This conclusion was supported by recent analysis from the Committee on Climate Change **on the UK's electricity market reform<sup>108</sup>, which made clear that moving towards a low-carbon power sector by 2030 with a carbon intensity of 50gCO<sub>2</sub>/kWh was a low regrets policy for consumers even in the event of substantial shale gas exploration in the UK bringing down the price of gas.** Under almost all scenarios analysed, the Committee argued that a move towards a near-carbon free power sector in the next twenty years would result in substantial savings on UK consumer bills over the lifetime of that infrastructure (between £25bn and £45bn in its central scenario) compared to remaining in an alternative scenario where the UK remains highly dependent on electricity produced by gas plants. The CCC projects in its central scenario that supporting investment in a portfolio of low-carbon technologies throughout the 2020s would add around £20 to annual consumer energy bills in 2030 compared to annual bills in 2020.

**Question 6: Which forms of electricity generation is shale gas likely to displace and by how much?**

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<sup>105</sup> *Golden Rules for a Golden Age of Gas*, the International Energy Agency, May 2012:

<http://www.worldenergyoutlook.org/goldenrules/>

<sup>106</sup> Also see analysis from the Committee on Climate Change in the "Next Steps on Electricity Market Reform" report, May 2013, pages 37-39: <http://www.theccc.org.uk/publication/next-steps-on-electricity-market-reform-23-may-2013/>

<sup>107</sup> Cambridge Econometrics, *A study into the Economics of Gas and Offshore Wind*, November 2012:

[http://www.wwf.org.uk/wwf\\_articles.cfm?unewsid=6342](http://www.wwf.org.uk/wwf_articles.cfm?unewsid=6342)

<sup>108</sup> Committee on Climate Change, May 2013, *Next Steps on Electricity Market Reform*:

<http://www.theccc.org.uk/publication/next-steps-on-electricity-market-reform-23-may-2013/>

31. When considering the forms of electricity generation that could be displaced by shale gas, it is important to bear in mind that there does not need to be a link between shale gas exploitation in the UK and the policies influencing the choices of power sources that should be developed in the UK. One of our concerns is that, at present, such a link appears to be being made<sup>109</sup>. This runs counter to the response of other countries who have an abundance of hydrocarbons but are now diversifying their domestic energy sources: for example, Saudi Arabia are reportedly looking to be “*the world’s foremost market for renewable energy*”<sup>110</sup> and the UAE have significant renewable investment plans.

32. To the extent that the lifecycle greenhouse gas emissions of electricity generation from shale gas can be kept firmly under those of coal – on which there is still some uncertainty (see response to question 8) –, shale gas could have a positive impact by displacing coal generation. However, the extent of this potential benefit is far from clear-cut, with the IEA recently highlighting for instance that it is also the case that “*lower natural gas prices lead to slightly higher overall consumption of energy and, in some instances, to displacement of lower-carbon fuels, such as renewable energy sources*”<sup>111</sup>. The Chief Economist of the IEA recently said that greater use of unconventional gas “*is definitely not the optimum path*”, adding that “*the optimum path would be to see more renewables, more efficiency and more low carbon technologies*”<sup>112</sup>.

33. In the UK, it is the expectation of the UK Government that while there are some concerns about the possible life extension of some coal power stations (a concern for our three organisations), the lifetime of existing coal power stations will be limited by air pollution regulations and technical constraints, not by displacement caused by increased gas production, which will not be cheaper except at high carbon prices<sup>113</sup>. Thus, additional gas burn will be likely to displace lower carbon sources of power.

34. It is worth noting here that the shale gas boom in the US, often hailed as a success story for reducing emissions cost-effectively by reducing the role of coal in the US, has not in fact replaced coal. The US drop in coal prices which followed the shale gas boom has simply resulted in coal being shipped to other markets in parts of Europe and Asia, where it is then burned, adding to global greenhouse gas emissions. According to the US Energy Information Administration, a record 12% of coal produced in the United States in 2012 (equivalent to 125.7 million short tonnes) was exported to markets in Europe and Asia – this compares to an average export share of production for US coal of 5% between 2000 and 2010<sup>114</sup>. The Tyndall Centre estimates that more than half of the emissions avoided in the US power sector may have been exported through greater use of coal elsewhere<sup>115</sup>.

35. More importantly and as made clear in response to question 8, a switch from coal to gas is far from sufficient **on its own** to prevent temperature increases in excess of 2C, the

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<sup>109</sup> <http://www.theguardian.com/environment/2012/dec/05/gas-strategy-unveiled-george-osborne>

<sup>110</sup> <http://www.arabnews.com/news/458342>

<sup>111</sup> [http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/WEO2012\\_GoldenRulesReport.pdf](http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/WEO2012_GoldenRulesReport.pdf)

<sup>112</sup> <http://www.euractiv.com/energy/fatih-birol-gas-definitely-optim-news-513043>

<sup>113</sup> <http://www.greenpeace.org.uk/newsdesk/energy/analysis/exclusive-energy-bill-loophole-about-let-uk%E2%80%99s-dirtiest-power-stations-unexpectedly-stay-open>

<sup>114</sup> US Energy Information Administration, What is the role of coal in the United States?, 16 August 2013:

[http://www.eia.gov/energy\\_in\\_brief/article/role\\_coal\\_us.cfm](http://www.eia.gov/energy_in_brief/article/role_coal_us.cfm)

<sup>115</sup> [http://www.tyndall.ac.uk/sites/default/files/broderick\\_and\\_anderson\\_2012\\_impact\\_of\\_shale\\_gas\\_on\\_us\\_energy\\_and\\_emissions.pdf](http://www.tyndall.ac.uk/sites/default/files/broderick_and_anderson_2012_impact_of_shale_gas_on_us_energy_and_emissions.pdf)

stated objective of the international negotiation process on climate change. This was made clear in the following observation by the IEA, regarding the implication of its central dash for gas scenario in the *Golden Rules for a Golden Age of Gas* report:

*“The Golden Rules Case puts CO<sub>2</sub> emissions on a long-term trajectory consistent with stabilising the atmospheric concentration of greenhouse-gas emissions at around 650 parts per million, a trajectory consistent with a probable temperature rise of more than 3.5 degrees Celsius (°C) in the long term, well above the widely accepted 2°C target. This finding reinforces a central conclusion from the WEO special report on a Golden Age of Gas (IEA, 2011b), that, **while a greater role for natural gas in the global energy mix does bring environmental benefits where it substitutes for other fossil fuels, natural gas cannot on its own provide the answer to the challenge of climate change.**”*<sup>116</sup>

36. As Fatih Birol, lead author of the WEO special report put it, recognising that high gas use would exceed the threshold for dangerous climate change, “We are not saying that it will be a golden age for humanity – we are saying it will be a golden age for gas”.<sup>117</sup>

37. For the UK and as made clear in answer to question 1, it is worth noting that the bulk of shale gas flow would occur during a period when rapid decarbonisation of the power sector would be taking place if the advice of the Climate Change Committee were being followed.

#### **Question 7: What impact will shale gas and oil have on household energy bills?**

38. Please see response to question 4. Evidence published to date on the projected breakeven price for UK shale gas suggests that UK shale gas production will only have a limited impact on reducing the future price of gas in the UK or no such impact at all.

#### **Question 8: What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

39. While gas has a transitional role to play in the transition to a low-carbon economy, a dash for gas infrastructure is incompatible with meeting the UK’s legally binding carbon reduction targets and preventing dangerous climate change globally. An analysis of energy infrastructure choices by staff at University of Stanford concluded that gas cannot have substantial impacts in mitigating global warming longer term compared to genuinely low carbon choices<sup>118</sup>. The transitional nature of gas therefore needs to be short.

40. It should be reiterated that rapidly decarbonising the UK’s energy system makes economic as well as environmental sense. A recent report from Cambridge Econometrics showed for example that compared to another dash for gas generation, policies enabling a continued deployment of offshore wind farms in the UK over the next 20 years would increase UK GDP by £20bn/ year by 2030, create 70,000 more jobs by then, reduce gas imports by some £8bn/ year with only minimum impact on UK electricity prices. Under this scenario emissions in the power sector that would be 3 times lower. Importantly, these

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<sup>116</sup> [http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/WEO2012\\_GoldenRulesReport.pdf](http://www.worldenergyoutlook.org/media/weowebiste/2012/goldenrules/WEO2012_GoldenRulesReport.pdf)

<sup>117</sup> <http://www.scientificamerican.com/article.cfm?id=golden-age-natural-gas-might-prove-climate-challenge>

<sup>118</sup> <http://iopscience.iop.org/1748-9326/7/1/014019>

conclusions remain valid under a wide range of assumptions on the future price of gas and the economic benefits remain the same with or without UK shale gas exploration<sup>119</sup>.

#### *Impacts of gas on international emissions*

41. The IEA warned in its latest *World Energy Outlook* report that two-thirds of the existing commercially viable fossil fuel reserves need to stay in the ground if the world is to stay well below the 2C limit, which scientific consensus says would constitute dangerous climate change. Those reserves still exclude to a large extent those “unconventional” shale gas and shale oil “resources” that increasingly enter the reserve base resulting from technological process.

42. This was followed by recent analysis from Carbon Tracker and the London School of Economics, which found that “60-80% of coal, oil and gas reserves of listed firms are unburnable”<sup>120</sup> if the world is to have a likely chance of staying below 2C. Importantly, the report highlights that the amount of fossil fuel reserves that can be burnt only increases marginally even under an optimistic deployment of carbon capture and storage technology (CCS). The analysis suggested that even under the IEA’s idealised scenario for CCS (which assumes a very optimistic deployment of CCS out to 2050), the permissible amount of carbon emissions to stay under a 2C scenario only extends by about 12% in the period leading to 2050.

43. When looking at the role of gas specifically, the IEA’s recent *Golden Rules for a Golden Age of Gas* report<sup>121</sup> made clear that **increased use of gas as a result of new unconventional reserves would have almost no climate advantage over business as usual and would put the world climate on a course for at least 3.5C of warming**. In particular the IEA pointed out that “in countries where the average greenhouse-gas intensity of power generation is already close to that of natural gas, as for example in Europe, the addition of extra natural gas to the fuel mix has relatively little impact on the overall [business as usual] emissions trajectory.”<sup>122</sup>

#### *The role of gas in the UK*

44. As highlighted in response to question 1, the role of gas will also have to diminish substantially in the UK by 2030 if the UK is to meet its legally binding carbon budgets and its long-term obligations under the Climate Change Act 2008. In the power sector for instance, electricity coming from unabated gas plants will have to represent no more than 10% of UK electricity demand if the UK is to have a near-decarbonised power sector by 2030, a key recommendation of the CCC in the Fourth Carbon Budget.

45. It should also be mentioned here that the more shale gas is extracted in the UK (and in any other Member State), the more this adds to the pool of fossil fuel reserves that is made available to the European market. This is counterproductive at a time where momentum is building towards agreeing a climate and energy package for 2030 that can help the EU meet its objectives of reducing emissions of greenhouse gases by 80% to 95% by 2050.

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<sup>119</sup> Cambridge Econometrics, A study into the Economics of Gas and Offshore Wind, November 2012:

[http://www.wwf.org.uk/wwf\\_articles.cfm?unewsid=6342](http://www.wwf.org.uk/wwf_articles.cfm?unewsid=6342)

<sup>120</sup> ‘Unburnable Carbon 2013: Wasted Capital and Stranded Assets’, Carbon Tracker and Grantham Research Institute (LSE), April 2013: <http://www.carbontracker.org/wastedcapital>, page 4.

<sup>121</sup> [http://www.iea.org/weo/docs/weo2011/executive\\_summary.pdf](http://www.iea.org/weo/docs/weo2011/executive_summary.pdf)

<sup>122</sup> *Golden Rules for a Golden Age of Gas*, IEA, 2012, page 92.

46. A recent DECC report by Chief Scientist David McKay and Dr Tim Stone on the potential greenhouse gas emissions associated with shale gas came to a similar conclusion: *“The production of shale gas could increase global cumulative greenhouse gas emissions if the fossil fuels displaced by shale gas are used elsewhere (...). The view of the authors is that without global climate policies (of the sort already advocated by the UK) new fossil fuel exploitation is likely to lead to an increase in cumulative GHG emissions and the risk of climate change”*.<sup>123</sup>  
*Shale gas: lifecycle emissions & the risk of methane leakage*

47. This concerns the leaks or deliberate venting of gas over the shale gas extraction process, which may reduce or eliminate any advantage which shale gas has over coal from an emissions perspective. This is an area where there is still considerable uncertainty and more peer-reviewed scientific evidence is urgently needed to get a more reliable perspective on the lifecycle emissions of shale gas.

48. Both Howarth et al of Cornell University and a study by NOAA have suggested that shale gas emissions are significantly higher than reported by industry:

- Howarth’s study found that *“compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon (20 year horizon puts global warming potential of methane at 72 times greater than CO<sub>2</sub>) and is comparable when compared over 100 years”*.<sup>124</sup>
- The NOAA study (Petron et al)<sup>125</sup> found that rates of methane leakage from a gas field in Utah were 9%. This followed a study last year<sup>126</sup> which found leakage rates of 4% at a gas field near Denver, Colorado. A study by University of Texas<sup>127</sup> found that where measure had been taken to reduce leakage, rates of emission were low.
- **Research for the Environmental Defence Fund and Princeton University published in April 2012 suggests that shale gas only has a benefit over coal where cumulative emissions are 3.2% or lower.** US Environmental Protection Agency data suggest that in 2009 leaks from the natural gas industry were 2.4%<sup>128</sup>. However, other studies have contradicted these findings and the science is still extremely uncertain. To a large extent, it is likely to be the case that emissions vary widely and depend partly on whether gas is deliberately vented or whether it’s flared or captured. However, it is also likely that in at least some cases, leaks occur even in the absence of deliberate venting.
- There is also a degree of controversy about the time period over which the emissions from shale gas should be considered. It is standard to measure the warming potential of methane over 100 year period (the Intergovernmental Panel on Climate Change (IPCC)

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<sup>123</sup> Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use, Professor David Mackay and Dr Timothy Stone, DECC, 9 September 2013: <https://www.gov.uk/government/publications/potential-greenhouse-gas-emissions-associated-with-shale-gas-production-and-use>

<sup>124</sup> “Methane and the greenhouse-gas footprint of natural gas from shale formations”, Cornell University, Ithaca, NY, USA

<sup>125</sup> <http://www.nature.com/news/methane-leaks-erode-green-credentials-of-natural-gas-1.12123>

<sup>126</sup> <http://www.nature.com/news/air-sampling-reveals-high-emissions-from-gas-field-1.9982>

<sup>127</sup> <http://www.pnas.org/content/early/2013/09/10/1304880110.full.pdf>

<sup>128</sup> <http://www.nature.com/news/methane-leaks-erode-green-credentials-of-natural-gas-1.12123>

do this for example). However, in the example used above, Robert Howarth also uses an alternative twenty-year time period.

- A study by AEA<sup>129</sup> on the climate impact potential of shale gas stated that “averaged over 20 years the Global Warming Potential (GWP) estimated by the IPCC is 72. This figure can be argued to be more relevant to the evaluation of the significance of methane emissions in the next two or three decades which will be the most critical to determine whether the world can still reach the objective of limiting the long-term increase in average surface temperatures to 2 degrees Celsius”.

### Question 9: Will shale gas and oil increase UK energy security?

49. There are a number of meanings to the term energy security. They include integrity/reliability of the energy system, insulation from price shocks, and access to hydrocarbon resources. We do not believe that shale gas extraction in UK would contribute to the first two.

#### System integrity

50. As was pointed out in a review of gas security by University of Sussex, “contrary to much of the energy security debate, the most significant recent threats to the UK’s supplies have not been from geopolitical crises abroad but from domestic infrastructure weaknesses in the UK”<sup>130</sup>. However, as evidenced by the recent Government decision not to extend support for gas storage<sup>131</sup> (based on analysis by Redpoint), there is little reason to believe that the UK system is highly vulnerable to interruption of gas supplies in the foreseeable future. Improving domestic infrastructure such as the gas network reliability would not flow from developing UK shale gas reserves.

#### Price shocks

51. As outlined in our answer to questions 2 and 4, there is little reason to believe that UK shale gas would affect prices or vulnerability to international gas price spikes. Indeed, research by Oxford Economics for DECC<sup>132</sup> has indicated that climate change policies are the ones that reduce UK economic sensitivity to international price shocks.

52. Further, shale gas production in itself is unlikely to offset the UK or the EU’s rising import dependency. In its recent ‘Golden Rules for a Golden Age of Gas’ report, the IEA indicated that even in the most optimistic “gas” scenario (one in which there is rapid growth in shale gas production and emissions are consistent with global temperature rises of 3.5 degrees), “the upward trend in net gas imports into the EU continues throughout the projection period (to 2035)<sup>133</sup>”. **The implications are clear – even in the most ‘optimistic’ shale gas scenario, the EU will only succeed in slowing down its increasing gas dependency.**

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<sup>129</sup> [http://ec.europa.eu/clima/policies/eccp/docs/120815\\_final\\_report\\_en.pdf](http://ec.europa.eu/clima/policies/eccp/docs/120815_final_report_en.pdf)

<sup>130</sup> [http://www.sussex.ac.uk/Users/prpp4/Gas\\_Security.pdf](http://www.sussex.ac.uk/Users/prpp4/Gas_Security.pdf)

<sup>131</sup> <https://www.gov.uk/government/news/fallon-no-new-subsidy-needed-for-gas-storage-decision-saves-bill-payers-up-to-750-million>

<sup>132</sup> <https://www.gov.uk/government/news/davey-climate-change-policies-could-halve-negative-impacts-of-energy-price-shocks>

<sup>133</sup> [http://www.worldenergyoutlook.org/media/weowebbsite/2012/goldenrules/WEO2012\\_GoldenRulesReport.pdf](http://www.worldenergyoutlook.org/media/weowebbsite/2012/goldenrules/WEO2012_GoldenRulesReport.pdf)

53. At the UK level, “no matter how large the resource, in order to have a substantial effect on UK gas prices, the rate of growth production must be high enough to displace imports.” As explained in answer to question 1, evidence to date suggests that “UK shale gas will not be available fast enough, cheaply enough or in enough volume to take over the price-setting role from imported gas”<sup>134</sup>.

#### *Access to hydrocarbons*

54. The only way in which shale gas could be seen to contribute to UK security is access to hydrocarbon sources. However, it is unclear that this aspect of energy security is particularly problematic as the University of Sussex review<sup>135</sup> concluded that supply diversity was increasing in UK and that this was potentially the least problematic dimension.

55. If the prospect of UK shale gas extraction were linked to changes in ‘use policy’ in, particularly, the power sector (as implied by the form of question 6), then shale gas could damage UK security by promoting an increased lock-in to gas infrastructure.

56. Given the limited potential that UK shale gas production is likely to have in terms of offsetting the UK’s imports of gas and reducing the UK gas price, an excessive focus on building new gas-dependent infrastructure would be problematic as it would increase even further the UK’s future exposure to gas price shocks. This is particularly concerning given the long operational life time of this infrastructure, which ranges from 25 to 35 years in the case of gas power stations.

57. Signs that this concern is starting to take shape were well evidenced in the UK Government’s recent Gas Strategy (December 2012)<sup>136</sup> and its Electricity Market Reform Delivery Plan (July 2013)<sup>137</sup>, which both contained a scenario where the carbon intensity of the UK power sector was at around 200gCO<sub>2</sub>/kWh in 2030. Whilst such a scenario would allow a significant expansion of the UK’s gas fleet, it also corresponds to four times the level of carbon intensity recommended by the CCC for 2030 and would severely undermine any demand for low-carbon technologies in the 2020s.

#### *Limiting the UK’s vulnerability to international gas prices*

58. A final point to note is that if the UK is indeed committed to the decarbonisation ambitions set out in the CCC’s Fourth Carbon Budget and its own Carbon Plan (as detailed in answer to question 2) in the heating and power sectors, this would significantly reduce the UK’s demand for gas and therefore its vulnerability to the volatility of international gas prices over the next twenty years. In other words, a clear decarbonisation pathway based on increased energy efficiency and home grown sources of low-carbon power are the best answers to increasing the UK’s energy security, not a dash for new gas infrastructure fuelled by hopes of high domestic shale gas production.

59. This is all the more the case as evidence suggests that even under optimistic assumptions on the deployment of shale gas in the UK, production levels are unlikely to be significant

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<sup>134</sup> Bloomberg New Energy Finance, 7 February 2013, “Is UK Shale Gas all it’s fracked up to be?”

<sup>135</sup> [http://www.sussex.ac.uk/Users/prpp4/Gas\\_Security.pdf](http://www.sussex.ac.uk/Users/prpp4/Gas_Security.pdf)

<sup>136</sup> UK Government, Gas Generation Strategy, 5 December 2012: <https://www.gov.uk/government/publications/gas-generation-strategy>

<sup>137</sup> UK Government, Consultation on the Draft Electricity Market Reform Delivery, July 2013: <https://www.gov.uk/government/consultations/consultation-on-the-draft-electricity-market-reform-delivery>



within a decade. Notwithstanding the clear public disquiet with fracking which will prove an obstacle to developers, a report by Poyry for Cuadrilla anticipated that significant flows of shale gas would not be forthcoming until towards the mid-2020s<sup>138</sup>.

**Question 13: What lessons can be learnt from the US experience of shale gas and oil?**

60. As outlined in various answers in this evidence, the analogy between the UK and the US should not be exaggerated. Shale gas won't begin to make a significant contribution to our energy mix until the mid-2020s. Fracking took off much quicker in the United States given its long established on-shore drilling industry. The context could not be any more different in the UK. The bulk of our drilling expertise and infrastructure has been offshore. This means it will take many years to develop the expertise and supply chains for fracking to take place on scale.

61. Development of shale in the US has left a legacy of mistrust owing to a series of technical and regulatory failures. Claims around spills, accidents or contamination of water from fracking are legion in US<sup>139</sup>. It is claimed that tougher regulations will mean none of that happens in the UK, as fracking firms will have to apply for several permits and will not be allowed near sensitive water tables. However, most of the monitoring will ultimately be down to self-monitoring by the firms concerned. There are examples of where such an approach has gone badly wrong before<sup>140</sup> and from which lessons need to be learnt.

*October 2013*

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<sup>138</sup> [http://www.poyry.com/sites/default/files/imce/files/shale\\_gas\\_point\\_of\\_view\\_small.pdf](http://www.poyry.com/sites/default/files/imce/files/shale_gas_point_of_view_small.pdf)

<sup>139</sup> <http://www.greenpeace.org.uk/blog/climate/3-reasons-why-we-could-all-be-fracked-fracking-20130812>

<sup>140</sup> [http://www.bbc.co.uk/news/special\\_reports/oil\\_disaster/](http://www.bbc.co.uk/news/special_reports/oil_disaster/)

## Friends of the Earth, Greenpeace UK and WWF-UK—Oral evidence (QQ 33-46)

TUESDAY 22 OCTOBER 2013

*Evidence Session No. 3*

*Heard in Public*

*Questions 33 - 46*

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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### Witnesses

**Mr Craig Bennett**, Director of Policy and Campaigns, Friends of the Earth, **Dr Doug Parr**, Chief Scientist and Policy Director, Greenpeace UK, and **Mr Nick Molho**, Head of Policy (Climate & Energy), WWF-UK

**Q33 The Chairman:** Good afternoon, and welcome to the Economic Affairs Committee. This is the third public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. Mr Bennett, Dr Parr, Mr Molho, you are very welcome. Thank you both for coming today and for the paper, which you have I think jointly produced. I am grateful if you would speak loud and clear for the webcast and the shorthand writer. Our questions will go mostly to you all, but where you agree with what the first respondent has said and have nothing really to add, do not feel you have to speak each time. A nod will be enough and I will record that for the transcript. Would any of you like to make a statement, or are you happy with the evidence you have given us?

**Mr Molho:** I am happy to make an opening statement if that is at all helpful.

**The Chairman:** Yes, fairly shortly. Please do.

**Mr Molho:** Our organisations are opposed to the development of shale gas in the UK, mainly on grounds relating to climate change, and there are two important aspects, which I would like to touch on briefly, if I may. First of all, at a global development, Dash for Gas infrastructure is incompatible with preventing the worst aspects of climate change. Recently, the International Energy Agency published research showing that in order to prevent global average temperatures increasing by more than 2°C, which is the threshold that scientific consensus describes as constituting dangerous climate change, two-thirds of currently

proven fossil fuel reserves would have to stay in the ground. In the case of gas, this requires just under half of currently proven gas reserves to stay in the ground.

It is important here to understand what the IEA means with this definition. Currently proven fossil fuel reserves are fossil fuel reserves that have been discovered and are technically coverable and can be extracted with a 90% chance of making a profit. In other words, we are talking about a very limited pool of fossil fuel reserves, compared with the ultimate pool of reserves that you have globally.

Secondly, bringing this issue back to the UK, our strong concern is that we are seeing signs that the exaggerated hopes linked to the exploitation of shale gas in the UK risks creating an energy policy that is excessively biased towards an increased reliance on gas infrastructure. This creates two sets of risks. First of all, it risks creating a breach of our carbon budgets, given the evidence provided by the Committee on Climate Change, which shows that both in the heating sector and in the power sector the UK needs to significantly reduce its reliance on gas during the 2020s.

Secondly, and as highlighted in the excellent report that your colleagues in the European Union Sub-Committee on Economic and Financial Affairs provided a few months ago, it also risks undermining the long-term policies that we need to attract substantial investment in low-carbon infrastructure. This is a concern not only because that infrastructure is key to meeting our carbon targets but because that investment is also key to keeping the lights on, to accelerating the cost reduction of new technologies such as renewables, and to help better insulate our energy bills against fossil fuel price variations.

**The Chairman:** I was going to ask you whether you could explain the position of your organisations, because obviously you have outlined a lot of it in the paper you have submitted, but I wondered whether others of you would like to pick out the key features.

**Dr Parr:** I think Nick has covered it adequately there. I am perfectly happy with that.

**Mr Bennett:** Yes, indeed.

**Q34 Lord Lipsey:** Let us leave aside the question of emissions and the global warming. You state other difficulties with gas in your paper of physical and environment damage. If those were the only factors and there was no question of emissions, would you still be against taking any shale out of the ground, or is it really because of the emissions that you want it left it?

**Mr Molho:** I think the emissions are clearly a very important factor, given that the reality in the ground is that the majority of fossil fuels need to stay in the ground if we are going to prevent the worst economic, environmental and other implications of unmitigated climate change. From a local level, the key issues that we would want to be looked at more carefully at a local level would include well integrity and the impact that this can have on groundwater contamination.

Just to give you a bit of background on this issue, a recent report from the European Commission suggested that up to 5% of fracking wells may be subject to well integrity concerns, i.e. there is a concern that the way in which those wells are sealed will not completely prevent contamination to the neighbouring environment surrounding the well, which at times can include groundwater. Given, in a hypothetical case, that the UK may be able to provide large amounts of economically recoverable shale gas, this would, according to Bloomberg, require the drilling of around 1,000 wells per year at the peak of activity. We would want to ensure that the regulatory framework led by the Environment Agency was

adequate to cover this, and we are concerned that the Environment Agency, which has suffered serious staff cutbacks in the last few years, with the final round of cuts announced just last week, is adequately resourced to cope with a hypothetical shale gas revolution in the UK.

**Lord Lipsey:** That was a learned response but did not answer the questions, which was: if there was no threat of global warming in this gas, would you still be against it, or would you say, as you perhaps did in your last answer, that if the regulatory framework is right, it could be a goer?

**Mr Molho:** We would revise the position accordingly, yes.

**Lord Lipsey:** Thank you.

**Mr Bennett:** I would like to add, if I could, that it all depends on the context and on the scale of the activity. One other area of local impact that I think should be a great cause of concern is about the consumption, the quantities, of fresh water required for fracking. That is worth emphasising, as fresh water needs to be used as opposed to saline. Studies vary, but in the United States water use has varied from 9,000 to 29,000 cubic metres for one frack on a well. That is a huge amount of fresh water in any context, but if you then link that to some of the predictions that for fracking to have any economic impact we need to see between 1,000 to 3,000 wells being drilled a year—just yesterday, Sir David King, the former Chief Scientist, told the TUC conference that he estimates that around 2,000 to 3,000 wells need to be drilled a year—that is an extraordinary amount of consumption of fresh water.

In a previous life, I worked at the University of Cambridge and ran the Prince of Wales's Corporate Leaders Group, and there I worked very closely with a whole range of water companies. They are already very concerned about where they will seek quantities of fresh water for the nation's needs in the 2020s, and certainly in a scenario where we might very plausibly towards the end of the 2020s see a series of hot dry summers, or indeed even dry winters, they are very concerned as to where they are going to find the fresh water resources to meet the nation's needs. If you then have a peak in shale gas activity at around that same time, that is a very difficult scenario for them. I have spoken to a number of them recently, and they emphasised that what really concerns them is that no one has actually spoken to them about this at this stage. This whole area of shale gas exploration has not received nearly enough attention.

**Lord Skidelsky:** What is the relationship between the resources of fresh water and the shale itself? Is the implication of your remark that most of the fracking would be done in areas of plentiful fresh water, as opposed to, say, in the south? What would the geographic implication of what you are saying be for the UK?

**Mr Bennett:** Of course, the impact of this quantity, this demand of fresh water, will be regional, so wherever we see a large degree of fracking, that is where you will see a large consumption of water needed to enable that fracking to take place. Of course, we do not know now for definite in which regions of the country we might see a good deal of fracking, and we cannot be sure either which regions of the country will suffer water stress or could suffer water stress during, say, the 2020s. But we do know that even to date, over the last couple of decades, we have seen parts of the south-east, including Sussex, suffer very significant water stress in some periods. We have even seen parts of the north-west suffer water stress at times, and that is just in the last couple of decades, let alone in any scenarios of future climate impacts that may exist in decades ahead.

I really think that the thing to emphasise here is that this is a whole area of concern where the research has not been fully undertaken, the modelling has not yet taken place, and the link between fracking shale gas at any kind of scale and any kind of economic impact has not been joined up with what that means for suppliers of fresh water, let alone cross-referencing that with future climate scenarios that plenty of science bodies have done in this country. We have not seen that work done yet, but what we have seen are some politicians pushing ahead and talking about a shale gas bonanza before any of that modelling has taken place.

**Q35 Lord McFall of Alcluith:** Professor Muller, who is our next witness, says in his submission to us, paragraph 14, that the dangers of waste water earthquakes from fracking can be eliminated by the requirement that flow-back water be recycled, and the technology for this has been developed in Shell Oil, so they hope to be able to recycle essentially all its waste water in that manner. What comment do you have on that from the professor of physics at Berkeley?

**Mr Bennett:** I have not read his submissions, I confess, but there have been plenty of studies that still raise very significant questions about that. I was talking there about the consumption of fresh water. I have spoken to people in the shale gas industry who tell me that the technology and practices they use at present are still using fresh water. There is speculation about alternative approaches that may or may not be appropriate in the future, but my understanding is that it all depends on context, and I think it would be rash to make a generalisation at this stage.

**Lord McFall of Alcluith:** If that technology was developed, would you be content?

**Mr Bennett:** I think we have to look at the whole context here, the whole package. What we cannot do is take any one element of this and look at it in isolation. We have to look at the whole package of impacts. As Nick has said right from the start, our primary concern is the impact of a large shale gas scenario on climate change, and I do not think we are in a position to see how we can just dismiss that as part of any plausible scenario.

**Baroness Noakes:** I just want to follow up on the water point. It seemed to me that this is not a question of a principled objection to fracking; it is just a practical issue that needs to be resolved, and it is not necessarily going to involve the water companies because it will be for those operating the fracking operations to obtain their water supplies, which could be straightforward abstraction, or it could be using the technology that Lord McFall referred to. It is perhaps not surprising that the water companies have not been fully involved in that, and it seems to me that this is just a practical issue that companies would have to resolve in the economics of whether or not they can proceed.

**Mr Bennett:** Except that in my time, in the work that I have done very closely with these water companies, they have very detailed modelling going into many decades ahead, in different climate scenarios, as to water availability. A large shale gas exploitation scenario has not been factored into any of those scenarios, so that in all the work that has been done between water companies and Ofwat right now to understand what kind of investments are needed to secure future fresh water resources, none of them consider at all the impact of a high shale gas scenario. The evidence would suggest that there is the potential for a high shale gas scenario to completely change those models and make them redundant. This has not been considered at all.

**Baroness Noakes:** Only a high case would completely change those models, you were saying, so a lower or medium case would be absorbable within the models?

**Mr Bennett:** We do not know what a low or medium case would necessarily be categorised as. I mean that a handful of wells will not have a huge impact, but if we are talking about a scenario of shale gas that has any kind of economic impact—according to Sir David King, that would be around 2,000 to 3,000 wells being drilled every year, across the decade—then unquestionably that would have a significant impact on the availability of fresh water resources.

To come back to your question on that, it also raises real questions as to who will be able to decide who gets that water. If you imagine a scenario where we have had a series of hot dry summers, there is a hosepipe ban in place in parts of the country in the mid-2020s, and there might even be standpipes in some streets in parts of the south-east, who is then going to decide who gets the water: households or Cuadrilla? That is a whole area of debate that has not been looked at at all yet. Indeed, I am not aware of anyone doing any modelling for that at the moment in this country.

**Q36 Lord Lawson of Blaby:** I understand where you are coming from on the question of global warming and all that, but of course what we do in this country is neither here nor there. It is a global issue, and it depends on what is happening globally. Leave that to one side. As Lord Lipsey was saying, if you were not concerned about that, would you still be concerned? What you said astonishes me. First of all, the amount of water that is used in fracking is derisory. Pretty well every industry uses water to some extent, and few industries use as little water as fracking. Agriculture is the biggest user of water, but there are many others that use more. What puzzles me even more is that you say that no studies have been done, that we do not know yet, and all that kind of thing. The fact is that it has been happening in the United States for many years, and in the United States it has been proved beyond any doubt that there is no merit whatever in the case you are making. What is there about the United Kingdom that makes it so totally different from the United States?

**Mr Bennett:** I am very happy to answer that. What I was referring to when I talked about the studies is that no studies have been done that look specifically at the impact of a high shale gas scenario on water resources in the United Kingdom, and very detailed modelling needs to be done on that.

**Lord Lawson of Blaby:** But it is happening the United States, so we do not need studies. We know.

**Mr Bennett:** What I would say—my colleagues will chip in here—is that many factors make the United Kingdom very different from the United States on this whole question of shale gas, but on this particular point about water what is very relevant, of course, is population densities. We have 60 million people living in these islands, and population densities in many parts of the United States, including those that have seen a good deal of shale gas extraction, are much lower. Therefore, demands for fresh water from populations in those regions are far lower than here in the United Kingdom. That is one key difference. I will let my colleagues fill in on any other points.

**Dr Parr:** I will go back to the original question about the local impacts and say that the impacts have been evaluated by, for example, the Royal Academy of Engineering. They do not regard these as insuperable, but let me draw out what Nick touched on earlier about there being an important difference between whether it can be effectively managed and whether it will be effectively managed. We have an Environment Agency, a Health and Safety Executive, even DECC itself, which are subject to deficit reduction plans, and my question, and it is a question, is whether they have the capacity to manage the sort of expansion that is being proposed and to develop whole new areas of understanding and expertise while

their core budget is being cut and staff are being cut right, left and centre. I would go further than that and say that for a new industry in these circumstances, particularly with issues like methane and air pollution, where issues that arise will pass with almost no trace, a level of monitoring by an independent external would be an appropriate way to think about how the regulation should be approached.

I emphasise first of all that we are ignoring what for me and Greenpeace is the most important starting point, which is about the level of fossil fuel and the impact on climate change. Secondly, of course, as I said, is the question whether there is the capacity to deliver on that effective regulatory approach, which has been outlined elsewhere.

**Q37 Lord Smith of Clifton:** Gentlemen, do you believe that the environmental risks you see in the development of shale gas are covered by existing regulations on onshore gas and oil production, or do you see a need for a new regulatory framework specific to shale gas? We have touched on water in previous questions. You also mentioned methane and earthquakes.

**Mr Molho:** If I can briefly make a point on the water issue, I think a lot of these questions really need to be answered by the Environment Agency, but I would highlight two differences between conventional fracturing, which has been going on since the 1940s, and hydraulic fracturing, which has been going on more recently in the United States. It is that first of all, as opposed to conventional fracturing, which tends to be done in vertical wells with low-volume processes and at low pressure, shale gas fracking requires a high volume of processes, higher pressure, and fracking into lateral sections of the well. There are some differences there, as well as the local impacts that come out of that need to be clearly understood to ensure that the regulatory regime is indeed appropriate, especially when you are looking at issues around well integrity.

Your second difference is that to sustain a high level of shale gas production, we will need at the peak of activity to drill a significant number of wells to sustain that level of production. According to Bloomberg New Energy Finance, in order for the UK shale gas reserves to take over the price-setting role from imported gas this would require over 1,000 wells drilled each year in the UK over the peak of activity. I guess it goes back to my point and the issue that Doug Parr highlighted around whether it would be done safely. That requires the Environment Agency to have the capacity and the adequate resources to do so, and the recent staff cuts are of concern to us in that respect.

**The Chairman:** Does anyone else wish to respond to that one?

**Dr Parr:** Only to add that there are already a number of existing processes, such as environmental impact assessment, and currently the AMEC is doing a strategic environmental assessment. There is plenty of process there. In many cases it is not about identifying whole new tranches of stuff but about doing the right things with what we already have, which goes back to my previous point about delivery on what is already there and what is already known about, rather than inventing new stuff.

**Lord Smith of Clifton:** We heard earlier from an expert in the legal framework necessary that the regulatory framework is really not up to scratch for these new developments. Do you believe that may be the case, or you just do not know?

**Dr Parr:** I just have not taken a view on it. As I say, I am aware that a lot of things need to be sorted out at implementation, but I am not closing the door on a different frame if that would be seen as appropriate.

**Mr Bennett:** I would like to add that just a year ago I had a conversation with the former deputy head of the Environmental Protection Agency in the United States, and she told me then that her concern was that so much of the so-called shale gas revolution that has occurred in the United States occurred far quicker than they were able to put the regulatory regime in place in that country. I think the strong view of regulators in the United States is that they do not currently have an adequate regulatory regime for shale gas. One of the concerns there in particular is that the studies have just not been undertaken over a long enough period, or indeed with the right baseline data, to give a proper understanding of the impact that fracking operations have had on a whole range of issues. Indeed, there is still not really the capacity to put those in place.

If that is our starting point, I would build on the point that Nick made as well that here in the United Kingdom at the moment there are already very significant concerns about a lack of capacity within regulators like the Environment Agency to even deliver on their current expectations that are placed on them with respect to water quality and other measures, even without an expansion of shale gas. It raises some very real questions as to how confident we can be that the regulatory capacity or indeed the framework could be put in place to give the assurances that many people in this country would seek.

**Lord Smith of Clifton:** Would you say that an increase in capacity now, in anticipation of what might come, is desirable, or are you saying that we are really not in a position to look at that regulatory requirement until things develop, and that we are in a chicken and egg situation a bit?

**Mr Bennett:** Indeed, but there is public concern about this issue. The public would very much want to see a regulatory framework put in place before we see shale gas operations at any kind of scale, to protect their local environment, protect water courses and so on. The problem is that our regulators at the moment do not have the current capacity to do that—that is what I am told—and there are questions as well as to where we would draw the evidence for setting the appropriate regulatory framework, given that there are questions about it even in the context of the United States?

**Q38 Lord Hollick:** You have identified a number of risks around shale gas and the extraction of shale gas. Are they materially greater than the risks around coal mining or the extraction of oil and gas in the UK?

**Mr Molho:** In terms of extraction and the well integrity that I mentioned earlier, there are some differences both in the type of fracturing that we are talking about and in the volume of wells that need to be drilled to sustain a high level of production. Those are issues or differences that we would want the Environment Agency to look at carefully, but it is absolutely fair to say that issues around, for instance, groundwater contamination, are applicable to other activities across the mining and oil and gas extraction centre. The difference is that we are talking about a different type of hydraulic fracturing process, and the volume of wells that we are talking about is higher.

**Lord Hollick:** The evidence for that is?

**Mr Molho:** The European Commission published a study recently looking at the history of well integrity in the United States and the differences between the traditional hydraulic fracturing process, which has been going on since the 1940s, and which, as I said earlier, is a low-pressure fracturing process that requires lower volumes of processes and is very much focused on vertical wells, and hydraulic fracturing—i.e. you are fracking into lateral sections of the well and you are using much higher pressure water and higher volume processes—



which introduces a different kind of risk. The analysis coming out from this report was that, on average, 5% of wells may have concerns around integrity and may not be properly sealed from the surrounding environment around the well, which can include groundwater. That is an issue that we would want the Environment Agency to consider carefully.

**Lord Hollick:** Is it your judgment that if the regulations were clear and the environmental agencies had the resources, the risks, the additional risks, the different risks, could be adequately managed?

**Mr Molho:** I think they could be adequately managed, but the key question is: will they? It is key to have these kinds of local resources, but, yes, they could be adequately managed. I would go back, I guess, to my opening point, which is that our biggest concern about the exploitation of shale gas, both in the UK and more globally, is the link with climate change.

**Q39 Lord Skidelsky:** My question gives you an opportunity to amplify, if you wish to, your original responses to Lord Lawson's comment. Does the evidence from the United States provide support for your view on the physical risks and environment risks? You mentioned differences in density of population, but there is also the issue of methane gas. I wonder whether you would be interested in doing that comparison.

**Mr Molho:** There are two things I could add to what I have said on the United States. On the issue of methane leakage, what comes out quite clearly from the evidence in the United States is that there is still a lack of understanding as to the exact amounts of methane that are being leaked at particular wells. We are seeing different figures being provided for a range of different wells across the country. It has also appeared that in several cases industry may have underestimated or underrepresented the amount of fugitive methane emissions that have taken place.

Research from Princeton University suggests that in order to maintain its so-called climate advantage over coal—i.e. the ability of shale gas to be below coal in overall carbon intensity—cumulative methane emissions should not exceed 3.2%. What all this tells us, and this was an issue that was highlighted very strongly in the scientific study that came out of DECC just last month, is that we need significantly more peer-reviewed research on the issue of methane leakage: first, to understand what the causes of methane leakage are, and how, and what amounts we are talking about; and, secondly, to understand better what we need to do from a regulatory perspective to cut those fugitive methane emissions and prevent them happening in the first place.

The second issue that I would like to touch on briefly on the United States is that the United States has often been described as a successful example of how greenhouse gas emissions could be reduced cost-effectively. What I find very striking about that observation is that this really underestimates the full picture—the full picture being that the increased shale gas exploitation and use of shale gas in the United States have led to significant increases in coal exports to other countries. According to the US Energy Information Administration, between 2000 and 2010 the average share of coal that was produced in the US and exported to foreign markets was in the region of 5%. In 2012, this rocketed to 12%. In other words, while we have seen an increased use of shale gas in the United States, that has been accompanied by an increased export of coal to European and Asian markets, where the coal is then being used and burnt and is adding to global greenhouse gas emissions, which often fails to be tackled by commentators in the shale gas debate. In other words, we really need to look at this issue and the impacts of shale gas in the round, and remember that in a lot of cases the increased use of shale gas, in the absence of binding

global greenhouse gas agreements, will result in more fossil fuels being burnt, rather than simply shale gas substituting for dirty fossil fuels.

**Lord Skidelsky:** You have pointed to a correlation. To what do you attribute the increased exports of coal?

**Mr Molho:** One of the big failures, especially in the European market, has been the incredibly low carbon price. Were it not for such a low carbon price, we would not have seen the increase in coal burning that we have seen in some European countries. Clearly the increase in gas prices has played a role as well.

**Dr Parr:** Yes, the decrease in coal prices in Europe has been strongly associated with the increased export from the US, and that is indeed why in the UK and Germany we are seeing a high level of coal burn. Our coal burn in the UK has increased more proportionally than that in Germany, in fact. There is no question that there is a spread of fossil fuel through some level of international market.

I guess I should just try to cover off your question about the physical effects in the US. Pm other issues such as groundwater contamination, there is no definitive study from an authoritative agency that says that there is a problem here. What we have is anecdotal, albeit rather a lot of it, about the issues that arise from groundwater contamination, and some correlations have been established between contaminants of groundwater and fracking activity—correlations but not causations, to link to your earlier point.

However, we also need to be mindful of the unknown level of what could be called gagging orders: in other words, where people who strongly feel that they have been affected have persuaded companies that they should enter into some kind of civil arrangement, whereby they are paid and then told to be quiet. That might serve the interested parties very well in the US. It does not particularly serve the evidence base for another country that is looking at the US experience.

**Q40 Lord Lawson of Blaby:** I would make one quick observation and ask you a question. The observation is that one of you said that the difference in the United Kingdom—and I asked this question—is that we have a greater population density. I would remind you that a lot of the fracking has gone on in the United States in Beverly Hills and the Los Angeles region more generally, which has a very high population density, so I do not think there is any merit in that argument.

Leaving that aside, on the question of the reduction in the coal price, you are quite right: there has been a reduction in the coal price, and although the main reason why Germany has moved so much to coal is that they decided in the wake of Fukushima, as you are well aware, to abandon the nuclear route, coal has taken up the space. In general, it is quite right that shale gas has become very cheap in the United States and could be elsewhere, no doubt, and coal has certainly gone down in price. Let me ask you this. Are you against cheap energy? Do you think it is a bad thing?

**Mr Molho:** I look at the issue of energy policy and climate policy by taking into account the economic aspects in our countries and those of others, including the developing world. I note in particular that the World Bank, in its two *Turn Down the Heat* reports this year on climate change, made it very clear that unmitigated climate change would impact hardest on the world's poorest countries, which are the very countries that have the least economic and technical ability to adapt to it. In order to address the all round issue of cost of living

both in the UK and internationally, we need to move cost-effectively towards a low-carbon power sector.

Bringing the issue back to the UK, the Committee's analysis on climate change was very clear that a move away from the fossil fuel system towards one that is based on energy efficiency and low-carbon energy was in the best interests of UK consumers in the long run. What the report found in particular was that by moving early and having a low-carbon power sector by 2030, UK consumers could save between £25 billion and £45 billion, compared to remaining in the fossil fuel-heavy system, especially if the world takes strong action to tackle climate change, because that will come with a gradually rising carbon price.

**Lord Lawson of Blaby:** The figures that you quoted have been contested. That aside, can you answer my question? Are you opposed to the idea of cheaper energy? I think most people in this country would love to have cheaper energy.

**Mr Molho:** Absolutely.

**Lord Lawson of Blaby:** It is even more important for the poor people in the poorest countries of the world not to have to pay high prices for their energy.

**Mr Molho:** The overwhelming evidence from the major bodies such as the International Energy Agency and the World Bank is that the most long-term, cost-effective way of moving towards a world that prevents the worst impacts of climate change and delivers cheap energy is to embrace a clear long-term strategy that is based on energy efficiency and low carbon policies that can deliver long-term reductions in the cost of energy. In other words, I am fully for cheap energy, but I strongly believe that in the long term if we want to live in a world that avoids the worst impacts of climate change on the world economy—we are talking about substantial impacts—we have to embrace the low-carbon route.

**Dr Parr:** If I can just add to that, in some ways, “Are you in favour of cheap stuff or expensive stuff?”, is a no-brainer. We routinely expect people to be paying more to look after the future than simply to take all the goodies at the present. If we did not, we would simply be abandoning pensions policy, whereas there is a whole suite of regulatory approaches and tax incentives towards helping people look after the long term. I see it in some ways as the same as that. We are potentially paying upfront in order to look after the long term.

**Q41 Lord May of Oxford:** By pure coincidence, I have the one question I really wanted to ask. It is rather strange. I declared my interest as a member of the climate change committee. I expected much more of what you were going to say to refer to our trajectory to 2030 and 2050, and as you all know we have a very ambitious trajectory to reduce by 80% the amount of carbon we put into the atmosphere by 2050. One way of doing it is, for example, to get tougher on immigration, but when I raise that on the climate change committee it is regarded as being in bad taste, so I will let that lie. My point is that you can see a feasible road to 2050 if everyone comes on board and we do it in a way that is not all that costly, but it does require decarbonising the energy supply almost entirely by 2030. En route to that, I differ from you. I have an upbeat view of fracking and shale gas, because, en route to 2030, we are still going to be using some conventional things, and I would rather have us using shale gas than coal because, apart from anything else, that comes together with the injunction of carbon capture and storage, which is at the moment beyond the bounds we have. In that route to 2030, I am all for embracing on an appropriately modest and targeted scale cleaner and cheaper forms of carbon-releasing energy, which shale gas may give, but I am surprised that you did not say that much of this discourse that we have

just had is on the premise that here is something that has, again, the real advantage that we are not going to be so dependent on other people, and that we can go to a much more independent, politically simple way of continuing on the road we are on. We are only on target for 2030 by virtue of the recession. With the current Chancellor, we may well stay on the road to 2050 if he completely prolongs the Session, but I do not think that is what he will do. I am just curious why you did not make a bigger point of that instead of banging on in such detail about other things.

**Mr Molho:** When we refer to the fossil fuel component of our energy system, clearly we would much rather that to be a gas-based fleet of plants than a coal-based fleet of plants, and that is why all three of our organisations are pushing together towards a toughening up of the emissions performance standard in the Energy Bill to ensure that emissions from coal plants can be better regulated and avoid undermining our long-term carbon budget.

There are two important points to make. The first is that we need to have a reality check about when UK shale gas will be available. The overwhelming evidence shows that, given the stage of development of the UK shale gas industry, we are very unlikely to see, even in the event of large amounts of economically recoverable reserves, the large amounts coming on stream until the early to mid-2020s, and even the report that was prepared by—

**Q42 Lord May of Oxford:** That has not addressed the question I just asked you. My ideal preference would probably be yours: that decarbonising energy generation by 2030 means that you are not putting more carbon into the atmosphere, so what happens beyond 2030? On the trajectory that is our target at the moment, and the one that is accepted by the Government, what you have just said is irrelevant, or am I missing something?

**Mr Bennett:** Let me make some comments on that, if I can. In so doing, I would like to answer a couple of the last questions all in one go, if I can. You are absolutely right, of course, Lord May, that the targets that the Committee on Climate Change have proposed and put in place and the targets under our Climate Change Act paint a feasible road as to how we are going to get to where we need to by 2050, if everyone comes on board. We have said, as the other organisations have, that of course there is a role for gas through to 2030 in that regard, but we have to be really clear that we can manage that role. That is why we strongly support the decarbonisation target for the power section that your Committee has proposed, and we very much hope that that can be implemented.

The reality check, though, if we move from the theory to the reality here, is of course that there has been political opposition to that decarbonisation target from the Chancellor—one of the staunches advocates of shale gas—which causes real questions about how you can manage the role of shale gas to make sure it is compatible with delivery of those targets that you are talking about.

Nick also makes a very good point that I think relates to a previous question about this supposed ability to be able to cut and paste the US experience to the UK experience. The US already had an established onshore drilling industry. That has two implications, one for the speed and one for the cost of how quickly they can deploy and scale up shale gas operations in the United States. Here, because we have not had a large-scale onshore drilling industry, it is going to take longer and it is going to be much costlier to exploit shale gas at scale, all of which means that people within the industries themselves all point to it being the mid-2020s before we see any shale gas operating at scale.

The scenario we see in front of ourselves at the moment is that it will be the mid to late 2020s before we see shale gas at scale. The Government are currently opposed to a

decarbonisation target to manage that and to make sure that the power sector is generating electricity at 50 grams per kilowatt hour by 2030.

The additional point to that, when you look at the alternative, is that we see a global renewables industry that is cutting its costs year on year. We see predictions from Bloomberg New Energy Finance and from Sir David King. Indeed, the very requests that the solar industry, for example, is putting in are for a lower strike price: a much cheaper cost. Just seven years from now, there is a good possibility that solar will be cheaper than fossil fuels. In all that context, we see the current focus on shale gas as a distraction, because the suggestion that it can deliver the answer to our energy problems is wrong given the timing and it will also not deliver on the climate challenge we really face.

**Mr Molho:** May I just say that I think you might also be underestimating the impact that the exaggerated hopes of future shale gas exploitation in the UK is having in the formation of future energy policy? We are seeing the hopes linked to shale gas already setting the basis for the potential for an excessive focus on future gas infrastructure that is not compatible with our long-term budget.

Let me give you an example. The gas generation strategy and the EMR delivery plan contain a set of three scenarios, including one scenario that envisages the power sector in the UK by 2030 having a carbon intensity of 200 grams of carbon per kilowatt hour. I have been talking to a wide range of investors in the low-carbon space who tell me how concerning they have found those scenarios to be and how they are reconsidering some of their long-term investments in the UK low-carbon market, and I do not blame them, because if you understand the implications of that scenario, the picture is rather concerning. If the UK meets its renewables target by 2020, for which it is on track for doing, the carbon intensity of the UK power sector will be in the range of 200 to 250 grams of carbon per kilowatt hour. Even setting a scenario that plausibly says that one possible outcome in the UK is that we may have a power sector with a carbon intensity of 200 grams by 2030 says in effect that there will be no demand for low-carbon capacity throughout the 2020s. This sends a very damaging signal to the supply chain. It is also an incredibly cost-ineffective way of building a long-term low-carbon industry in the UK, which will have repercussions on consumer bills and result in the UK missing out on several job creation opportunities in areas where it is currently an industrial leader, such as offshore wind, CCS, wave and tidal power.

**Dr Parr:** As we are, I think, running a little short of time, I just wanted to state rather more baldly the dilemma that I think we are in. As in our opening comments, it was pointed out that the IEA scenario for meeting the 2°C climate change challenge means that about half of existing known reserves are going to have to be left in the ground. That means that it is probably going to be the most expensive stuff, which will probably include UK shale, because again the IEA has identified the sort of gas that is going to have to be left in the ground, and that certainly covers ours.

It also means that some country somewhere is going to have to decide to leave its fossil fuels in the ground, and if it is not us, I do not know who it is going to be, because as soon as those become developed and property rights are established, they become a lobby for their exploitation, as we are seeing in the Arctic right now and as we are very shortly going to see in the Brazilian pre-salts, which are huge reserves of potentially new oil, creating new lobbies for burning it. If we are serious about this 2°C target, it does mean some pretty crunchy and uncomfortable questions.

**Lord May of Oxford:** I think we should go on to the next question. I find this disappointing.

**Dr Parr:** Maybe I have not understood your question.

**Lord May of Oxford:** We can discuss it later.

**Dr Parr:** Fine. Let us do that.

**Q43 Lord McFall of Alcluith:** If material volumes of shale gas are developed in the UK, which existing sources of supply do you believe would be displaced: conventional gas, coal, nuclear or renewables? I know that WWF has supported nuclear developments, but Greenpeace and Friends of the Earth support wind, so you may have a different view on that.

**Mr Molho:** I think we all see renewable energy as capable of being a key driver in overall decarbonisation efforts, but in answer to your question, I think the most likely impact will be that energy efficiency and low-carbon generation will be displaced. Let me talk you through my reasoning. Under the terms of the industrial emissions directive, the majority of UK coal plants will have to close around 2020 or thereabouts. Likewise, evidence regarding the speed at which UK shale gas reserves could be exploited suggests that even in the event of large amounts of economically recoverable reserves, those will not come on stream until the early to mid-2020s.

That is precisely the time at which the Committee on Climate Change is recommending that significant cuts in emissions and reliance on gas in both the heating sector and the power sector need to occur. To the extent that those reserves are brought out of the ground and encouraged to be used in our gas power stations and gas infrastructure, the most likely scenario is that this will displace low-carbon generation.

**Lord McFall of Alcluith:** But it is hypothetical, is it not? There has not really been a serious appraisal of the costs of shale gas and its production in the UK.

**Dr Parr:** It is quite difficult, but I think Bloomberg and Ernst & Young have both looked at what they think the expected costs are going to be, and they—

**Lord McFall of Alcluith:** We are far away from a sound analysis if we can only cite Bloomberg and Ernst & Young for a start. I do not mean anything against them, but they are just two organisations. We really are far away from a real, serious appraisal. That is really what we are looking at here.

**Dr Parr:** We do not actually know, because there is no on the ground evidence of how much UK shale gas is going to cost. They would have to do it to find out.

**Lord McFall of Alcluith:** Unlike Lord May's, you have answered my question.

**Q44 Lord Griffiths of Fforestfach:** If I can pursue that question a little more, from the US it seems to me that we know three things, given the scale of what has happened there. The first is that gas prices have fallen significantly. Secondly, coal prices have fallen significantly, and because of US exports into the world market, international coal prices have fallen significantly. I think you are saying that you think that in the UK this whole issue of shale gas is going to result in relatively little volume and high cost. If I can play devil's advocate to you, it seems to me that you are as much in the dark as anybody else as to what could happen on that, and as an economist I would say one of the key issues here is how much resources firms are ultimately going to put into exploiting all these resources. The difference between a static analysis and a dynamic analysis is fundamental, and basically you are trying to convince us of a case that, as far as I can see, you really do not have a strong empirical basis for, which is exactly what I think Lord McFall was really saying.

**Dr Parr:** If you are saying that the only thing we can judge our evidence base by is actual, empirical, on the ground evidence for what it is going to cost in the UK, that is kind of self-evident, is it not? The only thing we have is the best analysis by people whose analysis is usually taken as being reasonably robust. I do not know what more to say to that.

What we can do is say, well, what does the IEA say is going to happen? If we are going to chuck out all the analysis by bodies like that, then I think we are in a totally evidence-free zone.

**Lord Lawson of Blaby:** There is evidence on the ground. That is the point.

**Dr Parr:** Yes, but how applicable is the evidence in the US to the UK? That is absolutely part of what is going on here, and that is why people who do know about energy, like Bloomberg, like Ernst & Young, are coming up with different numbers from what is available in the US. As I say, if you do not trust those, I am not sure who you do trust, because you are essentially saying the only way we will ever know what the cost of this is going to be is to actually do it, which has a whole set of other problems that I think we have covered.

**Mr Molho:** May I just add this? A lot of the time the debate on UK shale gas can be very UK-centric, and forgets the fact that we are part of a well interconnected European gas market. Putting aside the fact that you may have views on the International Energy Agency's view and analysis on future prices, the analysis from the IEA shows that, even assuming a strong deployment of shale gas resources across Europe, the price of shale gas is going up. The price of gas in Europe will go up between now and 2035, and will remain sustained at high levels. I refer you to page 39 of the latest report from the Committee on Climate Change on electricity market reform, which has a very useful range of diagrams that show how the evolution of gas prices in Europe is likely to fare, even in the event of strong shale gas exploitation in Europe.

All that is to say that we have to remember that what really matters in all this is the ultimate European gas price, because that will influence the overall price of gas in the UK. When we see the evidence that we have available to us, it strikes us as a very dangerous mistake to associate exaggerated hopes on the future of UK shale gas exploitation with a policy that will encourage the construction of excessive amounts of new gas infrastructure, because the most likely outcome will be a continued high dependency on imports and continued reliance on high gas prices.

**Dr Parr:** If I could just build on my previous point, I have mentioned the analysis that has been done about UK and, as Nick has mentioned, EU gas prices, but these have been done by people whose views are generally taken as being authoritative. If one is going to abandon that, you have to have reasons for abandoning that. It is perfectly true to say that there is no empirical evidence, but on what basis does one choose to ignore the analysis and advice that is produced by bodies that are generally thought of as being authoritative?

**Lord Lawson of Blaby:** One reason is that nobody knew in advance of the modern fracking revolution in the United States how that would work out. Nobody knew in advance that it was going to produce so much cheap gas and that the price was going to fall so much. Until you try it, you do not know. It may be that the United Kingdom is different. It may be that it is not. Until you have done it, you do not know. They did not know in the United States.

A further point is that one of the curiosities about gas—and I have a little knowledge about the energy sector because many years ago I was Secretary of State for Energy in this country—is that the cost of transporting by sea is extremely expensive, because you have to

liquefy it first. Then you transport it in liquid form, and then you have to gasify it again at the end. The transport costs of gas are huge, and your evidence does not take that into account at all. That is not the case with coal. It is very easy to transport and therefore you have what has been seen. If we have a supply of indigenous gas, which avoids these transport costs, that is of considerable benefit, is it not?

**Mr Molho:** With all due respect, I accept your point about the transport costs of LNG, but you are looking at only part of the picture. Fundamentally, what impacts the UK gas price is the overall dynamics and the overall relationship between supply for gas and demand for gas in the European gas market. Comparing the price of UK shale gas versus the price of LNG only looks at part of the picture.

**Q45 Baroness Noakes:** If it could be established that our locally produced shale gas was cheaper because it did not have transport costs attached to it, would it not make entire sense for us to develop and use that? The answer to the question about who leaves their carbon resources in the ground is someone else.

**Dr Parr:** They will probably all say the same thing.

**Baroness Noakes:** Fine.

**Dr Parr:** Then we will all use them. I remember the IEA's report on the golden age of gas. It said, "It will be a golden age of gas. It will not be a golden age for humanity", for the reasons of climate change, which we alluded to earlier.

**Baroness Noakes:** So the UK is the sacrificial lamb?

**Dr Parr:** That is why I posed the question: if not us, who? Who else is going to do that? Or are we all going to go to hell in a handcart?

**Mr Bennett:** I would like to add that I do not think it would be just the UK, because already, of course, a number of countries in Europe have already banned exploitation of shale gas. There has been a lot of conversation here about cheap energy, and understandably so, because it is such a public concern at the moment, but we should not forget that there is nothing cheap about climate change. If you look at the analysis by Lord Stern on the economic impacts of climate change and climate change as one of the greatest threats to our global economy over the decades ahead, for us to just dismiss the science on climate change, to dismiss the work by Lord Stern and his team and many other economic models as well, to dismiss the very strong views that are being articulated at the moment by so many business leaders that they need to be able to operate in a clear framework that indicates how we can decarbonise our power sector, and even to dismiss the transformation that is occurring to global energy because of renewables and the falling costs of renewables year on year—to dismiss all that and to look at shale gas in isolation is not giving proper consideration to this issue.

**The Chairman:** I do not think anyone is looking at shale gas in isolation, I have to say. I do not think that is the context of our questions.

**Lord Hollick:** Is there not a danger, though, that if we leave shale gas undisturbed in this country, we will become a dumping ground for cheap coal? I am not quite sure how that solves climate change.

**Mr Molho:** This assumes that we are faced with a false choice between either burning lots of shale gas or burning lots of coal, when fundamentally we have another possibility ahead of us—one that is recommended by the Committee on Climate Change and the International



Energy Agency and others—which is to make a rapid move towards an efficient and low-carbon energy system. That, in the long term, will result in significant savings for consumers. The research I referred to earlier on by the Committee on Climate Change, which reviewed the case for decarbonisation as part of the Energy Bill, showed that a long-term decarbonisation strategy could save UK consumers between £25 billion and £45 billion over the lifetime of that infrastructure. We are not facing a binary choice. There are other options on the table, and options that make long-term economic sense.

**Q46 Lord Shipley:** Can I just be clearer on what forms of energy you are in favour of? You have left me with that reply with a vision of very, very large numbers of onshore and offshore wind farms, perhaps tidal energy. I am not clear what form of energy you think this country should be investing in, unless you actually think that it can all be done through energy conservation investment.

**Mr Molho:** I think there are three essential pillars that need to be pursued, or that we would certainly prefer to be seen to be pursued in the UK, and those are energy efficiency, strong deployment of a wide range of renewable energy technologies, and increased interconnection with the European power system, all of which have been proven to be delivered securely and can make economic sense in the long run.

I would like to touch on the piece of work that we did precisely on that, whereby we commissioned Cambridge Econometrics and asked them to compare the macroeconomic impacts of a high gas power system in the UK versus the macroeconomic impacts of the UK investing steadily in offshore wind. The study found that by having a stable regime supporting the deployment of offshore wind in the UK, the UK GDP would be higher to the tune of around £20 billion a year by 2030. It would result in the net creation of around 70,000 jobs, and it would reduce annual UK gas imports by around £8 billion a year by 2030. Critically, this could be delivered, with minimal impact on electricity prices, to the range of around 1% in 2030. I would be very happy to provide the Committee with this Cambridge Econometrics study.

**Lord Shipley:** I think I have seen the detail of that. Is that £20 billion figure that you are quoting a net or a gross figure? There are increased costs.

**Mr Molho:** It is net. It is the difference between the two scenarios. It is the increase in GDP in the offshore wind scenario.

**The Chairman:** I think we must stop it there. Perhaps you could let us know.

**Mr Molho:** Sure.

**The Chairman:** Can I thank you very much indeed for coming? We have another session immediately ahead, so thank you very much.

**Future Energy Strategies and United Kingdom Onshore Operators Group—Oral evidence (QQ 58-68)**

TUESDAY 29 OCTOBER 2013

*Evidence Session No. 5*

*Heard in Public*

*Questions 58 - 68*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord May of Oxford  
Lord McFall of Alcluith  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Smith of Clifton

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**Witnesses**

**Mr Dan Lewis**, Chief Executive, Future Energy Strategies and co-author of *All Hail Shale* in IoD's magazine *The Big Picture* and **Mr Ken Cronin**, Chief Executive, United Kingdom Onshore Operators Group.

**Q58 The Chairman:** Welcome to the Economic Affairs Committee. This is the fourth public hearing of our inquiry into the economic impact on nuclear energy policy of shale gas and oil. For the first session, Mr Cronin and Mr Lewis, you are very welcome. Thank you for coming and thank you, Mr Cronin, for your succinct but pretty comprehensive paper. I know you have already answered some of our questions, but perhaps you can answer them more fully during our session.

Mr Lewis, we have seen the article you jointly wrote for the Institute of Directors. I would be grateful if you could speak loud and clear for the webcast and the shorthand writer. Do you want to make an opening statement, or shall we go straight into questions?

**Ken Cronin:** I am happy to go straight into questions.

**The Chairman:** Can I start with the first question? It is a very general question and is particularly for Mr Cronin in the light of the paper that he sent us. Could you summarise your view on the potential for shale gas development in the UK for the sake of the inquiry and listeners?

**Ken Cronin:** I think the potential is huge. In the work that has been done by the BGS on behalf of DECC, we have seen in the north-west the Bowland shale potential gas in place of 1,300 tcf which, when you compare it with the total consumption in the UK of 3 tcf, is a very big difference. Clearly, that is gas in place, so we need to work out what is

economically and technically recoverable. Other parts of the UK have shale and coal-bed methane under the ground, including Scotland, Wales, the Weald basin and parts of the East Midlands and Yorkshire. The 1,300 number is exciting. It is a huge opportunity and I think it is just the start.

**Dan Lewis:** I do not have anything hugely significant to add to that, only that we are at the very early stages of finding out just how much there is and at what price we can get it out of the ground.

**The Chairman:** I think you have both been pretty cautious about the fact that we need to do the explorations in order to establish the exact prospects.

**Ken Cronin:** Yes, absolutely. The next two to three years are extremely important for the industry. We need to understand the costs of extraction as well as the geology that we are working with, how we work with local communities, regulation, et cetera. The next two to three years are the exploration phase and clearly very important.

**Lord Lawson of Blaby:** I would like to follow up the Chairman's questions. I appreciate again that these are early days and that until exploration takes place it is very difficult to give a firm answer. However, on the basis of what you know already, can you say anything—perhaps drawing on American experience—about what you think the effect might be on the British economy of the development of our indigenous resources of shale gas, both in using it as an energy source and as a feedstock for the petrochemical and some other industries?

**Ken Cronin:** Again, I think that the opportunity that the economic package that shale and coal-bed methane presents to the UK is quite important. Some 80% of our heat comes from gas. One of my observations from the discussion so far and from some of the submissions is that we always talk about electricity, but we have an even bigger dependency on gas and heat. Some 40% of our electricity comes from gas and is a very significant feedstock element to the petrochemical and fertiliser industries, et cetera. I think there is an economic package here. First, we have a huge opportunity to create jobs, both directly within the industry and the supply chain. The IoD report earlier this year estimated about 74,000 direct jobs, which compares to about 400,000 in the North Sea, so I think the numbers are about right. We also have a huge opportunity to create a supply chain for the UK and for Europe and elsewhere in the world in rig availability et cetera. There is also a huge opportunity for protecting jobs from other industries, including the petrochemical industry et cetera. Tax revenues from the North Sea are a significant part of this economy. As the North Sea declines, I see shale gas and coal-bed methane providing an opportunity for replacing some of that tax revenue to the Exchequer. Again, I think that is hugely important.

Finally, the industry has already announced that we are going to give significant community benefits to the local communities that we work in. That is a huge economic opportunity for local communities to share in the benefits of our industry.

**Dan Lewis:** I would add to that. You touched on something very interesting: the component of natural gas liquids. So far, as I understand it, the exploration in Lancashire has been mostly dry. It seems that next year the British Geological Survey is looking at places in Scotland and on the Weald that are much shallower and that will be wet, which means that they will have significant quantities of ethane, propane, butylene et cetera. It is sometimes overlooked that the Grangemouth dispute was not really about natural gas pricing. In terms of being competitive for the chemical industry, it is about ethane. In America, the ethane projection rates are now so high, and are projected to rise to 500,000 barrels a day, that they are struggling to get rid of it. This is how they are planning to save Grangemouth by

importing that ethane from the United States where it has become so cheap and where there are no export limits on NGLs as opposed to natural gas.

**Q59 Lord Shipley:** Can I pursue the economic impact and the comparison between the US and potentially the UK and whether you think there is, in economic terms, anything like as much potential as there was in the US? I refer to the level of US energy prices, their ability to repatriate manufacturing back into the US because of low energy prices and their ability to export. Is all this potential for us? Are we likely simply to use UK shale output in the UK? Is there potential for export? How do you see the economic outlook in the UK as a consequence of shale production? Is it anywhere potentially on the same scale as the US?

**Dan Lewis:** If I could just start on the prices, obviously in the United States you had a very dramatic fall in the price of natural gas over a short period of time from being the same price as it was here, which if you convert it was around \$10 per million British thermal units. It is now about \$3.5 million, \$3.7 million. The current price here is two and a half times what it is there. Will we see as dramatic a fall as quickly as in the United States? We said in our report for the Institute of Directors that it is too early to say what the impact will be on prices. However, I do see it as being a benign contributing factor. There are many things that influence natural gas prices in Britain. Many of those things are outside the UK. The question is how much gas we would have to produce domestically in order to start to drive down the overall price. Before then, I think you will see a decline in volatility in winter gas prices. That would be a very welcome relief to the spot market when it gets cold.

**Ken Cronin:** I will add a couple of things. First, we need to look at what the future holds. By 2025, the Department of Energy and Climate Change predicted that we will have an import dependency of about 75%. A lot of that will be LNG from places like Qatar and pipeline gas through Europe. That will bring with it price volatility, particularly as we will now see gas for the first time being able to be transported to places of demand. You only have to look at what happened during the Fukushima disaster when a significant amount of LNG went towards the East and prices went up significantly. If we had had an issue with a very cold winter at that time, we would have had to pay a considerable sum of money to get LNG to come to this country. I think there is an economic benefit there in terms of price volatility. You asked specifically whether we could use this in the UK. One of the interesting things about shale and coal-bed methane in this country is that it is local. I can see a place in the future where operators can develop shale and coal-bed methane and provide it to suit local industry and things like that. Again, that would be a benefit.

In terms of energy prices overall, most reports show that it currently depends on the quantity of shale gas that we can produce in the UK and Europe.

**Lord Hollick:** Mr Lewis, have you been able to calculate the level of production that would be necessary to bring prices down in the UK?

**Dan Lewis:** That is a very good question. I would have to say no. It is a fiendishly difficult calculation to make. If we were to produce massive amounts, much more than we need and could get rid of, then of course that would bring down prices. In the real world—and certainly we have modelled for what we think is a realistic, high level of production—up to about one-third of UK demand could be met ultimately by UK shale gas production: that is, natural gas demand.

What impact will that have on prices? I will, if I may, refer to my earlier answer. There are still many other factors outside the UK that influence those prices. How much more production will the United States have that will be exported to the Pacific basin? Will

Chinese shale start to become good? Will parts of mainland Europe start to produce and will a lot of the existing contracts, many of which are oil linked in some form or another, start to be unwound and linked to a different pricing mechanism, such as the Henry Hub in the United States? Some Japanese companies have just started signing those types of contracts. I think there are lots of factors there, and I wish I could give you a precise answer, but I fear I cannot.

**Q60 Lord May of Oxford:** I have a double-barrelled sort of question, partly as a follow up to this one. Other witnesses have suggested to us that whatever the regulatory framework in the UK, we have no experience of the large-scale exploration of gas and oil onshore. That makes for uncertainty. I want to go beyond that and ask how far British energy regulation needs to take account of the EU dimension. Should the EU Commission have a say over our regulatory framework, and will the mining waste directive apply to this?

**Ken Cronin:** Taking the experience of the UK first, this industry has been going in the UK since 1851, when we produced shale for the first time in Scotland. In 1874, we produced natural gas in Sussex for the first time. We have drilled more than 2,000 wells in this country, of which 10% have been hydraulically fractured. We currently have 120 operational sites and more than 300 operational wells, and we produce 25,000 barrels of oil equivalent per day, which is about 1.5% of the UK's consumption. We also have the largest onshore oil field in Europe at Wytch Farm in Dorset. So I think we already have a significant amount of experience of working onshore with oil and gas extraction. I have no concerns about the regulatory framework in the UK.

With respect to Europe, the industry currently in various different guises has to comply with about 14 separate EU directives ranging from water directives to minor waste directives, et cetera. What this industry is very good and practised at is complying with the regulation that is put forward in a way that is sensible, efficient and environmentally sensitive. Yes, there are challenges, some of them around mining waste et cetera. We are working through those challenges with the Environment Agency and the operators as we speak. I have no concerns with respect to that process.

**Dan Lewis:** If I may just add to that, one of the concerns that has been raised is that there are not enough rigs in Europe, for example, to undertake this work. I understand that there are 1,700 to 1,800 rigs at work in the United States. I think we would be looking at needing possibly only 100 to 200 maximum. I understand from talking to people in industry that the wait time to get one of those rigs once you order it is somewhere between nine months and even a few weeks in some cases. Compared with all the other delays that might happen, I do not think that on that point alone it is a barrier to entry.

**Lord Rowe-Beddoe:** Could I just bring you back to an earlier point, Mr Cronin, just for a moment? It would appear from your references that you are content with the current UK regulation and the infrastructure. Is that right?

**Ken Cronin:** Yes, I think we have a very good regulatory system in the UK. I have often been quoted as saying that the licensing requirements have a quadruple layer, where you have DECC at the very start, the Environment Agency looking after below the surface and above the surface environmental impacts, the Health and Safety Executive involved in well integrity and a process of independent well examination on top of that, and finally DECC again, looking after the process of hydraulic fracturing and flaring and venting. I think it is a very good regulatory system.

**Lord Rowe-Beddoe:** So you are content with it as it is? Do you think there should be further incentives, for example, in taxation or fiscal support?

**Ken Cronin:** In terms of fiscal support, the current Government have consulted on a proposed tax regime. They have yet to announce the full results of their consultation, but we have written back favourably with respect to their proposals.

**Dan Lewis:** If I may diverge a little, I would suggest that as this is a very new regulatory regime in terms of what we are trying to achieve, it should always be open to review. The test has to be: what is the production level and what is the level of public acceptance?

**The Chairman:** I am sorry, we are voting, so we will have to have a delay while we go to vote. We will be back as soon as possible.

*Sitting suspended for a Division in the House.*

**Q61 The Chairman:** I think we might recommence. The question I was about to ask you was on the tax regime. The Chancellor has said that he wants to make “this new tax regime ... the most generous for shale in the world”. Could you indicate what sort of things you think need to be in it to achieve that?

**Ken Cronin:** The first thing to say, and something that is very misunderstood, particularly by the general public, is that any tax regime that you put in place—certainly the tax regime that is being put forward—only really kicks in once the industry starts to make profits. It will be well into the production phase of our lifetime before profits are made. The current taxation system is 62% for onshore oil and gas companies in the UK. The proposal at the moment is an allowance based around capital expenditure. Our view as an industry is that that will reduce the 62% to around 50%, which is clearly a welcome incentive, but the reality is that it only kicks in once we have started to make profits. As I said before, the elements that we have in place for the regime as proposed, including an allowance based on how much capital expenditure you spend, is probably the right one for the industry and is very similar to the small-field allowance offshore and so builds on that process and that experience.

**Lord Griffiths of Fforestfach:** I would like to come back to the issue of regulation. You said earlier that we have a system at present in the UK that you are very happy with, by which I understood that it protects consumers and at the same time the environment. My question is really about Brussels. In other areas of the UK, especially the financial sector, we have seen a great divergence between the UK's interests and Brussels' interests that is not related, I think, to consumer protection but to a different philosophy of regulation and so on. The European Commissioner for the Environment has said that he would like to see a policy develop that is the same for all countries. I just wonder to what extent you think that is potentially a dead hand on successful exploration in the UK.

**Ken Cronin:** That is a very good question. It is also very apt. I spent a significant part of last week in Brussels. From what I understand, DG Environment would like to introduce a shale gas directive that would be an overarching directive of all other directives that are currently in place. The UK industry, I think supported by a number of our European colleagues, does not really want any further regulation to be put in place. We would like guidance to be put forward on the current regulation. There are a number of questions, in particular on the mining waste directive, on which guidance given to all member states would be helpful for interpreting the current legislation. DG Environment has put forward the concept of this

new shale gas directive on the basis of public perception. The reality for us, we believe, is that additional regulation will not improve public perception but the enforcement of the current regulation will. One of the things that we would like to see in this country is for us to get on and drill wells in this country through the exploration phase and to show people that we can do that environmentally sensitively, as we have previously.

**Lord Lawson of Blaby:** May I follow that up? There is a widespread suspicion that those who are pressing for this all embracing overarching EU environmental directive are doing so because they want to prevent the development of Europe's indigenous reserves of shale gas and oil. Of course in France, where I live as you know, the Government have said clearly that there will be no development of shale oil and gas. You mentioned that when you were in Brussels you thought that the British Government were trying to get support from other Governments to oppose this. Any such regulation would be subject to qualified majority, would it not? You said that you have just been to Brussels. What do you think the line-up is? Do you think there will be a qualified majority to support this kind of directive, or do you think there will not be?

**Ken Cronin:** I think the jury is out. I think that certain countries in Europe would like to have their own indigenous sources of gas and not to be dependent on, for example, Russia. I think that some countries such as France have made their own political decision in their own country but have not yet made clear how they would vote in the European dimension. One of the interesting things is that I was there during the Grangemouth scenario, and a lot of European countries are now starting to get the idea of feedstocks being an important part of the gas equation and that this is not just about power. But I think the jury is out. That is the honest answer.

**Lord Lawson of Blaby:** Thank you.

**Q62 Lord McFall of Alcluith:** How do you respond to the concerns of NGO witnesses who have been before us who say that extensive fracking in the UK would damage the environment and would mean missing the decarbonisation targets?

**Dan Lewis:** On a number of levels, the first point to realise is that this is an extractive industry that has never had a death. That is a very impressive safety record compared with other extractive industries. In terms of missing the carbon targets, is that not going to happen anyway? It seems to me that a huge level of investment is needed that is not happening because the money is not there and because many utilities have a very high debt profile. It is simply not doable. If you look at what drives investment for renewables, it tends to be policy. So I do not really buy into the argument that it is shale gas that will undermine renewables. I think that they can work in tandem. That has certainly been the case in the United States.

**Lord McFall of Alcluith:** Could you elaborate on the point about damaging the environment, apart from the point about no one having died?

**Dan Lewis:** Everything that we do has an environmental impact, but the actual footprint of the area would have a pretty minimal impact. It seems that the geology of the shale that we have seen in Lancashire is favourable to that because it is so thick and deep that you can drill down deep and horizontally a long way. Whereas in earlier plays in the States you would have multiple wells over quite large areas, you can have one well pad producing a lot more gas with a much smaller footprint.

**Lord McFall of Alcluith:** Do you think that the concerns of those who have protested on environmental grounds—and we have seen the protests out on the road—are misconceived and that they just do not understand the situation?

**Dan Lewis:** Well, it is hard to see entirely what they are getting at. Everything that we do has a trade off. We are going to have to buy a lot of gas one way or another. Are we going to buy it from abroad at a premium and at a cost to the balance of payments, or would we like to produce it ourselves and get some jobs and some taxes, and even some price stability? I am not going to say that the environmental impact is zero. I am not going to say that everyone should approve of this, because of course they will not, but I do think that of all the things that could be done this is actually a net gain relative to, for example, continuing coalmining.

**Lord McFall of Alcluith:** Do you think there will be a struggle to change public opinion on this issue?

**Ken Cronin:** If I may speak on behalf of the industry, taking the environmental point about the impact first, I think there are a lot of myths out there that have been propagated by NGOs. There have been various reports by UK institutions—I know that the Royal Society is presenting next—in which academics have commented that the regulation in this country is sufficient to manage the risks of shale and coal-bed methane extraction. Some 2.5 million hydraulic fractures have been completed in the world so far, and there have been no cases whatever of, for example, hydraulic fracture fluid ingress into water supplies. We have a very strict regime for well integrity in this country. It is sufficiently more stringent than the US's. I have no issues with respect to the environmental sensitivity that this industry will work under.

In terms of climate change, Dr Mackay and Dr Tim Stone published a very good report in September giving the various different carbon emissions and emissions data and comparing LNG, pipeline gas and shale gas. Again, that shows that there is a significant positive environmental impact on climate change of using indigenous sources of shale.

The last thing I would like to say is that I get very frustrated that the debate by the NGOs has been deliberately polarised. The facts are that we will need low-carbon forms of energy for the future, whether that is wind or nuclear. They are quite expensive at the moment, and we need to have a transition. The transition has to be gas, and it will have to be shale gas. What interests me is that we have two very separate policies: one from the US and one from Europe. The US has reduced energy prices and reduced carbon emissions, whereas in Europe carbon emissions are going up and coal burning is going up—this country is burning more coal. I do not think that we have got it right yet, and we need to accept that there is a transition from where we are now to a much lower carbon form of energy. We also have to recognise that it is not just about electricity; it is also about heat.

**Dan Lewis:** If I may come back on that as well, the United States now has the lowest per capita CO<sub>2</sub> emissions since the time of Eisenhower. Clearly that would not have been possible without shale.

**Q63 Lord May of Oxford:** I agree with you that on the trajectory to 2030 and beyond, shale gas can play a really important part, and I disagree with NGOs. On the other hand, as you are probably aware, the current recommendations from the climate change committee are that the target is to strive to have power generation completely decarbonised by 2030. If one were to take that seriously, I would have thought that that was a bit of a problem,



because no industry wants to develop itself knowing that it has a horizon. I wonder what your thoughts are on that.

**Ken Cronin:** I bring you back to some of the comments that I have previously made. First of all, electricity generation may well be low carbon earlier than other forms of energy, but the reality is that you will still need gas, and sufficient gas, to balance the system, amid all the intermittent renewables. Secondly, as I said before, we ignore at our peril the fact that gas produces 80% of our heat, both residential and industrial, and a significant proportion of our feedstocks to industry. Gas very much has a part to play.

In terms of electricity generation, even DECC's own forecasts show a significant increase in the number of gas-fired power stations that are required in this country to 2030.

**Dan Lewis:** I believe that the climate change committee also anticipated there being 1.5 million to 1.7 million electric cars on the road by 2020. We are clearly a very long way short of that happening, so we have to take a step back and start looking at what is realistic, achievable and affordable. I do not think that we have had enough of a realistic debate about that.

**Q64 Baroness Blackstone:** Before coming on to the next question, can I just push you on something that you said, Mr Cronin, on evidence from overseas? You claim that there was no evidence that there had been any direct environmental damage through the leaking of shale gas liquid into the water supply, for example, but do we really have enough proper evidence from the US, given the lack of baseline monitoring there?

**Ken Cronin:** I said there was a lack of evidence that hydraulic fracturing fluid was getting into the water supply. I agree with you that quite a lot of the problem with these US studies is that there is no baseline to start with. In the UK, every single operator has signed up to doing baseline monitoring of all their sites prior to the start of drilling. We will also monitor during drilling and after drilling. That will give a better indication of where we are. One of the things you will find is that the methane in water, for example, is probably going to be higher at sites that we drill, purely on the basis that methane is in the vicinity.

**Baroness Blackstone:** Thank you. Could I then go on to the bigger question? Given that there could be the large-scale development of shale gas in this country, do you see as a result of that some major changes in our energy policy? Both of you touched on that just now, but I wonder whether you could go into that in a bit more depth?

**Ken Cronin:** The big change we will see over the next 10 to 20 years is the position of coal and the position of imports. We currently produce about 50% of our electricity from coal, and with more indigenous forms of shale gas and coal-bed methane we will see a significant displacement of coal quite quickly. Then we will see a displacement of LNG and pipeline gas thereafter. Whether that impacts policy is probably a different matter. A lot of people out there talk about the fact that shale gas might impact on renewable energy investment, for example. I cannot see that, because the targets for coal and imported gas rather than for renewable energy are quite clear. Renewable energy should flourish under shale gas.

**Baroness Blackstone:** Will there be any impact on the development of nuclear power?

**Ken Cronin:** Nuclear power is a very different beast. It is very large and very expensive in terms of total investment required at the same time, but it is also baseline in terms of generation. As I said, I think there is a very big place for heat in terms of gas, and gas generation in terms of the balancing mechanisms et cetera. Again, I do not see shale gas having any impact on nuclear whatever.

**Dan Lewis:** We are seeing a trend away from the really big investment numbers that were talked about some years ago. Ofgem, with its Project Discovery, talked about £200 billion being spent by 2020. Then came the recession. Now, more recently, the figure has been more like £110 billion, and in some quarters it is more like £60 billion, £70 billion or £80 billion. Where shale gas has an advantage, which is still fairly latent to be appreciated, is that it is not asking for a subsidy. There seems to be growing consumer discontent with bills, which may or may not be to do with how much is given over to big renewables and forthcoming nuclear, but certainly the nuclear programme is much less than it was meant to be.

**Q65 Lord May of Oxford:** We have heard from at least one previous witness that any delays in permitting or encouraging the development of shale gas could mean that the UK misses the boat, investment goes elsewhere and we are left importing gas instead of producing it. Do you share these concerns?

**Ken Cronin:** I think that could be held for any form of energy investment, whether it is wind, nuclear et cetera. I think we have a really good chance of this happening in the UK. We have a supportive Government and supportive policy. We are working through the regulatory environment. We are working hard at local community level on public perception et cetera. I think we have a really good chance of this happening, and I think we are probably ahead of our colleagues in Europe.

**Lord Hollick:** The evidence to date suggests that local communities are unpersuaded of the benefits of shale gas in their backyard. What steps need to be taken by the industry and the Government to change minds?

**Ken Cronin:** The first thing to say is that we all look back with respect to the issues around Balcombe during the summer, but I should also remind the Committee that we drilled five other exploration sites during that period without any issue. We need to work equally hard in every single local community to ensure that they understand what we are doing, what the risks are and what we are doing to mitigate. Equally, if not more, important is making sure that local communities understand the regulatory process in this country. In my written evidence, one of my recommendations, which I am pleased to say government is already acting on, is to ensure that at a local community level government and regulators impart information about the regulatory system to give confidence to local people that we have a very robust and enforced regulation system in this country. That alone will give a lot of comfort to local communities that these things will be done right. The other thing to say, drawing back on the comment that I made earlier, is that we have been doing this since 1851. Once you start talking to local communities about the fact that there is a site down the road or around the corner that has been going for 30 years in areas of outstanding natural beauty, I think that gives confidence, too. Finally, there was a lot of coverage over the summer of one site. I think that that is not going to be representative of the industry moving forward.

**Lord Hollick:** Do you think that the payments to local communities are adequate incentive to secure support?

**Ken Cronin:** I think the economic benefits to this country as a package, as we have talked about, are a huge incentive for the country to do this. We introduced at the end of June community benefit packages that in production will give £5 million to £10 million per local community. That is not a payment or a bribe; that is a reward for hosting one of the sites for the rest of the country. We think that that £5 million to £10 million is a significant

injection into the local economies. We look forward to being able to do that and learning from that experience.

**Lord Hollick:** Would that be distributed on a household by household basis?

**Ken Cronin:** We have yet to put all the information into the public domain on how the whole process will work. We are currently listening to a lot of people—MPs, local councillors, local people et cetera. Certainly, the No. 1 principle behind this is that money will be given to local communities and decisions on what it is spent on will be taken by local communities and no one else.

**The Chairman:** What feedback on that are you getting at the moment, or is it too early to say?

**Ken Cronin:** The feedback, as you would expect, is that one person says one thing and somebody else will say completely the opposite. Overall, we are getting positive feedback for the actual proposal itself, which is a good one and is at a sufficient level to have a significant impact on local communities.

**Lord Griffiths of Fforestfach:** Has the Chancellor commented on it?

**Ken Cronin:** The Chancellor did comment on it and the Secretary of State for Energy and Climate Change did, too.

**Lord Griffiths of Fforestfach:** And the Chancellor approved it?

**Ken Cronin:** The Chancellor welcomed it, but it was an industry scheme.

**Lord Griffiths of Fforestfach:** It is not often that the Treasury allows funds to go elsewhere.

**The Chairman:** There would be no tax benefit coming in. As I understand it, it would be the companies that provided it.

**Lord May of Oxford:** A quick question. As distinct from what you euphemistically said was not a bribe, what about the impact on local employment and jobs? To what extent is that an incentive?

**Ken Cronin:** Alongside the community benefits, we also published in June a community engagement charter which each operator that is part of my organisation signed up to. Part of that is a commitment to provide as much local community benefit as possible, whether it is supply chain or jobs. Clearly, some of this will be on a more regional basis in terms of local communities. We need only look at how Aberdeen has fared during the past 20 or 30 years as part of the offshore industry. I think that certain parts of the country would benefit equally from our industry.

**Q66 Lord Smith of Clifton:** We have touched on this, but perhaps you could be a bit more specific. Do you believe that shale gas if developed commercially would displace imported gas, coal, nuclear or renewables in the UK's energy mix? Could you indicate which will suffer most and which will suffer least of those different energy sources?

**Dan Lewis:** We actually modelled for this. Looking at DECC projections for UK gas demand and projected imports, we thought that half of those imports could be met by UK shale gas production. If you were to ask who would be out of pocket, it would be those gas exporters to us. Nuclear, and a number of the other players, is really driven now by EMR. The EMR level of subsidy, if I may call it that, is running at about £7.2 billion a year until 2020. That is still in place, so I do not see a direct replacement there.

**Ken Cronin:** To a certain extent, it is very much for the market to decide, because we live in a market-based system. If I were to turn the question slightly around, in terms of climate change it has to be coal first. We are burning more coal than we have ever done before.

**Lord Smith of Clifton:** Neither of you mentioned renewables.

**Ken Cronin:** I do not see that the renewables industry should have any fear of shale gas in this country. Shale gas will give the opportunity for a transition to enable renewable energy to become cost-competitive.

**Dan Lewis:** If there is one effect, and if it does turn out that shale gas prices bring overall prices lower, it is perhaps not a bad thing that there is some price competition for renewables, because prices have not fallen as much as projected.

**The Chairman:** That brings me to my question. We have seen huge public and media focus on energy price rises. What impact do you think the development of a material volume of shale gas in the UK would have on prices to consumers and, of course, businesses?

**Dan Lewis:** Pricing to UK consumers is very seasonally affected. I think that the first impact you would see of a significant contribution from UK shale gas would be in winter pricing at times of peak demand. Where we see spikes in the natural gas price in the UK, it is because of a shortage of availability within these shores. LNG cargoes can be brought in, but they never get there quite quickly enough and certainly not quickly enough to lower prices before they have gone up. You might say that it is not really in their interest to do so either. I think that would be the first major contribution. As I alluded to before, there are a lot of factors at play, and the key has to be to start to unwind some of the contracts that are oil linked and start linking them to the Henry Hub in the United States. I see that Centrica had a contract earlier this year that did that. That would take place from 2015—there are some other players as well. The more of that we see, the more we will see an overall decline in natural gas prices across the board, across the world, and less volatility. In a way, what we do or do not do here in the UK will be a contributing factor, but perhaps not a very big one.

**Ken Cronin:** From quite a lot of people who have already given evidence, and certainly in our written evidence, the comment is that it is too early to tell. The reality is that we need the next two or three years to do the exploration work. We will then have a better understanding of gas flow rates, costs et cetera. But I do not want this debate to be fixated on just one element. This is an economic package of job creation, increased tax revenues, supply-chain jobs et cetera. One of my ambitions is to ensure that if we have a shale gas industry in Europe, the UK benefits from the beginning in the supply chain, jobs, manufacturing of rigs et cetera in a way that we probably missed out on with offshore wind.

**Q67 Lord Lawson of Blaby:** May I just make one quick observation, Mr Cronin, and then ask a question which I think lies behind a lot of the questions that you have had from around this table? The observation is, as you said a moment ago, that we have a market-based energy system in this country. Many experienced observers such as Dieter Helm and Malcolm Keay, both of whom will be well known to you, feel that once the current Energy Bill is on the statute book, which I presume will be quite soon because it is coming right towards the end of its parliamentary passage, it will no longer be a market-based system. Leaving that aside—you have indicated, quite rightly, that it is too early to tell for sure and that we need to get ahead with the exploration if we are going to find out—you both seem to think that there is probably a great opportunity here for the British economy and for the

successful development of shale gas in particular, and maybe shale oil, too. I was interested incidentally that you mentioned Wytch Farm, for which I have great affection since I privatised it in 1982. You seem to suggest that there is probably a great opportunity here with our entire indigenous reserves. What is the biggest single thing that you fear might prevent this opportunity being realised?

**Ken Cronin:** Planning and permitting is probably the biggest obstacle that we have to getting this right in the UK. We have quite an adversarial approach to planning and we have to work very hard as an industry to convince all the stakeholders that this is the right thing to do. I am not suggesting for one minute that the planning process is wrong, but it is challenging and we need to work very hard to go through that process. I do not think that that would be any different if I were sitting here trying to build a nuclear power station or an onshore wind farm. I think that the planning process is challenging. As I have said before, we have some challenges in the environmental permitting that we are working through with the Environment Agency at the moment. Getting those two right is the key to this industry moving forward.

**Q68 Lord McFall of Alcluith:** The Scottish Government's stated aim is to generate half of all electricity with renewable energy by 2015 and to generate all Scotland's electricity by renewables by 2020, with the creation of 40,000 jobs. First of all, is that a realistic target? Secondly, do you think the phenomenon of shale gas will change that picture?

**Dan Lewis:** It was just last week that we had the dispute over Grangemouth. Next year, we are going to hear from the British Geological Survey about a stretch of land in Scotland. It is shallow and is what they call wet shale, and it may contain a lot of natural gas liquids. It is the natural gas liquids and their competitive price that keep the chemical industry going. Coming back to Lord Lawson's point, my greatest fear is the cost of not doing this. We can all quibble about how many jobs UK shale gas and oil might create, but I think that the downside is much greater in the jobs that could be lost. What you see at Grangemouth is just the start of some very tough times, because with the price of natural gas liquids still falling in the United States and the petrochemical industry gearing up, we are in big trouble. It is fascinating that 90% of diesel in this country is now imported, but last year more than 50% of new cars for the first time had diesel engines. It is within our power. Scotland's renewables target is certainly ambitious. I would not want to bet on that coming true. A big part of the Scottish energy economy is still very much oil and gas, and they would neglect that at their peril.

**Lord McFall of Alcluith:** Yes, but will the existence of shale gas change that picture?

**Dan Lewis:** Well, it would probably be more shale oil and natural gas liquids, but it would certainly work in their favour as a positive contributing factor.

**Ken Cronin:** I live in Scotland; I should make that clear from the start.

**Lord McFall of Alcluith:** I did not recognise the accent.

**Ken Cronin:** No, I am married to a Scot. The reality is that, whichever system you employ in electricity generation, you will always need something to balance out intermittency. The most cost-effective way of doing that is through gas. Scotland also has very big ambitions for carbon capture and storage, which will play well into that environment. Scotland has not only significant shale resources but significant coal-bed methane resources, particularly in the central belt and particularly opposite Grangemouth. Again, that is going to be a huge potential source for Scotland. I do not think that the Scottish Government at present are as ambitious as the Westminster-based Government, but we are certainly working on that.

**The Chairman:** Gentlemen, we have covered a lot of ground in a comparatively short time, and that is due largely to your very clear, concise and to-the-point answers. We are very grateful. Thank you very much for coming.

## The Geological Society of London (GSL) and the Petroleum Exploration Society of Great Britain (PESGB)—Written evidence

- I. This submission has been produced jointly by the Geological Society of London and the Petroleum Exploration Society of Great Britain:
  - i. The Geological Society of London (GSL) is the UK's learned and professional body for geoscience, with more than 11,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government with a broad range of perspectives on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-specialist audiences.
  - ii. The Petroleum Exploration Society of Great Britain (PESGB) represents the national community of Earth scientists working in the oil and gas industry, with over 5,000 members worldwide. The objective of the Society is to promote, for the public benefit, education in the scientific and technical aspects of petroleum exploration. To achieve this objective the PESGB makes regular charitable disbursements, holds monthly lecture meetings in London and Aberdeen and both organises and sponsors other conferences, seminars, workshops, field trips and publications.
2. Between September 2012 and April 2013, the House of Commons Energy and Climate Change (ECC) Select Committee held an inquiry into 'The Impact of Shale Gas on Energy Markets'. Although some of the detailed questions it addressed differed from those set out in the terms of reference for the present inquiry, its focus was similar. It investigated the widely differing estimates which have been made of the amount of shale gas resource under the ground in the UK, how much of this might constitute reserves (i.e. the amount which can be economically recovered), and the possible implications for UK energy markets<sup>141</sup>. It reviewed similarities and differences between prospects in the UK and the US experience, and considered possible impacts on climate change and on investment in renewable/low-carbon energy technologies. The report of the ECC Committee inquiry was widely regarded as an authoritative and realistically comprehensive assessment of the policy environment and economic factors relating to shale gas development in the UK. The Geological Society responded to that inquiry and we subsequently identified a witness to appear in an oral evidence session, Professor Richard Davies (Durham University). Following the evidence session, we provided supplementary written evidence at the request of the committee. It is not clear to us why the present inquiry is being held on a very similar topic so soon after that of the ECC Committee. With this in mind, we believe that the initial and supplementary written evidence we provided to that committee last year is relevant to the present inquiry.

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<sup>141</sup> **Resource** is the amount of gas underground. **Reserve** is the amount of gas which can be produced economically – that is, which we can realistically expect to extract from the ground given current technological, economic and social/regulatory constraints. Another term which is sometimes used is 'technically recoverable' resource – this is the amount which could be extracted given current technology, but without reference to economics (cost of extraction and price) or social acceptability.

3. As recognised in the terms of reference for this inquiry, the British Geological Survey (BGS) released updated estimates of shale gas resources in the Bowland Shale in Northern England in June 2013. Its report gives a central estimate of the gas resource in place in the Bowland Shale of 1329 trillion cubic feet (tcf), a considerable increase on the previous 2010 estimate of 4.7tcf (though this was in respect of the Upper Bowland-Hodder unit only). The report also notes that the revised estimate remains highly uncertain. The extent of reserves which can be extracted economically is even more difficult to quantify. The reasons for this uncertainty are discussed in our submissions to the earlier inquiry (attached – see paragraphs 4-12 of our October 2012 original submission and paragraphs 2-4 of our December 2012 supplementary memorandum). The revised BGS estimate represents an important step in developing understanding of the shale gas resources of the UK. However, it does not in itself significantly change the economic basis for decision-making about shale gas exploration, regulation or production from that which pertained when the report of the ECC Committee inquiry was published in April 2013, particularly as it was already widely anticipated at that time that the new BGS estimate would be much higher than the earlier figure.
4. We would be pleased to discuss or provide further information on any of the issues raised in this document and the attached earlier documents, or any other matters relevant to the present inquiry which the Committee does not consider are adequately addressed here.

*September 2013*



## **The Government—Written evidence**

*This response has been prepared by the Department of Energy and Climate Change (DECC) with input from HM Treasury, Department for Business, Innovation & Skills (BIS), the Department for Communities and Local Government (DCLG), the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA).*

### **Introduction**

1. The Government is pleased to submit its views for the Committee's consideration as it takes forward its Inquiry into this important subject.
2. Unconventional gas and oil reserves, and particularly shale gas reserves, have the potential to have a significant impact on future gas markets. This has been apparent in the United States. Between 2007 and 2012, US net gas imports fell by 55 per cent and by 2020 the US is expected to be a net exporter of natural gas. This has increased US security of supply and improved the US balance of payments, as well as significantly reducing the costs to consumers of gas and electricity, particularly helping the competitiveness of energy-intensive industries. The extent to which the US experience can be replicated in the UK is uncertain. However, the Government is committed to ensuring that a world-leading framework for investment is in place so that if the geology should be favourable, the industry can prosper.

### **The industry is still in an early phase of development**

3. We are at an early stage of development of unconventional gas and oil production in the UK. At present, there is limited exploration activity. Scientists from the British Geological Survey (BGS) have estimated that the total volume of gas in place in the Bowland-Hodder shale in northern England is some 1300 trillion cubic feet (central estimate). To put that figure in context, if one tenth could be produced, that would be equivalent to more than 50 years' current consumption. The BGS study is the first in the UK to provide investors, operators and regulators with an indication of where to target future exploratory drilling. But only further exploration and appraisal activity can determine the extent to which the resources are capable of commercial production. The industry estimates that it will have to drill up to 50 wells over the next 2 years in order to establish the commercial viability of extracting shale gas.
4. It would be irresponsible of the government not to do everything it can to promote the safe and sustainable exploration and development of shale gas. Accordingly, it is putting in place the regulatory conditions, planning regime and fiscal framework necessary to encourage the development of these exploration wells. Only once this activity has taken place will it be possible to answer more confidently questions about the potential for production and the expected costs of any potential production.

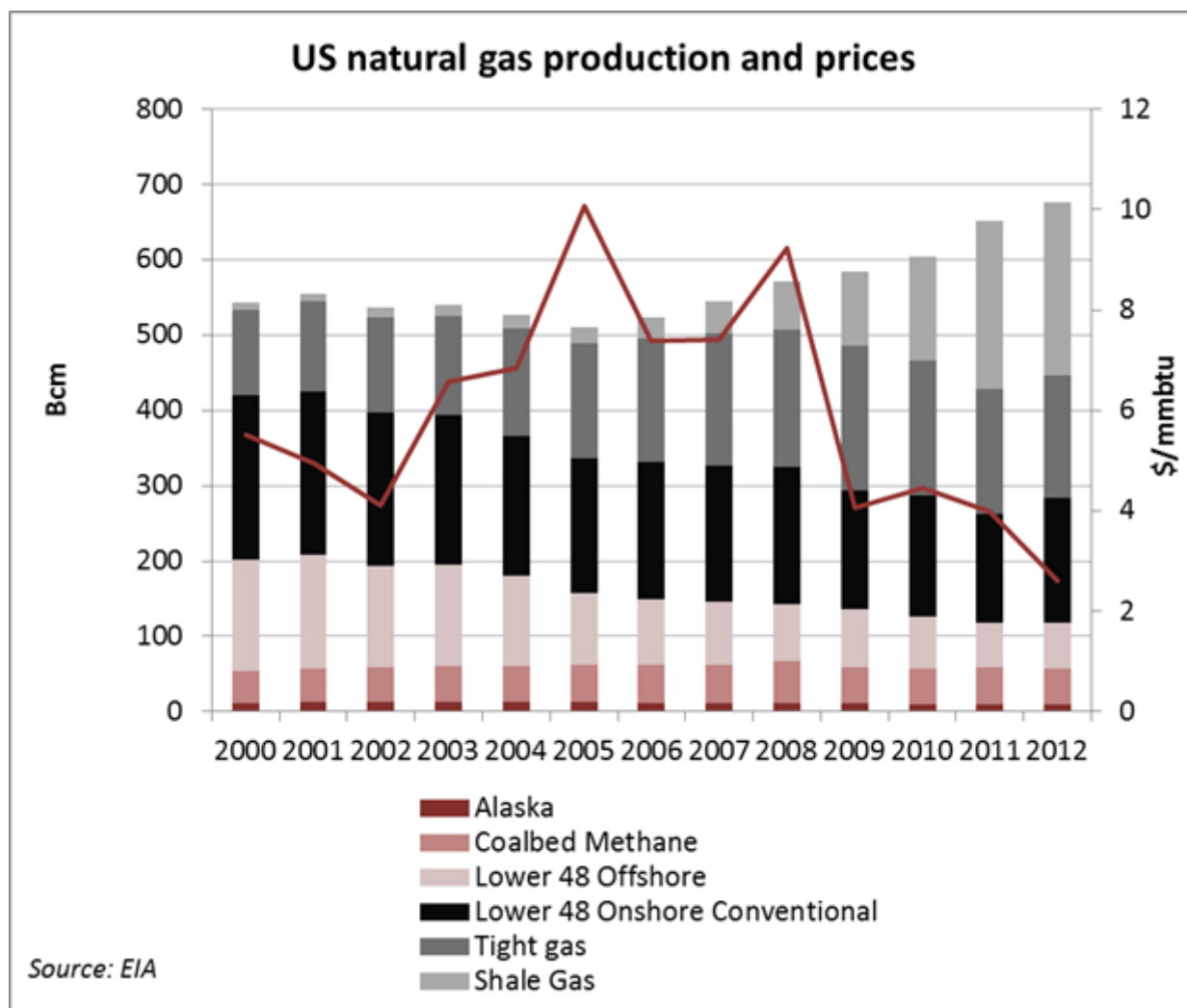
### **Potential energy security benefits from UK production of unconventional oil and gas**

5. There are considerable potential energy security benefits to increased levels of unconventional hydrocarbon production in the UK. These apply in particular to potential production of gas.

6. Recent assessments by Ofgem and by independent consultants for DECC have found that the chances of a disruption to gas supplies affecting protected customers are very low. A diverse range of gas sources contributes to this positive supply security picture, ensuring we have alternate supply sources if there is a problem anywhere in the market. The UK receives gas from the UK continental shelf, Norway, the EU, global markets via LNG and storage facilities.
7. Given the important role gas plays in our energy mix it is essential that we maximise gas security of supply where it is good value for money to do so. Unconventional gas production would provide a new source of gas supply for UK consumers. Increasing reliance on imported gas brings new sources of gas and adds to diversity, but can expose the UK to new gas supply risks, whether from geopolitical events disrupting long import supply chains, or from diversions of gas supplies driven by higher prices in other markets. As UK conventional production continues to diminish, so the potential impact of these risks increases. Onshore unconventional production could mitigate these risks.
8. The same benefits attach to unconventional oil production, although to a lesser extent given the higher levels of oil stocks and greater portability of oil and oil products compared to natural gas. We are also much better able to regulate production techniques of domestic compared to foreign production to ensure that associated emissions, impact on the environment and so on are acceptable to us.
9. Shale gas activity in the UK is very much in its infancy and it is too early to make any useful assessment on the extent of the impact of domestic shale gas production on UK energy security. DECC will continue to monitor the potential effect of shale gas on the UK's security of energy supply.
10. However, the Government is clear that if significant resource could be developed in a safe and environmentally sustainable way, this would bring energy security benefits to the UK. The Government is therefore committed to enable the exploration of UK shale gas in a safe and environmentally sustainable way to establish its potential.

**Potential for unconventional production to lead to lower prices for gas and for oil**

11. The potential for increased levels of unconventional production of gas to lower market prices has been clearly demonstrated in the US (see chart).



12. There are significant differences between the US and the UK. Unlike the US, the UK is also closely integrated with other energy markets in our region. Accordingly, we would not expect a repeat of the US experience if UK production increased. Studies including by Navigant<sup>142</sup> suggest that in a number of scenarios, price impact may be small, though there are also scenarios where the impact is higher, noting that the Navigant report found that shale gas production outside the UK might have an even greater impact than UK production in putting downward pressure on UK prices. Failure to explore the potential of shale gas could result in UK gas prices being higher than they might otherwise be, as large volumes of shale gas production in the UK could be expected to exert downward pressure on UK gas prices.

13. International gas markets have already been influenced by unconventional gas production in the US. Because of reducing US import demand, LNG supplies from third countries were able to satisfy increasing demand in Japan following the Fukushima earthquake in 2011, and associated rising demand for gas for power generation. In this way, the rising level of US production has already had an influence on global gas markets. We would expect this influence to increase, whether in the form of direct supplies of shale gas to the UK or onto international markets from the US and in the further distant future,

<sup>142</sup> <https://www.gov.uk/government/publications/unconventional-gas-the-potential-impact-on-uk-gas-prices>

potentially other states, or satisfaction of domestic demand in other states that reduces global import demand below what it would otherwise have been.

14. Oil is globally traded and conceivable levels of UK unconventional oil production are unlikely to significantly influence prices. However, the IEA predicts that an increasing proportion of global oil production is likely to be unconventional; prices are likely to be lower if such production materialises than if it fails to increase at the rate projected.

### **Changes to domestic arrangements to encourage activity**

15. The Government is determined to ensure that our fiscal and regulatory arrangements should facilitate investment in exploration and, should that be successful, production. In March 2013 it launched the Office of Unconventional Gas and Oil which aims to promote the safe, responsible, and environmentally sound recovery of the UK unconventional reserves of gas and oil.

16. The Office is not a regulator, but plays a key role in co-ordinating activity on shale across Government. We have taken important early steps since the establishment of the Office. The Department for Communities and Local Government (DCLG) has published planning guidance that clarifies the interaction of the planning process with the environmental and safety consenting regimes. The Treasury is consulting on fiscal measures to incentivise shale exploration and development, recognising the high upfront costs associated with shale gas projects. The Environment Agency (EA) has announced actions to streamline and simplify the regulation of exploratory activity while maintaining environmental protection. As a first step it has published technical guidance for consultation.

17. The Office has also led on working with industry to ensure communities will benefit from shale development in their area, and is now developing plans for engaging the public in a well-informed debate on shale.

### **Making sure communities benefit where unconventional oil activity takes place**

18. We are determined that there should be local as well as national benefit from unconventional oil and gas activity in the UK. The industry has now come forward with a scheme of community benefits so that communities which host shale gas developments can share in any proceeds. This package includes: £100,000 in community benefits to be provided per well-site where hydraulic fracturing takes place at exploration stage; 1% of revenues in community benefits at production stage; publication of evidence each year of how these commitments have been met; and regular reviews of this package as the industry develops.

19. Potential employment impacts of unconventional oil and gas activity in the UK will depend on the level of activity, which as explained above is uncertain, but the Government notes that the Institute of Directors in its 2013 study, "Getting shale gas working," estimated that the industry could directly employ an average of 74,000 workers once production reaches the levels set out in its medium case. Much of this employment would likely be in rural communities, including some where alternative well-paid employment is difficult to find.

### **Potential role of shale gas in electricity generation**

20. The role that gas produced from shale resources, either in the UK or elsewhere, may have in the future generation of electricity, as with the levels of electricity generation from other fuel sources, will be determined by the market within the constraints of the emission limits set by the Carbon Budgets. However, the Government's Electricity Market Reform is designed to incentivise investment in low carbon forms of generation.

21. Analysis for the Government's draft EMR Delivery Plan shows that whilst we may need more gas capacity in 2030 than we have today, the role of gas will increasingly become one of balancing a system with increasing amounts of intermittent and inflexible low carbon generation (i.e. wind and nuclear).

22. Within this projected lower use of gas in electricity generation, there is clearly potential for shale gas to contribute, whether produced in the UK or overseas. The potential contribution of UK shale will depend upon the speed of development of production here. With regard to imported supplies, UK companies including Centrica are already seeking supplies of gas in the US for importation to the UK.

### **Potential new infrastructure requirements, and supply-chain opportunities**

23. Great Britain already has effective and well-developed infrastructure for gas transmission and distribution. Gas network operators are required under condition of their licence to operate safe, reliable and efficient supply infrastructure and to meet all reasonable requests to connect. There will need to be additional infrastructure if there is to be extensive production at numerous sites on shore. The infrastructure requirement will depend upon the location of production and its extent.

24. If gas producers wish to buy additional capacity to supply the gas network (known as incremental capacity), gas network operators will automatically receive additional funding to support its investment in delivering that capacity.

25. BIS is working with DECC, with stakeholders from the regions and from the onshore sector to develop a supply chain mapping exercise. This will highlight the potential opportunities and identify the capacity and capability needed to meet this new industry. BIS is working to convene a steering group for the shale gas supply chain which will develop the specification and oversee the study.

### **Learning lessons from the US**

26. The Government believes that there are many lessons to learn from US experience, although allowance has to be made for the many differences in regulatory practice and requirements between the UK and the US, and between different States within the US. We have already benefited from many valuable reports from the US, including from the Secretary of Energy's Advisory Board and the National Academy of Sciences. DECC officials have also visited Washington, Houston and Pennsylvania over the last twelve months to learn at first hand from regulators, industry and other interest groups. We will continue to maintain close dialogue with US counterparts and to follow developments in the US closely, both in terms of science (much valuable work is being carried out in researching the development of the more mature industry there) and regulatory thinking.

**Dr Tony Grayling and Rt Hon Owen Paterson MP—Oral evidence  
(QQ 268-287)**

TUESDAY 28 JANUARY 2014

*Evidence Session No. 18*

*Heard in Public*

*Questions 268 - 287*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Lord Griffiths of Fforestfach  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Examination of Witnesses**

**Rt Hon Owen Paterson MP**, Secretary of State for the Environment, Food and Rural Affairs, and **Dr Tony Grayling**, Head of Climate Change and Communities, Environment Agency

**Q268 The Chairman:** Good afternoon, and welcome to the Economic Affairs Committee. This is the 14th public evidence session for our inquiry into the economic impact on UK energy policy on shale gas and oil. Secretary of State, you are very welcome. I do not know whether you wish to make an opening statement or go straight into questions.

**Mr Owen Paterson:** Good afternoon. Thank you for inviting me along, because this is an enormously interesting issue. I begin by introducing very briefly Dr Tony Grayling, from the Environment Agency, who handles the permitting of shale gas applications.

**The Chairman:** Thank you. May I begin with this question? You are reported to have said in a recent speech to the Local Government Association conference that some of the fears, at least those expressed by the opponents of fracking, had been massively exaggerated. I should stress, by the way, that although we are looking mainly at the economic implications, and we have been doing that very thoroughly, these environmental concerns have been coming up. That is why we want to focus today mainly on the environmental concerns. Do you think that some concerns are legitimate, and if so, what are they?

**Mr Owen Paterson:** Yes, of course there are concerns, but from day one when I arrived at Defra I stated that I am a very strong supporter of the extraction of shale gas in a fully responsible, measured manner. As Defra handles the environmental aspects of shale gas extraction, the one service that I can do the country is to make sure that the manner in

which shale gas is extracted is wholly professional and that we respect the extremely robust, internationally respected regulatory regime, which we have had in the North Sea and elsewhere for, what, over 50 years. I think we would do huge damage to the potential of the industry if were seen to be in any way reducing the rigour of our regulation.

My strong belief, having read some material from the States and having been to see the Environmental Protection Agency in America, is that there is huge economic potential from the extraction of shale gas and that we should pursue it but in a thoroughly professional manner. If conducted with the usual rigour, there should be no dangers to the environment.

**The Chairman:** Would you like to indicate the areas where fears have been massively exaggerated?

**Mr Owen Paterson:** First, the threat of earthquakes attracted significant attention. We have an earthquake somewhere in Britain, I read, every day. It is a very modest one and probably has the same drama in someone's house as a bus going past. There are obviously significant worries about water, and that is an absolutely classic case where, done irresponsibly without respecting regulation, extraction could cause significant environmental damage. But we have a whole range of directives under European legislation that were originally mainly addressed to the mining industry and which, if implemented correctly, would ensure that there was no potential damage to water. Then you have issues such as flaring and emissions, which again have been handled by the oil extraction and gas industry for decades. Again—I keep repeating—if this is done responsibly within our current regulation, I do not see that there is a danger to the environment.

**Q269 The Chairman:** There has been a report in the press this week that in relation to some of these environmental issues—i.e. the ownership of land under the surface of where wells will be put down and where fracking will take place—the department is considering overhauling the trespass and planning laws to cope with this problem: a problem, I have to say, that has been raised with us in our hearings. Is there anything that you can say on that at this stage?

**Mr Owen Paterson:** I have nothing new to add to what you might have read in the newspapers. This occurred very recently—in the last couple of days. Dr Grayling, is there any new development on that?

**Dr Tony Grayling:** I do not believe so. Of course it is a responsibility of the Department for Communities and Local Government, and it has recently changed some of the way in which it provides notification to landowners, but beyond that I have nothing to report.

**The Chairman:** Obviously to some extent it is to do with the differences between the way in which land is owned in the United States and here. We have had evidence that it is much easier to get permission there and that some of the rights go back to the owners who own rights well below the surface, which is different from the situation here. I assume that the concern is that in this particular area there might be further hold-ups in getting on with the exploration and so on if there are going to be all sorts of challenges by owners who own the land in which the exploration is to take place. Is this a concern?

**Mr Owen Paterson:** Delays to the whole industry are of concern because, as I have said, I see a massive potential advantage to this country. The responsibility for the various competences is spread around government. I do environmental. I think the issue you are referring to is done by DCLG. Think of what happened for centuries with coalmining. Coal seams run under land owned by a whole range of different landowners. That industry

brought great prosperity to this country, and I do not see why we cannot, with a bit of wit and good will, come to a similar arrangement for shale.

**Q270 Lord Lawson of Blaby:** That was a long time and people have become a lot more litigious in the intervening century or so. There are two problems with litigiousness, it seems to me, and I would like your comments. One is what Lord MacGregor has just been talking about: that if access is required from a particular landowner's land, he can strike a deal with the company that wants to develop the shale resources underneath it, the company can pay him something and he will agree to that, so there is no problem. If, however, it is not under his land but under the land of somebody else because they are drilling horizontally and do not need access to that person's land, the law of trespass comes in, so that is something to be looked at.

You say that the Department for Communities and Local Government is looking at this, but you do not seem to know much about it. There is a concern that there are at least four interested parties in all this: your department, the Environment Agency, DECC and the Department for Communities and Local Government. There does not seem to me to be quite the degree of understanding and agreement between all of them, and it is very difficult, therefore, to get rapid shale gas extraction on the safe basis that you would like to see if there is this bureaucratic muddle.

There is another problem on top of that, which is the fear that even though protesters, who are no doubt deeply sincere, have no case at all, they can demand a judicial inquiry into any proposed fracking enterprise, which will cause further considerable delays. Eventually the companies will give up and think that there are other parts of the world where it is simpler to get the permission. So we might have standards of environmental protection that are perfectly sound and, I hope, perfectly clear—they should be—and the Government's keenness to get ahead, which you have voiced now, but it is not going to happen.

**Mr Owen Paterson:** All I can do is speak for what I have done in my department. On turning up on day one, I was aware that there had been delays in issuing permits within the competence of my department relating mainly to environmental issues. I asked the Environment Agency to set up a one-stop shop so that there would be a concentration of experts within the Environment Agency who would handle the permits, who were used to the details and who I hoped, once the industry got into the swing of regular development, would be a pool of competence and knowledge to speed the whole thing up. If, say, there was an application from somewhere in the south-west of England, the experts would be able to refer to a permit that had been passed in the north-west of England and they would use that knowledge to hurry it up. That we have already done, and we are also in the process of speeding up the manner in which we issue permits. But I do not carve up the responsibilities and competences through government and I am fully aware that the industry may be frustrated by the fact that under our system DECC does energy and I do environment. All I can do is make sure that the areas under my competence are run as efficiently as possible and, as I have said, can offer a swift service to those applying, but are also able to reassure those who are concerned about the environmental aspects that these activities will be conducted in a thoroughly professional manner, respecting the current rigours of our legislation. Otherwise, as you have touched on, we would open ourselves up to legal attack.

**Q271 Lord Lipsey:** Lord Smith of Finsbury, when he came before us last month, said, "It is probably fair to say that groundwater contamination is the biggest environmental risk", and I do not think that what you have said contradicts that in any way. There seem to be



two issues, the first of which is whether we really have a truly robust system of regulations to protect well integrity. The second issue is whether, even if we do have such a system, the Environment Agency and the HSE can between them be trusted to get their act together to enforce those regulations. I wonder if you could comment on both issues.

**Mr Owen Paterson:** I think that Lord Smith is probably right. Worries about water, which we have touched on already, are the area that has attracted the most public attention. All we can do at Defra and through the Environment Agency is reassure the public that there is a whole range of directives—I can send a note to the Committee or I could read them out; there are probably around 10 different European directives—under which this activity has to be conducted legally.

**The Chairman:** I think a note on the list will be sufficient.

**Mr Owen Paterson:** Compared with other European countries, we have a professional organisation in the Environment Agency. It is a national organisation, which is different from many member states and certainly different from America, of course, where the federal system has definitely helped to get some projects going faster in some of the more disadvantaged parts of the United States. All we can do is reassure the public that our intention is to do this robustly and to respect the legislation. If we do not, as Lord Lawson has said, we will get JR-ed and attacked. I would like to see the establishment of a framework of regulation that is transparent and delivers clarity. What is exasperating the industry is that projects are constantly open to attack using another piece of legislation, probably conceived for a thoroughly worthwhile aim such as stopping radioactive water leaking from some old, disused coalmine. That is why we have had pretty close discussions with the Commission and I have been working with other member states that have a positive attitude to this. My view is that we would like to arrive at a position where permits can be issued rapidly through a process, and that once a decision is made it is final and it is not open to endless delay.

**Dr Tony Grayling:** Perhaps I can add to that. Of course it was a key concern of the Environment Agency that groundwater should be protected. We were particularly concerned that the regulations around well integrity should be good, so we commissioned our own review of the regulations, which are mainly overseen by the Health and Safety Executive and apply to the design, construction and operation of wells to see whether they would do a good enough job protecting the environment. That report concluded that they did and it has been published on our website. Of course, it is important that the regulations are properly complied with, and you are quite right to bring that up as a further issue. We have forged a working-together agreement with the Health and Safety Executive to ensure that we work together to see that the regulations are properly complied with. Moreover, because of public concerns around hydraulic fracturing, we have agreed that we will make joint inspections of hydraulic fracturing sites at key stages of the construction of the well and through the fracking process itself.

**Lord Lipsey:** The trouble is that not only do you have to see that it is done, you have to be seen to be doing it. We have had a litany of complaints about your agency and the HSE, with people saying, “The HSE has not visited here”, and promises that have been broken. These complaints have come from several individual groups. Of course, the more you cut off the procedure, as the Secretary of State is suggesting by having a sort of final decision, the more those groups can say, “Well, you did not really look at our case”. There seems to be a dilemma around what is actually going to deliver safety and what will convince those who are sceptical about that safety being delivered. That is a hard one to crack.

**Mr Owen Paterson:** Can I take up that point? You have indicated that by having a quick process, it is necessarily not going to be a robust process. I do not see that the two are mutually exclusive. If we have a team of experts in the Environment Agency who are really experienced at this, as the industry develops I think it will be possible to issue permits rapidly that at the same time are rigorous. Look at our record. We have been extracting hydrocarbons from the North Sea for decades. Wytch Farm near Bournemouth produces around 20,000 barrels of oil a day. I think it is located in an area of outstanding natural beauty. The operation is producing valuable hydrocarbons and is not damaging the environment. That is because the process is being conducted professionally and is being properly supervised by the Environment Agency. Look at what is happening now rather than listen to some of the scare stories. We have a long history of extracting oil and gas in this country and I think we should respect the manner in which our agency supervises it.

**Q272 Lord Smith of Clifton:** Secretary of State, would you please explain how the current environment permitting process works? How many permits do operators require and what are the timescales involved?

**Mr Owen Paterson:** I might hand this over to Dr Grayling. Our intention is to reduce the timescales—I believe that we are well under 13 weeks at the moment—with the intention of there being a standard permit. It was hoped that we would reach that point by this January, but we had an issue with hydraulic muds and therefore it will be later in the year by the time we arrive at a standard permit. However, I will defer to Dr Grayling as the expert on the detail of the issuing of permits.

**Dr Tony Grayling:** The number of permits and consents that are required on the environmental front will depend on the site in question, its geology, and what activities are actually proposed. As a minimum, a mining waste permit will be required, but depending on what activities are proposed and the local geology, a permit may also be required for the management of radioactive substances and/or for groundwater. An abstraction licence may be needed, along with several others that in some instances may be required. Most of these permits are brought together under the environmental permitting regulations, and in practice you can end up with one permit that covers several issues.

In terms of the timescales, over the past nine months or so we have issued permits to six onshore oil and gas exploratory sites. They have all been for conventional processes, and only one was for investigating shale. The average permitting time for the eight permits that we have issued in relation to those six sites was nine weeks.

**Q273 Lord Smith of Clifton:** You have enumerated six and you said that there may be more, but in the case of Cuadrilla, which applied to the Environment Agency for permits to sink three test exploration wells in August 2012, the eventual permit determination date was 31 December 2013. Can you give us any insight into why that process took so long?

**Dr Tony Grayling:** Those permits were in fact withdrawn in the final analysis for what I think was a combination of reasons. The first was that we were going through a learning exercise as an agency, while the industry was also going through a learning exercise on how to apply for the appropriate permits. Another key factor was that in the middle of the process, Cuadrilla needed to apply for renewed planning permission, and actually it was the planning permission that was the limiting factor. As part of that, Cuadrilla decided voluntarily to undertake an environmental impact assessment, and it is the case that an environmental impact assessment may produce findings that are material to the determination of the permit. At the point at which Cuadrilla decided that it was going to carry out an

environmental impact assessment, we had to agree with the company that we would delay determining the permits until such time as the environmental impact assessment was published. In practice, Cuadrilla decided to withdraw those permit applications. We are currently in pre-application discussions with the company and we are expecting it to submit a new set of applications for several sites in the north-west, along with planning applications, later this year.

**Lord Smith of Clifton:** Last week the Minister of State, Mr Michael Fallon, hoped to get down to a two-week period. How far along do you think you are towards achieving that aim?

**Dr Tony Grayling:** As the Secretary of State has said, we are in the process of developing proposals for what are called standard rules permits. We will be going out to consultation on the first set of those standard rules permits in mid February. Subject to consultation and agreement on those, once they are available, provided that the activities being proposed by the operator come within the remit of those standard rules, we will be able to issue permits within two to three weeks. The first set of standard rules that we are going to be consulting on will cover the basic drilling of a well with aqueous or oil-based drilling muds. They will cover the management and disposal of radioactive waste—because there are low levels of naturally occurring radioactive waste in some of the waste materials. They will also cover the issue of flaring if a permit is required under the Industrial Emissions Directive because the operation will be flaring more than 10 tonnes per day. That will cover a number of the activities that are associated with oil and gas exploration. The first set will not cover well stimulation, including hydraulic fracturing. It is our intention then to go out to consultation on a second set of standard rules over the summer with the intention of that second set being available early in 2015. At that point, many activities will be permissible through these standard rules permits.

**Q274 Lord May of Oxford:** Eight days ago the European Commission published a recommendation that laid down a number of minimum principles in relation to shale gas development. I realise that that is not very long ago, but I wonder to what extent you have been able to assess whether the UK regulatory regime meets these minimal principles, and in particular whether you think the recommendation highlights any gaps in UK regulation where action will be required.

**Mr Owen Paterson:** It might help the Committee if I give a bit of background on how we as a member state have been involved in this. There was a meeting of the Environment Council soon after the Lithuanians took over the presidency at which the issue of hydraulic fracking across Europe was discussed. What emerged was that you could break down the member states into three basic groups. There were the “positives”, and I would name us, Poland, Romania and subsequently Lithuania, once it had left the bounds of the presidency and it could make clear its view, one that was not surprising since 100% of Lithuania’s gas comes from Russia and the tap is on the other side of the border. Then there were the “open minds” like Holland, the Republic of Ireland, Portugal and Spain. Lastly, there were some states that were firmly “against”, which included the Cypriots. I should say that France is going to stay back because both President Sarkozy said and President Hollande has said that they have 75% nuclear, so France does not need it. Similarly, Germany is holding back because it has a very different energy policy and this is a contingency of its coalition.

From that position, we pushed for my concept of having an arrangement of regulation that would be transparent but could deliver a final result, so that we would not have the endless delays to which Lord Lawson referred. It would not be subject to continuous process. I had

meetings with Commissioner Janez Potočnik, and we then had a further meeting before the next Council at which we took a lead. Most of the countries I have already mentioned were then joined by Estonia and Holland. To accelerate the story, we followed that up with a further meeting at the next Environment Council, at which the Spanish joined us. The Spanish Minister was over here talking about another subject to do with agriculture, but when he learnt about what we are doing, he joined in very enthusiastically. We put it to the Commission that we absolutely did not want a whole raft of new European legislation to go through the European Parliament, which I think was the intention. As you will see when you get my note, there is already plenty of European legislation covering this issue in the form of around 10 different directives. What we wanted was clarity on how those directives should work in order to deliver certainty, which is where I think the real source of delay lies. In fairness, the Commission has come back with its recommendations. They are not legally binding, but they do give some clarity on a number of issues. However, as I said in my opening remarks, I personally think that we are well covered. The various different directives cover pretty much every aspect of where this process could damage the environment.

**Lord May of Oxford:** That is helpful and interesting, but perhaps I may put my question again. Of the recommendations that have been made in this document, do you think that there are any which highlight gaps in UK legislation where action is required? There are two that I think go right against the very thoughtful report, or rather they highlight where at present we are doing things that run against two of the recommendations that were also set out in the report of the Royal Society and Royal Academy of Engineering—with which I am associated.

**Mr Owen Paterson:** What are the two issues that you are concerned about?

**Lord May of Oxford:** The first one is that the full results of the integrity tests made on the wells should be reviewed by an independent and qualified third party, to ensure a well's operational performance and its environmental and health safety at all stages of project development and after well closure. Again, this should be carried out by an independent and qualified third party. As you know, this is not consistent with what is currently happening, where the inspectors can be employees. When the Committee questioned Peter Baker from the Health and Safety Executive on this point last month, he said, "It is right that operators have the option of using someone that they directly employ ... Our assessment and the evidence indicate ... that it does not necessarily follow that having your own people do third-party verification is a bad thing". I think that was bad PR and substantially improper. I rather like the stricter view put forward as one of the recommendations, and I should like to hear your view on that.

**Mr Owen Paterson:** Again, I would refer to our current experience with existing oil and gas wells. I am not aware of any cases of serious damage having been done because there had not been proper scrutiny after a well was closed. The HSE is an independent body in its own right.

**Lord May of Oxford:** That is great and I am happy that we have not screwed up yet, but I still do not see why you are so keen to endorse a practice that is bad PR. I will certainly trust an independent evaluation more than I would that of an employee of the person operating the well, and I would be surprised if you did not feel the same. Indeed, I would be rather shocked if you did not feel the same.

**Mr Owen Paterson:** The HSE is an independent body. We should not devalue what we have achieved. We have extracted huge volumes of oil and gas in very different circumstances.

**Lord May of Oxford:** If the Health and Safety Executive is a separate organisation from Cuadrilla, that is okay, but if I am to believe the notes, there have apparently been some of these instances. Peter Baker of the Health and Safety Executive feels that it is okay for operators to have the option of using someone they directly employ. I do not think that that is a good idea and I would be surprised if you do.

**Mr Owen Paterson:** Again, as I have said several times, I would look at our record. The current arrangements have delivered huge volumes of oil and gas which have been of enormous benefit to the economy. I would be very interested if you could cite me an example of where a well has been closed and has caused severe environmental damage afterwards. I repeat: the HSE is an independent body in its own right.

**Q275 Lord May of Oxford:** Let us not go around that issue again. The second issue is the environmental safety of the wells themselves. The EU regulations, which I clearly like better than you do—the Offshore Installations and Wells (Design and Construction, etc) Regulations 1996—require that well construction and design takes account only of the risk to the health and safety of people. It does not require risks to the environment to be taken into account. The Royal Society, jointly with the Royal Academy of Engineering, has called for this scheme to, “be widened so that well integrity is also considered from an environmental perspective”. How do you feel about that one?

**Mr Owen Paterson:** Under our current arrangements, if well integrity is not satisfactory, the permit will not be issued. It is as simple as that.

**Dr Tony Grayling:** Perhaps I can add to that. It was those regulations and the Borehole Sites and Operations Regulations 1995, the other key set of regulations relating to the design and construction of wells, that we commissioned our independent review of in order to check that they can do a good environmental job. We concluded that they do, provided of course that they are complied with. That is why we have our working-together agreement with the Health and Safety Executive. It ensures that we jointly inspect sites and jointly ensure that the regulations are complied with.

**The Chairman:** If you would like to give us a further note on the question of independent and qualified third parties, that would probably be very helpful in relation to the possibility of the EU acting on it.

**Q276 Lord Skidelsky:** It may be a bit premature to ask a question about abandoned wells as we do not actually have any fracking wells yet, but concerns have been expressed about the lack of regulation. I wonder whether you can tell us what regulations there are and whether you are satisfied that abandoned wells will not noxiously spring to life after they have been decommissioned.

**Mr Owen Paterson:** That is a perfectly fair question, but it goes back to some of the replies I have already given. When I provide the list of the extensive amount of European legislation under which permits will be issued, it will be clear that the issue of dying wells, exhausted wells and closed wells exists at the moment. It applies to the current industry. Permits will not be issued if there is an unsatisfactory programme at the end of the life of the well.

**Lord Skidelsky:** But fracking has not been tested so far. It raises new issues, does it not?

**Mr Owen Paterson:** Yes, but it is gas extraction, which we have been doing very successfully for a long time without damaging the environment. I go right back to the beginning: it is incredibly important for the environment, as well as politically and commercially, to keep the confidence of the public by our being seen to be doing this in a professional manner. There is absolutely no question of cutting corners at the end of a well's life, and that will be an integral part of the issuing of the various permits. This is really important to the whole commercial future of the industry; it has got to be seen to be done properly—during the exploratory period, during the extraction period, and once a well has finally been exhausted.

**Lord Skidelsky:** You are therefore satisfied that the concerns that have been expressed about this are groundless.

**Mr Owen Paterson:** Yes. We should be proud of the manner in which we have conducted the work of this industry over the past few decades. I do not see this as an enormous revolutionary change. In fact, in some ways it is easier because the current sites are on land. They are not in an incredibly hostile marine environment.

**Dr Tony Grayling:** I would like to make a specific point here. Under the requirements of the environmental permits that are held by operators, they have to develop what is known as a closure and rehabilitation plan and they have to implement it before they can surrender their environmental permits to us. We would not allow them to surrender those permits unless and until we were satisfied that there was no ongoing risk to the environment

**Q277 Lord May of Oxford:** In that context I come back to the Royal Society and the Royal Academy of Engineering. I should say at this point that this is not about the bleeding heart greenies or anything like that. The society and the academy have said that, “Monitoring arrangements should be developed to detect possible well failure post abandonment”. They noted that operators have an open-ended liability to remedy any ineffective abandonment operations. However, the report also recognised that time passes and memories fade, so the report makes a recommendation that, “consideration should be given to establishing mechanisms, such as a common liability fund, to ensure funds are available to respond to well failure post-abandonment in the case that the operator can no longer be identified”. That seems to be a sensible precaution. How do we stand on that?

**Dr Tony Grayling:** As I understand it, this is an issue on which there are live discussions between the Office of Unconventional Gas and Oil and the industry to develop appropriate arrangements. However, I go back to the point that, from an environmental perspective, we would not allow the permit to be surrendered unless we were satisfied that there would be no ongoing issues.

**Lord May of Oxford:** But the reality comes from decades past. It is tricky enough even with the stuff in the Gulf.

**Lord Lipsey:** Moreover, this is a very fast-moving entrepreneurial industry, or at least it is in the US. The firms that are here today may not be those which are around in five years' time. They may not have a long-running set of files and detailed references to the obligations they undertook when they applied for the permissions. They may be long buried. Who is going to take responsibility then?

**Mr Owen Paterson:** I do not take such a black view of this. I see it as hopefully being a very profitable activity that will generate wealth for many decades ahead. The percentage of extraction that people are looking at is very low, at less than 10%. We are talking about leaving significant volumes of shale alone, although one would expect that, as the technology

develops, more could be extracted. You have all raised an incredibly important point, which is that to keep the confidence of the public, there must be absolutely no risk to the environment. Arrangements have to be made for after a well closes. But we have had large businesses exploiting the North Sea and we have had quite small ones doing the same. We have managed to do that in a manner which has not led to environmental problems, and in a very difficult environment. I think that you have to be more glass half full about this. The opportunities here to generate wealth and employment are enormous and it is absolutely our intention that these activities will be carried out responsibly. I see the industry as being highly profitable, so to answer your question directly, I think that funds will be generated which will make sure that agreements prior to a permit being issued on the conditions that pertain after a well has dried up are adhered to.

**Q278 The Chairman:** Dr Grayling, I think you suggested that the issue of what happens when an operator can no longer be identified is the subject of an investigation with the industry at the moment to see if some solution can be found. It would be helpful if you could let us have a note on that.

**Dr Tony Grayling:** I fear that that is beyond my remit. I think that you would need to go directly to the Office of Unconventional Gas and Oil.

**Mr Owen Paterson:** What we can do is give you the current arrangements for existing wells, because I do not see this as an enormous step change.

**The Chairman:** You can see that it is of concern. A further note that includes what you know about what is happening would be useful to us.

**Mr Owen Paterson:** That concern is completely justified. These are exactly the questions that we must answer in order to reassure the public, and so that we are not subject to a constant process of query and judicial action. However, I will keep on repeating the point: look at the success of this industry in recent decades.

**The Chairman:** We have taken that on board, but what we are considering here is a narrow but quite important point.

**Mr Owen Paterson:** It is our intention to roll our enormous experience as a nation and our success in regulating the industry on to this new extension.

**Q279 Lord McFall of Alcluith:** Minister, I hope to be able to lighten your mood by referring to a newspaper that is hugely important to you—the *Shropshire Star*, which is your local newspaper. Following the announcement of the 14th licensing round last month, a poll conducted by the newspaper found that four out of five people were opposed to the idea of shale gas drilling taking place in the county. A poll commissioned by the BBC's "North West Tonight" surveyed nearly 2,000 people and found that 44% of those who knew about fracking supported it while 34% were against. Some 73% of those in favour said that they still had concerns about the process. Why do you think that there is quite a substantial level of local opinion against fracking in your area?

**Mr Owen Paterson:** First, I am absolutely delighted that Lord McFall reads the *Shropshire Star*, one of the UK's largest-selling regional evening newspapers and about to celebrate its 50th year of publication. I am pleased that not only sane and sensible people in Shropshire read the paper, but also distinguished people from north of the Scottish-English border.

I am quite open about this. I would like to see shale gas exploited all over rural parts of the UK because I think it will bring with it wealth, prosperity and jobs. In Shropshire we have a

long tradition of extracting hydrocarbons, producing top-class industrial products and selling them and shipping them down to what we regard as the soft south. The Industrial Revolution began in Shropshire. Following the demise of the coalmines and their no longer being competitive, I see the extension of shale gas to areas such as Shropshire as being of real benefit. But, as you say, there is a large problem with public opinion where those who are opposed to it have made all the running. This is why the questions posed by Lord May are incredibly pertinent. I think that it is very much up to those who support it to make it absolutely clear to the public that we are going to do this in a manner that will not risk the environment and which will help the economy by bringing jobs. The two go together. Frankly, we are behind the curve. The opponents have been getting a lot of media and television coverage, they wear exciting clothes, they have exciting banners and easy slogans. I am afraid that a lot of their stuff has been misleading, but they have made the running with public opinion. We have to face up to that. Those of us who support this issue need to get on the front foot, and that is why these deliberations are very helpful.

**Lord McFall of Alcluith:** Nottingham University has been tracking public opinion on this issue. A January 2014 survey confirms that an apparent turn against fracking for shale gas that had been seen in the previous survey held in September 2013 has continued. The area the survey focused on was the contamination of drinking water, which has been a key concern of the protesters, encouraging a negative attitude to shale gas because of the risks in that area. The same is true where people see shale gas not as a clean form of energy overall; that increases the negative score. Also, people do not see shale gas as a cheap form of fuel, so the trends are moving away. This shows that over three or four recent months the trend has become more negative. I think that all Members of Parliament will be in the frame on the issue of fracking. What would you do, as a Member of Parliament, to provide an example to your constituents and others around the country, to show that you are determined to turn public opinion around on this?

**Mr Owen Paterson:** The facts that you have mentioned are pertinent because they are wholly misleading and wrong. When I went to see the Environmental Protection Agency, I do not think that it could name a single case of drinking water pollution from fracking. If you do this incorrectly and unprofessionally so that operators carry out their procedures in an irresponsible manner, of course there is a risk, just as there is a risk in anything. My whole point is that this is why we need robust regulation. However, I do not think that there are any risks to groundwater. For instance, I went to Poland to look at some trial wells there. They were drilling thousands of metres below the surface, whereas drinking water is found in the top few hundred metres. We asked very direct questions about this and we were told that, as long as the well is properly sealed, there is no risk to drinking water. But I will be open about the fact that we have failed to convince the public.

On the issue of the costs of shale gas, it is obvious that the drop in gas prices in America has had the most spectacular effect on the American economy. Whole sectors of industrial activity are now coming back to America because they are no longer competitive in China. That is an incredibly important point, but we have completely failed to get it across. On cleanliness, the weekend before last I was in Saxony in eastern Germany and we were discussing the opening of 10 new coal power stations in Germany that will be burning brown coal. The environmental advantages of burning gas over coal, let alone brown coal, are enormous, and that is before you get into the whole health issue of PM 2.5. However, you are right to ask these questions because they show that, so far, we have failed to win the public argument.



**Lord McFall of Alcluith:** Minister, I asked you what you are going to do about it. We know that there is a litany of failure here, but given that the trends have been more negative over the past three or four months I would suggest, from my experience of having been a Member of Parliament for 23 years, that if I went into my local community hall and the concerns of individuals were so firm that four out of five people were against something, and I said to them, “You are all wrong”, I would probably be heaved out of that community centre. What are you going to do to ensure that there is mediation and negotiation, so that people can be turned around rather than just told that they are wrong?

**Mr Owen Paterson:** What I can do in my position is emphasise and repeat incessantly that this activity will be permitted only as long as those who carry it out respect the robustness and rigour of our current regulations. There will be absolutely no cutting corners. That is why I slightly jumped on Lord Lipsey that the idea of having a quicker permit could be seen in any way as cutting corners. That is my role. We will lose the public completely if we are seen to be watering down the regulations or cutting corners in any way. Again, that is my main role. But, if asked on a public platform whether I think this activity is a good thing and whether I see economic advantages in it, of course I will trumpet them. You only have to look at America. Fracking has had the most amazing impact on America. It is a pity, since we have potentially enormous volumes, that we cannot move the process forward faster.

**The Chairman:** I can assure you, Secretary of State, that we are very clear about the benefits in America. We have taken a lot of evidence on that, including from entrepreneurs who have been involved in fracking in North Dakota and elsewhere. We have been told about the benefits and the reduction in gas prices, as well as the impact on energy-intensive industries.

**Q280 Baroness Noakes:** I want to move on to the financial benefits for local communities. The industry is currently consulting on the community benefit of a 1% share of revenues, which has not thus far been wholly supported by those who have commented publicly on it. Do you think that a 1% share is enough?

**Mr Owen Paterson:** I think that the potential of 1% of revenues could be an absolutely enormous sum that compares favourably with the regime pertaining in other countries. If we consider the volumes being talked about in, for instance, Lancashire, down the years a 1% share could be a very significant sum of money.

**Q281 Baroness Noakes:** The Local Government Association has said that, “returns should be more in line with payments across the rest of the world and be set at between five and 10 per cent”. Do you think that that is achievable? If there is so much money around, is such a percentage capable of being absorbed?

**Mr Owen Paterson:** I admire the association’s bargaining technique, and let us wait and see whether it succeeds. You asked a straight question. I think that 1% of the potential volume is a very large sum of money and will potentially be welcomed in quite remote rural areas where there are not many great wealth creation opportunities. That is what is so good about this. It could bring new wealth and new jobs to quite remote parts of the United Kingdom.

**Baroness Noakes:** One of the issues we have been discussing is that of convincing a possibly sceptical public that this is a good thing and will bring benefits. That war has clearly not been won yet. It is not clear whether your fellow Members of Parliament are sufficiently behind it. For example, a group of MPs in the north-west have, together with council

leaders, written to say that the 1% share does not go far enough. Do you believe that there is a sufficient body of opinion even within Parliament to support that regime?

**Mr Owen Paterson:** Again, I admire the desire of my fellow parliamentarians to barter and negotiate on behalf of their constituents. The sums are pretty significant. You could be talking about £5 million to £10 million over the lifetime of a well at the very modest rates of extraction being considered at the moment. I will stress that: we are being quite pessimistic about a rate of less than 10%. If MPs in Lancashire or wherever are asking for more, that is fine. It is their job to stand up for their constituents, and Lord McFall, who has just left the room, knows what an MP's job is. But from my point of view as a member of the Government, I think that people should not turn their noses up at this. It is significant money that will come from a completely new activity. I think that once it gets started, it will be very widely welcomed.

**Baroness Noakes:** The Local Government Association is also concerned about the durability of such arrangements and is worried that the operators might walk away from their obligations in due course. Would you favour enshrining them in legislation?

**Mr Owen Paterson:** A deal is a deal. If there is a contract and the percentage is agreed, I would have thought that it would be legally binding.

**Baroness Noakes:** Do you think it should be enshrined in a legally binding contract?

**Mr Owen Paterson:** That is probably more a question for DECC as it is an energy question but—

**Baroness Noakes:** We love joined-up government.

**Mr Owen Paterson:**—speaking for north Shropshire, should a well be drilled in my constituency, I would look forward to welcoming £100,000 for the test and then I would look forward to welcoming 1% on the subsequent revenues. I would expect that to be legally binding.

**Baroness Noakes:** You would want it to be legally assured.

**Mr Owen Paterson:** It would be a legally binding commercial transaction.

**Q282 Lord Griffiths of Fforestfach:** Secretary of State, I think you will be delighted to know that we have had witnesses, especially those from North America, who have said that the glass is indeed half full and not half empty. However, one issue has been raised and we have asked a number of people about it. What value does the evidence from America have for us in view of the differences in population density between the United States and here? People are arguing that because the population density in America is so much less than here, we would have to drill between 1,000 and 2,000 wells a year just to figure out whether this industry could take off and deliver the kind of benefits you have mentioned. Some Americans have said that in places like Texas they have drilled close to cities with very high population densities. The judgment of some people has been that they are sceptical of whether the planning permission regime in Britain would be amenable, given the scale of what we have to do to convince the general public. There are three areas to consider. The first is the visual impact, the second is noise and the third is traffic. As a politician, what do you think is the likelihood of planning permission being given for the scale of take-off that will be necessary to deliver the benefits?

**Mr Owen Paterson:** On the three issues you mentioned, the site I saw in Poland was a test well. It was probably rather less than the size of a football pitch and had a rig that stood up

above the forest where the operation was being conducted. What they made clear was that there was a very substantial membrane—

*Sitting suspended for a Division in the House.*

**The Chairman:** In the interests of time we had better move on, although not all the members of the Committee have come back yet.

**Mr Owen Paterson:** I finished by saying that I was very impressed by the robustness of the Polish membrane, which will be lifted once the test rig is removed. Should it become a commercial rig, they showed me photographs of what would be put in its place. It was really quite a modest and unobtrusive metal construction. I was told that in America, although I did not see any photographs, rigs are operating in the centre of Fort Worth and the centre of Beverly Hills. The Americans also made it clear that, if done properly, this activity is not incompatible with an urban area.

The points you have made are important. First, on the number of wells, we are lucky that our shale is dramatically thicker than the American shale. In some areas I believe that it is around 10 times thicker, so we might not need as many wells and they would be more productive. On noise, the main noise coming from the Polish drills was produced by a high-velocity diesel generator. Once you get into production the noise level is much reduced. The bigger area which no one has mentioned yet would be vehicle movements and traffic. To start with, that would be significant, and it is something which could possibly irritate local people. That is why the community money is incredibly important, because then everybody would benefit. More broadly on planning, let us not forget that the Environment Agency is a consultee and plays a key role in the issuing of planning permission.

The whole thing is really one of the chicken and the egg. While there are views out there which were expressed by Lord McFall, and until we get started, there is hostility and some planning committees may fear it. However, once we get started, we will see a benign and virtuous circle develop. People will realise that this is an activity very similar to the extraction of hydrocarbons that has gone before. I go back to the example of Wytch Farm. I said that it was producing 20,000 barrels a day, but in the break I checked the figures and found that it is around 18,000 barrels a day. It is situated very close to Bournemouth and to some of the most expensive property in western Europe. It is in an area of outstanding natural beauty and, having talked to some of the local Members of Parliament in the area, no one knows that it is going on because it is being done in a thoroughly professional manner and does not interfere with people's lives. This is very much a chicken and egg situation. We have got to get started. That is really important in order to convince people.

**Lord Griffiths of Fforestfach:** Do you think the Government can and should do more to convince the public in order to get started?

**Mr Owen Paterson:** I think it is not just for the Government.

**Lord Griffiths of Fforestfach:** I am thinking specifically of the Government.

**Mr Owen Paterson:** I think I answered that earlier and I am quite clear about it. My role is to reassure the public that there is absolutely no way that we are going to be cutting corners, that we are not going to water down the rigour of our environmental regulation and that, done professionally and properly in the way we have been doing for decades, there is nothing to fear. I think that the companies themselves have a role to play in this. They too have to get on the front foot. They are up against campaigners who are running a proper political campaign. Their opponents are leafleting, they get on to the local radio stations, they are using all the modern media outlets such as Twitter and Facebook, and they have

done a good job of alarming the public. We have to counter that, but it cannot just be done by the Government. Certainly people like me have a role, but I am a politician in a suit and a species that, I might say, is therefore less trusted than some others. It is up to people across the board to address this. It is up to communities as well. There must be communities in remote parts of rural England that would benefit from the new wealth that this would bring, and they should get out there and be positive about it.

**Q283 Lord Rowe-Beddoe:** Thank you, Secretary of State. Perhaps we can move from potential revenue for local communities to talk about the other benefits arising from this operation that you think would accrue to them.

**Mr Owen Paterson:** I think that there could be very significant job opportunities. The Institute of Directors has said that it could mean just under 75,000 jobs. That would be of real benefit to certain parts of the country. If you take somewhere like Lancashire where the coal mining industry is no longer competitive, along with some of the older manufacturing industries, this could bring real hope and prosperity. We have seen that in the States, where quite remote and poor areas have been revived thanks to the new revenue being generated by shale gas and, in the case of the United States, shale oil.

**Lord Rowe-Beddoe:** I have a particular hobby horse, which is the former coal pits of South Wales. It is an area where this Committee would like to see a little activity because we have already seen carbon extraction there. Coming back to the effect on jobs, you have quoted the IoD, but we have had other institutions quoting half that figure—some 20,000 to 30,000 jobs were mentioned the other day. Obviously, the numbers are imprecise at this stage. We understand that actual job creation around the fracking and drilling procedures will be relatively small and that the benefits will be in the supply chain. Would you agree with that?

**Mr Owen Paterson:** There are benefits both ways. There are benefits in the supply chain and there are those who can take advantage of a cheap, clean and plentiful supply of energy. High-energy industries are not disappearing; they are just moving to parts of the world where carrying them out is cheaper. The Alcan plant in Northumberland sadly has gone back to Canada. I can think of several places around the coast where aluminium smelting is not that difficult—you bring in a large amount of bauxite and stick a very large energy charge through it. Whole industries could come back, as they are doing in the United States. We should not fixate just on the issue of gas; we should be looking at the benefits of having a long-term, reliable and secure source of clean energy.

**Lord Rowe-Beddoe:** I understand that, Secretary of State, but the quotation from the IoD states that its estimate is on the production phase of shale gas. I am questioning that figure. I believe that there will be enormous opportunities, but we have to be careful about all these estimates that are coming out. That is my worry.

**Mr Owen Paterson:** My view is that we just want to get on with it. We want to get started and let the benefits accrue. That will bring public opinion with us. They will see the wealth and the jobs being generated, and they will see the new downstream industries that will become competitive.

**Lord Rowe-Beddoe:** That is true, and hopefully they will see some financial benefit as well. Chris Wright, who I think we have already referred to by name, was one of the US entrepreneurs who came to visit us. He said something very interesting which I shall quote. He said that, “jobs in the industry tend to follow drilling rigs”. That is a good key phrase to bear in mind. Going back to the questions about the apparent lack of co-ordination in trying

to get the message across to the people of this country that there is great potential benefit, I would suggest that a great deal more needs to be done. I know that every department is different and everyone has other things to do, but one of the Committee's concerns, when looking back at all the evidence we have taken, is the lack of joined-up leadership. Let me put it this way. Every time a misinformed or uninformed comment is made, it gets the headlines. We then hear subsequently from experts that it is not correct for this or that reason, but that is the message which has to be sent before the headlines. Do you agree with that?

**Mr Owen Paterson:** I think that it is a little unfair. The Prime Minister has taken a very strong lead and the Chancellor is a clear supporter. Ministers in charge of energy and the environment are all enthusiastic supporters of getting going. The problem is a fear of the unknown. Until we get started, we cannot get into a position where we can point to a Wytch Farm, which is chuntering away every day producing 18,000 barrels of oil without disturbing anyone. That is the happy position we need to reach.

**Q284 Lord May of Oxford:** In connection with the 74,000 jobs, it would probably be as well to be aware that that figure has been more recently corrected by a strategic environmental assessment undertaken by some acronym that was commissioned by the Government. It concluded that the figure would be more like 16,000 or perhaps up to 32,000 jobs by the point of the 14th licensing round. It may seem that I am not dead keen about this, but actually I think that shale gas extraction has a very important part to play in meeting our climate change objectives to 2030, so I am all the more distressed about the attitude you project, which I do not think is helpful. You did not meet a single one of the questions I asked you. You are not familiar with the academy's report, or else you do not care for it. Even a bit of dissimulation is necessary here. Given what you are trying to do, it is unhelpful.

**Mr Owen Paterson:** I am sorry if I have been unhelpful. I thought I had made my position very clear.

**The Chairman:** We must move on because I know that the Secretary of State will need to leave at 5.30 pm. We have two more sets of questions.

**Q285 Lord Shipley:** Secretary of State, perhaps I may look at the perception of potential health risks and whether there are any plans, or you think there might be a case for plans, for research. I have two specific examples from the United States. The first comes from the University of Missouri school of medicine in a paper published just before Christmas. It found that people living close to fracking sites could be at a greater risk of suffering infertility, cancer and birth defects. It was ground and surface water that was found to have been contaminated by hormone disrupting chemicals. Secondly, two studies carried out in Colorado were highlighted to us by Balcombe residents. I think that Dr Grayling commented on them when he last appeared before the Committee. The Colorado studies suggest that people living close to fracking sites are at greater risk of developing cancer. Do you have any plans to undertake research? Is this something that is being actively thought through?

**Mr Owen Paterson:** I do not think that health is an issue for Defra. Our role is to ensure that the environmental regime is properly implemented. But anyone who supports fracking should be aware of and read the reports coming from around the world, and then consider whether they might be appropriate to what we will have in this country—whether the circumstances are similar. We should not turn our eyes away from reports, whichever

country they come from. America is obviously far more advanced in this activity than any other part of the world that I know of, and we should heed what is said. But the Americans I have talked to—and I have talked to the Environmental Protection Agency in Washington—have not told me about any severe health threats.

**Lord Lipsey:** I wonder if I have misunderstood you. Did you just say that health is not an issue for the environment department? Is there not something called environmental health that concerns you?

**Mr Owen Paterson:** Defra's competence does not cover the health of the population. As far as this activity is concerned, it is to supervise the environmental regulation.

**Lord Lipsey:** Environmental regulation is there partly to protect people's health. If you are pumping out gases that cause people to get cancer, that is a matter for your department. I am not saying you are doing that, but it is a matter for your department, is it not?

**Mr Owen Paterson:** No. The health of the public is the responsibility of the Department of Health.

**Lord Shipley:** My understanding of the situation reflects the question of whether the Government as a whole are joined-up in this area. I understand that the responsibility lies with Public Health England. However, the question here is this: who is doing what? I believe that a draft report was published last autumn by Public Health England which concluded that, "the risks to public health from exposure to emissions from shale gas extraction are low if operations are properly run and regulated". My question is whether we are satisfied that our ability to regulate will produce the outcomes that we would like to see from that regulation. I think that Dr Grayling did say, when he was last before us, that certain practices were permitted in the United States that we would not permit in England or other parts of the United Kingdom. I do not know whether any further work has been done on that. I think that Dr Grayling was not personally familiar with the work, and I do not know whether he has followed it up since we last spoke.

**Dr Tony Grayling:** Our role is to make sure, as Lord Lipsey was implying, that the way we regulate for environmental protection also protects human health. That is part of the duties of the Environment Agency, and we are satisfied that the current regulatory regime enables us to prevent releases into the environment that would cause health problems. One of the things we are planning to do to help provide further reassurance on this front is that there is to be more monitoring than we would usually do ourselves in relation to the atmosphere, water and the environment close to these sites. We will be reassuring ourselves that, as we expect, there are no releases of the kinds of carcinogenic substances or other poisonous substances that are of concern.

**Lord Shipley:** Let us be very clear for the record. That monitoring would include air emissions. I think you have just suggested that.

**Dr Tony Grayling:** It absolutely does include air emissions, and we are currently formulating our plans for the monitoring exercise.

**Q286 Lord Lawson of Blaby:** What has emerged from all this is that the Government have not got their act together. I am as keen as you are that we should go ahead with this exploration because, until we do that, we have very little idea of the scale of our commercially exploitable shale gas resources, and we need to know that. In fact, very little or even nothing is happening. When your colleague Michael Fallon came to see us, his great ambition was that between 20 and 30 exploratory fracking wells should be drilled in the

next three years. That will be between seven and 10 a year, which is pathetic. We will never get anywhere that way. Let us look at what happened in the United States.

You have been making a number of comparisons with what happened with North Sea oil. There are huge differences, one example of which is that the question of contamination of groundwater does not apply. As Lord Lipsey has said, this has been put to us as the biggest environmental threat from fracking. It does not apply with offshore oil production. There is a whole range of other things that do not apply, so North Sea oil will not cut the ice anywhere. A little over 30 years ago I was the Secretary of State for Energy in this country and I had responsibility for North Sea oil. That responsibility, in governmental terms, was entirely mine and no other department was involved. But here DECC is involved, your department is involved, you mentioned the Department of Health a moment ago, and earlier you referred to the Department for Communities and Local Government. On top of those are the independent agencies like the Environment Agency and the Health and Safety Executive. The whole thing is completely fragmented and no one has any responsibility. There is no joined-up government and no Minister is saying, “Look, these concerns about the contamination of groundwater have been raised, and this is the position”.

When you were asked about this issue, Secretary of State, you replied that no one believes politicians any more. That is no good. You cannot escape the responsibility of politicians to give a lead. If you abdicate from that and you say that it is someone else’s job, with the greatest respect, I do not think that you are going to get anywhere. We need a Minister, whether it is yourself or the Secretary of State for Energy—it may have to be the Prime Minister—who will pull the whole thing together and say, “These are the problems. We know from the American experience that if the regulations are properly enforced there will be no danger of contamination of groundwater”. We need to answer the questions. No lead is being given anywhere and the whole thing is completely disconnected. There is no joined-up government on this issue, which I deeply regret—I am sure you do too—and as a result we are not getting anywhere. My question is this: what are you and your colleagues going to do about it?

**Mr Owen Paterson:** I think that that is a somewhat pessimistic and inaccurate view of what has happened. We have had a clear lead from the Prime Minister, but this activity inevitably cuts across a whole range of departments. The health issue which has just been raised is an interesting one. Obviously, health is primarily the responsibility of the health Secretary, but there will be areas where activities will impinge on health. All I can speak for is what I have done in my department. Within days of arriving I set up the one-stop shop to make it as easy as possible for those who want to invest in this activity in this country to move forward.

**Lord Lawson of Blaby:** I was not criticising you. I was criticising the Government as a whole.

**Mr Owen Paterson:** Again, all I can speak for is what I have done. I can only speak on the area of issuing environmental permits. As you have heard from Dr Grayling, we intend to make that process easier and swifter for potential investors without in any way diluting the value of the permits. But the fact is that this activity does cut across a range of departments. Defra has never done planning. If this activity is going to be carried out all around the United Kingdom, it is bound to touch on the department which handles planning. As it concerns the extraction of gas, which is obviously an issue for the Department of Energy, it is a matter for the energy Secretary. We just have to live with the fact that fracking for shale gas has come upon us quite recently and, because of the nature of the activity, it is going to

cut across a number of different government departments. That does not mean that the Government are not enthusiastic across the board. It is getting a very strong lead from the Prime Minister.

**Lord Lawson of Blaby:** But it is not joined up, is it?

**Mr Owen Paterson:** It is joined up. We have a very clear steer that this is a priority for the Government and all the Ministers involved—Michael Fallon, whom you have had before the Committee, Ed Davey and the Prime Minister at the top—have given a clear steer that everyone within their own sphere of competence should be doing everything they can to facilitate progress. The fact that it cuts across a number of departments is something we have to live with.

**Q287 The Chairman:** I have to say that some witnesses we have heard from, particularly from the industry, do feel that the Government could do a lot more in terms of putting the case across in a joined-up way. I think that it is very important to get this absolutely right and to put the message across. Do you have a ministerial sub-committee that is looking at all of the issues so that they can be discussed at an interdepartmental level by Ministers?

**Mr Owen Paterson:** There is the local growth committee chaired by the Prime Minister where this issue has been discussed, but it is not just the Government that should get the message across. We take the point that politicians may not be the best people to convey the message. We have to accept that fact. It has to come from politicians, from industry and, I think, from communities.

**Lord Lawson of Blaby:** You have to do your best.

**Mr Owen Paterson:** It is a very important fact that those who lead local communities should be persuading their neighbours of the advantages of moving forward on this issue. That is really important given that the sums of money being offered through the community fund are very significant.

**Lord Lawson of Blaby:** The Lord Chairman has asked a pertinent question, which was whether there is a shale gas sub-committee or other committee on which all the relevant Ministers serve so that the whole thing is co-ordinated. It would appear from your answer that there is no such committee.

**Mr Owen Paterson:** We are led by the Prime Minister. The most powerful person in the land has given a very clear steer to his Cabinet and to the Ministers responsible to help accelerate this.

**The Chairman:** What we are getting from a lot of witnesses is a clear indication of all the benefits that could be brought to the UK from shale gas and oil. There is also a concern that not enough of the responses to the concerns being expressed out there are being addressed in a sufficiently vigorous way. That probably lies behind some of the questions which have been put to you today. No one is in any doubt about your position on shale oil and gas because you have made it very clear, but the issue is around overcoming some of the other fears, unjustified though they may be. That is equally important.

**Mr Owen Paterson:** That is quite right, but by far the worst thing I could do, going right back to my early comments, is to be seen to be in any way watering down or cutting corners in my area of competence on regulation. Let us not forget that there is very significant judicial activity here.



**The Chairman:** I would be very surprised if anyone on this Committee disagrees with that. I know that you have to go to another meeting, so we ought to wind up. Perhaps you could give us a note on the one other question we wanted to put to you. How would you deal with the concerns that have been expressed about potential water shortages once operators start to produce shale gas? It would be helpful if we had the department's view on that. I think we have asked for two other notes, and we would be grateful for those. Thank you both very much indeed for coming in for what has been a most stimulating session.

Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy (CCCEP)—Written evidence

**Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy (CCCEP)—Written evidence**

Submission to be found under [Centre for Climate Change Economics and Policy \(CCCEP\) and Grantham Research Institute on Climate Change and the Environment—Written evidence](#)

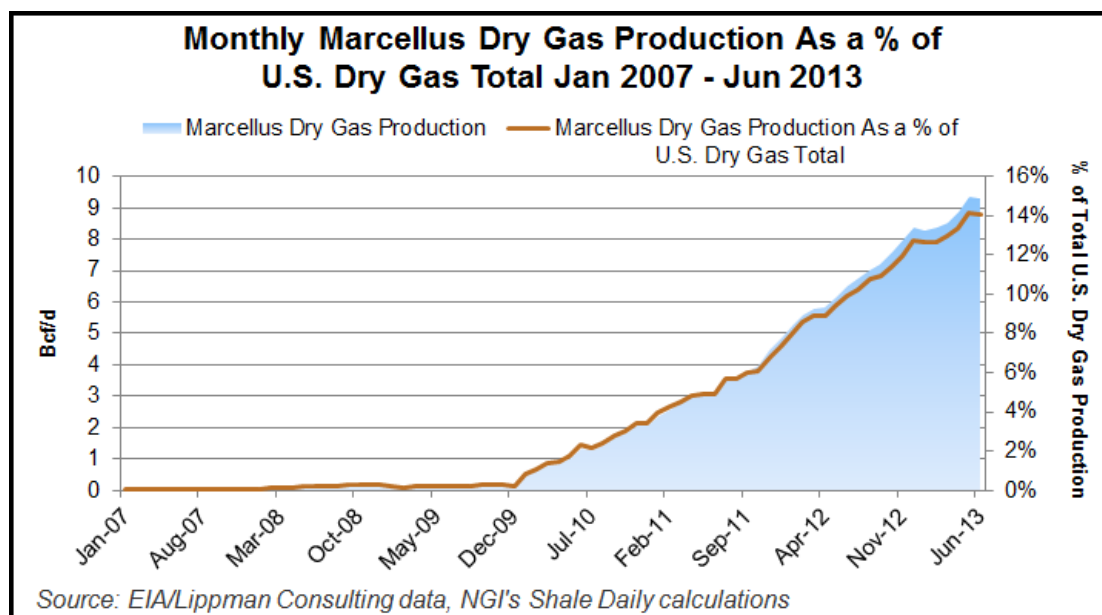
## Nick Grealy, No Hot Air—Written evidence

### How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what time frame?

1. Absent any significant exploration for gas or oil onshore in the UK, any estimates can only be the subject of speculation, but given the BGS resource survey estimates of approximately 1300 TCF for the Bowland Basin alone, they are likely to be able to provide a substantial contribution to the UK energy mix, and thus, energy security, retail prices, carbon emission targets and the viability of other generation technologies.
2. However, the shale revolution in North America is changing rapidly and studies of costs and production levels prior to 2013 cannot provide an accurate picture of the costs or results that may be achieved, or not, in the UK.
3. It must be understood that the UK does not have the option to sit out the shale revolution. The UK is neither an energy nor economic island, and it would be a fundamental error to maintain that allowing actual UK production, *or not*, may have much material impact either way.
4. Almost all energy observers note that the UK will depend on varying levels of natural gas in generation, heating and industrial use for several decades. Thus the choice revolves around whether to produce gas domestically or to import it. The subordinate choice is then whether to pay the UK to produce it, or to decide that we can pay other
5. The size of the Bowland Basin resource is substantial in comparison to other shale plays. It appears to be larger than any play in North America apart from the Marcellus Shale. For comparison purposes, the Barnett Shale centered on Fort Worth Texas is estimated to hold 43 TCF of recoverable gas. The ratio of resource to reserves, Gas in Place to Estimated Ultimate Recovery is different for each play, and is subject to considerable variation, but even a low range estimate of 5% could mean the Bowland alone could have an EUR of 65TCF.  
<http://www.eia.gov/analysis/studies/usshalegas/pdf/usshaleplays.pdf> page viii
6. US experience shows that it is unknown for a shale formation of the Bowland's size not to be produce commercial quantities of either natural gas or oil.. It is thus clear that any discussion of EUR in the Bowland is irrelevant in many respects. Many observers, such as the Institute of Directors, have for example used a 10% rate, but others have said this is conservative. But even a 65TCF EUR would over the course of a 40 year field life (which again is on the cautious side) yield an average of 1.625 TCF (46.02 BCM) out of a total UK demand in 2012 of 78.3 BCM (2.765TCF)
7. 46 Billion Cubic meters is a prodigious amount of gas. Some have actually tried to dismiss UK gas resources/reserves as inconsequential on grounds that they would not ensure energy security, but the entire UK North Sea produced 41 BCM in 2012 (BP Statistical Review of World Energy). If North Sea production were to plateau at the 35 BCM level it would not be unreasonable to assume that the UK could in fact be energy independent even of Norwegian and Netherlands North Sea production, and certainly from all LNG imports.
8. It has always been my contention that the UK must consider importing energy as analogous to exporting money. The value at present day prices of 46 BCM of approximately 23 pence per cubic meter (£10.58 billion) needs to be consider two

key points. £10.58 Billion off the UK Balance of Payments deficit is not a number to be dismissed lightly. Similarly, dismissing UK shale potential, dismisses over £6BN in tax and royalty revenue alone. The multiplier effect of the shale gas exploration and production industry and the economic impact of a reduction in domestic prices leading to an increase in disposable income also need to be considered.

9. The above discussion is only about natural gas. The UK used 499 thousand barrels of oil per day more than it produced in 2012 (967 thousand bbl/d), an annual cost of at \$105/bbl of £12 billion added to the current account deficit and a possible £7.2 Billion in foregone tax revenue. Decarbonisation, electric vehicles, vehicle efficiency and natural gas consumption in HGV and buses will mean that oil consumption falls over time, but so too will North Sea production. There is very little anyone is willing to say in public about the potential for UK onshore oil production ahead of the 14<sup>th</sup> Onshore Exploration round, but given the North American, Argentina, Russian, and Australian experience of using hydraulic fracturing techniques to produce oil from rocks previously considered fallow or un-prospective, it appears that at least some oil, and thus commercial advantage could accrue to the UK via onshore oil.
10. On the subject of time frame, conventional wisdom appears to believe that UK shale gas or oil production may be a matter of many years away. The reasons proposed include alleged environmental opposition, resource constraints in the drilling and service sector and a lack of pipeline capacity. However, much of the opinion stems simply from extrapolating US experience. Under that scenario, the UK will repeat the multi year emergence of the US shale industry from Mitchell Energy's initial efforts 20 years in the Barnett Shale to today's production levels in areas such as the Marcellus.
11. Thus predicting the future by using the past as example for today is unwise for several reasons. One is that while UK exploration will inevitably move ahead - and back - in sometimes unsteady steps, just as Poland's shale effort appears to have, many fundamental scientific advances in petroleum exploration and production in the US have already been achieved and the rest of the world need not re-invent the wheel, thus shortening development times considerably.
12. The attached chart from Shale Daily, September 25, 2013 illustrates the speed of the transformation in the Marcellus Shale of Pennsylvania. The very first exploratory wells in Pennsylvania date from 2004, and the period from then to commercial production was not decades long but only a matter of five years. That was followed by a period of rapid growth that has accelerated in 2012/13. The Marcellus then went to produce 9BCF a day (93BCMY) within a period of only 42 months from standing start. Current predictions are for the Marcellus to produce 20BCF a day by 2017 onwards.



**How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

US Shale experience informs us that US shale economics and production change rapidly, yet also differ from area to area and often within it. Thus it is difficult, and perhaps even pointless, to engage in conjecture as to what UK production costs may be. US experience does show that drilling is far more efficient than even two years ago and that there have been substantial improvements in drilling times, lateral lengths and concomitant increases in production. Dr Terry Engelder of Penn State University stated on September 24 2013

*The average Marcellus well is going to have a production history that looks to me like it will net somewhere on the order of three times as much gas as the average Barnett [Shale] well*

<http://shaledaily.com/news/engelder-marcellus-production-proving-early-detractors-wrong-sd20130924b.shtml>

Much of the US improvement stems not only from geological factors but also from improved micro-seismic techniques that allow operators target "sweet spots" of gas concentrations with far greater accuracy. Thus studies such as the OIES shale study of 2010, Chatham House (Stephens 2010) and Pøryr for Ofgem (2012), which study US shale production costs current at those times, are unlikely to provide a guidepost for UK production cost estimates.

A September 2013 view of UK costs is more likely to follow developments noted in Bank of America Merrill Lynch's Global Energy Weekly 21 August 2013 "Still Choking on Natural Gas" which noted the following on costs in the Marcellus:

*North America simply remains awash with dry natural gas. The latest natural gas producer earnings reports indicate that the structural uptrend in output remains firmly in place. Producers with a strong footing in the Marcellus reported remarkable well performance, improved efficiencies from*

*pad drilling, upgraded production estimates and, perhaps more importantly, significantly upgraded estimates of the underlying resource potential of their acreage. Some producers show IRRs in the Marcellus of 96% at \$4/MMBtu! The strong results are now leading us to upgrade our dry production growth forecast to 0.6 bcfd in 2013 and to 1.5 bcfd in 2014, likely placing a cap on US nat gas prices for the time being.*

Prices for the UK cannot be solely estimated as being repeatable from the Barnett in 2009, but more likely to follow advances in the Marcellus and other formations today – and the inevitable improvement likely even on those levels.

### **What impact will shale gas and oil have on household energy bills?**

The basic issue of UK energy bills is that there is no mechanism to discover the true wholesale component of household bills. This is analogous to petrol stations not posting prices on either motor fuel, bread or milk, but the UK regulator has stated that they believe that 67% of gas bills come from commodity costs.

<https://www.ofgem.gov.uk/information-consumers/domestic-consumers/understanding-energy-bills>

Electricity bills commodity is 58% and in an even more murky market it is believed that gas nevertheless plays an important factor in electricity costs.

The question then is how could the average commodity only cost of £385 for gas and £248 for electricity based on average use at 2013 prices be reduced. The current UK gas price of 65 pence per therm on the wholesale market is equal to \$10.34 MMBTU, whereas US Henry Hub gas prices have not exceeded \$3.90 so far in 2013

It has been widely noted that UK gas prices will follow internationally traded gas prices in North West European hubs. Simply put prices tend to follow the declining amount of oil indexed prices with the margin prices set as LNG gas costs influenced by Asian, predominantly, Japanese, LNG import requirements.

However, US LNG exports will enter world markets from 2015 onwards and whether they come to Europe or not, the price affect of the molecules will be substantial. With US LNG costs depending on Henry Hub +15%, plus processing and shipping costs at exporting and receiving terminals, the costs are estimated to be in the area of \$8MMBTU into European markets and we can expect that conservatively European prices will reflect this 22% drop in prices. As stated above, we cannot be guaranteed that UK retail prices will reflect this drop under the present light touch regulation practiced by Ofgem.

I also must point out that the increase of shale volumes internationally, will inevitable lead to an unraveling of the oil link in the present form. It is the contention of several international experts that we may be entering a period of lower and less volatile gas prices based not only on lower natural gas, but on lower oil prices as the shale oil effect in the US causes a drop in US demand. Evidently, Chinese and other demand will continue to support oil prices, but perhaps at lower levels than previously held in the Peak Oil era which shale energy has now thoroughly discredited.

I have stated in the past that if Benjamin Franklin were alive today, he would update his famous maxim to include utility bills along with death and taxes as being certain.

If wholesale cost falls were passed on to consumers, this could lead to at least a £120 pound a year increase in disposable income. The multiplier of the echo effect of what would be effectively a tax cut for consumers would have a noticeable impact on the economy which should also be considered.

Time prevents a discussion of the impacts of more lower energy costs on businesses, which would both increase their profitability (and government revenue) while lowering or moderating costs to consumers in both food and durable goods.

What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?

UK natural gas resources will not only displace coal, but may conceivably affect the use of diesel in transportation. As natural gas vehicles are inherently 30% less CO<sub>2</sub> producing than diesel this will have a clear effect on UK CO<sub>2</sub> levels. The substantial health effects of particulate pollution and other greenhouse gases found in diesel but broadly absent in cleaner, cheaper and quieter natural gas engines can only lead to other savings in carbon, money and most of all in human life, as the NHS has stated that 13,000 premature deaths happen each year due to air pollution stemming from coal and diesel use.

<http://www.nhs.uk/news/2012/04april/Pages/air-pollution-exhaust-death-estimates.aspx>

**Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

Yes

**What lessons can be learnt from the US experience of shale gas and oil?**

The essential lessons from the US experience have been positive for consumers, energy security and CO<sub>2</sub> levels. The United Kingdom, as do Europe, Canada, Australia and many other jurisdictions, have a history of effectively regulating not only the oil and gas industry but a wide range of other everyday industrial processes, at even greater levels than in the US.

No process, policy or economic choice can ever be risk free. The UK must follow the US in showing successful mitigation of risk, but perhaps needs to be more forthright in explaining energy policies to the public. It has been my experience during five years of experience in the issue that those who concentrate on catastrophic problems often believe in magical solutions.

Shale energy provides a path to a lower, but not lowest, carbon world and does so where the costs of energy production accrue, for good or bad, to those who actually consume it. We need to have a pragmatic energy policy that depends on the physically, economically and socially acceptable. Shale gas has been described by Michel Rocard, former Prime Minister of France, a blessing from the gods.

[http://abonnes.lemonde.fr/politique/article/2012/11/10/michel-rocard-avec-le-gaz-de-schiste-la-france-est-benie-des-dieux\\_1788711\\_823448.html](http://abonnes.lemonde.fr/politique/article/2012/11/10/michel-rocard-avec-le-gaz-de-schiste-la-france-est-benie-des-dieux_1788711_823448.html)

It may also be a Pandora's Box, but we do have the benefit that the United States has already taken a very long peep inside.

It would be foolish, if the United Kingdom were to be so imprudent as to not at least explore.

Nick Grealy, No Hot Air—Written evidence

*September 2013*



**Nick Grealy, Phelim McAleer and Viscount Ridley—Oral evidence  
(QQ 134-152)**

TUESDAY 26 NOVEMBER 2013

*Evidence Session No. 11*

*Heard in Public*

*Questions 134 - 152*

Members present

Lord Lipsey (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lipsey  
Lord May of Oxford  
Lord Shipley

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**Witnesses**

**Nick Grealy**, Principal and Publisher of *No Hot Air*, **Phelim McAleer**, Journalist, *Fracknation* and **Viscount Ridley**, British Scientist and Journalist

**Q134 The Chairman:** Good afternoon and welcome to the Economic Affairs Committee. This is the eighth public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. Mr Grealy, Mr McAleer and Viscount Ridley, you are very welcome. Can I also thank Viscount Ridley and Mr Grealy for their excellent written evidence to us? It was all very clear. I would be grateful if you could speak loud and clear for the webcast and the shorthand writer. Our questions are, of course, to all three of you, but if you agree with whatever the first respondent has said, do not feel that you need to repeat it all. Only come in when there is something additional or in contrast that you want to say. Would any of you like to make an opening statement? I know two of you have already given very clear written evidence. Would any of you like to make an opening statement, or shall we go straight into questions? Can I then go into the first question?

I know that this has been partly dealt with in your own written evidence, but for the sake of the discussion and the record, I have a very general question. Could you indicate how you believe shale gas development in this country has the potential to bring material economic benefits to the UK? In asking that question, as in your evidence, I am not just thinking of the issue of shale, oil and gas in itself, but the wider economic benefits, or if you think there are any disbenefits that they bring for industrial development and various other aspects of the economy. Who would like to kick off?

**Nick Grealy:** It looks like I have been designated. Shale gas, and oil, is an extremely positive development that is disruptive, which is why it is occasionally described as controversial. It will supply lower-carbon, not no-carbon or lowest-carbon energy. It will have substantial

carbon impacts, and substantial cost falls for consumers and for industry. We are really only at the very early steps of shale. It is difficult because five years ago, when I first started looking at all this, the narrative was that fossil fuels were running out. Now it suddenly seems that we have gone completely the other way, and that is confusing and disruptive to people. However, it is an overwhelmingly positive thing.

I make the analogy of Naseem Nicholas Taleb's book, *The Black Swan*. I would say that of the power of disruptive events of a very low likelihood, this is perhaps a white swan in that it is a positive development of very low likelihood, akin perhaps to winning the lottery. It is a very low-likelihood, high-impact event and somebody has to win it. This is a positive one, yet some people want to leave the ticket in the drawer.

**Viscount Ridley:** Can I add a point that I think is often lost? This is clearly a case where if we do it and it comes off, there are enormous benefits. If we do not do it, and other people do, it is potentially a huge threat to the British economy. Unlike the oil price, there is no equalisation of gas prices around the world, even with all the LNG exports, which I am sure we will come on to discuss. Imported shale gas from the United States will always be twice as expensive here as it is in the US because of the cost of liquefaction. What bothers me about this issue is that we cannot get the benefits unless we do it at home. We can get some of them, but not all.

The main answer to your question "what is the evidence of benefit" is what has happened in the United States. There is no doubt that 10 or 20 years ago, or even five years ago, you could say it looked like pie in the sky that might not work, and now we have seen the enormous benefits from it. From a standing start in about 2009, the Marcellus field in Pennsylvania alone is now producing more gas than the whole of the UK consumes. The McKinsey Global Institute estimates that between \$380 billion and \$690 billion, 2% to 4%, will be added to US GDP as a result of shale gas by the year 2020. The Pöyry report, which came out yesterday, puts a figure on potential benefits to the European economy of up to \$3.8 trillion. I would agree with Nick, who, by the way, was one of the first people I went to talk to when I was first investigating this, so I got some of it from him. I do think there is now much less doubt than there was even two years ago, that this is a serious potential resource.

**Phelim McAleer:** I can speak only from the American experience. I basically spent the past 18 months in almost every shale area in America. It is very difficult to explain to this Committee the transformative effect that shale has had on remote communities in America. I recommend you all go there.

I was talking to someone this morning, debating the industrialisation of a rural area. The locals love it. I come from a rural area in Northern Ireland and there is only one thing worse than lots of lorries on the road, and that is no lorries on the road. They love it. Making the documentary created enormous difficulties for us. You cannot get a hotel in a shale area. We had to base ourselves an hour away. Even though they were building hotels as fast as they could, they could not keep up with demand. In Williston, North Dakota, hundreds of people get off the train every day with bags looking for work, all men. My wife went there by herself and she almost got two proposals of marriage, there are so many men there. She was asking directions, and when she got back to her car there was a note asking her for a date. There are hundreds of men. It is like there was a camera filming the Gold Rush in San Francisco. In Williston, North Dakota, it is hard to get people to work in shops there, because if you arrive there with a truck-driving qualification, a commercial driver's licence, you start on \$75,000 a year. If you have any experience, you get more than that. That is a lot of money anywhere. It is really a lot of money in rural America.

Honestly, you need to be there to believe it. These communities are buzzing. That is all I can describe it as, a buzz. Everyone is walking around with a smile on their face. Everyone is talking about shale. It would be a real tragedy if Britain did not take part in that boom. I will talk about it later, but there are certain aspects of the British shale situation that may stop Britain from taking part in that boom. I am not talking about the environmental issue; I am talking about royalties and other legal aspects, which I will talk about later. Economically, if Britain embraces it fully, you will not believe it. I do not know whether you can do this, but I recommend Williston, North Dakota. Do not go in the winter, though.

**Q135 The Chairman:** That makes it rather difficult for our inquiry. Leaving aside the budgetary implication, we were hoping to end before the winter is over. We are going to come on later to the question of the impact on other industries, other than the oil and gas industries. Could I just ask you this question? Pretty well all our witnesses in favour of development have argued that you cannot say what the scale of development will be at this stage until we have done the exploratory work. Given that, and in terms of the material economic benefits, do you have a view of the timescale involved?

**Phelim McAleer:** I made a documentary, which came out in 2008, about the coal industry. It was about global warming but focused on a coal town. I was going to a lot of conferences in 2008 and 2009. I was at one conference where a leading expert on the gas industry was giving a presentation, and he said, “America is running out of gas. There are only two countries in the world that have gas of any significance, and they are Russia and Iran”. He put a picture of Ahmadinejad on the wall and said, “We will have to be nice to these people now”. Now no one cares about Russia’s gas, or Iran’s gas. That was in 2008.

**Nick Grealy:** One of the things that has always annoyed me about the UK and European situation is that this is seen in some way as not for the likes of us, or that it is 15 or 20 years away. The example I could give you would be Susquehanna County, Pennsylvania, which in 2008 did not produce a single molecule of natural gas. This year it is producing in the area of 20 billion cubic metres, within four years. It does that with a remarkably benign impact on the landscape. There are only nine rigs currently operating in Susquehanna County according to the Baker Hughes well count. I have been in the natural gas industry for 25 years and the first 20 years were really, really boring. People moved away from me at dinner parties immediately. Now all of a sudden we have this complete transformation, but it is quite boring because most of the action is going on underground. One of the reasons why it looks quite horrendous sometimes in North Dakota, or Eagle Ford, it must be said, is because they have the luxury of space. The way technology is evolving in the United States there can be one shale pad covering 20 to 25 square kilometres. It would be akin to having a shale well pad in the green outside, draining gas anywhere from Earls Court to Canary Wharf. It is not really a blot on the landscape with the technology we would be able to use in Europe.

**Viscount Ridley:** On the point about speed, as Nick emphasised, the Marcellus shale in Pennsylvania has gone from a standing start at the end of 2009 to about 60% more than total UK production today. There is no question technologically that if you have enough drilling rigs and so on, that speed can be achieved. The speed seems to me to be set entirely by the regulatory environment

**Phelim McAleer:** These are capitalists. They like oil and gas.

**The Chairman:** I ought to have explained at the beginning that we are rather short of Members today, because a number of our colleagues are participating in the banking Bill on

the Floor of the House. That is why we have rather fewer numbers than we normally have. I apologise for that.

**Q136 Lord Shipley:** One of the attractions of shale gas is said to be lower gas prices. Could you each say what you think the effect of the development of shale gas in the UK will be on both wholesale and the domestic gas prices?

**Viscount Ridley:** You should not pay attention to anybody who thinks they can forecast gas prices, of course. That said, it does seem to me that the assumption that gas prices must or probably will go up very steeply in the next few years now looks extremely shaky. That is not to say that they will necessarily go down, but it does seem more likely now that they will go down than up over the next few years in the UK, because of the effect of exports. I am just back from Australia, which is spending AUS\$80 billion on liquefied natural gas exports. They will not come here, but they will take market share from Qatar, which is going to send gas here, so it will have an impact. America is doing the same. Supply and demand tells you that it is more likely that gas prices will go down than up, or at least that they will not go up as steeply as we say. Nobody forecast Fukushima. That had a huge impact on gas prices because the Japanese stopped using nuclear. Something like that could push gas prices up again. The figure that struck me was that in order for the Hinkley Point nuclear strike price to look like a good deal, gas prices will have to go up by 130% from here by 2023. I do not think that is very likely.

**Nick Grealy:** In the short term, up to 2020, we will see the price of gas being set by US LNG, which is effectively US shale exports. Cheniere says that that will be happening in the second half of 2015, and I believe slightly ahead of schedule on that. There are a number of other trains and terminals behind that. There is so much gas in North America that has to go somewhere. Even after going into generation, even after going into natural gas transportation, even after the reshoring of the chemical industry, we still have a massive amount of gas in the United States. That pressure will be done only by gas exports. I would expect that if you put in the cost of exporting gas from North America to Europe, and expecting around a \$4 gas price, you will be looking at \$8 here in the UK, compared to \$11 today.

The problem with the UK domestic price is that it is completely untransparent. The regulator Ofgem has never had any interest in showing any kind of transparency. It says that approximately 60% of the cost of a bill is from fuel. If we have a reduction from \$11 MMBtu, or 70p a therm down to slightly below 50p, we would be looking at £140, £150 to all 34 million energy consumers in this country. Ben Franklin famously said, “Nothing is certain but death and taxes”, and now he would say nothing is certain but death, taxes and the electric bill. This is effectively a £140, £150, £200 gift to every family in Britain.

**Lord Shipley:** When would that apply from? I want to be clear about the timeline here. We are in 2013; there is the potential for US export, there is the potential for us to produce our own. Can you say a bit more about how you see that timeline?

**Nick Grealy:** US exports will happen first. If we could start drilling in the UK next year, we could see production starting from 2015 to 2016. It could ramp up to have a significant change by 2020. The US LNG price will set the marginal price in Europe. People are absolutely correct; many on the green side say that it will not change anything because of the international gas price. International gas prices are coming down anyway, we hope.

**Q137 Lord Lipsey:** Is there any chance the cost of transporting gas will come down dramatically itself now that this enormous export opportunity had suddenly presented itself?

**Viscount Ridley:** My guess is there is a physics problem there, because of the need to take it down to 162 degrees below zero, or whatever it is. The Australians are building a floating liquefier that sits over an offshore gas field and liquefies gas straight out of the offshore—this is not shale gas, it is offshore gas. There is innovation going on in how to get liquefaction done. That is partly about saving cost. I cannot see a huge cut in the price of liquefying, but I might be wrong.

**Nick Grealy:** It would mostly be the number of ships available. Right now we are talking about \$150,000 a day to hire an LNG tanker. A few years back it was below \$50,000. There are a very large number of ships sailing over the horizon, luckily, from about 2015 onwards. We could see the development of a spot gas price based on LNG.

**Q138 Lord Hollick:** Do we have the infrastructure in the UK to cope with significant imports of LNG? It was rather an interesting decision taken by British Gas recently, where it decided to bin a £1.25 billion LNG plant, presumably because they were not impressed with the economics.

**Viscount Ridley:** Was that a storage plant?

**Nick Grealy:** Yes, I think that is more of the storage.

**Lord Hollick:** It was a storage plant, which I presume is part of the infrastructure you need within LNG.

**Viscount Ridley:** Nick may know more than me, but the Isle of Grain did increase its capacity pretty dramatically in recent years, I believe—obviously, because we have been importing more—not for storage, but for handling LNG. There is supposedly a famous incident in December 2010, when a Qatari gas ship on its way to America—it may even have got into US national waters—turned around when it heard what price we were prepared to pay to keep the lights on in this country. It reached the Isle of Grain on Boxing Day that year. If it had not, we might have been in trouble. I do not know whether we are running close to a capacity issue there. The Grangemouth people are building an LNG terminal I believe.

**Nick Grealy:** There is no LNG capacity. We have a basically underutilised gas network in this country. We are very lucky that the gas pipeline from Lancashire basically follows the M6. We are very lucky in that.

**Lord Shipley:** Mr McAleer has not answered the original question.

**Phelim McAleer:** I do not want to repeat what Viscount Ridley said; he summed it up well. From my experience in America, the biggest threat to the American shale gas industry is that they produce too much of the stuff. It is becoming slightly uneconomic for them to pay large sums of money for leases and then to drill at \$3 or \$4 a unit, whatever the unit is. I have been wrong about almost every major economic development in the past 20 years—it is not my expertise—but supply and demand are pretty vicious masters. In America that is the biggest problem. Lots of companies are saying the price has got so low that they are worried it has become uneconomic for them to exploit the resources they have. They are selling acreage off in fire sales because they cannot afford to keep it or drill it. I would say: look forward to cheaper gas prices, based on the American experience.

**Nick Grealy:** I noticed in the evidence you had from Bloomberg New Energy Finance about the costs of producing shale gas that in Susquehanna County, Pennsylvania, some of the cost

of producing shale gas is as low as 40 cents. The economies of scale and technological advances are making it that much cheaper. Plenty of people can make money at \$4.

**Q139 Lord Griffiths of Fforestfach:** I wondered if we could carry on with the export from the US of liquid natural gas. If we put the development of shale gas in the UK to one side for a minute, there are two questions: can you describe to us what the transmission mechanism is, from the export of LNG from the US to European markets and to Asian markets? Secondly, last week we had evidence that suggested that US exports would not have much of an impact in Britain, whereas what you have said is very different. Can you explain what assumptions you would make to reach one or other of those conclusions?

**Nick Grealy:** I would say that LNG will be setting the price at the margin in the western European gas market. It is very complicated, but that is what is happening. Thierry Bros, who was here a couple of weeks ago, was quoted in the *FT* the weekend afterwards talking about why UK gas jumped from 65p to 70p. It was because there was a 10 billion cubic metre pipeline between Libya and Italy. The gas traders were given the sentiment that gas prices were going to go up, because the market was going to be tight. If there is going to be 20 billion or 30 billion cubic metres of UK shale gas, it will have an effect on prices.

US LNG is coming anyway. It is very complicated; what we have to understand from the US is that we also have Canadian, North American LNG. The molecules do not necessarily have to come here or to Asia. It will basically be either Asia or Europe. The thinking now is that those molecules that come from the United States to Europe, in a complicated way—which we do not have all day to explain—that will bring down Asian prices anyway. It would happen in reverse as well: if Asian prices come down then our prices will come down. We are a long way off yet from a single world gas price. Eventually—we are talking about the 2020s here—one will develop.

**Viscount Ridley:** Just to expand on that point, Japan drove up our gas prices by increasing their demand in the wake of Fukushima. Clearly, how that transmission mechanism works is gas tankers changing direction in the sea. I gather the Japanese are currently trying to break the link between the oil price and the gas price in their negotiations with the Australians in particular. That is a link that was broken in the United States in 2010, with a dramatic divergence thereafter. It is a link that is still pretty intact still here in Europe. If oil prices go up you tend to find that most contracts are linked to the price of oil. The breaking of that link is what the US LNG exports could achieve, even at the margin. That would be one of the transmission mechanisms for changing the picture.

**Lord Griffiths of Fforestfach:** So you see a convergence to a single global gas price with some regional variations around them?

**Nick Grealy:** The example I may say would be that we essentially have the Brent price of oil and WTI price in oil. The Brent price is affecting gas prices as far away as Australia or the Urals. It is not going to be exactly \$4, \$5, \$6 in every part of the planet because of the transportation differentials. I think we will see some convergence.

**Viscount Ridley:** Some convergence, but you would probably agree with me: it is very unlikely to go all the way to a full convergence because of this extraordinary cost of liquefaction.

**Q140 Baroness Blackstone:** I want to move on to how much shale gas we have here. The British Geological Survey has I think estimated that there is something like 1,300 trillion

cubic feet in the Bowland Shale. To what extent can we use the American experience to predict how much of that will be economically recoverable?

**Phelim McAleer:** Everyone who went into the shale in America will tell you that when they went down they knew nothing. They are learning every day. It is a learning game. Now they are five years into the learning game, so you should listen to the latest thinking about it. They completely got it wrong and underestimated what was down there in America. I have learnt a lot about the oil and gas industry these last couple of years. A lot of it is salesmanship, trying to get people to invest in a place. You have to sell an investment and say, “There is definitely oil and gas down there”. Normally they over exaggerate what is down there. The thing about shale in America is they all got it wrong. There was much more down there than they thought. Now they are five years on, so they are probably a bit more accurate, but all I can say is the experience has been that they have always underestimated what is there. That is all I would feel comfortable saying.

**Viscount Ridley:** The key figure is the percentage of the gas in place that you can get out. Most people are using a figure of 10%. That is pretty conservative. If you look at some of the US gas fields, they are doing considerably better than that, they think. When I first went to see the Marcellus in Pennsylvania, it had just released an estimate that there might be 500 trillion cubic feet, which was a ridiculously large number. Everyone was shaking their head saying, “This is absurd”. The Bowland Shale is nearly three times that, so that gives you an idea of the sort of numbers. As I say, the Marcellus is producing considerably more than we consume from its 500 trillion cubic feet. There is no question that, if we can get 10% of 1,300 trillion cubic feet, that is worth £1 trillion straight there. That is more than enough to keep us going for a very long time.

Just today, there was a new thing on a blog called “Energy Matters” giving the data from one county in Pennsylvania called Bradford County—I do not know whether that is anywhere near Susquehanna County.

**Nick Grealy:** It is next door.

**Viscount Ridley:** It is in what they call the sweet spot of the Marcellus where the wells tend to do best. It is not all uniform and obviously there are some places that do not work as well. There has been steady improvement in the yield of wells over the years there: the wells that started in 2009 produced about 60% as much as the wells that started in 2011 did in their first year. More interestingly, there is a much slower decline rate too, so they have got better at fracking the wells, with the consequence that now the decline rate in the first year for the wells driven in 2011 is only 22%.

**Baroness Blackstone:** Will that continue? Will the decline rate go along?

**Viscount Ridley:** It looks exponential. You get a long tail, but the tail is thicker than it used to be, if you see what I mean.

**Baroness Blackstone:** So you would be extremely optimistic in that sense that there is not going to be fast decline?

**Viscount Ridley:** We are coming in when an awful lot of the hard work has been done. That is the other thing to remember. Fifteen years ago in Texas, George Mitchell and his friends still had not managed to get significant quantities—economic quantities—out of any well in the Barnett Shale, and they had been at it for 10 years. Then they made a mistake one day and forgot to put the gel in the fracking fluid and left it too watery. They got a good result and that got them thinking. They decided to leave 95% of the chemicals out because it was cheaper anyway, and suddenly they found that these slickwater fracks worked much

better. They got the time it takes to frack a well down from six weeks to two, and then they worked out how to do the multi-stage fracking such that they got a better yield, they can steer the drill bit better and keep it inside the seam etc. All these improvements we can leapfrog. We do not have to do these from scratch, presumably, in this country.

**Q141 Lord May of Oxford:** This question takes off from an article in the *Economist* last week that said that gas exploration in the US was, “increasingly being determined by the prices of oil and NGLs. If they are high enough, energy firms will drill for these, treating natural gas as a by-product”. Some honcho quoted in this—somebody called Rick Grafton—said, “While gas prices remain at historic lows, it will remain unattractive to invest in wells that produce only gas—as opposed to ones that produce oil or a mix of gas and natural-gas liquids such as butane and propane”. Would you say that is a sensible thing? If it is, how important do you think it is that, in the UK, shale gas producers find wells that also produce natural gas liquids and oil? Wells that are capable only of producing shale gas probably would not be viable. We sort of touched on this earlier, but not in the light of the article in the *Economist*, so you will have to bring us up to speed.

**Viscount Ridley:** I read that article and it was very interesting. The short answer is, yes, at \$3 per million cubic feet, you do not want to go near a gas-only well if you can avoid it, and the rig count has been dropping in those fields such as the Marcellus that do not have a lot of gas liquids and increasing in the Bakken where there is a lot of gas liquids. As Nick said, it is becoming uneconomic to do a frack job just for gas in some parts of the United States. However, at \$11 a cubic foot, which is what we have here roughly, it would be a completely different picture. In other words, I would have thought that it would be nice to have gas liquids too because they are valuable things—ethane, butane, propane and so on—but methane would cut it at that price, presuming the costs would be the same here, which, of course, is a big question. I would not have thought that it is quite the same picture here. Another difference is that the American petrochemical industry largely uses ethane as a feedstock for some reason and we do not. We use oil.

**Nick Grealy:** Number one I would say is—and this is not at all discussed in the UK—that we, most likely, have a very large resource of oil in the UK. IHS Energy Consulting, for example, believes that there are 4 billion barrels of oil recoverable in the Bowland Shale. That is very nice to have as well. And Toni Harvey from DECC told you—and it certainly surprised me, pleasantly—that when they are doing the assessment of the Weald Basin they may not even bother with gas and they will go straight to oil. There are plenty of people that who me that the Weald is analogous geologically to somewhere like the Bakken or Eagle Ford. That would be like winning the lottery and finding that, oh, you won the raffle as well.

**Q142 Lord Lipsey:** Mr McAleer, you painted a rosy picture of the gold rush in America. Of course, the reaction over here so far has been quite contrary to that. I mean, at Balcombe, a combination of some very energetic residents, their green advisers and activists have forced Cuadrilla out of the place. Is there anything that could be done to win over local communities over here, or will this simply be a very long ongoing battle that might, in the end, mean we cannot get any shale or gas?

**Phelim McAleer:** Going by the American experience, I am not sure that communities are opposed to fracking. I am not sure that they are in favour of fracking. I do know that environmental organisations are very noisy, very media savvy and tell a good story, but I am not sure they have widespread support. I do not know.



I think the gas industry needs to be more aggressive. No, I do not know what can be done because it is hard to deal with it when people—I use this word; maybe I am not allowed to use it in the House of Lords—lie. It is very hard to combat lies. I use that word deliberately. These are lies. These are not emotional mistakes or a grey situation. These are people who say, “Oh my God”—excuse my language—“my water is going on fire”. Everyone in that area knew that you could light your tap water on fire decades before fracking started.

There are three places in America called Burning Springs. The Indians called them that. George Washington had a bet with Thomas Paine—he wrote about it in his diary—about lighting the Milford River in New Jersey. After having a revolution against a certain country, then they had some time on their hands and they had a bet about whether they could light the Milford River, and they did. They went out and stirred up the river and lit it. I think Thomas Paine won the bet.

People have been lighting their water in America because of gas coming up for hundreds of years, which has nothing to do with fracking. The people who put out that video, Josh Fox and HBO, knew that. I asked Josh Fox about that in an interview and he said, “I knew people could light their tap water decades before fracking started but I choose not to include it because it was not relevant”. How do you deal with that? I have no solutions. How do you deal with someone who deliberately conceals relevant information from the public? It is easier to scare someone than to reassure them. We have had scare stories; I think we need aggressive science stories now.

**Lord Lipsey:** The funny thing is, you say people are lying. I have read through quite a lot of the stuff produced by the Balcombe residents. I do not get the impression that these are people lying in the sense that they know that what they are saying is untrue. Indeed, I believe that most of them passionately believe what they are saying to us; they believe it to be based in science and they believe that the companies are the ones who are distorting the science, which makes combating it—if that is what you decide to do—even more difficult.

**Phelim McAleer:** Sorry, maybe I was imprecise. I am not saying that the residents in that area are lying. I am saying that the people who supplied them with the information—the people who have supplied that story, that scenario—were deceptive. They withheld information. They withheld evidence. You now have people with genuine beliefs, but based on fundamental deception. That is a very difficult thing to overcome because these are genuine beliefs.

**The Chairman:** I know that Lord May wants to come in in a second, but do either of you other two want to answer the original question?

**Nick Grealy:** I would just say very quickly that what we need to do in the UK is drill some wells and show that the taps do not catch on fire and the earth does not shake, and all this kind of stuff. It is ironic that the Balcombe Great Gas Gala was about an oil well that was conventionally drilled. The number one concern from the Balcombe residents was traffic. It does seem rather paradoxical that you would have a demonstration of 1,000 people protesting about traffic. I think Cuadrilla was trying to show originally that there is absolutely nothing to fear. If you take away the demonstrators, nobody would have noticed a thing.

**Viscount Ridley:** Just a quick point; I do, to some extent, agree with Phelim: this has gone beyond exaggeration and into actual mythmaking. When you look at the actual evidence for serious earthquakes, serious aquifer pollution, radioactivity, methane leakage—all these kind of things—the actual numbers are nothing like what an awful lot of people have heard and are worried about. I also agree with what Nick says. If you talk to MPs from Sussex, in the

end they find that people eventually see through the myths and end up more worried about the traffic. Coming from the north, I think the south of England is one big traffic jam anyway, but apparently it can be made worse.

That seems to present a possible solution, which is that we know you can get local support for really quite intrusive industrial activities in the countryside—I am thinking of open-cast coal mining in Northumberland, which I know well—by working hard on the local communities and giving them lots of benefits like reroofing the church or the cricket pavilion, supporting sports group and all that sort of thing, but also by focussing on what people really do mind about, and that often is traffic. If there were enough funds in the kitty to do road improvements in these areas as a quid pro quo for having too many lorries for a few weeks, it might well be popular. Something imaginative like that in the way of a quid pro quo is going to have to be done to get people on-side, particularly in some of the more nimby parts of Britain.

**Q143 Lord May of Oxford:** Could I just quickly pick up on the slight assertion that the opposition to this comes from residents who are a bunch of liars? The only bunch of people who by objective criteria are on record as what could generously be described as being economical with the truth are, indeed, Mr Egan. His company—and I will read you the documentation on this—has already been found by the UK Advertising Standards Authority to have breached numerous codes of UK advertising practice, including CAP code rule—whatever they are—3.1, misleading advertising; 3.6, subjective claims; 3.7, substantiation; and 3.11, exaggeration. I just think there will be high feelings on both sides of this. Just to speak as you did, I think it is quite over the top, particularly when we are speaking essentially on behalf of people who have been found by a rigorous process to be economical with the truth.

**Phelim McAleer:** I did not call the residents of that area liars, and if I did, I will apologise.

**Lord May of Oxford:** Yes, you did.

**Phelim McAleer:** No, I tweaked it and I said that the people who are supplying them with the information were liars. I looked at all the serious cases of pollution in America: the flaming waters of Dimock, the flaming waters of Texas and the earthquakes of wherever. I looked at every sick dog and ill granny and person telling me their husband does not fancy them anymore and their sister's left leg is shaking—every story that they come up with.

**Lord May of Oxford:** I did not mean to provoke—

**Phelim McAleer:** I wrote it out here, and I put it in capital letters: all of them were bogus. Look, these are people who are suing oil and gas companies. They are suing the biggest companies on the planet for money. We need to look at what they are saying with extreme scepticism. The Americans had a thing—I think it was a bank robber called Willie Sutton or Willie Lomax—and they said to him, "Willie, why did you rob so many banks?" He said, "Because that's where the money is". "Why are you claiming all these illnesses against these oil and gas companies?" "Because that's where the money is".

**The Chairman:** Perhaps I can widen the question on public relations and all of that because we have been focusing on the local communities. In your written evidence to us, Lord Ridley, and I think in your article in the *Telegraph*, was it not—

**Viscount Ridley:** It was probably *The Times*.

**The Chairman:** In *The Times*, in response to a certain diocese that was producing arguments against fracking. In your evidence, and in that article, you stressed quite strongly

all the positive benefits, as you see them, on a much wider scale: lower gas prices; lower prices for the consumer; produced at an environmental cost far lower than either coal or renewable energies so it has a significant impact on carbon emissions; the effect on industry and the threats to our competitiveness if we do not go down that route. These are all the arguments that you put in your paper. Do you think enough has been made of those, at the moment, in public?

**Viscount Ridley:** I would like to see the Government or somebody, as well as the industry, make these positive cases, because I do think that it does not get across. For example, just to take one of those things you mentioned, on the environmental impact of this, it is no good taking one form of energy in isolation and saying, “This has an environmental impact”. It has to be compared. I think the land footprint of gas compares extraordinarily favourably to the land footprint of wind, for example, or, indeed, solar. The calculations I have done are that one well pad in Pennsylvania produces about the same as 500 wind turbines per year. I have seen another figure that 25 acres of Pennsylvania produces more energy than the whole of the UK wind industry. Obviously, we are going to need a lot of acres to produce as much as our gas industry does, but just to produce as much as our wind industry does, which has had a huge environmental impact, not just on landscape values, peatland and all that kind of thing, but on birds too. The eagle kills are not insignificant in some places.

Getting out there and making a positive case for the environmental and particularly the economic side of this is something we could see more of. It would be nice to see the Government getting home to people just how many jobs could come if we could get gas prices down, not to mention the fact that people in fuel poverty would be in a better position and, as I said earlier, the threat to existing industries if we do not. We have a huge petrochemical and chemical industry in this country. By chance, a lot of it is very close to where this gas has been found—Cheshire is next to Lancashire—and it is in this country because of cheap gas from the North Sea. It is ready to leave. I think Professor Dieter Helm made this point to your Committee: we are not seeing any new investment in that. We are seeing INEOS get very twitchy feet about leaving if it can. There is a great deal of heavy manufacturing industry that we could be getting if we did this, and that we could be losing if we do not do this.

**Nick Grealy:** One of the problems of the industry—the energy industry in general—is that the majority of people seem to think that electricity comes out of the wall. People do not understand how hard some people work so that they do not have to think about us at all. That is certainly the case of the electricity and gas industries in general.

It is very unfortunate that here in Europe, unlike among many green organisations in North America, the green organisations see the gas industry as their enemy, whereas we are their enablers. We say—I think by “we” I would be speaking for the majority of people in the energy industry in Europe—that there is going to be a multitude of solutions, including renewables, nuclear and everything we would like to see, except for coal. It would be a lower-carbon situation, which is what we are really working for. Gas could solve a lot of problems, but unfortunately we do have to go out and speak to a lot of people who never ever think about energy until all of a sudden, this year, they finally get sick and tired of gas and electricity bills going up for no apparent reason.

**Q144 Lord Hollick:** The Chancellor has set his stall out to create a new tax regime which he wants to be the most generous for shale in the world. He has just finished a consultation. Evidence that we have heard harks back to the last question and previous questions: the industry is looking to the Government to get behind the argument, get into

the debate, get engaged. There is a suspicion that it does not necessarily always speak with the same voice. Secondly, the planning process is incredibly laborious and stands in the way of rapid exploitation. I am sure that the industry would not turn its nose up at a tax break—who would—but do you think that tax breaks are necessary and essential to get this industry off the ground?

**Phelim McAleer:** Can I address that? I think tax breaks are a completely wrong way of looking at the situation. With the American experience, which has been a success, the gas companies deal directly with farmers and pay them leases for their acreage. In places like Pennsylvania, they started it off at \$100 an acre. As it became hotter and hotter, people were getting \$5,000 an acre. If you have 100 acres, you have a cheque for \$500,000 in your hand and then you have a royalty.

The Chancellor, rather than giving the company a tax break—I do not know if this is even possible, but this Parliament—should look at handing farmers and landowners back their mineral rights. America is the only country in the world where the farmers own their own mineral rights. As the most successful shale country on the planet, I do not think those things are coincidental.

**Viscount Ridley:** A small correction there, Phelim: it is only hydrocarbon mineral rights that have been nationalised in this country; other minerals rights are not. Otherwise you are correct.

**Phelim McAleer:** Thank you. When you have a farmer owning the mineral or shale rights, the company comes and negotiates and the money goes straight to the farmer. It goes straight to the community and it creates, in this age of austerity, a massive stimulus going straight to families in these communities. There are farmers there with 200 acres. They are getting \$1 million—300 acres. It is a lot of money. Then they get a royalty cheque every month.

The Chancellor, rather than giving multinational oil companies a tax break—it would even be better for the companies, too, because they would have locals bought into the process. By the way, it would also mean that if the farmers did not want fracking on their property, they could say, "No thanks". Then we would have this massive referendum about how popular or how unpopular fracking was, because people could say, "I don't want to deal with you. I don't want your \$500,000. I don't want to do the lease". People then would be free to choose.

Giving oil companies tax breaks—I am a free-market person, but that to me just smells bad. Giving people the rights to what is underneath their own property sounds to me like a wonderful idea. It is the selling of council houses for the 21st Century. That is what it could be. That was a hugely popular decision: to give people the houses they lived in and allow them to buy them. Give people back the mineral rights of the land they own and it is this massive economic stimulus. Whichever party decides to do it might reap an electoral windfall as a result. I do not know, but would that not be wonderful legislation? You would be giving millions of farmers money from oil companies and all the other farmers would be thinking, "The thing is, we do not know what's down there. Five years ago, shale was worthless; now it is worth all this money". "What else is down there?", thinks the rest of Britain. By giving them their mineral rights, it would be an emotional and financial feel-good factor.

**Lord Hollick:** I have a sense that Mr Grealy does not agree.

**Nick Grealy:** I would say that one thing we do have a shortage of in this country is poor farmers. It is physically impossible. When I was at Tim Yeo's Committee a couple of years ago, somebody asked me, "How much of a subsidy does the industry need?" I said, "With respect, I know that the nuclear industry and the wind industry and everybody are coming in here with their paws out". They said, "You do not understand: we want to give you money". We have this issue here where the United Kingdom Government is a 62% shareholder of this resource. Unfortunately, until this year, they have been a very silent partner who was dithering about it and really wished it would go away. Now they are unambiguously in support of that, at least at a national level. We have to get it down to the local level.

This gas in Balcombe is the property of the people in Balcombe. It is also my property and it is the property of the people in Northern Ireland, Scotland, Wales and everybody there. It is about the last communally held property that the Governments which ran from 1979 to 1997 did not nationalise.

**Viscount Ridley:** De-nationalise.

**Nick Grealy:** I think that if we look at it in the other way it will work better for that. It is also a physical impossibility in this country because we are in a much smaller country and we would end up giving royalty cheques to hundreds of thousands of people.

**Phelim McAleer:** 8.3 million royalty cheques go out in America every month—8.3 million. I think the oil and gas companies can send out a couple of hundred thousand royalty cheques every month. You say it is physically impossible, but I am sure that people said to Margaret Thatcher—who I have mixed feelings about, I might add, for all sorts of reasons—that it is physically impossible to sell the council houses, it is physically impossible to sell the telephone company, you cannot sell the steel company. You can. I own some property in Northern Ireland. You do not own it, Nick. It is not your property. I do not want you under my land and I am sure that the farmer in Sussex does not want people under his land. Give it back to them. You will have a real referendum about fracking.

**Q145 Lord Hollick:** Can I follow this up with Mr Grealy before we go to Viscount Ridley? Do you believe that the poor energy companies, oil companies, need a tax break to get started?

**Nick Grealy:** On the exploration side that would be very valuable. I believe that that is all that they are seeking and I am not quite sure if everybody sought that. Certainly, on the other side, the present tax regime, which is for a total of 62% going to the Government, the industry can more than live with that.

**Viscount Ridley:** Just to your point, I think you are right that a tax break is less important than the planning system in holding this back. In other words, it is the planning system and all the things around it. Coming to the issue of land ownership, as someone who does own a lot of land, it is not people like me who should be given windfalls at the moment, by the way.

**The Chairman:** Having been involved in the sale of council houses, I did not want to make that point. But it is a fair point, the different beneficiaries.

**Viscount Ridley:** It would be a regressive move. I am not convinced that this ownership issue is going to be a major stumbling block, except in one sense, which I will come to in a second. In other words, it is perfectly possible, as the coal industry in my part of world shows, to reward landowners even if they do not own the coal. You could just say, "Look,

we want to disturb your life. Here's compensation". I do not believe it is impossible for the companies to do that to people in a round about way. It is slightly trickier because of the horizontal drilling under people's properties. That is where there is an interesting issue. I believe that the law of trespass is coming into play for some of these things in this country, in as much as, even if Phelim does not own the hydrocarbons under his Northern Ireland property, if I start drilling on a neighbouring property and go under his property, I am committing some kind of trespass and he has some legal case against me.

Objectors to this technology are already talking about buying up strategic plots of land. There is perhaps a case to look at for some kind of compulsory purchase, eminent domain rights, so that an individual vexatious property owner could not cause confusion. They would not be getting any compensation; they would just be getting in the way.

**Phelim McAleer:** Personally I think, given the American experience, if you go down that track you will never have a shale revolution in England. Given the bad feeling that it has and the many myths about it, to put on top of that compulsory purchasing and forced excavation—it just smells so bad to me. It will put so many people's backs up that it will hold back shale development for a long, long time.

**Nick Grealy:** I do not think that trespass is much of a problem. The company that would have a tremendous problem with trespassing under people's homes is London Underground, in which case go and get them first. I think it is a technicality that will not stand up in court and if it does, Parliament should legislate against it.

**Q146 The Chairman:** It is an interesting one. I do not want to spend more time on it now, but if you would like to develop the point in a note to us, we would be grateful and we can pursue it further. Following on from the discussion we have just had, could I ask why is it that the major energy companies have not been involved in UK shale gas development to date? The industries we have had in front of us, by and large, have not been major industries.

**Nick Grealy:** They were not present at the creation in the United States either. What we really need to see in Europe are companies like Devon or Cabot—of that level. Basically, somebody like Shell, for example, has billions of opportunities all over the world. People make, for example, a lot out of the fact that ExxonMobil left Poland, but they left for better opportunities in the Bazhenov shale in Russia, for example. This is something where the small companies are the technological leaders, because it is relatively cheap to get into this business. You do need some money. Somebody like Shell, they may just say, "We do not need the grief because otherwise we are going to have people protesting outside every Shell petrol station".

**Viscount Ridley:** A lot of the companies that pioneered this in the United States were sort of entrepreneurial spin-outs from the big companies. The people who founded Chesapeake and, I think, some of the people who ended up at Mitchell Energy and Devon Energy were fed up with being unable to get their bosses in ExxonMobil to take new US gas seriously. The story was that everybody agreed that the US was finished as a gas field; the interesting thing to do was to go to the Caspian Sea or off the coast of Africa or South America or something. The historical reason there was that the majors were not interested in the US when this got started at the creation, as Nick said.

It was similar here. I remember when I first wrote about this, and I went to see Nick among others. Britain at that stage was at the "no, we do not seem to have any" answer, disappointingly. Poland was the interesting one in Europe. Suddenly out of the blue a little

company that had jumped over here from Oklahoma because it could not find any decent opportunities any longer in the US—Cuadrilla—suddenly said, "Hang on, we think we have found the right kind of shale in the UK". It is an entrepreneurial story and I do not think one should look at it, therefore, as a bad thing, as it were. It just shows how un-nimble those big companies are. Centrica has now bought into Cuadrilla, so some pretty big bucks are behind some of these people. The shale gas thing was so new and so different that the oil majors had no advantage in it.

**Q147 Lord Shipley:** Could you tell us, each of you, what your views are on the environmental risks of shale gas development and what we can learn from the US experience? We touched earlier on the issues of perceived risks, but what are the risks and what do we learn from the US experience?

**Nick Grealy:** Number one, we have to have some kind of baseline monitoring, which we are having in the United Kingdom, so that people cannot come two or three years down the way and say that their water is poisoned or what have you, and so we know exactly what is going on.

All the environmental questions are very relevant, especially to local communities, but they can all be addressed. There are issues. There is an issue out today with the one from Harvard in the US—this continuing one that will not go away—about CO<sub>2</sub> methane emissions. I think that that is eminently solvable, because we go to all this trouble—we have all this grief in the Balcombes and the Lancashires of the world—and a large amount of expense to get the gas out of the ground by releasing it into the atmosphere. It is mad. I would think the main one though—I say this kind of facetiously—may be traffic. I say, "Yeah, everyone is going to be able to afford a car. Shocking. The roads are going to be packed". That is going to be a very interesting environmental product out of it. Hopefully, they will be doing so in natural gas vehicles.

**Viscount Ridley:** Phelim will have more experience on this from the US point of view. I have simply followed all the environmental objections and tried to track down—

**The Chairman:** I am sorry. We have a Division, so perhaps we could come back as quickly as possible.

*Sitting suspended for a Division in the House.*

**Q148 The Chairman:** Can we resume our public session? We are still on the question about the environmental impact and it is Viscount Ridley.

**Viscount Ridley:** I was about to answer Lord Shipley. The way I see it, there are six major environmental issues that have come up over the years: earthquakes, aquifers, radioactivity, methane leakage, the amount of water you need to use and the content of the fracking fluid itself. I have satisfied myself that none of those have been a big problem. I think you have heard from Durham University, now that they have done this comprehensive study, that relatively minor earthquakes are all that is possible, really. There are much worse earthquakes from other technologies like hydropower. Phelim knows more about aquifer contamination than I do, but every case that has been looked at has not been proven to be the case. Certainly from fracking there might have been some contamination from well-casing failures, which is like any other conventional well. Both the US Energy Secretary

and the head of the EPA have confirmed that there are no proven cases of aquifer contamination.

Radioactivity is a relatively minor one, which has largely gone away. Methane leakage: again, Cornell raised this as an issue early on. It turned out that their numbers were greatly exaggerated. All of the numbers I have seen recently are no different from conventional gas and are really quite minor. There are some big numbers floating around for the amount of water used, but the number I have seen is that 0.3% of US water is used for fracking at the moment. That is an awful lot less than is used for golf courses, for example.

The content of the fracking fluid is a really interesting one, because the chemical content of fracking fluid was reduced by 95% in the late 1990s, when they realised that water worked better than gel. The stuff has become terrifically cleaner. We are talking about 0.5% of this being chemicals. They are nearly all chemicals you can find under your kitchen sink at home. They are far more dilute in a fracking fluid and they are going down a well into a strata that is full of organic chemicals anyway, if you see what I mean, a lot which are far nastier in terms of carcinogenic priorities.

I am not convinced that any of those is a really serious environmental objection to this, but they do all have to be monitored to give people comfort.

**Q149 Lord May of Oxford:** In this very helpful note you wrote, there was something about the one thing where nasty things did come up was because the pipe that was going down broke.

**Viscount Ridley:** It was the well casing, yes.

**Lord May of Oxford:** I take it that that is a very rare event.

**Viscount Ridley:** I think so, yes. There was a case in Pennsylvania—I cannot remember the name of the company—where it was thought the well casing might have failed. Certainly at the well I went to see in Pennsylvania, for the first 100 metres or so they had six-fold well protection, six concentric rings of steel or concrete, which decrease as they go down. Well-casing failure does seem to have happened in the past and therefore you could get leakage from that. However, it is not caused by the fracking, obviously, by the water at the base.

**Phelim McAleer:** I would agree with Viscount Ridley. All the major environmental risks and stories have been proven to be unfounded and there are different motives for them being publicised. Some people are genuinely scared of fracking; some people are deceptive; some people are against fossil fuels and will use any means necessary to attack the fossil-fuel industry.

There are environmental risks to not fracking. Many of the gas fields in America are within two hours of New York: upstate New York and Pennsylvania. If you do not frack there, people want it for holiday homes. You then have farmers who do not have any money, selling off land. In America, a holiday home is not a little cabin; it is a five-acre tract. People sell off five acres of their land for a holiday home. That means concrete, asphalt, a sewer system, laneways and roadways. These are now dotted all over what used to be a pristine farm. If you do not bring money into that area, the environmental risk is that the area will become more built up.

Again, this is a wider point. Look at the dirtiest places on the earth: they are the poorest places on the earth. If you want to clean up your environment, make the place rich. Bring money to these places and farmers will stop cutting corners with the environment and start



treating their environment well. There has been a lot of fracking going on in Pennsylvania. Pennsylvania is also one of the top tourist attractions in America with all the civil war sites. The Amish live there: my God, the Amish have communities in Pennsylvania and we are told it is this toxic wasteland. It is simply not true.

There really are environmental risks: there will be negative environmental impacts if you do not make these areas prosperous. Poorer areas have very bad environmental records.

**Q150 Lord Griffiths of Fforestfach:** Could I ask you what you think of the regulatory framework we have at present for exploration? In particular, is it too complex? Are there too many agencies involved? Although it is good, in the end, is it actually a mortmain on development?

**Viscount Ridley:** One of the worries is that it may load so much cost, through delay and other costs, onto the industry as to make it uneconomic and make it not happen. We would then have the disbenefits of it not happening. For example, to require an environmental impact statement every time you do an operation or drill a separate well from the same pad or something would, I am told, be prohibitively expensive. As another example, the relatively sudden decision by the Environment Agency—under pressure from the European Commission, which itself was under pressure from Friends of the Earth, by the sounds of it—to require any frack-fluid water that has been pumped down the well and left there to have a waste disposal licence was, as it were, a vexatious way of throwing a spanner in the works and causing further delay. There seems to be no doubt that that is what the motive was; nobody was really bothered about leaving 99.5% water 5,000 feet underground in a stratum that is already full of organic content anyway.

I am not at all optimistic about the UK shale industry. It has enormous potential, but it could fail to take off because of too much environmental and regulatory expense.

**Nick Grealy:** I would agree that, certainly, the noble cause of carbon reduction from the Friends of the Earth and Greenpeace and so on has been taken over by, quite frankly, vexatious time-consuming legal manoeuvres, which, of course, do absolutely nothing to cut any carbon.

The entire matter of the planning system—Lord knows I tried to get a loft extension and it was like I was trying to build the Shard—seems fundamentally anti-democratic, in that you can have one person holding up huge things. We have to decide, as a country, what we want to do: do we want to progress or do we want to say, “We may be British and we have the most expensive gas in the world, but my Lord we have a planning system second to none”? We really do have to decide.

I saw a speech that Michael Fallon did last week and it was very promising, in that he seemed to say that the underground issues were all going to be done centrally via the Environment Agency, the minerals agency and a number of other bodies. The local planning permissions would depend, quite reasonably, on things like visual impact and traffic and so on and so forth. That is a positive sign, but we have the negative example of Poland, where the Central Government was very positive about shale, but did not transmit that down to the local people.

That goes, finally, to an idea of how the industry should promote itself. We have to go out and sell natural gas as a fuel again, because we have a great, fabulous product that has perhaps been a bit unloved and tarred with the shale-frack brush.

**Phelim McAleer:** I cannot speak for the British regulatory system, but delay is fatal. One thing I would agree with environmentalists on is that these are vast multinational organisations and if they cannot make money here, they are going to make money there. I cannot speak about the regulatory system, but, in America especially, if they were getting trouble in Pennsylvania they just moved next door to Ohio or went to Texas. They will go where it is easiest to make money, so be very careful.

**Q151 Baroness Blackstone:** Can I ask each of you to what extent the development of shale gas will encourage the development of local companies?

**Nick Grealy:** First off, shale gas provides an energy source. In the UK, something like 96% of industry is close to an existing gas supply. That will not matter in the UK context, but there are places like Vermont in the United States that do not have gas, but oil is being replaced in forestry with natural gas. There is huge infrastructure going down to the hotels and suppliers to the hotels; it is going to benefit this part of the supply chain.

**Viscount Ridley:** On my one visit to Pennsylvania, I was very struck by how car dealerships to furniture stores in the area were all looking spruced up compared with how they had looked a few years ago—or so I was told. There are a lot of SMEs that would benefit from any kind of money that is floating around from this, obviously. The manufacturing industries, obviously, would benefit from anything that cheapens the cost of their energy and their feedstock. There are equipment suppliers who would benefit.

That gives me an opportunity to mention one thing, which is that I thought I had no vested interest in shale gas, but someone pointed out to me that I had declared an interest in a shareholding in the Weir Group, one of whose divisions does supply equipment to the oil and gas industry. I am happy to declare that; it is not the reason I am interested in this subject, but there obviously are a lot of equipment suppliers who are going to benefit.

**Phelim McAleer:** I met four workers in the shale industry. They were telling me that they were in a restaurant having lunch one day; they went to pay the bill and the bill was paid for them. They looked around and the guy says, “I own the local car dealership”. This is a small town—it is almost like a village—in Pennsylvania. He said, “You guys spent \$3 million with me last year”. This is a town you have never heard of. As I say, I wish you could all go there; there is a buzz going on. The first thing the oil and gas companies do when they arrive in these places is improve the roads. They do not even have to be asked. It is in their interest to get lorries and trucks in and out as quickly as possible. They do not want roads to be collapsing. They also reconstitute bridges, which creates a whole industry. There are even industries moving water. There are hundreds of people employed just to move pipes of water. These are strange things you would never have thought would be necessary, but they are.

**Baroness Blackstone:** You mentioned quite a number of chemical industries being close to where some of this Bowland shale might be developed. Do you agree with what Dieter Helm told us last week, which is that energy-intensive industries in Europe were in danger of becoming uncompetitive in relation to some other parts of the world because of energy prices? Do you think shale would make a difference?

**Viscount Ridley:** Yes, I do. It is a real risk. The reshoring—this rather wonderful word—of the American manufacturing, engineering and chemical industries is really a very striking phenomenon. The number somebody quoted to me is that there was almost no investment in chemical industry plant in the US for the 20 years up until two years ago; now, the amount of plant is doubling. There is no question but that, as Professor Helm said, if you

are sitting in BASF headquarters saying, “Do we open a new plant in Europe or America?”, at the moment it is much easier to justify doing it in America, because of this extremely cheap gas price. It is everything. The fertiliser industry is totally dependent on gas as its main feedstock. The cement industry requires an enormous amount of energy, so it is terrifically dependent on what the energy price is. We talked a bit about the suppliers and so on, but one should not focus on the jobs created in producing an energy source; one should focus on the jobs created in consuming an energy source. That is a much bigger issue.

**Q152 Lord May of Oxford:** As you know, we have the Climate Change Act, which says that by 2015 we are going to have a carbon account 80% lower than the 1990 baseline. To that end, the Energy Bill currently going through Parliament is introducing contracts for renewable electricity where it will stabilise revenues by having a strike price, which you all understand. However, renewables tend to be intermittent, of course, and that presents problems. We heard from Dieter Helm the suggestion that the electricity suppliers that do not want to use gas might need a similar form of encouragement, which prompts the question: do you think any changes to the Government’s energy policy are necessary to accommodate the development of significant volumes of shale gas?

**Phelim McAleer:** The question of a Government changing its energy policy for shale does not really make any sense to me. Shale will look after itself; it does not need a policy. It is there, the technology is there to get it, people are willing to get it. It comes up; you burn it. There was no energy policy for shale in the United States.

**Viscount Ridley:** That is the problem, Phelim. Our policy is that, when somebody wants to make electricity, they will take the wind power first and the gas second. They will only take the gas if the wind is not blowing. As a result, they are not going to build the gas plant because they cannot run it all the time. We are now finding that we have to subsidise people to build gas plants, which seems crazy. I do worry that we are talking about spending £100 billion by 2020 and another £200 billion on renewable, nuclear and other forms of investment by 2030, when £15 billion of expenditure on pure, unabated gas that was allowed to sell at the top of the merit order—I think that is the phrase—would achieve the same result of keeping the lights on.

In the short term, it would also make us more exposed to imports, but maybe not in the long term if we can get our shale-gas act together. The Energy Bill does disadvantage gas and does create the need to subsidise gas through the capacity-market mechanism. Professor Helm talked about the need to get to auctions as soon as possible. That is a cross-party preference and it is worth bearing in mind.

**Nick Grealy:** In the United States, for example, in Texas 35% of electricity is generated by wind. Gas and wind have been working together very well there. However, this is less so as the subsidies for wind are coming. UK energy policy basically proves that if you subsidise one thing you have to subsidise everything. It is mad. Certainly, you might not have to subsidise the gas-production industry at all, but you might have to subsidise the gas-generation industry, because otherwise you may turn on the light and nothing will happen.

**The Chairman:** On that interesting point, we must close. We have had a long afternoon; I apologise for the interruption for voting. We have certainly had a fascinating session. It was sometimes controversial, but always very interesting for us to pursue further. Thank you very much indeed.



Greenpeace UK, World Wildlife Fund (WWF-UK) and Friends of the Earth England, Wales and Northern Ireland—Written evidence

**Greenpeace UK, World Wildlife Fund (WWF-UK) and Friends of the Earth England, Wales and Northern Ireland—Written evidence**

[Submission to be found under Friends of the Earth England, Wales and Northern Ireland, Greenpeace UK, and World Wildlife Fund \(WWF-UK\)—Written evidence](#)

Greenpeace UK, WWF-UK and Friends of the Earth—Oral evidence (QQ 33-46)

**Greenpeace UK, WWF-UK and Friends of the Earth—Oral evidence (QQ 33-46)**

Transcript to be found under [Friends of the Earth, Greenpeace UK and WWF-UK—Oral evidence \(QQ 33-46\)](#)

## **Health and Safety Executive—Written Evidence**

### **Summary of the Safety Regulatory Regime for Shale Gas and the Role of the Health and Safety Executive (HSE)**

#### **Introduction**

1. The Health & Safety Executive (HSE) is the health and safety regulator in Great Britain for work related activities, including those associated with shale gas.
2. HSE's role is to ensure that operators of shale gas activities are adequately managing and controlling risks to the health and safety of people, whether workers, contractors, or members of the public.
3. HSE has no role in setting energy policy and deciding what is the right mix of energy sources. HSE is also not involved in environmental protection, licensing or planning decisions related to shale gas. However, HSE does work collaboratively with the bodies responsible for overseeing such areas.
4. For shale gas operations, HSE focuses on ensuring gas wells are designed, constructed, operated, maintained, and ultimately decommissioned to ensure that the flow of gases and fluids in the well, whether fracking fluids or extracted gas or water is controlled and stays within the well. This is called 'well integrity' and is equally important for safety as well as environmental protection.

#### **What are the main process safety hazards?**

5. The effective management and control of well integrity is key to safe shale gas operations and mitigating the risk of environmental pollution.
6. The main hazard from shale gas operations is the uncontrolled release of hydrocarbon gas due to a failure of the well structure, which may then reach a source of ignition leading to a fire or explosion. A well-designed and constructed well will reduce the risks of a release of gas or fluids as low as is reasonably practicable. The actual level of risk varies, depending on how quickly and easily any release can be controlled, and on geological conditions.
7. Where there is a loss of well integrity, there is also the possibility of fracking fluids or water being released to the surrounding rock strata or at surface, which may have environmental consequences depending on the location of water aquifers.
8. The occupational health and safety risks to workers from shale gas pilot activities are considerably lower than for other mineral extraction industries (e.g. coal mining and offshore oil and gas). People are generally working at ground level on sites with traditional health and safety risks comparable to a simple construction site, including falls or being hit by something.

### **The health and safety regulatory regime**

9. HSE's regulatory regime is long established and is goal setting. The general duties under the Health and Safety at Work Act etc 1974 (HSWA) require risks to workers and the public to be reduced so far as is reasonable practicable. This is supplemented with more specific regulations particular to the extraction of gas and oil through wells, which includes shale gas operations.

10. The specific regulations are:

- The Borehole Sites and Operations Regulations 1995, known as BSOR. The guide to these Regulations can be found at:  
<http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717662876>  
These regulations require notifications to be made to HSE about the design, construction and operation of wells, and a health and safety plan which sets out how risks are managed on site; and
- The Offshore Installations and Wells (Design and Construction etc) Regulations 1996, known as DCR:  
<http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717662968>  
These regulations include specific requirements for all wells, whether onshore or offshore, and include well integrity provisions which apply throughout the life of shale gas wells. They also require a well operator to provide HSE with regular reports of any activities on the well and to appoint an independent well examiner to undertake regular assessments of well integrity.

11. This combination of duties ensures that HSE is provided with information at key stages in the lifecycle of a well and allows HSE to assess whether risks are being adequately controlled and, if not, to intervene.

### **How does HSE conduct its interventions?**

12. HSE's intervention approach has two elements.

13. The first has been to contribute to the development of best practice standards for the industry as a whole with the United Kingdom Onshore Operators Group. These standards were published in February 2013. Such guidance, and existing industry codes dealing with well design and operations, sets clear expectation between HSE and operators as to how the general goal of reducing risks so far as is reasonably practicable can be met.

14. The second element is to focus HSE interventions with particular sites and operators on the key risk control measure of ensuring well integrity. For this, HSE uses its team of expert wells engineers who cover all types of hydrocarbon wells both on and offshore. As an oil or gas well is a complex engineered construction, most of which is not accessible to visual inspection, HSE takes a lifecycle approach to well integrity.

15. This lifecycle approach consists of:



- **Well notifications submitted to HSE**  
This allows HSE to assess the well design before construction starts. This is a key phase of work where the vast majority of issues likely to have an impact on well integrity will be identified and addressed by the well operator. It includes ensuring that safety features are incorporated into the design.
- **Weekly operations reports submitted to HSE**  
This provides HSE with the assurance that the operator is constructing and operating the well as described in the notification. When they are not, HSE can take the appropriate action.
- **Interventions with well operators, prior to and during the operational phase**  
This includes site inspections to assess well integrity during the operational phase. For new and first time shale gas operators, HSE and the Environment Agency will meet and advise them of their duties and conduct a joint inspection of their key operations.

### **The independent well examiner**

16. HSE's regulatory approach is supplemented by the requirement in DCR for an independent well examiner to assess well design, construction and maintenance. The well examiner is an independent competent person separate from the immediate line management of the well operations being examined. The well examiner can be an employee of the operating company or, as is normally the case for UK onshore wells, a contractor.

17. The examiner's task is to review the proposed and actual well operations to confirm they meet the operator's policies and procedures, comply with DCR and follow good industry practice. This may include periodic site visits.

18. HSE checks that the operator has these arrangements in place. The well examination scheme and involvement of the well examiner is for the complete lifecycle of the well from design through to final plugging and decommissioning.

### **Coordinated approaches**

19. HSE has long-established arrangements to ensure joint working with DECC, the Office for Unconventional Gas and Oil (OUGO), the environment agencies (Environment Agency, Scottish Environment Protection Agency and Natural Resources Wales) and the relevant planning authorities. HSE works closely with these bodies to share relevant information and to ensure that there are no material gaps between the safety, environmental protection and planning authorisation considerations, and that all material concerns are addressed.

20. In England, the Environment Agency and HSE have a Memorandum of Understanding in place that sets out the day-to-day arrangements for managing the broad range of operations that fall under their regulatory control. This includes how they will work together to regulate shale gas developments.

21. HSE and the Environment Agency have agreed jointly to inspect the next series of hydraulic fracturing operations in England. For new and first time shale gas operators, HSE

## Health and Safety Executive—Written Evidence

and the Environment Agency will meet and advise them of their duties under the relevant legislation; and conduct a joint inspection of the key operations, such as cementing.

*January 2014*

Health and Safety Executive, Department of Energy and Climate Change and Environment Agency —Oral evidence (QQ 153-184)

**Health and Safety Executive, Department of Energy and Climate Change and Environment Agency —Oral evidence (QQ 153-184)**

Transcript to be found under [Department of Energy and Climate Change, Environment Agency and Health and Safety Executive—Oral evidence \(QQ 153-184\)](#)

## Professor Dieter Helm—Oral evidence (QQ 115-126)

TUESDAY 19 NOVEMBER 2013

*Evidence Session No. 9*

*Heard in Public*

*Questions 115 - 126*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Baroness Noakes  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witness**

**Professor Dieter Helm**, Oxford University

**Q115 The Chairman:** Good afternoon, Professor Helm. This is not our normal Committee room, so it is rather large. Worse than that, we gather that some of the lights are not working. I hope you can see all right if you want to make any notes. We will endeavour to make sure that we see you properly.

**Professor Dieter Helm:** No problem.

**The Chairman:** We are very grateful indeed to you for coming, because we well know of your wide-ranging expertise in this area. Do you want to make a statement, or shall we go straight into questions?

**Professor Dieter Helm:** Let us go straight to questions, if that is helpful to you.

**The Chairman:** It is a very basic first question, because we are getting some differences in responses from some of our witnesses. How do you see the UK and European gas prices influenced by US developments? Is there a global market in the same way as there is a global oil market?

**Professor Dieter Helm:** The transmission mechanisms from US shale gas to world markets are many, varied, quite complicated, and typically poorly understood, so the impact of US shale gas on world gas prices is, and is likely to remain, very limited. Even if the US develops all the LNG projects that are currently in the pipeline, they are not enough to make much difference to the world price. If anyone thinks that US shale gas is about to reduce UK gas prices, the answer is that it is very unlikely. However, that does not mean that there are not significant effects. Two of the transmission mechanisms are very obvious. The first is that shale gas has displaced a significant amount of coal in the US, which is now in export

markets. Coal prices are and have been falling quite sharply for some time for a variety of reasons, but US coal exports have added to that. The immediate price impact is to drive down the price of coal in Europe. The coal burn has expanded very substantially in Europe, and since the coal burn has gone up a lot in Britain and the coal price has gone down, you might have expected that electricity prices would be falling in the UK rather than going up. That is a major transmission effect.

The second one is clearly in the product market. It is not so much that energy-intensive companies in Europe are leaving Europe; it is just that no investment is being made in energy-intensive activities across the whole of Europe. Major petrochemical and other investments are being made in the United States, which is a serious long-term competitive threat. The inhibition on oil exports from the United States means that much of the unconventional oil surplus in the US is refined and turned into refined products. That is why places like Grangemouth are in some difficulty now, as the US is very competitive in that territory too.

Apart from that, the other major effect on US gas exports will probably be to raise the price of gas in the United States. That is another poorly understood impact, as there is a degree of equilibration, but only a degree, between world prices and much cheaper prices in the US, with people seeking to choose export markets to get higher rents.

**Lord Lawson of Blaby:** That is why in the United States, of course, there is considerable resistance, which appears gradually to be breaking down, to exporting its gas.

**Professor Dieter Helm:** Yes. For the incumbent energy-intensive users, having a gas price of about 3 or 4 in the United States compared with, say, 10 to 12 in Europe or 16 in China is a huge competitive advantage, and I do not think that any time soon US prices will rise to anything like the levels experienced in Europe or the Far East. Indeed, if you look at the forward price of gas in the United States, there are good reasons for believing, even with the exports, that it will remain amazingly competitive against the UK.

You have to bear in mind one other thing when it comes to the industrial companies. Ethane, which is gas based, is used as the feedstock for petrochemicals in the US, whereas we in Europe tend to use oil-based feedstocks for petrochemicals, and there is an enormous difference between what the ethane costs and what the oil-based inputs are to petrochemicals in Europe. This is an enormous strategic threat, and it is likely to remain so even without the exports.

**Q116 Lord Lawson of Blaby:** What about other countries? Obviously the shale gas revolution in technological terms is not US-specific, and it is well known that there is shale in many if not most places around the world. Where would you see the capacity for significant production of gas from shale outside the United States?

**Professor Dieter Helm:** The first thing to say is that shale as a rock structure is ubiquitous around most of the planet, so there is a very large amount of shale rock about. Where there is shale there tend to be carbon deposits, most of which are uneconomic and unexplored, and we cannot know in advance in any detail what these resources are like until we have done some drilling. I started to write down the countries that you might think of in this category. Argentina clearly has enormous deposits. Russia has substantial deposits. Ukraine has pretty good deposits. Algeria has enormous deposits. Then there is Saudi, the Middle Eastern states, China, South Africa, indeed Europe, Canada. Once you start to list them, it is quite hard to think the other way around, which is: which countries do not have the potential for these resources? That does not mean that they are necessarily going to be

economic, but it is a complete illusion to think that in the medium term this is a US phenomenon.

**Lord Lawson of Blaby:** Right.

**Professor Dieter Helm:** That is only the case in the short term, and there are very good reasons for that, but one can imagine a world of potential gas supplies—it depends on the price—which means that from a policy point of view, instead of assuming that gas is a scarce fuel source that is likely to run out any time soon, you would be better placed to assume that there is so much of the stuff that you should assume not that it is infinite but that there is enough to last through a full technological cycle. That is all one is really concerned about when one is thinking about security of supply.

**Lord Lawson of Blaby:** Just one last point on this. You have reeled off the list of countries, and a continent in one case, where there are substantial reserves. As you say, until exploration is done we do not know whether it is going to be economic, but it would clearly be very odd indeed if the only place in the world where it was economic was the United States. There must be a presumption, surely, that at least in some of these other places it will be economic.

**Professor Dieter Helm:** There are some areas where it is speculative, but quite a lot of drilling has already been done outside the United States, so it would be quite surprising if Argentina did not turn out to have a pretty economic and substantive position to bring to the market. Indeed, that is already being developed, and similarly with Russia. The Algerian deposits look to be enormous, and they are right on the border with Europe, although there are issues about the availability of water and other kinds of resources for those. China is putting serious effort into developing its resources. It has some water issues as well. Ukraine is developing substantial resources. Poland has done quite a lot of drilling. We are not in ignorance about some of these countries coming forward; it is just that there is great demand in the wider policy discourse to know how much of it there is and how quickly it will turn up. The answer is that we do not know, but that does not mean that one should conclude that there is not much of it or that it is not going to have a big impact. We still do not know how much oil there is going to turn out to be in the North Sea. Only recently, Statoil found three large oil deposits in the southern North Sea after 10 years of exploration. One must always bear in mind that the potential is large; we already know that. Some of it is almost certainly going to be economic. Much of it may turn out to be economic.

**Q117 Lord Lawson of Blaby:** One very last question on this. What you have just said, I would have thought—contradict me if you wish—is likely to have a considerable bearing on the likely future course of gas prices worldwide. As I understand it, DECC's forecasts at the present time are based on a substantial further rise in the price of gas. Do you share that view or do you think that the shale gas revolution has changed that?

**Professor Dieter Helm:** I am very reluctant to forecast prices, and I think the Government should be very reluctant to forecast prices as well. However, there are certain things that you know. The world with shale gas as opposed to the world without it is clearly a different world. The perception and the possibilities of gas supplies are clearly much, much higher than they were five or 10 years ago. How much this has impacted on the price of gas is quite a complicated economic consideration, because it depends on how fast you think people can switch from oil to gas: in other words, how fast the demand is going to chase up against this now much more abundant resource that is available. I personally have no particular reason for believing that the gas price is going to go up in the medium term.

There are quite good reasons for thinking that it is going to go down. It is abundant in supply, and I think one should be very sceptical about this Government and the last Government embarking on policies that require them to assume that the oil and gas prices are going to go up and then pursuing those policies and not being willing to contemplate the consequence of that not being the case. It is not long ago that Ministers from both parties—it is not tied to any particular political grouping—loosely talked about oil and gas prices doubling. This was very much common parlance across the European Community at the end of the last decade. If you think the oil and gas price is going to double and that peak oil and peak gas means that we are going to run out of the stuff, you had better build as many wind farms and solar panels as you can, because these things are going to be in the market relatively quickly because the oil and gas price is going up way above. Europe will then have a competitive advantage over those poor Americans who have been encumbered with all that fossil fuel, and the petrochemical industry and others will be flocking to the shores of Aberdeen and elsewhere to get access to what in relative terms will be cheap offshore wind. This is the danger of trying to base an energy policy on assuming that you know the future course of prices. As an aside, I see no good reasons for believing that there is any better case for thinking that the oil and gas prices are going to go up than thinking that they are going to go down. Indeed, normally what happens is that when the price of fossil fuels rises, that contains the seeds of its own destruction, as it did in the 1970s, and a lot more resource then comes on course. You can understand shale gas and shale oil being a response to relatively high prices in the 2000s.

**Q118 Lord Griffiths of Fforestfach:** Can I ask you for your view of the potential for shale gas development in the UK?

**Professor Dieter Helm:** There are two answers to that. One is a potential question: what do the rock structures look like, and are they are the kinds of rocks that might contain significant shale deposits? That is a question for the geologists, and I understand that the answer, pretty unsurprisingly since we have lots of coal, conventional gas and conventional oil anyway, is that they are potentially pretty large. The reality, though, is about economics. It is not about whether rocks contain shale gas; it is about whether they are accessible at reasonable cost. The answer to that, as I understand it—and I am an economist rather than an engineer or a geologist—is that you have to find out, and that means that you have to drill some holes. My suspicion is that we do not really know until we have done quite a lot of drilling how much is there. That was true of offshore oil and gas as well; it took a long time to realise the scale of the deposits. You might think that my answer is evasive, but from a policy point of view it is right to assume ignorance, except in respect of the possibility, and to get on and drill some holes and find out what is there. Then you can decide what to do about it, or not.

**Lord Griffiths of Fforestfach:** That is certainly an honest response. I just wonder whether any possible lessons, any hints, could come from the drilling that is taking place in America and so on that would give us a little clearer guide than you have given.

**Professor Dieter Helm:** On the one hand, America has engaged in an enormous R&D programme. We should remember that all we are talking about here is the combination of three technologies: the ability to drill horizontally, the ability physically to frack the rock, and the ability of IT to detect where the drill bit needs to go. That is what it is about. It is not the rocket science of any particular technology; it is the combination of those technologies. A lot of that is practical stuff: drilling, seeing how it works, trying it out in different rock structures et cetera. So the benefit from the United States' extensive work in

this area is that it ought to be cheaper to get it out than it otherwise would have been. That means that the deposit that is available could be larger than you previously thought it to be.

In terms of rock structures et cetera, the geology is well beyond me, but again I would have thought that you learn a lot about geology by getting on and drilling some holes and finding out what is there. So my guess would be that the first mover is the United States, of course in different formations and so on, but this must make it easier for us than it otherwise would have been.

**Lord Hollick:** Following up on Lord Griffiths' question, you said that quite a lot of wells would have to be drilled to establish whether or not there was exploitable gas from an economic point of view. Has the US experience given a ratio of the number of wells you need to drill in order to establish whether or not there is an economic field there, and could that help us to establish and take a view here as to what quite a lot of wells might be numerically?

**Professor Dieter Helm:** I am probably not competent to answer that question. I certainly do not have the data and I do not have the geological knowledge to give you a good answer to that question. You have to understand that shale gas is not like conventional drilling for a big natural gas deposit or a big oil well. You drill a well, you go horizontal, you go a certain distance, you stop, you then move and drill the next one. This is about relatively mobile small-scale individual capital investments. It is much more flexible. You can even decide how much drilling you want to do on the future price six months ahead of the gas price. That is completely different from trying to drill an oil well, sitting on that and running that deposit out through its time. So I suspect that the costs of doing the exploration are quite limited. On the question of how many you need, if you struck a deposit that was much better than you imagined, you would end up with a very different answer, but I am probably not expert enough to give you a good and full answer to your question.

**Q119 The Chairman:** In terms of exploration, we are obviously at a very early stage indeed in the UK. The United States is obviously in advance of us, but are there other countries that are much more advanced in exploring their resources than we are?

**Professor Dieter Helm:** Yes. There are other countries in Europe. Poland in particular has drilled quite a lot of holes. Ukraine is drilling quite a lot of holes. A lot more are drilled in Argentina. China is getting on with this process. Russia is drilling holes. Lots of countries are doing it. It is not actually that difficult or expensive to drill a hole once you are allowed to do it, because it is not on the scale, as I say, of an enormous oil or gas well development. This is quite small scale and quite focused. I do not know the number of wells that were drilled last year, but it is not negligible outside the United States.

**Lord Griffiths of Fforestfach:** Could I just ask one follow-up question? There is this potentially phenomenal resource that we can tap, and we have a lot of private sector companies that are potentially interested in doing it. Do you have a comment on the response that we have seen so far from companies on drilling?

**Professor Dieter Helm:** The problem is not the drilling; the problem is getting the permission to do the drilling and facing the kinds of difficulties that have confronted particular drillers in particular sites. The reasons for this are pretty obvious. If you follow the line of argument that I pursued earlier, which is that you need to assume that the oil and gas prices are going to double and that gas is going to be a scarce fuel like oil in order to make the renewables economic, if you come from the renewables side and you are collecting the economic rents associated with wind and existing solar et cetera, this kind of



technology is a real threat to you. It might even turn out to be a much more efficient way of reducing carbon emissions in the short term by going from oil to gas, but from the perspective of being an advocate, a lobbyist or a rent seeker in some of the existing winners the Government have picked, you have a vested interest in making sure that this stuff does not get off the ground. If in a small crowded island you play up the nightmare visions of the water out of your tap catching fire, earthquakes shattering around you and huge machinery coming on to your landscape, it is not hard to create a coalition of interests that make it extremely difficult even to get past what you might call go, which is the initial drilling to find out what is there.

**The Chairman:** In terms of your previous answer about the amount of exploratory drilling that is going on elsewhere, presumably there will be less of the resistance—we will come on to this—to exploratory drilling there than there is in the UK.

**Professor Dieter Helm:** Yes. There are very special reasons why it is more difficult in the UK than in a number of other countries. We are an extremely densely populated island and a relatively wealthy economy, and if you are in a less densely populated country that does not have the wealth, you are more likely to want to drive to exploit that resource. If you are a country like Ukraine, which is dependent on the Russians and the Russian pipelines of gas, and you have the kind of income levels in those kinds of countries, of course you are going to push on a lot quicker. I think there are perfectly legitimate and understandable reasons why it might be more difficult, slower and indeed more restricted in a country like Britain than it would be in the wide open spaces of the United States, China, Ukraine, Poland, Argentina or a host of other countries. That is just part of the frame.

**Q120 Lord Shipley:** It might be more restrictive in the UK, but there is still significant public hostility to the development of shale gas. I wondered whether you had a view as to why this was, and whether you think that it is the responsibility of government or regulators to intervene more in that debate.

**Professor Dieter Helm:** If you know nothing about the complexities of shale gas drilling, which must be 99.9% of the population, and look on the web and see films of the water coming out of your tap catching fire or open your newspaper and read about earthquakes happening around you, and you have a vociferous lobby group that has a vested interest in making sure that drilling does not happen, it is hardly surprising that this builds up a difficult framework that is all in advance of showing what would be involved. This is before you really see whether this would be an intrusion on the landscape and whether it would create these kinds of outcomes. Any responsible Government, and indeed any responsible media, should want to explore the factual basis behind some of these claims. Of course one would want to make sure that regulators are on top of any environmental consequences that might flow from drilling, but I find it truly extraordinary that people want to ban fracking in a context where they are not prepared to ban coal mining, and indeed across Europe actually promote coal mining. When one thinks about the relative environmental impacts of the alternatives, coal mining is truly evil in comparison. I find it extraordinary that people are legally allowed to mine coal if you want at the same time to have a blanket ban on shale gas extraction.

**Lord Lawson of Blaby:** If I may say so, that is the point of Lord Shipley's question. On the one hand you say that there are the rent-seeking groups and so on with a vested interest in preventing it. On the other hand, you have the drilling companies that might well say that there is nothing to worry about, but people will say, "Well, they would, wouldn't they". Lord Shipley was asking whether there was not a case for the Environment Agency or the

Government in some shape or form setting out objectively the state of play. What do think the position is?

**Professor Dieter Helm:** I think, more than that, that it is entirely appropriate, as it is for any of these fossil fuels—indeed, any fuels—that there be appropriate environmental regulations. If you look at shale gas, there are a number of issues which you would want addressed. In some contexts, because shale deposits vary from context to context, you would want to prohibit them, and in some circumstances you would want to be very careful about regulation. Methane leakage is an issue. It should be regulated. You do not want to drill for this stuff along a geological fault line that is going to cause earthquakes that are going to bring down cities. On the other hand, you might not be bothered about minor tremors that happen on a very regular basis all over the place. You might well want to regulate what happens to water, and you will be very concerned about whether this is close or not close to water tables and so on, as you should be with coal. It seems to me appropriate that these public bodies should set out an appropriate regulatory framework. To be fair, that is being done both in the EU and here. Whether they should engage in the public debate about these things is well beyond my competence to comment upon.

**The Chairman:** But you made the point earlier that we do not actually know what the resources are until we do the experimental drilling. Do you think, as some of our witnesses have argued, that a distinction should be made between exploration and drilling and that the Government could make a stronger case for the exploratory approach?

**Professor Dieter Helm:** There is no point in doing exploratory stuff unless you think there is a serious prospect of doing the drilling. There is not much difference in environmental impact—the things you want to regulate—between an exploratory drill and an actual drill. I would much prefer a comprehensive regulatory framework but one that puts it in context with the regulatory framework around coal, oil and other sources of energy. As I said earlier, when you do a proper like for like comparison between coal and gas, it seems to me extraordinarily hard to make the case that the damage done by fracking for gas could be remotely like the damage done by coal mining and its consequences. Therefore, one wants relatively consistent, proper, enforced, credible regulation of these activities.

**Q121 Baroness Blackstone:** Should the comparison really be between coal mining and fracking for shale gas, rather than between shale gas and nuclear or renewables? You keep referring to coal, but there is an alternative approach. I wonder whether that is what the French have done: decide that they want protect nuclear and their investments in renewables, rather than because they see it as somehow preferable to mine coal.

**Professor Dieter Helm:** There are lots of different issues, with respect, in that question. Practically now, in Europe and the UK, we are switching from gas to coal. We have gone from about 28% of our electricity generated by coal a couple of years ago to about 40% today. Germany is bringing 7 to 8 gigawatts of new coal on to its system. Coal stations are being built across eastern Europe. The coal burn generally has gone up across Europe. Germany has gone from nuclear to coal and from gas to coal. This is a really serious environmental development across Europe. There are people who argue that we should go straight from coal to renewables or nuclear power. There are two answers to that. The first is that people who argue that we should be honest with the public and tell them the costs that they are going to bear for doing that. There should be no shilly-shallying about trying to cap rises in energy prices. This is a world in which, as we already know, the first nuclear power station is twice the current wholesale price in this country, and that wholesale price is much higher than other wholesale prices in Europe. Just as a factual point, the wholesale

price in Britain is about £50 a megawatt hour, or a bit more, and in Germany it is €30-something a megawatt hour. If you compare German wholesale prices with the cost of new nuclear, it is a ratio of about 3:1. If you want to go straight to nuclear or to renewables and miss out the gas bit in between, that entails an enormous investment programme and a massive increase in electricity bills. I have always thought that an energy policy is sustainable only if, first, the customers can pay and, secondly, they are willing to vote for politicians who will force them to pay, neither of which criteria seem to be applicable for part of the population now. That is my first answer. I do not think that we have the political framework to force customers to do that. Now, of course, it would be sensible if you thought that oil and gas prices were going to double but, as I pointed out earlier, that is a myth which a number of politicians sadly espoused in the development of the current technologies. The second thing to say is that conventional wind and conventional solar cannot crack climate change. There just is not enough land, surfaces and shallow water to make any significant difference to climate change. The third thing to say is that the climate change problem over the next 10 to 20 years is almost entirely about heading off the already enormous and increasing coal burn globally.

China is on course, even if it achieves all its latest 12-year plan, to add between 400 and 600 gigawatts of new coal by 2020. Emissions have been going up since 1990 to now, with no impact from Kyoto or any of the European activities, because the coal burn has gone up from about 25% of world energy to about 28% or nearly 30%. That is a percentage of an absolute increase through time. So the question, if you are serious about global warming, is whether there is anything that is politically affordable that people will sign up to that could cut into that coal burn quicker. The answer from the United States is that it has about the fastest-falling CO<sub>2</sub> emissions of any developed country without having any serious climate or energy policies that I can detect. It is going from coal to gas. Gas is not the long-term solution, but neither are the current technologies. The final thing I would say is that there is really is not much option but to develop some more gas. By 2015 or 2016, the capacity margin this country will be very close to zero; in fact, I have done some numbers which suggests that it might be below zero. What is going to fill the gap in 2017, 2018, 2019 and 2020? We will be lucky if Hinckley is on the system by 2022 or 2023. More nuclear power stations are coming off between now and then. Most of the coal, through emissions control, thankfully, is being closed. There are not enough wind farms and solar panels to fill that gap in a credible way. I would love to believe that you can go from fossil fuels immediately to zero or low-carbon options, but I do not think that that is practically possible. That is why I think that it is inescapable that gas is a transitional fuel and can actually make a big impact quickly. That is the lesson from the United States. Compare the United States with Europe. The United States has the fastest-growing oil production in the world. It has an enormous increase in its competitiveness and it has among the fastest-falling CO<sub>2</sub> emissions. It is going from coal to gas. In Europe, we are going from gas to coal. As I say, people are building new coal power stations in many places in Europe, and that is a locked-in disaster, which would make gas stations look like a picnic in comparison.

**The Chairman:** We have a lot of other questions that we would like to ask you, so we must move on.

**Q122 Baroness Noakes:** Staying with this issue about gas being a transition to a low-carbon future, back in May of this year, at a European Commission seminar, you said that there was clearly a massive argument in the UK Government as to whether that was the case. I wonder whether you would like to expand on where you see the sources of that disagreement within the Government. You also said that you thought that it was starting to

win some credibility in government. I would be interested to see whether, since May, you think that that opinion has moved on.

**Professor Dieter Helm:** I think it is fair to say that in virtually every Government in Europe, and in a number of Governments around the world, this is a hot issue. That is because there is one group of people who had absolutely convinced themselves that they knew what the future was going to be like. If you are absolutely certain that the oil and gas price is going to double and go on ever upwards, you must be extremely reluctant to allow a world in which you develop oil, gas and coal reserves on your system. You know the answer, so it is straightforward, and you therefore think that it is economically nonsensical to allow any development of fossil fuels because you know that they are going to be incredibly expensive.

That is one group. There is another group of people in most political systems who believe that the future is in decentralised, small-scale renewables, in particular wind and existing solar panels. They are utterly convinced that that is how societies should be organised. You can find in the Energiewende supporters in Germany people who have a whole ideology—that is not to criticise it; it is a world view—about how society should be organised, within which these decentralised technologies fit. That group is committed to a particular outcome. It is represented, and I say this without criticism, in the Green Party in Britain, and among some aspects of the green components of all the major parties. Then there are people who think that actually our climate change policy should be addressed in a global context, and that since nobody else is doing very much, maybe we should not do a great deal either. I am not in favour, nor do I support, any of those positions, but that creates a political argument. In terms of how it has been contextualised in the UK, the previous Secretary of State at DECC held a very strong view about the role of renewables and how one should avoid a great build-out of gas. The climate change committee at one stage held a pretty strong view about limiting gas on to the system. It is no secret that other elements of the coalition took a more pro-gas position. When I alluded to the fact that things had moved on, it is highly significant in energy policy terms in Britain that the Secretary of State at DECC is now supportive of developing fracking. As an aside, it is also significant that after the party conferences this year, all three political parties are supportive of nuclear power. That is a big shift in the politics of energy policy here.

**Baroness Noakes:** So you would not characterise it today as a massive argument within the Government.

**Professor Dieter Helm:** No, I think quite a lot of the argument is over. That was not true in 2010 or 2011. We have moved on a long way since then.

**Q123 Lord Skidelsky:** Absent from indigenous production of shale gas, are you worried that energy-intensive industries may leave the United Kingdom because of the high energy prices with a loss of competitiveness to the UK economy?

**Professor Dieter Helm:** I think that is, as I alluded to earlier, not really the question, although that is what everyone measures particularly when it comes to carbon leakage. The real question is whether anyone is going to invest in any energy-intensive industries in Europe, to which the answer at the moment is no. If you were in the boardroom of a major petrochemical or energy-intensive company in Europe and your board was confronted with the question, “Shall we build our new plant”—that is the footloose bit—“in the US or in Europe?”, the answer would be blindingly obvious, and that is what we see happening. I would put it the other way: name me a single energy-intensive investment taking place anywhere within the European Union now, then do the comparator and list the numerous developments in the United States. You will see immediately what is going on. It is a major

competitive threat. We can decide in Europe that we do not want to produce energy-intensive stuff. Then we can pretend that our emissions have fallen as a result by deindustrialising, but of course we will just import the stuff from somewhere else. That is why our carbon consumption, our carbon footprint, in Europe has been going up since 1990, whereas we pretended that we have made a difference to climate change by reducing our carbon production.

Just in the UK sense, our carbon production—that is, the emissions from our installations—went down by about 15% between 1990 and 2005. If you recalculate it for the stuff that we used to produce here which we now import, carbon consumption went up by about 18% to 19% in the same period. That is why world emissions carry on going up. It is just that China produces the emissions for us and for the US, and by relocating these industries elsewhere we pat ourselves on the back and say that we have achieved our Kyoto targets. We have actually made no difference to climate change whatever. You can argue that since these things have been offshored to more polluting places like China, at least with its current electricity industry configuration, we may well have made emissions worse globally while pretending that we had made them better here. However, the competitive threat here is enormous and substantive, and currently, with the gas price differential, it is hard to make a case for imagining that Europe is going to have an energy-intensive industry in the future.

**Lord Skidelsky:** In other words, in your view, the decline of investment in energy-intensive industry is a secular thing in Europe rather than a cyclical thing.

**Professor Dieter Helm:** Oh absolutely. It has been going on for a considerable period of time. That is what lies behind the emissions. There are special features to this. When the Berlin Wall came down and the rust-bucket energy-intensive industries of eastern Europe came into the EU fold, that created a wonderful baseline in 1990, against which to claim that our emissions were reduced. It is smoke and mirrors. The only thing that matters in climate change terms is your genuine carbon footprint. That is your carbon consumption. The Kyoto measures and the triumphant statements that come from the Europeans do not measure that. To make matters worse, in this country and particularly in Germany, even our emissions of CO<sub>2</sub> are now going up. Why? Because we are going from gas and nuclear to coal. You could not make it up as a strategy on climate change. It is disastrous if you care about the growth of emissions, and you can only care about the growth of emissions in a global sense.

**Baroness Blackstone:** I just want to pick up on one thing that you have just been saying. If it is the case, as you are claiming, that this lack of investment in energy-intensive industries has been going on for some time, can you put a bit of flesh on which sectors in the UK in particular, but maybe also in countries like Germany, are being affected? Presumably that is happening already. Which part of our economy do you see declining in competitiveness in relation to the US, or indeed anywhere else?

**Professor Dieter Helm:** My first comment was that nobody is making any new investment in these areas. That is probably too strong a statement. You might find some energy-intensive investment here or there, but BASF is not building anything new in Germany and you do not see people opening new steel mills in Britain. If you look at the core energy-intensive industries, we have lost quite a lot of them anyway. Part of that has been being a petrocurrency, which we were in the 1980s and 1990s, with a high exchange rate, et cetera. If you think about chemicals generally, petrochemicals, fertiliser, steel and things like that, these are the industries that one has in mind—and refineries, too. We are closing refineries in Europe. Grangemouth is on the margin. It is another example of an industry driven by US, in this case, shale and conventional oil production. As I say, it is not that anything is just

about to close, although Grangemouth did get quite close, it is that nobody is making new investments in this territory. I would love to be found to be wrong on that, but I do not see any steel mills being built anywhere in the UK any time soon.

**Q124 Baroness Blackstone:** I will go on to the main question. We had evidence from the Tyndall Centre for Climate Change Research in Manchester about what it calls the gilded cage phenomenon, whereby we may be locked into high carbon emissions as a result of investing in gas or shale. What is your view about that? Is the Tyndall Centre right or not?

**Professor Dieter Helm:** As I tried to argue earlier, lock-in in Europe is especially a problem associated with coal. Building a new coal plant, particularly in Germany when it is based on lignite coal, is a pretty serious consequence. The difference between gas stations, coal stations, nuclear stations and so on is that gas stations are very cheap to build relative to other technologies and they can be built very quickly. Therefore they can be depreciated very fast, so you get your economic return back pretty early on in the cycle. You might say, “Well, since you built the thing, you will just carry on running it”. If you would forgo the carbon reductions between coal and gas in order to avoid facing the policy decision later on that you could just tell them to close, why not? We are telling coal stations to close. The Germans told the nuclear industry to close. It might be a sensible framework for policy to say, “These are our targets going forward. Within that envelope, if there are more fossil fuels than are consistent with the targets, these stations may have to close”. But if you are so worried about the possibility that in 10 or 15 years’ time you cannot face up to closing kit that has already recovered its costs, and you are willing to forgo the advantage of building that kit now relative to the other alternatives, that is a pretty sad position to be in, and a weak one. I think it should be clarified. Remember my earlier point: we do not have any other options. If you do not want to build any stations, you have to tell the public the price of electricity that will be necessary to cut demand by so much that supply equals demand. You cannot wish the electricity to be there if you do not want build gas stations. Something else has to generate the electricity, particularly if the economy is growing. What else is going to generate that electricity in the next five to 10 years? Not wind farms, not solar panels and, by definition, not nuclear power stations. Remember: we are closing an enormous amount of our capacity in the short term. Our coal and closures of nuclear power stations are on virtually the same path as Germany, except for Sizewell B and, after 2023 or beyond, Hinckley. There is a big gap. It would be nice to have the luxury to say, “We don’t like this, we don’t like that, we won’t have this, we won’t have that, we mustn’t have a gilded cage”. My practical question is: so what are you going to do instead? I do not think that there is any answer provided to that question.

**Q125 Lord Lawson of Blaby:** I would like to follow up the lock-in point raised by Baroness Blackstone. For the record, you said that the bulk of Germany was undergoing a big switch to coal and that the new coal-fired power stations were lignite. In fact, they are not; that is a minority.

**Professor Dieter Helm:** One of the recent ones is. It is hard coal and lignite.

**Lord Lawson of Blaby:** The bulk is hard coal. Anyway, on the lock-in, the Government are in the process of signing long-term contracts for nuclear. They are going ahead very strongly, under the Energy Bill that is being debated on the Floor of the House as we speak today, with contracts for wind farms, particularly offshore. Do you think there is a danger that what you implied might be sensible—to use gas and, if we have the indigenous

resources, shale gas—as a bridge fuel on a large scale will not come to be, because it will not be economic as we will be locked into these contracts for nuclear and renewables?

**Professor Dieter Helm:** The contracts have a time period, and clearly a lock-in can be applied to any technology in the sense that the sunk costs for things on the system and whatever the marginal costs are determine its economic attractiveness. I think the problem is slightly more complicated than that, with respect, and it is this: once you have developed a sufficient amount of intermittent generation on your system with zero marginal cost, you render everything else on the system intermittent too. Something has not been understood about the nature of renewables, because we have not had many of them to date, but it is obviously becoming apparent in Germany already, and it is coming within the investment horizon of those who might build new gas stations: rather than the normal economics under which you build the thing—run it flat out when it is new and efficient, depreciate the asset and get your sunk costs back to make your investment sensible—suddenly you are in a world in which you do not know when it is going to run. If there is sufficient wind with priority on the grid, it displaces everything else. So now you have to sign a gas contract with a gas supplier, and you say, “How much gas do you want?”. “Well, I don’t know”. The gas contract has to be intermittent, dependent on the wind flows. This is very, very important in changing the economics of gas stations. Therefore you end up in a world where, since you have given a fixed price to wind, solar and nuclear, the only way you are going to get the gas stations built is if you given them a fixed price, too. That is where the capacity market issue comes into play. I would personally prefer the whole thing to be auctioned in a coherent and consistent way, but since that is not going to have any effect on the system until at least 2018, we have a major energy crisis to get through between now and then. My guess is that what is going through in the Bill at the moment is almost as if the underlying fundamentals of what is happening in our energy market are happening on another planet. When we get the price spikes that come from a capacity margin tending towards zero in winter 2015-16 or earlier—because the economic demand for electricity will be in my view considerably higher than the assumptions that are based in the result that gives the 2% margin—reality will have to hit the framework of that Bill. You could say, optimistically, that these are powers that the Government are taking that they do not have to use. They do not have to issue lots of FIT contracts if they decide that this is not a good thing to do. They do not have to issue lots of nuclear contracts. However, I always wonder, from an investor’s point of view, if you are thinking about building something and the Government have lots of residual powers that can change the nature of the economics of your project, how high you want to cost of capital to go before your project looks economic. This is a mess. I have written about it. It is a very, very slow-motion car crash. The date is pretty well known. Things will happen in advance of that date. It is pretty clear what will happen to prices through that framework, and it is very clear that the prices that are consistent with a capacity margin close to zero are not ones that consumers can pay, or that I suspect politicians can live with. That is where the coincidence of this comes. In the meantime, why would you build a gas station when you do not know what the contract is, you do not know how much wind is going to be on the system, you do not know whether you are going to be able to run your plant and you have no idea what to tell the gas supplier about the gas supply arrangements that you want. We have thought about everything else, because we thought the future was windmills, solar power and nuclear, and have forgotten that there is a consequence of the one bit that you have missed out: what are you going to do about gas? Benign neglect was the policy, because it was just assumed that people would build the gas stations anyway. That has turned out not to be the case. If you look to 2015-16, the next power station coming on is

Carrington. That will not be coming on until 2016. Nothing else can be built in the time period between now and then. That is the problem we find ourselves with.

**Lord Lawson of Blaby:** So if you were Secretary of State for Energy, what would you do now?

**The Chairman:** Regretfully, I have to leave for a long-standing engagement. I look forward to reading the transcript, but I now ask Lord Lipsey to take the Chair.

**Q126 Lord Lawson of Blaby:** I will give you a moment to think about it, but I am sure that you have thought it over. If you were Secretary of State for Energy and Climate change, what would you do now?

**Professor Dieter Helm:** I would probably emigrate as quickly as possible; I would hate to perform such a task. The obvious answer is that when you are in a hole, the first thing you do is stop digging. Many things are currently being pursued that would make things significantly worse. The second thing is that you have to get on with getting some power stations built. The die is cast. The Government are committed to being a central buyer by issuing all these contracts. Therefore they have to think seriously about auctioning capacity contracts. I would have a single unified capacity auction that included the FITs and the non-FITs in one framework. I would be in the business of doing two things: first, getting contracts in place for new gas stations as fast as possible; and, secondly, thinking about emergency procedures to use in the event that the capacity margin gets extremely tight. You need then to think about the role of the system operator who is going to make this system function in those circumstances. The general point is that energy policy is not rocket science. It is not an unsolvable problem. There are solutions to these things but, sadly, the current policy will not solve those problems and the seriousness of the potential crisis will be looming very soon.

**The Chairman:** I think that is a wonderful note on which to conclude one of the most trenchant pieces of evidence we have had. Tuesday afternoons are not always this entertaining, so thank you very much for giving us the benefit of your considerable knowledge and expertise.

**Professor Dieter Helm:** Thank you very much indeed for listening.



## Michael Hill C.Eng MIET—Written evidence

The following is a summary of my conclusions following my review of the existing state of regulation and monitoring in the UK onshore for unconventional fuel exploration and development. The purpose of this summary is to provide clear and simple advice to the UK Government (DECC), European Commission (Environment), Regulators and general public on what is now required for this industry to be regulated in an efficient and safe manner.

I am an independent Chartered Engineer, ex-oil and gas, who has conducted a three year study, (still ongoing), into the practice of regulation regarding the on shore oil and gas industry and in particular use of hydraulic fracturing. The evidence I used to draw upon was taken from Freedom of Information Act responses, letters, mails, teleconferences and actual conferences. I consulted with, advised and presented evidence to the DECC, EA, HSE, DECC Select Committee, IGEM, BGS, The Royal Society and The Royal Academy of Engineering.

The following is a subset of a full detailed analysis by the author of regulation necessary in the on shore hydraulic fracturing industry to ensure safe practices are developed, implemented and verified.

- On Shore Gas Regs - There is a clear need of specific onshore industry specific regulations. At present there are none. The regs developed in the 1990s (DCR) and the other regs (BSOR) following Piper Alpha disaster are not sufficient to address the issues with on shore drilling, exploration and production. The DCR are aimed at offshore development (no public or agriculture or tourism), BSOR is prior to HVHF and both are entirely self-regulatory. The author gave evidence to the Royal Society and Royal Academy of Engineering on this subject and they have incorporated this directly into their report published in June 2012. The UK Government has chosen to ignore this vital recommendation.
- Verification – independent (financially and professionally) verification, testing and inspection of the wells to the new regulations. Presently virtually all self-regulatory. What is now required is a ‘hands on’ inspection regime of a type similar to that a number of US states have now adopted.
- Regulations. Efficient regulations needed to protect public health and minimize damage to the environment. All of the below will require verification based on frequent and random site visits by independent monitors.
  1. Cement quality (on site sampling and laboratory testing) , cement bond logs and well construction plans.
  2. Annular pressure readings (instruments used, calibration, how recorded in SCADA etc.).
  3. Examination of formation integrity tests as they are executed.
  4. Seismic monitoring TL System and post tremor actions. Bond for local populations adversely affected.
  5. Surface methane detection (baseline, operational and legacy).

6. Publication of which “fracking” chemicals used at each well with MSDS & REACH disclosure.
7. Flowback fluid storage, treatment and disposal (Permit). Fracking fluid left in target formation - evidence.
8. Recycling of flowback (presently illegal – need a regulation to define this process and legalize it), flowback water quantity verification.
9. Green tanking with minimal/no flaring. (Need reg to define this and ensure it happens)
10. Fugitive emission monitoring and reduction (Methane and Radon).
11. Sourcing water from mains (pressure issues) and testing of local boreholes/wells/surface water.
12. Bond for abandonment (including monitoring of well and surrounding land within agreed radius for agreed period)

Most of the above, if not all, the industry claims it is executing already. The problem is that there is no independent verification of any of this. We (the general public) are just left to take the operator’s word on it. The same operator who has private investors/shareholders to satisfy and stands to make or lose millions of pounds which could be very much dependant on how they interpret/obey any of the above regs. It is important to note that none of this list is compulsory and has any backing in law. Each individual oil and gas company can chose to ignore any or all of these points as and when they feel necessary.

- Overview –The new Office for Unconventional Gas and Oil (OUGO) based on the author’s own proposal for an Office for Regulation and Inspection in Shale Gas (ORIS), presented to the Government in Sept 2012, has stated at its first meeting that no new regulations will be brought forward at all! It has effectively abdicated its own responsibility to the public before it has begun. In addition the inspection regime has been left in a completely unsatisfactory state. One of the two regulators charged with regulating this industry, which had experience of oil and gas (HSE –OSD), has been scrapped (restructured in state speak) as of 1<sup>st</sup> April, 2013. This is a farce and a disgrace. The Government in the UK see any regulations as a” barrier” to be overcome and are determined to ensure there are zero regulations in this area with absolute minimal inspection as they dash for gas and revenue for the exchequer to the detriment of the health of the citizens of the UK and the environment.
- Compliance – The regs should be implemented through random and agreed on site visits when key actions (like cementing) are happening. There needs to be serious repercussions if an operator is found to be in breach of the regs. Fines, license revocation and criminal proceedings if necessary.
- Funding – a seriously robust regulatory regime requires funding. Random inspections, frequent site visits to a rapidly expanding industry will mean a significant increase in costs to the HSE and EA. A new funding structure, negotiated with the industry, needs designing and implementing. The author has developed such a plan and discussed it with all parties. It must be done and soon to ensure we have not only the regulations but also the implementation of them at the well site.

This is a brief summary of the key recommendations. For each point above and additional points not shown, I have a considerable amount of detail already developed. The “regulations” bullet points above I developed after much consultation and then had peer reviewed by the industry. They were supportive of the list. I would be very happy to work with all interested parties in the bringing forth of new regulations. These must be both sensible and practical for the industry to follow. They must also ensure the industry is safe and seen to be safe in the view of the general public.

*November 2013*

Glossary:

DECC:	Dept. of Energy and Climate Change
EA:	Environment Agency
HSE:	Health and Safety Executive
OSD:	Offshore Safety Division
BGS:	British Geological Survey
IGEM:	Institution of Gas Engineers and Managers
CBL:	Cement Bond Log
BSOR:	Borehole Site and Operations Regulations. 1995.
DCR:	Offshore Installations and Wells (Design and Construction). 1996.
MSDS:	Material Safety Data Sheet (standard availability across Pharma/Chem industry)
SCADA:	Supervisory Control And Data Acquisition

IGas Energy, INEOS and Cuadrilla—Oral evidence (QQ 76-95)

**IGas Energy, INEOS and Cuadrilla—Oral evidence (QQ 76-95)**

Transcript to be found under [Cuadrilla, IGas Energy and INEOS—Oral evidence \(QQ 76-95\)](#)

## **IGas—Supplementary correspondence with Committee Clerk**

Dear Mr Austin,

### **Economic Affairs Committee: Inquiry into *The Economic Impact on UK Energy Policy of Shale gas and Oil***

Since you gave evidence on 5 November the Committee has heard more witnesses and is nearing the end of oral evidence-taking in this inquiry.

One main theme common to most witnesses is that no-one can know what the UK's economically recoverable reserves of shale gas or oil might be until exploratory drilling takes place.

Industry witnesses indicated that they were keen to go ahead with exploratory drilling but that regulatory constraints impeded progress.

Witnesses from the regulators indicated on 3 December that regulatory requirements were clear and known to the industry and that responses to applications for the various permits were normally quite speedy. But, according to Tony Grayling of the Environment Agency, no application to drill by hydraulic fracturing had come in since the moratorium was lifted in December 2012.

Can you add anything to your evidence to help the Committee understand why an industry eager to get exploratory drilling under way is apparently not pursuing the necessary permits?

It would be helpful if you could reply by 16 January, in part to inform the Committee's questioning of forthcoming witnesses.

Yours sincerely

Bill Sinton

(W B Sinton)

Clerk to the Committee

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Dear Mr Sinton

### **Economic Affairs Committee: Inquiry into *The Economic Impact on UK Energy Policy of Shale gas and Oil***

I am responding to your request in respect of operators not pursuing the necessary permits.

We must bear in mind that the moratorium on hydraulic fracturing was only lifted by the Government a little of over year ago. In that time we have tried to move as quickly as

possibly but at the basic level the process is time consuming notwithstanding the shifting sands of regulation. A different approach was being taken to permitting in areas such as waste drilling muds where information was sought in relation to both bespoke permitting and the consideration of a standard rules permitting approach. The industry is entrepreneurial and IGas is a relatively small but growing business with finite resource to be able to pursue multiple permits if they were continuing to be as complex and changing in nature.

During 2013 the permitting regime was still unclear and is only now gaining clarity with the EA working towards a streamlined approach and that will make the process more manageable and give us the ability to pursue a number of permits concurrently. However, as it stands, the standard rules do not cover hydraulic fracturing and therefore we will be required to seek a bespoke permit.

Yours sincerely

Andrew Austin  
Chief Executive Officer, IGas Energy Plc

*January 2014*

## INEOS ChlorVinyls—Written evidence

### EXECUTIVE SUMMARY

1. The UK has vast shale gas resources, which could provide energy security for decades to come, while creating thousands of jobs, improving energy prices, and generating significant tax revenues.
2. The UK will be reliant on gas for the next few decades to keep the lights on. There can be no question that indigenous shale gas is preferable to gas and coal imports, given the economic and security benefits, and the fact that studies have shown the carbon footprint is the same or slightly better.
3. Shale gas could reduce the amount of coal-fired generation in the UK, improving emissions in the medium term. It could also have a long-term role in the green economy in conjunction with CCS and non-firm renewables.
4. Energy prices in the UK are already uncompetitive and this is set to worsen drastically up to 2020. This is a serious threat to the future of energy-intensive industries in the UK that employ 225,000 people and generate 1% of GDP. Shale gas could help secure the long-term future of these valuable industries in the UK.
5. Shale gas would particularly benefit the UK petrochemicals industry, which is not only energy-intensive, but could also use shale gas as a source of secure and competitively priced essential raw materials (ethane and propane). The double saving on energy and raw materials has rejuvenated the petrochemicals industry in the USA and this could be replicated here.
6. With established gas and petrochemical infrastructure, the UK is well placed to take full advantage of shale gas and develop quickly over the next few years as gas supplies from the North Sea continue to decline. The country also has an excellent record of regulating this sort of technology. It will be important to ensure communities are convinced of the merits of extraction, however, if development is to proceed effectively.

### About us

2. INEOS is a global manufacturer of refined oil products, petrochemicals and plastics. INEOS was founded 15 years ago in the UK, and is now one of the largest chemical companies in the world. Worldwide INEOS operates 51 manufacturing sites in 11 countries, employing 15,000 people. INEOS has six sites in the UK, employing 3500 people, including a refinery at Grangemouth, and a chlorine plant in Runcorn
3. INEOS ChlorVinyls is one of INEOS' 15 businesses. We are a leading manufacturer of chlorine and PVC, employing around 3,300 people at nine production facilities in the UK, France, Germany, the Netherlands, Belgium, Norway and Sweden.
4. INEOS has direct experience of using shale gas in the USA as a source of energy and the key chemical raw materials, ethane and propane. INEOS has the expertise and infrastructure to separate out and use high value chemical raw materials found in shale gas in the UK.

**How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe? What infrastructure investment will be necessary to cope with the development of shale gas and oil? How will this investment be financed?**

- The British Geological Survey estimates that central Britain has shale gas resources (gas-in-place) of 1,329 trillion cubic feet. The proportion of this gas that can be viably extracted is as yet unknown and will depend on economic, geological and social factors. It is clear, however, that there is very significant scope for extraction in the UK. Assuming conservatively that only 10% of resources could be extracted, this would be equivalent to over 50 years of gas requirements for the UK at current usage rates. It is important to move forward with exploration to better understand the scope for shale gas production capability in the UK.
- The UK has significant natural gas and hydrocarbon infrastructure already in place. As North Sea gas declines this supply must be replaced. This has already happened through increasing UK imports through pipelines (Langeled, IUK and BBL) and LNG imports. Without question domestic shale gas production could easily be brought into the mix through existing and well developed infrastructure. The UK has a strong track record of building new infrastructure. The development of a massive oil and gas production and transmission infrastructure was achieved in a relatively short period in arguably a much more challenging environment (the North Sea). There is no reason that this could not be replicated for shale gas production. Transport infrastructure should not be considered the key issue – it is developing and demonstrating production capability.
- Shale gas is not just a fuel; it is also a source of valuable chemical raw materials (ethane and propane) that the chemicals industry uses to make commodity compounds and plastics such as polyethylene and polypropylene. The UK is well positioned to make use of shale gas as a chemical feedstock, extracting maximum value from the resource. The UK has effective petrochemicals infrastructure, and INEOS' ethylene cracker at Grangemouth is one of only four in the EU capable of processing gas liquids in this way.
- INEOS recently completed supply and infrastructure agreements that will enable the company to use chemical raw materials sourced from US shale gas from 2014/15. Under the arrangement, ethane and propane from shale gas in Houston will be piped to Marcus Hook. Ethane will then be separated by fractionation and shipped to INEOS' gas cracker at Rafnes in Norway, where ethylene product can be used by INEOS' European sites. INEOS is also considering investing in import infrastructure at its Grangemouth cracker to receive ethane sourced from US shale gas.

**How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

- INEOS is not in the business of extraction, or energy generation, so cannot comment with authority on the economic viability of competing technologies. We would note, however, that there seems to be no shortage of commercial interest in extracting shale gas despite the absence of subsidies or price mechanisms that support other forms of energy. Indeed shale gas would provide significant long-term revenue to the exchequer.
- The scientific and engineering consensus is that the environmental risks associated with extraction are minimal and manageable, and no greater than those associated with other extraction technologies. Indeed the technologies and processes involved are not novel or unfamiliar to regulators. A study conducted by the Royal Society and Royal Academy of Engineering concludes that seismic risks associated with hydraulic fracturing are low, with any



events likely to be smaller in magnitude than natural geological events and those caused by coal mining. It similarly concluded that fracture propagation is unlikely to lead to groundwater contamination. With appropriate monitoring of seismicity and robust regulation of well integrity, extraction can be managed safely.

- The UK will continue to require gas for the next few decades to meet energy needs in the face of coal/nuclear closures, and intermittency issues with renewables. The only issue is whether to use indigenous shale gas or imports of conventional natural gas and LNG. Using indigenous shale gas rather than imported gas would have no additional environmental cost (and significant economic and energy security benefits). The Committee on Climate Change calculates that the carbon footprint of shale gas is equivalent to conventional gas and slightly better than imported LNG (assuming well integrity).
- Coal-fired power stations emit roughly twice the amount of carbon dioxide as gas-fired stations. Due to low coal prices and high imported gas prices, coal-fired generation has increased in recent years, worsening the UK's carbon footprint – the exact opposite of what has been happening in the US. Extracting indigenous shale gas would provide generators with a more secure and competitively priced source of gas, encouraging a switch from coal generation, and potentially reducing emissions.
- In the longer term, the development of CCS technology could mean that shale gas is more than just a transition fuel for the UK, and could form a vital part of the energy mix in the green economy into the long term.

### **What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

- The Institute of Directors estimates that during the production phase, investment in extraction could peak at £3.7bn a year, supporting 74,000 jobs, including geologists, drilling specialists, construction workers, truck drivers, cement manufacturers, water treatment experts, and people working in retail and services.
- Energy intensive industries need secure supplies of competitively priced energy to survive and prosper in international markets. Similarly, the UK petrochemicals sector requires secure and competitively priced raw materials. These industries employ around 225,000 people in regional economies across the UK but face decline because energy prices are set to increase dramatically in the UK up to 2020, at a faster rate than in other countries, due to policies such as EMR and the carbon price floor. Using shale gas in the UK is an opportunity to address this competitiveness gap, promoting jobs and growth in the manufacturing sector.
- Unlike in the USA, landowners in the UK do not own rights to minerals beneath their land. Local communities may also be inconvenienced by increased traffic during development. For these reasons, INEOS welcomes the proposal from extractors to offer £100,000 to the community for each well drilled, and 1% of revenues. It is also important that more is done to communicate the benefits of shale gas to local communities, and address misconceptions about environmental risks. Benefits could include new jobs, local economic growth, revenues for the community, and lower energy bills.
- Shale deposits are geographically dispersed and are located close to key industrial clusters around the UK (for example Central Scotland and the North West of England). As a consequence there is significant scope for developing shale extraction on brown field locations. These developments should be fast-tracked and supported by the government to demonstrate the potential of shale gas.

### **What will be the impact of shale gas on the cost of electricity generated at gas-**

**fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable? What impact will shale gas and oil have on household energy bills?**

- The gas price is critical in determining the price of wholesale electricity. Increasing wholesale gas prices have caused wholesale electricity prices to increase. With the UK generation mix being more dependent on gas than most other European markets, this has resulted in UK wholesale prices rising to highly uncompetitive levels.
- INEOS is not an authority on consumer bills, but as a large industrial energy user, we expect shale gas to put downward pressure on gas and electricity prices, by increasing supply in the market. The effect is unlikely to be as dramatic as in the USA, because the UK is connected to the wider European market, and falling North Sea reserves will offset increased supply. Nevertheless, extracting shale gas in the UK is likely to have a beneficial effect and at the very least stem price rises. Depending on the amount of shale gas that can be extracted viably in the UK, and whether other European countries extract reserves, benefits could be very significant, especially for energy-intensive industries that are vulnerable to price increases.
- Shale gas would also help stabilise prices, which is vital to provide the long-term certainty that industry needs to invest. By providing a secure indigenous supply of gas, the UK would be better protected from volatile import prices, which have been a problem in recent years as countries compete for LNG shipments when supply is low in the market.
- Wholesale gas and electricity prices in the UK are already uncompetitive, and as BIS acknowledges, UK decarbonisation policies will severely widen this competitiveness gap with Europe and the rest of the world in the next decade. Energy-intensive industries are seriously at risk of being pushed out of the UK, resulting in thousands of job losses, lost GDP, and lost tax revenues. Global emissions meanwhile, will not improve and could even worsen as production simply moves to other countries. Shale gas could help address this problem, preserving the competitiveness of energy-intensive industries.
- To conclude, there is clear evidence from the United States that shale gas has the potential to be the most competitively priced hydrocarbon – cheaper than coal which has double the carbon intensity and significantly cheaper than the prices being suggested as “strike price” for new nuclear in the UK.

**Which forms of electricity generation is shale gas likely to displace and by how much? What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

- North Sea reserves of gas are declining, while the need for gas generation is increasing due to coal-fired stations being decommissioned, and the fact that renewables and nuclear will be unable to meet electricity needs for some time. It is already clear that gas will continue to be hugely important in the medium term for both heat and power generation – and indeed there is already a significant amount of gas power plant currently moth-balled. Shale gas would help meet this demand for gas generation, in a more competitive and secure way than importing conventional natural gas or LNG.
- Since 2000, coal-fired power stations have been used to cover for unavailable nuclear-fired stations, and gas-fired stations while gas prices have been high. This has led to a significant increase in carbon emissions. Insofar as shale gas would put downward pressure on gas prices it would encourage a switch from coal-fired generation to gas-fired generation, reducing emissions.

**Will shale gas and oil increase UK energy security? Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

- As North Sea reserves have declined steadily over the last decade the UK has become increasingly dependent on imports and is now a net importer. This has resulted in prices being higher on average, and more vulnerable to fluctuations in the market. About 80% of our gas imports come from Norway, and the rest from Qatar in the form of LNG. IMechE predicts that the UK will be importing 80% of its gas by 2030, meaning we will become increasingly reliant on the Middle East and Russia. This is a political and economic risk, and will lead to further price uncertainty, which is bad for consumers and deters manufacturers from investing in the UK.
- The discovery of vast shale gas resources in the UK, which can be compared to the discovery of natural gas in the North Sea, is an opportunity to return to a position of energy security for many decades to come. This is especially important given forecasts from Ofgem that the UK is heading for an energy crunch and potential blackouts. The Government recognises (through its Gas Generation Strategy) that natural gas will necessarily play a major part in the UK's energy mix in the medium term (for both power generation and heat) if we are to keep the lights on ahead of the wider development of new nuclear and renewables. In this situation, it very clearly makes sense to use indigenous supplies that are more secure.

**What changes to public policies are necessary to maximise the potential of any shale gas development?**

- It is important to move forward as quickly as possible with extraction, while meeting robust standards. Development should be facilitated through supportive policy, efficient regulation, and by addressing misconceptions about risks. The Government has already announced plans to support shale gas in the tax system and simplify regulatory processes, which INEOS welcomes.
- Local support is also crucial to overcome planning obstacles. The Government should focus on communicating the benefits of shale gas and define what communities can expect to receive in return for hosting extraction sites. Support for energy bills and development of community projects would help win hearts and minds.
- Government should also support local “off-grid” supply arrangements to quickly demonstrate the wider benefits of shale while supporting critical energy intensive manufacturing sectors.

**What lessons can be learnt from the US experience of shale gas and oil?**

- The growth of shale gas in the US has had a profound impact. Natural gas prices have fallen dramatically and are now among the lowest in the world—certainly of the transparent liquidly traded gas markets. Rather than being a net importer, the US is now expected to be a net gas exporter, with a number of major liquefaction projects announced (in part using the terminals that were constructed to import gas). Thus, rather than exporting money to buy gas, the US will have a large new revenue stream.
- Extraction has directly created thousands of jobs and regional growth. In just four years, Pennsylvania, a state with a population of around 12 million, has gone from producing no natural gas, to producing more gas than the entire UK North Sea and employing almost 160,000 people in the sector.
- Lower gas prices have also resulted in lower electricity prices, giving a massive competitive

advantage to US electro-intensive industries and manufacturers more broadly. The increased availability of competitively priced chemical raw materials has also caused a boom in the petrochemicals industry, with almost 100 investment projects announced as of March 2013, primarily to expand production capacity for ethylene, and ethylene derivatives such as PVC. This is unprecedented in recent US history.

- A recent report from the American Chemistry Council published in May 2013 finds that 97 chemical industry projects worth \$71.7 billion have been announced as a result of the shale gas boom. It calculates that these will deliver the following economic benefits up to 2020: 485,000 direct jobs, 258,000 indirect jobs, and a further 442,000 payroll-induced jobs, as well as \$20 billion in tax revenues.
- Natural gas is now far more competitive than coal for power generation in the US. In direct contrast to the situation in the UK and Europe, gas has displaced coal in the power generation sector and the US has seen a significant reduction in CO<sub>2</sub> emissions.
- The UK can replicate these benefits, delivering energy security, promoting industry, countering rising energy bills, and even reducing emissions in the medium term. In particular, the US example shows that indigenous shale gas could be transformational for UK energy-intensive industries, and especially the petrochemicals industry, which would benefit from secure and competitive energy and raw materials.
  - The fact that individuals in the USA own the rights to the minerals on their land has proved essential in the pace of development. This suggests the UK must ensure local communities benefit from extraction to more forward successfully.

*October 2013*

INEOS, Cuadrilla and IGas Energy—Oral evidence (QQ 76-95)

**INEOS, Cuadrilla and IGas Energy—Oral evidence (QQ 76-95)**

Transcript to be found under [Cuadrilla, IGas Energy and INEOS—Oral evidence \(QQ 76-95\)](#)

**Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking (RAFF)—Oral evidence (QQ 185-195)**

TUESDAY 1 DECEMBER 2013

*Evidence Session No. 13*

*Heard in Public*

*Questions: 185 - 195*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord McFall of Alcluith  
Lord May of Oxford  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky

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**Witnesses**

**John Kersey**, Lancashire Chairman, Institute of Directors, **Lee Petts**, Managing Director, Remsol Ltd, **Ian Roberts** and **Tina Rothery**, Residents' Action on Fylde Fracking (RAFF)

**Q185 The Chairman:** Good afternoon. This is, I think, the 10th session of our inquiry into the subject of shale gas. I would say at the outset that we have been anxious to get evidence and hear the views of people right across the spectrum on this, which means that we have had a very tight and difficult timetable, but we are keen for everyone to give evidence.

We have two sets of witnesses this afternoon, so we will probably have to stop close to just after 4.15, so I ask you to be as brief as you can because there are a lot of topics we want to discuss. Could I remind you to speak up, mainly for the recording of the transcripts and so on? If you find that in answer to one question you agree with somebody, do not simply repeat what they have to say, in the interest of time. Can I start with a very general question, which is, just very briefly can you explain the view of your respective organisations on the prospects for shale gas exploration and development in Lancashire? I ask that because obviously this session today is particularly focused on Lancashire.

**Ian Roberts:** I wonder whether I might be permitted to make a brief opening statement, just to put this in a bit of context.

**The Chairman:** Very brief, yes.

**Ian Roberts:** Thank you, and thank you for inviting us here today; we really appreciate it. Tina and I are here representing RAFF, which is Residents' Action on Fylde Fracking. It is a rather cumbersome title; it would have been easier to say that we are against fracking. When we formed two years ago, though, we were genuinely open minded about this industry. We thought that maybe with tight regulation it would be worth backing.

Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking (RAFF)—Oral evidence (QQ 185-195)

However, after two years of research, we now regard this industry as a potential disaster in environmental and economic terms. We are not lifelong environmental campaigners; we are simply concerned local residents.

We have two aims today: firstly, hopefully to demonstrate that those of us on this side of the argument are not disaffected outsiders, as we are often portrayed: secondly, that the industry and its supporters in Government are not, we believe, presenting a balanced case to the British public. Thank you.

**The Chairman:** Would you like to just indicate your own organisations, please?

**John Kersey:** Thank you. I would also like to thank the Committee for asking us to appear. I have been running a business in Lancashire for 45 years, and I cannot remember an economic opportunity this significant in all that time. The Lancashire economy shows no real signs of improving. We have a strong manufacturing base and great industrial heritage, but our manufacturers have to compete on a global scale with economies that have access not just to a cheaper workforce, but also to cheaper energy.

I would like to share some interesting and quite depressing statistics about gross value added; that is each person's economic contribution. According to the Office for National Statistics, gross value added per head in Lancashire does not compare well regionally or nationally. Lancashire added is £16,077; Greater Manchester is £18,113; Cheshire is £22,743; the UK as a whole represents £20,873; Aberdeen is £31,944. Within Lancashire, GVA in Blackpool on the Fylde coast where the shale gas extraction might take place represents £12,720, which is 21% lower than Lancashire. As a whole, it is 40% lower than the UK average. On dispensable income and quality of life, again according to the Office for National Statistics the index of gross dispensable household income, where the UK as a whole represents 100, shows that in 2011 the people of Lancashire had less money to spend in the economy, with an index of score of 90.3. Looking again to Blackpool, in 2011 it had an index score of 79.9. Compared with the UK average, therefore, people who live there are worse off. According to a league table compiled by UK Trade and Investment—

**The Chairman:** I am sorry to interrupt you but I wonder if you could put this in as a written piece of evidence, because otherwise we are going to run out of time for all the questions we want to ask. I take the point you are making: that this is an area that could do with a lot more employment and all the other issues concerned with industrial development. However, I think you could make that point to us in writing, if you would.

**John Kersey:** Okay, I have got that. It is very brief, actually. I was just making the point about how the area needs the employment and investment.

**The Chairman:** Yes, and if you want to add the statistics, please do.

**Lee Petts:** I agree with much of what John has just shared with the Committee. I see shale gas as a potential economic boost for Lancashire, which, as John has just said, has struggled for quite some time now. In fact, some people would say it has been in terminal decline since the end of the Industrial Revolution.

It also presents an opportunity environmentally in terms of helping Britain to achieve the carbon cuts that it wants to achieve. I appreciate that may sound counterintuitive because it is still a fossil fuel, but there is an environmental opportunity associated with shale gas extraction in Lancashire.

**Q186 Lord Lawson of Blaby:** We have heard a certain conflict already from our witnesses. Mr Roberts has made no bones about the fact that he considers that to allow

fracking in the Fylde would be disastrous. May I ask Mr Petts? You clearly do not agree with him. Why do you think he is wrong?

**Lee Petts:** Firstly, I do not think Mr Roberts is wrong to hold that view. I think he is entitled to form his own opinions from the information that he sees.

**Lord Lawson of Blaby:** Yes, but we have to take a view, and we have a conflict of evidence, so we have to try and resolve that.

**Lee Petts:** I have been working in the environmental sector now for 18 years, dealing daily with environmental risk management. My perception of the risks associated with shale gas extraction suggests to me that it could be adequately controlled with the right risk control measures. Many of the risks that people are fearful of I genuinely do not think will be manifest. Like Mr Roberts, I live in Lancashire with my family. I breathe the same air and drink the same water as the people that are opposed to shale gas. This is not a view that I hold loosely. I think it could be very good for us. I do not believe the risks are as significant as other people may say, and I believe that it can be done safely and responsibly.

**Lord Lawson of Blaby:** What do you think, Mr Roberts, is the principal risk? Why do you disagree with Mr Petts?

**Ian Roberts:** You can go from the micro argument, which is all about traffic, congestion, roads and infrastructure, right through to the macro argument, which is: this is entirely the wrong horse to be backing. This is an industry that should be consigned to history.

**Lord Lawson of Blaby:** Why?

**Ian Roberts:** There is a blossoming renewable energy sector in Lancashire. I was talking to people in Bowland last week who were involved in producing the new installations and equipment that will harness all the renewable energies. They are out of the starting blocks. I thought they might say, "The subsidies have been decreased and we are on our knees." Not at all; they are saying, "This is an industry that is maturing and we are ready to take the reins here", so I think in broad terms this is entirely the wrong industry to be backing. We need now to be backing the renewable sector.

**Tina Rothery:** Also, for us in Lancashire, we have been dealing with this for two years, attending public meetings and Cuadrilla's meetings as well as doing our own research. Aside from the risks that we find unacceptable to the community, we have also found dealing with this industry less than favourable and not something we would like in our community. The ASA has already pulled them on over-claiming safety and misleading us in the information they are putting out in the brochures we receive and the public meetings we attend. Aside from all the risks, it is like asking us to do business with people we do not trust. After what they have done so far, it is very hard to actually start from any good point to discuss moving forward with it.

**Lord Lawson of Blaby:** I do not want to hog this, but of course it is not unknown that sales brochures sometimes put forward a glossy picture that is not completely Gospel truth. It is not the first time this has happened and it will not be the last. As to the concern you expressed, what are these great, unacceptable risks to which you referred?

**Tina Rothery:** The risk of wellhead failure. The industry drilling company, Schlumberger, put out their own report that said that one in six or one in nine failed in the first few years. When a wellhead fails, it is not the fracking so much that is the problem down below. When a wellhead fails at the top, though, at a point where they are either putting in chemicals or withdrawing flow-back water, there is a risk of contamination to our



groundwater and agriculture. In Lancashire, we make great cheese. Our dairy herds breed there, so consequently if they are feeding on land that has been tarnished, that will damage that whole industry.

There is also £3.5 billion in Lancashire tourism every year, and 55,000 jobs. With shale gas extraction, you get methane burn-off, so there will be 30-foot high pipes with methane burn-off. They want 800 wells; that is at least 80 well pads. This is an unattractive, dangerous industry that is going to be damaging to agriculture and tourism, which are Lancashire's two prime industries.

I do not want to sound NIMBY-ish; we do not want this in anyone's backyard. Since we started studying it, we have had people come over from America and Canada. Dr Mariann Lloyd-Smith, from Australia, has worked with the UN on toxicity of chemicals and their effects on agriculture. She has come over, and it is like getting the ghost of Christmas future. They have come and forewarned us what it is like where they are. Jessica Ernst came over from Canada. She is an industry exec, and is now suing the Canadian Government. These people have experienced it, and have come and forewarned us. We have the benefit of this forewarning, and it is wrong that we do not heed it. They have had the accidents and problems. These are not risks; they are provable incidents. Why would we put ourselves through this? Why would our Government expect us to tolerate that? We all have children and grandchildren; it is an unacceptable thing to ask us.

**The Chairman:** We have two points there: groundwater and methane.

**Lord Lawson of Blaby:** What do you have to say to that, Mr Petts?

**Lee Petts:** The risks and benefits in this debate are being overstated a lot on both sides, I would say, and I do not think that is helping at the moment. From a groundwater perspective, most people agree that the most significant risks of groundwater contamination will be surface risks from spills, particularly of things like fracturing fluid or the flow-back waste water. A lot of that is based on the experiences of other countries like Australia and particularly the US, where the controls are very different to those we typically employ in this country.

In terms of the waste water storage issue, for instance, in the United States, it is very common for them to store waste water in open pits. They may be lined, but it is very difficult when you store anything like that to determine whether you have lost the integrity of your liner; you just cannot see it. We do not do that in this country. Waste water here will be stored in above-ground tanks, sat in what we call secondary containment on a well pad that has been constructed to provide tertiary spill-containment. Effectively, you have three layers of protection there, and that is what we call it in risk management parlance: layers of protection, so if one fails, it fails to a safe condition. I believe that that is what we will see in this country; that is what our regulators would expect; and I do not believe they would allow it to take place if those expectations were not met. I do not believe therefore that the risk to groundwater is as significant as people say.

**Q187 Lord Shipley:** You mentioned groundwater and waste water. I would like to pursue each of those to get your views on the risk of contamination of groundwater and whether there are robust plans in place in Lancashire for coping with waste water produced in hydraulic fracking. We have heard that the Royal Society in 2012 said that the risks to aquifers is very low, provided shale gas extraction takes place at depths of many hundreds of metres or several kilometres. The Environment Agency has said there are no groundwater aquifers anywhere near the drilling location in Lancashire. Could we be clear as to your

views about the risks to groundwater, and drinking water in particular? Secondly, just be clear about whether contaminated water, waste water, actually can be dealt with. I would like to hear in particular from Remsol about that because you have been working with Cuadrilla on ways of minimising the problems caused by waste water. That is quite a wide agenda, but I would like to hear first about groundwater.

**Ian Roberts:** There is a risk of groundwater contamination because of the wellhead failure; the cement bond. There are aquifers in Lancashire very close to the surface. A lot of people who are not on mains water draw the water from a well. Farmers' livestock is at risk, so there is a risk to groundwater because of the well failure.

On the waste water, this is a really interesting one, because our understanding is that they do not have any plans in place to treat safely and dispose of the waste flow-back water. I was speaking to Cuadrilla and Arup representatives at an information event only last Wednesday, and I asked them what they were going to do with the waste water. They said, "Well, it may go to Stoke or it may go to Leeds. It may or it may not." They have not got any plans in place, as far as I can ascertain, to dispose of this water. If we go back to the waste water that came out of the Preese Hall site, we really cannot get a straight answer as to what happened to that. We know that it was going to the treatment plant at Davyhulme for a time, but our understanding is that that plant became overwhelmed with the quantity, toxicity and radioactive nature. Ultimately 18,000 gallons was stored on the Preese Hall site for a long, long time before it disappeared. This is key: this stuff contains some nasty chemicals; what are they going to do? We cannot get a clear answer.

**Lord Shipley:** Can Mr Petts answer that?

**Lee Petts:** If we take them in reverse order then, the material that was stored at the Preese Hall well was consumed in the plant-scale trials that we performed last year at a range of existing industrial waste water treatment facilities to prove the concept of how to treat this waste safely and securely. As I understand it, those trials were communicated to local stakeholders in Cuadrilla's summer newsletter that year to say that these trials were taking place. That is what happened: the material was taken away and put through these trial treatments to prove the concept to us and give us some comfort that the treatment method we had identified would actually work. That is what happened to the material that was stored at the Preese Hall site.

In terms of the plans going forwards and where some of the confusion comes from, everybody is keeping a watching brief on this at the moment. We have identified that this waste water can be treated at about a dozen existing industrial waste water treatment plants around the UK. We have selected two initially—one in Leeds, one in Stoke-on-Trent—as what we see as the host sites going forwards in exploration. The reality is: if there is an opportunity presented to treat the waste water at site and recycle it so it can be reused in subsequent fracture treatments, that is what Cuadrilla will want to do. For a start, it would be less expensive for them and make shale gas extraction more economic. Secondly, it would reduce the number of road tanker movements leaving those sites, which has been another key concern of local stakeholders. When they say it has not been decided yet, that is what they mean. It is not that there is no plan there, because there is. If we wanted to start taking this waste water away today, we could do that at these two locations.

**Lord Shipley:** How many lorries is it, then? People might draw the conclusion from that that it has to go a long way, and it would have to be transported there in a very large number of vehicles. Can you quantify that?

Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking (RAFF)—Oral evidence (QQ 185-195)

**Lee Petts:** In terms of the vehicular movements, from memory we estimate that departing the site—so one-way journeys—one well would produce somewhere in the region of 144<sup>143</sup> transport movements to take the waste water away in exploration.

**Lord Shipley:** Sorry, in total or per day?

**Lee Petts:** In total. On an average basis over the three-month life of waste water removal, the average would be about four tanker movements a day, but it does not quite look like that in profile. Most of the waste is removed in the early stages after fracturing has finished, so you might see for the first few days perhaps 10 tanker journeys a day, and then it tails right off down to one or two for the remainder of the fracturing process.

**The Chairman:** Then on the other point?

**Lee Petts:** Sorry, I thought that was both points; one on Preese Hall and the other on the waste water arrangements.

Going back to the question around groundwater, do I think there is a risk? Well, of course there is always going to be a risk. None of these processes we conduct in industry could ever be seen to be risk free. The trick is to identify the risks and then manage them. I believe that is what will happen in this industry.

The issue we have to bear in mind here is that this particular part of Lancashire sits atop the Sherwood Aquifer, which is recognised to be a very important aquifer in the UK, but not for the whole of the aquifer. In the Lancashire patch, it is very brackish and saline. It is not used generally for drinking water purposes. There will be pockets of fresh water in that aquifer that people can tap, and they do. In terms of the number of people that draw water from wells, though, I believe the Drinking Water Inspectorate think there are somewhere in the region of 50,000 private water wells in the UK supplying drinking water to homes. They represent 1% of the total in the UK, so they are very few and far between. I honestly do not believe that there are enough of those wells drawing water from the aquifer in the Bowland area to present a concern. With the controls that are in place and the construction requirements for the wells, the sort of failure rates that people talk about are very unlikely.

**Q188 Lord Lipsey:** I would like to know some more about Mr Roberts's remark about nasty chemicals. We know that in the US the actual liquid used for fracking has become much less chemically intensive. Indeed, Viscount Ridley told this Committee, when he appeared to give evidence, that it contained nothing that is not found in the normal kitchen cupboard. Which chemicals specifically do you describe as nasty, and what is the evidence that they exist in concentrations that could in any way be dangerous?

**Lord May of Oxford:** My question was essentially the same, so let me just quickly piggyback it on this point. The RAFF website points out that up to 40% of this thing we just call simply "waste water" comes back up the well as contaminated fracking sludge, which contains toxic chemicals, heavy metals and naturally occurring radon. It has not got a permit yet from the Environment Agency to be transported to a treatment facility. Maybe I am misunderstanding something, but just using the rather anodyne phrase "waste water" for this strikes me as a bit odd.

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<sup>143</sup> Mr Petts later sent the Committee staff the following clarification: "I stated this incorrectly during the evidence hearing. The true prediction, assuming that each well is hydraulically fractured using 10,000 cubic metres of fracturing fluid; that 40% of this returns to the surface soon after fracturing operations have ceased and flowback operations begin; and that it will be removed in road tankers with a 35 cubic metre carrying capacity, is just 114 one-way transport movements to take the wastewater away per exploration well."

**Tina Rothery:** Could I also just interject? When Mr Petts is talking about the amounts and volumes, he is talking about the exploratory stage. He is not talking about what happens in shale gas production. We really need to differentiate between those two actions, because the exploratory stage is nothing compared to what happens once we go into full scale production. That is huge. Also, when he talked about recycling, it is not recycling as we know it, or the public knows it. This is water that is removed from the water table and it will not come back. It is too contaminated. They will reuse it perhaps to frack the wells, but they will not get it back into our water table, so not recycled like your recycling.

**The Chairman:** Mr Petts, would you just like to reply quickly to that? Then perhaps you could come back to the questions that Lord Lipsey and Lord May have asked.

**Lee Petts:** I am afraid I disagree with Ms Rothery's view. When we talk about industrial liquid wastes, recycling processes and clean-up technologies, it is very different to conventional recycling processes that most members of the public may be familiar with, but it does not mean it is not possible. We have found that it is eminently possible to remove the vast majority of the contaminants from this fluid that returns from below ground after the fracturing process, such that after further biological treatment in the sewage system it can be returned to the natural environment and discharged into a water course. We have supplied evidence to that effect to the Environment Agency, which they have accepted. So it can be treated, the contaminants can be largely removed and it can be returned back into the water environment, in my opinion. What would be a better option longer term would be to clean it up at the drill site so that it can be reused by fracturing another stage in the well. That would make much more sense.

**The Chairman:** Mr Roberts, would you like to respond to the points raised by Lord Lipsey and Lord May?

**Ian Roberts:** I do not have a scientific background and I cannot detail the chemicals involved here. Suffice to say that we know that the chemicals that are used, as Tina says, in the exploration stage are nothing compared to what would be used in extraction.

**Lord Lipsey:** That may be so, Mr Roberts, but I asked you what nasty chemicals you were referring to and what concentration they are in. If you cannot answer that, you have given some evidence to this Committee which you do not appear to be able to sustain with factual information.

**Tina Rothery:** We will do our best but we are a residents' group. What we have discovered is that 1% of the fracture fluid that goes down is chemical, and the chemicals that go in when you are just doing exploration can be quite light, just like hydrogen chloride or chlorine—I am not sure which one it is; I cannot remember the difference—but the spillage from that when it is travelling raw and undiluted on agricultural roads would be a huge risk. When they go into full production, they have access to up to 600 chemicals in the States at each well. Each shale play is entirely different so they will use any combination of those that suit that particular shale play. We cannot say which ones they will use because generally they will not say. It is very hard to get this information. We try very hard, and we have spent two years giving up all our personal time to do this, but unfortunately it is a very challenging subject and quite well locked down.

**Q189 Lord Rowe-Beddoe:** Let us move from chemicals, which seem to still be a mystery both in quantity and detail, and talk about earth tremors. I understand that at Cuadrilla's Preese Hall site they have been responsible for two tremors. One that took place in 2011 was 2.3 on the Richter scale, and the second tremor was measured at 1.5. Evidence we

have heard suggest that the 1.5 tremor is something no bigger than a truck just passing outside. Of course, if you live on a country lane you do not normally have a large truck outside your window, so that is something. However, my point on tremors is that the Royal Society suggests that the most that could ever be achieved is a 3.0. What is your feeling about tremors and earthquakes? Is this one of your major concerns or less of a concern than the content of the waste?

**Ian Roberts:** It is a concern. I think Cuadrilla have accepted that the tremors resulted from their operations; there is no mystery there. A particular concern is that they failed to tell the regulators for six months about the damage that those tremors caused to the Preese Hall well. In response to that, they are proposing to use a traffic light system, and I think we have to acknowledge that that might mitigate further problems.

It is what happens below the surface that we have a particular concern about. It is the damage to the well integrity. In reality, we do not know what is happening down there. Nobody has gone back to Preese Hall to give us a clear picture of the geological faults that surround that, and what is happening to them. I understand that Professor David Smythe has submitted a paper to this Committee, suggesting that the geology of Lancashire makes it completely unsuitable for hydraulic fracturing because of the number of faults. His conclusion is that drilling is unpredictable, and the faults in the geology in Lancashire make it completely unsuitable for this sort of activity. It was not a huge earthquake, but it was an earthquake and it did cause damage. Small earthquakes can cause damage to the wells with the problems that that can cause.

**Lord Rowe-Beddoe:** I like the way you are bringing in the word “earthquake” and I used “tremors”.

**Ian Roberts:** I do not want to overstate it. If you want to use “tremor” I am happy to use “tremor”.

**Lee Petts:** I am quite happy to share an opinion, but in that regard it is no better than anybody else's. I am not a geologist or an expert in seismicity. I would say, though, that that was 2011 and a lot has happened since then. For instance, Cuadrilla has undertaken a huge amount of work to map the sub-surface geology in a large part of its licence area in 3D, which means they can see where the faults are. I imagine that will influence site selection in the future so that they can avoid a repeat of the problems in 2011. I think the traffic light system improves that considerably further. With that control, and activities stopping if a seismic event is recorded at anything above a very low threshold of 0.5 magnitude, they have the opportunity to pause if they see some activity, and investigate the integrity of the well. My understanding is they have tools that they can run down the well to pinpoint where any damage has occurred, assess the level of damage and then repair it. That makes a lot of sense because if the object of extracting hydrocarbons from these wells is to sell them and make a profit on that activity, it is not in their interest for it to be leaking out underground because of a minor tremor damaging a well. You would expect them to have the ability to go in and repair the well to prevent those losses.

If you look on the British Geological Survey website you can get a history of tremors almost day-by-day that are taking place in the UK. There was one in Wigan in Lancashire last month or the month before that was a magnitude 1.5. We have not heard anything about that in the press; there has been no discussion of that. No damage appears to have been caused. It is not uncommon for us to see that kind of seismic activity in the UK at that level.

**Tina Rothery:** Can I answer just one point, which was that Cuadrilla did not admit to it? This goes back to our problem with trust and trusting what information they are telling us. If they do not tell us and then carry on fracking and drilling in for six weeks after the earth tremor, even though they caused it, that is a deep concern for us.

**Lee Petts:** Can I just comment on that point? One thing that strikes me about that is until the investigations had concluded I do not think they could say with certainty that it was their activity that caused it. As I have just said, tremors of that magnitude are not that uncommon. They would not necessarily immediately rush out to say, "That was us," and "Yes, we caused that," because they did not know at that time until some activity had taken place.

**Tina Rothery:** It is not the magnitude; it is the depth.

**Lee Petts:** I am not sure that is necessarily a reason to suspect that that would not happen in the future.<sup>144</sup>

**Q190 Lord Griffiths of Fforestfach:** We have talked about contaminated water; I would like to raise the issue of water shortages. Sir David King, a former Chief Scientific Adviser to the Government, said in October of this year that in order to have shale gas production at a reasonable level you need 2,000 wells being drilled, and this could lead to water shortages. Would you agree with that?

**Tina Rothery:** The way we describe it at our public meetings in order to make it visual for the members of the public who come to see us is, when you frack one well once, you take approximately four Olympic-size swimming pools. Two of them possibly will not come back because that remains underground after it has been infused with chemicals. That stays underground, and that should be part of the EU mining waste directive, but currently is not. However, the two then come back up. Essentially, you are using four Olympic-size swimming pools per frack, per well. On the Fylde, they would like 800 wells. Each one of those wells will be fracked no less than 30 times, so it is an awful lot of water. Maybe in the north we are blessed; we have a great deal of rainfall and a great deal of water. United Utilities would struggle, and they say they put the public first, but I think certainly places down south would suffer a lot more. We have yet to know the quantity and the types of usage there is going to be, so it is very hard to comment on that. Again, it is too light on information. We are surprised it has progressed this far with so little information.

**Lord Griffiths of Fforestfach:** Can I ask Mr Kersey or Mr Petts to comment on that?

**John Kersey:** I realise that the extraction process uses a lot of water, but I am told in the context of industry as a whole the projected amounts are very, very low.

**Lee Petts:** I can add to that. The Waste and Resources Action Programme, or WRAP, a Defra-funded organisation, promotes resource efficiency amongst other things. It undertook a study in 2006 to 2007 looking at industrial water consumption across the whole of the UK, and reported some very surprising numbers. For example, the hotels and food sector, which they group together, in the UK combined consumed, in that period, 134.9 million cubic metres of water in one year. To put that into a shale gas context, assuming that the predictions made in the IOD Report in May this year are correct, and I

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<sup>144</sup> Mr Petts later sent Committee staff the following clarification: "I would expect Cuadrilla to have an open exchange with DECC in accordance with the traffic light system, should a relevant seismic event be detected. Therefore simply because there was an apparent delay in reporting previously, it is not reason to suspect that such a delay would be evident in future"

think nobody can say that with certainty at this stage, one well uses 13,000 cubic metres of fluid to fracture. The amount of water that that WRAP study suggests was consumed in hotels and the food sector could be used to fracture 10,000 wells. In the context of existing water demand and usage, it is actually a very small amount. I know it sounds very big, but I am not convinced in that context that it necessarily is.

The other thing we need to recognise, and I say this as a businessman, is that we are viewing this now. We are assuming that in production, although there will be more activity, the scale of water use and waste creation and so on will mirror what we see in exploration. I am not convinced that is the case. I think what we will see happen is efforts, as I believe there are in the United States now, to move to waterless fracturing systems using inert gases instead of water to reduce that water demand. Why would they do that? Well, for two reasons principally. First of all, less water demand and less waste water means fewer public concerns, and they are eager to try and overcome some of those concerns. Secondly, it will inevitably be less expensive if there is no water to buy and no waste water to dispose of. That is going to make shale gas extraction more economic. That is one of the benefits of further exploration now. They can learn more about the geology and how the fracture propagation works in this particular shale, which may enable them to start making some plans for how they can fracture in the future. That is why we need to see more exploratory work now, to answer some of those questions.

**Lord Lawson of Blaby:** I believe that in the United States they are increasingly using saline rather than potable water. Presumably that could happen here.

**Lee Petts:** Again, I am not an expert. I have spoken to Cuadrilla about exactly that notion of using saline water. They appear to be of the opinion that it is possible, and it is something that is being trialled a lot in the United States at the moment.

**Ian Roberts:** We would not want to overstate this problem. Any quality drinking water that is lost down there forever has to be a concern. It is a wonderful commodity, is it not? Let us not forget, it is not that long ago we faced a drought in April 2012 before the heavens opened. However, from our research, Water UK particularly has suggested it is the south east that is most at risk of water depletion.

**The Chairman:** It will not surprise you to know that we are looking at all these issues in some considerable depth with a whole load of witnesses. We are just anxious to get your reactions, and we must move on fairly quickly.

**Q191 Lord McFall of Alcluith:** Mr Petts, you mentioned about fewer public concerns. Tina, you mentioned that Cuadrilla had been less than open with you. What do you think the company would have to do to reach an accord with local people, to ensure that fracking goes ahead?

**Tina Rothery:** We have struggled with several points, partly because they have been sanctioned by the Advertising Standards Authority on overstating safety claims, misleading the public and things that were really important to us when we had our community consultations. These mattered. If they had come in and been honest, it would have been a better start. They have started dishonestly. They have given us PR people to speak to instead of engineers. When we ask questions, they do not have the answers. They tell us they will come back to us by email; it does not happen. How do we get them to endear the community? Certainly not through offers of cash; that does not take away any of the risks that we have discovered along the way. I wish I could be more giving, but I cannot think of a single thing they could do to make this acceptable when we have seen so much

demonstration of the harms it causes, having been spoken to by some experts on the subject who have lived it, breathed it and seen the evidence of it.

**Lord McFall of Alcluith:** Is it a case of no surrender? In other words, you are never going to come to an accord. There is not going to be any community harmony along with Cuadrilla's drilling.

**Tina Rothery:** I do not believe that the industry can be regulated in a way that is going to make it so safe a community could tolerate that risk to itself. Any community in the country is going to look into it the same way we have, and then we are going to be told "gold standard regulations". No offence, but EA has just had its budget cut.

**Lord McFall of Alcluith:** So there is nothing they can do to satisfy you? That is really the question.

**Tina Rothery:** I am not looking for satisfaction; I am looking for reassurance and safety for the future.

**Lord McFall of Alcluith:** There is nothing they could do to satisfy you, you do not think.

**Ian Roberts:** I do not believe so, no. As I said earlier, I think we are backing the wrong horse here.

**Lord McFall of Alcluith:** And money would not preclude that?

**Ian Roberts:** No. It is a community matter.

**Lord McFall of Alcluith:** Okay, so if it cannot satisfy you, I think you have to convince people of your concerns. Apart from the seismic activity and water supply, what other concerns do you have regarding fracking so that we can have a public record of that here? For example, on your website you mention a few, such as air pollution and the risk from chemical spills and so on. What are the big things for you?

**Tina Rothery:** The pads are illuminated 24 hours a day, and they have methane burn-off. That puts methane into our atmosphere. Methane is worse than carbon, so we do not believe that that is going to be very good for us. We have already mentioned the risks of the road traffic that is travelling and carrying undiluted chemicals. We also have the waste water being transported. There are also issues that are going to arise on infrastructure that is going to be required to transport the gas once it flows. We are also concerned that the job claims are nowhere near what they say they are. This is a very automated industry. They bring in people at the beginning who are highly skilled and do the work, and then there is not much left. Once you have fracked that well, it flows, because each of those fissures is opened by a little sand granule. It will flow until the next time you fracture it. The risks are not worth what they say are the gains, because the gains are not what they say.

**Lord McFall of Alcluith:** Lastly, you said they have not been honest. If they will be honest with you, and you have an agenda and they work along with that agenda with you, could there be a smidgeon of a chance that you could get community accord and allow fracking to go ahead?

**Tina Rothery:** I think most communities would ask the same question, "Why?" This is a finite industry. There are plenty of jobs in the renewable sector. Lancashire is one of the leading counties.

**Lord McFall of Alcluith:** What is the answer there; yes or no?

**Tina Rothery:** No.



**The Chairman:** All right; a clear answer.

**Q192 Lord Skidelsky:** What I want to ask follows on from Lord McFall's set of questions. Have you been involved in any local consultation process? Presumably there have been some. Have there been enough of these local consultation processes? And, then, you say no because of the risk, but you have not really supplied us with any quantitative estimate of these risks. There have been words like "huge" and "enormous", but in order to be rational about this you have to have some idea of what risks you are actually running and be able to rank them in some sort of order of concern.

**Tina Rothery:** We do not have the industry occurring in the country yet. We are basing our risk assessment and our ideas of risk on what we have seen actually happen elsewhere. The UK is an entirely different country and geology to America, Canada, Australia and South Africa. It is very hard to get those figures that you would like, and certainly for us in a three-quarter hour session to lay out entirely a case from a residents' group.

**Lord Skidelsky:** From what you are saying, they all seem to be red circles. They are all risks that are unacceptable and likely, but one wants to know the magnitude and the likelihood.

**Tina Rothery:** One in nine wellheads fail in the first couple of years. Every wellhead fails over time. No cement block holding that pipe—

**Lord Skidelsky:** In the UK?

**Tina Rothery:** Anywhere in the world. We do not have that here. This is Schlumberger, the biggest driller in the industry. In their report, it is documented that all wellheads will fail over time. When they finish with a well, they will then cap it with cement, which does not last the lifetime of the planet. You then have a direct route to the methane, naturally occurring radioactive material, and all of the waste that we have left underground. What happens when they abandon that well? These are not facts and figures, but they are facts on the process of shale gas extraction that will bring us into risk situations.

**Lord Skidelsky:** Mr Petts, do you have anything to say on that? In particular, do you think consultation processes, as they have happened, have been adequate in discussing the matters just raised?

**Lee Petts:** Are the consultation processes adequate? It is very difficult for me to express a real view on that because it is not something that I have been involved with directly. I am aware that lots of consultations have taken place, particularly around the applications that we made on Cuadrilla's behalf for the environmental permits that they require. I know the consultations have taken place. Is it enough? I do not know, and I am not sure what more anybody could do to convince residents locally that are worried, as these two are, that those risks are and will be adequately controlled. Part of the problem is that when we talk about risk, people in industry that deal with risk every day, and score risk in the manner that you have just described, have a perception of risk generally that is much lower than the general public does of the same issues. When we think about the nuclear industry, most members of the public are frightened of nuclear power for whatever reason. It is because they do not understand the risks and the controls, so we have a perception in the public of risk that is often much higher than reality, and I do not know how you change that.

I have read around that topic fairly recently, and one of the problems that has been identified previously is that, where information gets into the public domain in a deliberate way by an operator, for instance Cuadrilla in this case, it is much better received than it is if

information appears to enter the public domain but tells a different story and emerges from somewhere else, and I think that is what is happening here. A lot of people are seeing information emerge from the United States. They are not having that information provided to them necessarily in the United Kingdom, perhaps not by Government and the regulators either, which could probably do a little bit more in this regard to improve the flow of information. I think because of the way that information is obtained, it creates a bigger perception of risk than is actually the case.

**Ian Roberts:** On consultation, there are two things. Cuadrilla put a community newsletter out in July 2012, which was heavily criticised by the Advertising Standards Authority. Public information sessions are held in two obscure locations within the Fylde. There is one at Elswick Village Hall, and the Pipers Height Caravan Centre, which are nowhere near the major towns in the Fylde. The Pipers Height one is inaccessible on public transport. Very few people go there and they are just not connecting with the local community, in our view. We hold public meetings and we invite Cuadrilla and the industry to attend. We hold far more meetings than they do, and try to be open-handed. We show their information film at our events. They are not engaging with the community, in our opinion.

**John Kersey:** The problem is the operators are seen as having vested interests, and it causes a little bit of mistrust with local residents.

**Q193 Lord Hollick:** We have heard from witnesses from the United States that the industry's risk management is now much improved. The technology is much improved and the risks have been substantially reduced. What changes, Ms Rothery, do you believe should be made to the regulatory regime to reduce risk here in the UK? Perhaps, Mr Petts, you would also like to give us your view of that.

**Tina Rothery:** On the regulation, the Environmental Agency has just had its budget cut by 15%, and its workforce as well. They have made it clear that they would not be able to reach every well to inspect it, so essentially here is how the regulation is going to work on it. There would be a nominated person at each site. Generally, that person can be employed by the operator—i.e. Cuadrilla—and they would be the well inspector. That person will then tick the box and say that this went well, and they will send that back to the Environment Agency, who will then approve that he ticked the box. To us that is not regulation; that is self-regulation. As far as the regulatory regime goes, it is weak; it has no strength. It is essentially asking the industry to mark its own homework, so we are not happy with that at all. Regulation has not gone overly well in lots of sectors in this country, from banking to food.

**Lord Hollick:** If the regulations were being reviewed by members of the Environment Agency, would you be satisfied?

**Tina Rothery:** If they were reviewing the wells it would certainly go some way.

**Lord Hollick:** What are the shortcomings in the regulations that concern you?

**Tina Rothery:** There are no actual onshore regulations. These are based on offshore regulations. They have set up—I know it by its acronym, and it is not the right one, which is “OffUGO”; I cannot remember—the Office of Unconventional Gas and Oil. It is populated by people like Lee Petts and others who are in the industry itself. Again, that does not instil any confidence in us at all, and that is the regulatory people there, so what can they do? Start from scratch, because where they are now is nowhere. They are marking their own homework. The people involved in the new group are all involved in the industry, so where do we start? You would start from zero.

**Lord Hollick:** Mr Petts, would you like to respond to that?

**Lee Petts:** I am not involved in the Office of Unconventional Gas and Oil, which is a Government Department, but I am involved in the All-Party Parliamentary Group. That is drawn not just from industry members. I have seen the correspondence many times go out with a call for green NGOs like Friends of the Earth and Greenpeace to join that group and contribute to the debate through the APPG. Although it is heavily weighted towards industry at the moment, the opportunity is there for people to join that group and contribute to the debate.

In terms of the regulatory structure, one of the problems we have in the UK is that there is a lot of regulation out there that applies to these activities; it is just a bit clunky and disjointed, or it appears that way to people who are not familiar with it. Some of the feedback that I have had suggests that people feel it is unregulated because we do not have an overarching piece of legislation on the statute book called “The Shale Gas Regulations 2013” that they can go to and identify what all of the regulatory requirements are. The regulatory requirements are dotted around all over the place, so to someone who is not au fait with that, it can look disjointed and appears to have gaps.

I think it is wrong to say that there are no onshore regulations too. The Borehole Sites and Operations Regulations, BSOR, specifically says that it does not apply offshore, but it does apply onshore, and that sets the tone for well construction and for drilling any well in the UK.

**Tina Rothery:** But not high volume hydraulic fracture. There are no onshore high volume hydraulic fracturing regulations. No matter how many ways you say this, they do not exist.

**Lee Petts:** That is the point. I do not think we need something specific. It is covered through lots of our existing legislation. It is a mistake in the way the regulations were titled too. Another set of regulations that apply, and this is where the requirement for an independent well examiner comes from, is the Offshore Installations and Wells (Design and Construction, etc) Regulations, and because there is a comma missing in that title, the assumption when people read it is that it is offshore installations and wells, so the whole thing is offshore. If you actually read the detail, it does explain that it applies to offshore installations and onshore installations designed to extract hydrocarbons, so we do have onshore regulations, without doubt.

**Q194 Lord Hollick:** I do not want to be heroically optimistic, but I detect a degree of agreement around an independent regulation. That is what you both say.

**Tina Rothery:** I think he mentioned an independent well examiner, who may be actually employed by the company operating the well.

**Lord May of Oxford:** My personal view is that it was not very clever of the Prime Minister at the Conservative Party Conference to toss off the one-liner, “Let us make Blackpool the centre of Europe for the shale gas industry”.

**Ian Roberts:** That did not go down well.

**Lord May of Oxford:** It does prompt the question: do you think the Government, as well as the regulators, should be doing more to address concerns over shale gas exploration and development? What specifically would you like to see them doing?

Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking (RAFF)—Oral evidence (QQ 185-195)

**Lee Petts:** It is really difficult. A lot of this needs to be led more by the regulators. Ms Rothery has commented about the perceived weakness of our regulators. I think our regulators do a tremendous job in this country, often in difficult circumstances.

**The Chairman:** Can I just interrupt and say we are taking evidence from a lot of people on this subject, including international regulators as well?

**Lee Petts:** Sure, okay. I think our UK regulators do a very good job in often difficult circumstances. They need to be seen to be much stronger in their responses to some of these concerns because a strong regulator that comes out strongly in its own defence and says, "No, we understand this, we understand the risks and we will set those out clearly for communities," would be perceived to be strong regulators that would also wield the regulatory power effectively with the industry. We need to see the regulators doing more.

I am not sure the Government can do much more than it already has, in fairness. The tone has increasingly become very supportive in the last 12 months. Again, a bit like operators and us in the supply chain, we're seen to have a vested interest, and I think the Government are perceived to some extent to also have a vested interest, so it is hard to see what more Government could do. The regulators need to do a much better job of coming out and taking a stronger line.

**Ian Roberts:** Can I just comment on the regulation? I watched a speech made by the Chief Exec of Dart Energy recently. He was rejoicing in the fact that the Government are so supportive that they are going to reduce the time needed to get permission for their activities down from nine months to two weeks. He was talking about the Office of Unconventional Gas and Oil as if it were there to open doors for them, to smooth the way and to promote the industry, which was not what I thought "OffUGO" was going to be about.

I would like the Government to be more honest about the risks. There was a recent report from Public Health England that suggested the potential health risk from exposure to chemical and radio pollutants as a result of shale gas extraction were low. However, this was thin on evidence and research and data so it was impossible to understand how they had reached those conclusions. They referred to the Elswick well, which is often drawn on as, "Here is one we made earlier; this is fine; it is benign." This is 20 years old. It is not a current example of a fracking well, and yet it was quoted in this Public Health England report as being indicative of how the industry is going to go and the potential health impacts. We need to get down to facts.

**The Chairman:** Which is exactly what this Committee is endeavouring to do.

**Q195 Lord Lipsey:** If I could address Mr Kersey particularly on this one, you explained how Lancashire lags behind the rest of the country in terms of GDP. Can you say what you think the impact on jobs and growth in Lancashire of the fracking programme might be?

**John Kersey:** I think it is self-evident really. I know Tina said that she is not sure that there would be many jobs created. The IOD report put forward that at its height there could be up to 74,000 jobs created. Those figures were taken from examples that have happened in America. Not all the jobs are direct jobs. Some of the jobs could be indirect and then induced-type jobs in the communities around.

**Tina Rothery:** I think that indirect and induced means more waitresses, a couple more bartenders and more hotel chambermaids. Basically, the claims are misleading. The industry claimed 74,000 jobs would be created and yet the *Financial Times* last month

reported that they were forecasting just 15,900 to 24,300 nationwide, both direct and indirect jobs, and the jobs would be typically short-term, between four and nine years. We can all quote the figures because there are lots of them being bandied about, but finding the accurate ones is like the needle in the haystack.

**The Chairman:** Well, we have certainly been taking evidence from America on this as well, and what has actually happened there in practice, so it is another area that we are very interested in, and trying to get at the facts. Are there any other comments that you would wish to make?

**Lee Petts:** My only other comment would be that I hear very often that there is a risk that shale gas will divert investment and attention from renewables. I am not sure I believe that, because when we talk about renewable energy, what we really mean is renewable electricity. Yet, actually, a substantial amount of the gas that we use in this country is used in home heating, industry heating and as a feedstock for industry, and not so much by comparison in electricity creation. That being the case, and for a long time yet we are going to need a lot of gas in home heating, it does not strike me that intuitively it will mean a reduction in investment in renewable electricity generation, nor should it either. I support the development of shale gas because of the climate benefits I think it can deliver, because of the economic benefits I believe it can deliver locally, but I also strongly suggest that we need to build a more diverse electricity-generating mix, and for me that needs to be new nuclear and more renewables with natural gas helping to displace coal, which is naturally the dirtiest fuel that we have available for electricity generation at the moment.

**Ian Roberts:** I would say, having spoken to the renewable energy suppliers in Lancashire last week, they are concerned that this is going to take investment away from them. It is a vibrant emerging industry, and I think that is where the investment should be. That is the future.

**Tina Rothery:** If we are in closing statements, we also wanted to point out that our group have spent two years writing to politicians, lobbying our MPs and councillors, not doing the “bad stuff”; not doing the standing on the roadside or blocking trucks. For all we have done and all the petitions we have done, if it was not for the earthquakes this would have been proceeding by now. Then we looked to places like Balcombe, where a lot of us spent the summer, and the community protection camp at Barton Moss. We are concerned that because they did not address groups like ours over the last two years honestly, and that we caught them out with the ASA and various other things where they were being dishonest with us, that is what the industry has brought upon itself: that communities will then seek to protect themselves. We started off as a few groups, but now there are tens of them.

**The Chairman:** You have made that point three times and I do understand it. I can assure you that this Committee is looking in great depth. We have a very wide range of expert witnesses at all the issues that you have raised today. What we wanted to give you was the opportunity to express your view from the local point of view, which we understand, and there are a number of points that you have made today that we will be following up later with other witnesses. In that context, you may even like to stay for the second half of this hearing when we are receiving other witnesses, but meanwhile thank you very much indeed for coming. Thank you.

## **Institute of Directors—Supplementary written evidence**

Thank you for giving me as the chairman of the Lancashire branch of the Institute of Directors the opportunity to give evidence to the Economic Affairs Committee on the potential development of a shale gas industry in the UK. Further to the oral evidence given to the Committee, I wish to submit further written evidence. In particular, we would like to focus on the economic context in Lancashire, believing it to be of profound relevance to this debate.

The Institute of Directors believes that shale gas reserves in Lancashire represent an opportunity that cannot be missed. The IoD does not conduct geological tests, but we have no reason to doubt the number of independent scientific bodies who believe there to be substantial shale gas reserves in the Bowland Shale, which encompasses Lancashire.

If Aberdeen was able to become a European, and indeed global, centre for offshore oil and gas expertise, there is no reason why Lancashire cannot become a centre of expertise for European shale gas development. In many respects, Lancashire is in fact in a stronger position than Aberdeen was in the 1960s. Inherent strengths in advanced engineering and manufacturing, coupled with the opportunities presented by shale gas, could enable the area to regain its role as a national economic powerhouse.

### Lancashire's Economic Context

Despite the best efforts of the region's local government and small businesses, Lancashire's economy has performed relatively poorly compared to the rest of the UK in recent decades.

Nor can Lancashire's economic troubles be put down to a simplistic North-South divide. Compared with neighbouring regions, Lancashire lags considerably when looking at per capita Gross Value Added.

Even more strikingly, GVA/head in Blackpool is just £12,720.

This lack of productivity translates into other depressing economic figures; hourly pay for full-time workers in Blackpool is £9.29, compared to a North West average of £11.98 and a UK average of £12.88. Blackpool's residents enjoy a disposable income of just 79.9% of the UK average; nearby residents in Cheshire East and Westensjoy disposable incomes 8.5% and 7.1% *above* the UK average. This low pay, of course, translates to a depressed consumer economy.

Amongst young people, Blackpool is believed to have "the highest level of youth unemployment in the North West." And, in 2011, The Work Foundation described Blackpool as "one of the worst 10 areas in the UK for young people." Notably, Aberdeen was one of the best.

With economic growth lagging behind the rest of the UK, it is all the more depressing that Foreign Direct Investment (FDI) is also significantly below the UK average. UKTI assisted 1,105 FDI successes in 2011-12; only 6 of these were in Lancashire or Cumbria, creating 124 jobs. In Greater Manchester alone, there were 53, creating 9,291 jobs.

Furthermore, many residents of Lancashire and the surrounding areas still see their future away from the region. Net migration in the North East is negative, with all too many residents moving away.

In short, Lancashire's economic situation is dire. A lack of investment – and jobs – means that many young people in Blackpool currently outside of education, employment or training are likely to stay unemployed in the long-term. Their voice – and their future – should be at the heart of this debate.

#### Jobs and Growth where they're needed most

Shale gas could represent a multi-billion pound investment in the UK economy, create tens of thousands of jobs, reduce imports, generate significant tax revenue and support British manufacturing.

The IoD believes that at peak investment of £3.7bn/year, the industry could support some 74,000 jobs. Furthermore, shale gas production could generate significant tax revenue; HM Treasury's recently announced tax regime (62%) is balanced between ensuring the taxpayer will benefit from shale gas extraction without putting off private investment.

Lancashire has the potential to benefit significantly from a fully-functioning shale gas industry. Not only does the area around Blackpool, Fleetwood, Southport and their inland surrounding areas sit above what the British Geological Society believe could be the biggest shale basin in the world, but possesses much of the crucial infrastructure that could allow Lancashire to completely revolutionise its economic future on the back of the shale gas industries.

It has been suggested in some quarters that the jobs created by the shale gas industry are poorly-paid, and ultimately not beneficial to the local economy. We profoundly disagree. The oil & gas industry is already one of the country's largest employers, supporting around 440,000 jobs in the UK. One recruitment firm believes that as investment picks up in the North Sea, another 40,000-50,000 new jobs could be created. These jobs are generally well-paid, with skills shortages pushing up salaries still further. Mean gross earnings for extraction of crude petroleum and natural gas stand at £79,566 per annum, second only to fund management activities. At the direct level, the industry pays well; at the indirect level, the increase in money flowing in the local economy produces stable service jobs at the lower end of the economy. The taxation implications of these highly-paid jobs, and the potential business rates windfall derived from the consumer economy which will grow up around the industry, are clear.

#### Lancashire's Natural Advantages

One of the interesting aspects of the development of Aberdeen as a centre for North Sea oil and gas was that much of the infrastructure and expertise had to be built up from scratch. In some respects, the same will be true in Lancashire, but overall, Lancashire is probably better placed now than Aberdeen was in the 1960s.

- Lancashire has potentially excellent shale gas resources on land, rather than many miles out to sea.

- The National Transmission System for gas has spare capacity and runs through Lancashire. Several compressor stations already exist.
- Road, rail, air and port infrastructure is excellent.
- The UK's largest CNG filling station, capable of filling 500 HGVs a day, is located in Crewe, a little to the south of Lancashire.
- There are two universities, the University of Central Lancashire (UCLan) and the University of Lancaster. Both institutions have considerable energy expertise across a wide range of disciplines.
- The North West has a large industrial sector, which could benefit from Lancashire shale gas.
- Advanced engineering and manufacturing is a key Lancashire strength, with around 90,000 people working in the sector.

The shale gas industry could provide the spark needed to ignite the North West economy. Lancashire has a proud economic history and a heritage of innovation and industry, from the Industrial Revolution to the worldwide success of Lancashire-based Rolls Royce. The chance to revitalise the prospects of the economy and local residents by capitalising on natural resources is one that should be grasped with both hands.

Furthermore, we believe that Lancashire residents, if persuaded of the case for shale gas and the economic growth it could potentially bring to the area, will accept any temporary disruption caused. In addition, the combination of the Government-led Community Benefits Scheme and the UK Onshore Operators Group's "Shale Community Engagement Charter" will ensure that local areas most affected by the initial phase of development benefit. This fund could be worth between £5-10 million for each community over 25 years, increasing local government's ability to provide services and training for local residents if they so desire. It should be noted that after the initial development, disruption to areas around shale gas pads is marginal.

## Conclusion

Until exploratory drilling has been undertaken, it is difficult to be entirely confident how much shale gas is recoverable from the Lancashire region. However, the overwhelming scientific consensus indicates that the area has the potential to be a world-leading centre of shale gas extraction. We would anticipate significant investment and a transformative number of much-needed jobs to be created in the region once the industry begins to develop.

Lancashire is in need of positive economic news. Perhaps most worrying of the statistics available to us is the disengagement of young people in the area with the job market or with education, remarkable in an area with two respected universities. Developing a shale gas industry will provide highly-skilled, well-paid jobs for these young people.



The IoD has no doubt that Lancashire could see a transformation similar to that created by the North Sea Oil industry in Aberdeen in the late 1960s and early 1970s, benefits which exists to this day.

*January 2014*

## International Energy Agency, Shell and Société Générale—Oral evidence (QQ 96-114)

TUESDAY 12 NOVEMBER 2013

Evidence Session No. 8

Heard in Public

Questions 96 - 114

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Skidelsky  
Lord Smith of Clifton

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### Witnesses

**Dan Dorner**, Senior Analyst—Global Energy Economics Directorate, International Energy Agency, **Dr Graeme Smith**, VP Exploration and New Ventures—Unconventionals, Shell and **Dr Thierry Bros**, Senior European Gas and LNG Analyst, Société Générale

**Q96 The Chairman:** Good afternoon, gentlemen, and thank you very much for coming. Welcome to the Economic Affairs Committee. This is the sixth public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. Thank you also to Dr Bros for your written evidence and for copies of your book, *After the US Shale Gas Revolution*.

I understand that today is also the day the IEA has published its latest *World Energy Outlook*. We have had a brief note of the extracts, but you might like to refer to some of it in the evidence if it is appropriate. I would be grateful if you would speak loudly and clearly for the webcast and the shorthand writer, and if you all agree to answer a question, simply nod and we will acknowledge that in the transcript. Do not feel that you have to repeat what has already been said if you are in agreement. If you have something to add or if you disagree, please do so. It might be helpful if you very briefly outline, as each of you answers the first question, your background, current post and background experience for the benefit of the transcript. Would any of you like to make an opening statement, or shall we go straight into the first question? No. Thank you very much.

The first question is very basic. Could you explain how the development of shale gas in the US has affected the international gas market: what has happened to prices, what the effect

has been on the energy market as a whole, and, in particular, because we have had quite a bit of evidence on this already, do you expect these changes to last?

**Dr Thierry Bros:** I am happy to start. Thank you for the opportunity to address the Committee. To present myself, I am working for a French bank on energy. I have been working on gas for 20 years and, as you have said, I have published a book. On your question, perhaps we can say that total gas production in the US has grown by 25% in the past five years. Demand did not follow, as gas was trapped in the US because there was no export option. We have seen four consequences of this. The first is that cheap US coal has been exported and has displaced gas in power generation in Europe. The second is that spot pricing is becoming more important than oil indexation to price gas in Europe, and we could see the US imposing this spot-pricing mechanism worldwide—i.e. even in Asia. The third consequence: US LNG, is already a game changer as the industry has forgone expensive projects to focus on brownfield US projects that are much cheaper. The fourth consequence is that the industry needs to move from a gold-plated mindset to a low-cost mindset. You heard in a previous meeting Professor Riley telling you that resource is now chasing capital. I would add only that markets want to invest in profitable projects.

**Dan Dorner:** Just to add to that, my name is Dan Dorner. I am senior analyst in the International Energy Agency in the team that specifically publishes the *World Energy Outlook* every year, so we are very much focused on the economic analysis of global energy markets across all fuels, looking out from today to 2035. If we look back at price differentials between the three regional gas markets, you can see that as recently as before 2008 the regional differentials between North America, Europe and Asia were relatively close when it came to gas prices. From 2008-09 onwards, the differential really expanded very rapidly as US gas prices stayed very, very low, while European prices, and even more so Japanese prices, increased.

As was mentioned rightly, the difference in the pricing mechanisms between spot pricing and oil indexation has an important role in this, but shale gas and the significant forthcoming quantities of shale gas in the US have made a really big difference. So from a consumer perspective, both the gas consumers and the electricity consumers in the US have seen a real benefit. We are right to point out that one of the consequences of this has been the increased use of that gas in the US in the power sector, pushing coal into Europe. Europe as a consequence, in some countries at least, has seen its coal consumption increase in recent years.

One of the other benefits that we have seen as a potentially longer-term gift for Europe is the fact that it is becoming a little more of a buyer's market when it comes to gas. In the longer term this could give a bit of a stronger hand to Europe when it comes to renegotiating its gas contracts with its suppliers. Around two-thirds of the gas that is currently contracted is coming up for contract renewal within Europe within the next 10 years, so, although what happened in the US is fairly confined, given that the North American market is quite a gas island in global terms, it has had knock-on consequences that are both relatively bad if you do not want to see coal increase but also potentially relatively good, with the potential to renegotiate gas price contracts.

**Dr Graeme Smith:** I would add just one thing. My name is Graeme Smith. I am vice-president of Unconventional Exploration and New Ventures with Shell, and I am an explorer by background. One thing that you have seen as a consequence of, if you like, an oversupply is the price going down. That is challenging operators at the moment in North America, so you are seeing a shift in focus from gas-rich players to liquid-rich players in North America.

The fundamental thing though is that this is a fundamental change to the industry. A massive new resource base has been opened up that had previously been uneconomic to extract.

**Q97 The Chairman:** In 2011, I think, the IEA report asked the question: are we entering a golden age of gas? Would you like to update us, and see whether you can make some responses to your own question?

**Dan Dorner:** Absolutely. As you say, both in 2011 and in 2012 we did special reports on gas, the first being on whether we are entering a golden age, and the second being the golden rules for a golden age of gas, looking specifically at the kind of policies and regulatory framework that might be required to bring forth that golden age in unconventional production.

Now, looking at gas more generally and at our *World Energy Outlook 2013*, which was published today, we still see that the outlook for gas is very, very promising and very bright. We estimate that the global demand for gas will increase by around 50% through to 2035, and that will be followed inevitably by production, which we see going from over 3.3 trillion cubic metres today up to 5 trillion cubic metres in 2035.

As has been touched on, one of the other positive things that has happened is that the scale of gas resources is much larger than we originally estimated, because the unconventional resources have become economically viable—and, as people continue to do further exploration and evaluation, we think that those resources will increase still further.

Looking at Europe specifically in our projections, we see that actually European production declines over the next two and a half decades. It is one of the few regions where gas production declines. It is offset somewhat by reasonably strong Norwegian production, but we see declines in the Netherlands and in the UK. Looking to North America, we see that unconventional gas production will continue to be strong and that the US and Canada will be the driving force in the further increases in unconventional gas production this decade, but towards the end of this decade we will also start to see more meaningful production coming from Australia and China. After the end of this decade, we see unconventional gas production ramping up yet further in those countries, and we see them being joined by others such as Argentina, potentially even India, and a little in Europe. By 2035, we have fairly cautious estimates for European unconventional gas production. We have 20 billion cubic metres, the largest share of that coming from Poland and a smaller share coming from the UK.

**Q98 Lord May of Oxford:** I have a question for Mr Dorner, and it is probably an inappropriate question because it goes a bit wider and it reveals my ignorance. Is the International Energy Agency looking at global energy in a rounded way, or is it the “International Energy for Putting Fossil Fuel Carbon back into the Atmosphere Agency”, although we may be looking more at the ways in which gas would be better than coal and so on in the interim? I find it a little disconcerting that so much of the things that are presented to us are so narrowly focused on something that cannot continue indefinitely in the way we are doing it, even if it was in abundance.

**Dan Dorner:** We are absolutely the International Energy Agency in a holistic sense. The analysis that we do covers the full range of fuels, including renewables.

**Lord May of Oxford:** That is a pleasing answer. Thank you.

**Dan Dorner:** We also map multiple future trajectories based on different policy decisions, including a 2-degree climate scenario, and in June we did a special report specifically on

climate change, which we called *Redrawing the Energy Climate Map*, so we give very due and dedicated attention to renewables, to nuclear and to the issue of climate change.

**Lord May of Oxford:** I am glad I asked that question. Could I ask whether you would be so kind as to distribute the documents to me—I will give you my address—because I will happily look at the knowledge?

**Lord Griffiths of Fforestfach:** If you divided the world into areas such as the Americas or North America, Europe and Asia, and you find with discoveries and so on that prices start diverging between these regions, through the process of markets and adjustment, will you end up with a global convergence of price, or will you have permanent and significant differences between different regions?

**Dan Dorner:** I am happy to take that question. With our analysis, we expect to see a gradual convergence in regional gas prices, but we do not expect to see an actual global gas price from now to 2035. There are a couple of reasons for that. One is the strength and degree of the interlinkages between the different markets and whether they are actually pricing the majority of their gas on gas fundamentals or on oil, and in long-term or short-term ways. There is also a quite basic and fundamental fact, which is that the cost of transporting gas is about seven times that of transporting oil on an energy-equivalent basis, so even if the price of the gas itself is the same, once you start transporting it from one region to another you will at least see transport differences between the different regions.

**Lord Griffiths of Fforestfach:** So you could see European prices being permanently higher than, let us say, North American prices?

**Dan Dorner:** Absolutely.

**Q99 Lord Hollick:** An earlier witness suggested that because the earlier leases that were given out for fracking gas in the United States were relatively short in duration, it was necessary for economic reasons to exploit them as soon as possible. That led to a dramatic fall in the price of gas, which certainly I inferred was going to even itself out, so the price of gas in the United States would rise because the current level was artificially low because of this early activity. Do you recognise that analysis?

**Dr Graeme Smith:** Yes, I do. As an explorer, when you get leases in America, which are quite small by international standards, you quite often have a commitment to a landowner or whoever to drill a well. That series of commitments, when you build up a large acreage position, comes to an awful lot of wells if you are not careful. It also impacts on the way technology is used, or not used, in order to develop it, because you need lots of wells locations, whereas you could reduce that into a single well location with lots of wells going under the subsurface. You can choose a different solution if you have a different driver.

**Lord Hollick:** Do you think that the price is therefore somewhat artificially low at the moment in the United States?

**Dan Dorner:** To take that from our perspective, the current US price is around \$3.50 per million British thermal units, though obviously it has been substantively lower within the past couple of years. In our recent projections, we think that in order to continue to bring forth the unconventional gas in the volumes that we expect, especially from the drier plays where they have fewer liquids to help the economics, we think that a price between \$4 and \$6 dollars would be required. In our projections, by 2035 we have the US gas price being just under \$7.

**Dr Thierry Bros:** I slightly disagree with this one. I think that we can extract quite a lot of shale gas in the US at \$4 per million British thermal units. Yes, prices today are just below the cost of production, but thanks to a huge improvement in technology, and when we look at what companies are saying to analysts, we think that \$4 is an area where you can have loads of shale gas production. Again, if you have shale gas with shale oil, the costs could be even lower.

**Lord Lipsey:** For a long time, America was not exporting much of this gas, partly because of the transport cost point that you made. Former Energy Secretary Chris Huhne argued recently in the *Guardian* that in fact they were in breach of free trade rules in failing to export. Now that exports are starting to rise, no doubt partly motivated by the very low price in America, I wonder how far you think that rise will go and how far you think it will affect the world gas price.

**Dr Thierry Bros:** Please remember that the US has been an energy exporter for quite a long time. It has been exporting from Alaska since the 1970s, I believe. We made a projection two years ago that North America (US and Canada) could export 50,000,000 tonnes in 2020, which would be between 15% and 20% of the total LNG supply. Again, as was stated before, please remember that you have to add the cost of liquefaction, transport and regasification, which at the end of the day means that you have a spread differential of something like \$6 per million British thermal units between the US price and what the European price could be.

**Dan Dornier:** Just to add to that, in our latest analysis we have recently seen a number of LNG export facilities and licences being approved, and we are expecting more significant volumes to come forth towards the end of this decade. In our analysis we expect around 50 billion cubic metres of LNG to be exported, in net terms, from the US by 2045. In our analysis we have also done a special case where we have examined what the implications would be if that doubled and we saw around 100 billion cubic metres coming from the US in a nearer timeframe. We saw that this, along with market reforms and tougher prices, could help to bring Asian prices in particular down by a couple of dollars.

**Q100 Lord Smith of Clifton:** Gentlemen, is the technology of shale gas developments advancing? Will that reduce costs and prices? Are there any intellectual property problems—is there free exchange, is it licensed out or what?

**Dr Graeme Smith:** The technology is developing very rapidly. Fundamentally, we are using conventional technologies; we construct wells; we drill, sometimes horizontally; and then we use hydraulic fracturing, which has been used for a while. How we complete those wells, the fluid that we use to do the hydraulic fracturing, the new technologies to reduce the amount of water, reduce emissions and reduce the footprint—as I mentioned before, these are advancing all the time. With regard to intellectual property, yes, there are different concoctions, such as the difference between Coca-Cola and Pepsi; there are different ways in which you can mix the chemicals to ensure that you get an effective frack. Mostly, though, we are trying to reduce the amount of chemicals that are used and just use pure water for fracks, or indeed no water. That is where the intellectual property goes. The aim of the technology is to reduce costs to make more of this gas extractable, but we also spend a lot of time trying to increase production—that is, the amount of gas that we get out of each individual well. That of course would also save money on the number of wells that we drilled.

**Lord Smith of Clifton:** Do you think that the rate of innovation in the technology is going to slow up, increase or be much the same as it is now?

**Dr Graeme Smith:** I would imagine that it will be much the same as it is now. It has already been very rapid over the past 10 years. A lot of it is about optimising existing and fairly traditional technologies and making them better. Remember, a lot of them can also be used for conventional production as well; they are not purely for unconventional use.

**Dr Thierry Bros:** I would like to add that technology improvement might also improve acceptability on the part of the public. If we use less water or greener chemicals for this, that will help.

**Q101 Lord Hollick:** Do you expect a significant increase in shale gas development outside the United States? If so, in which countries? Would there be a significant cost difference between the extraction and exploitation of gas in those countries?

**Dr Thierry Bros:** Perhaps I can begin on this question, as a Frenchman. For my part, the places to watch are the UK and China. I say China because of its huge resource and its ability to develop massive infrastructure—what I call the “factory factor”. Once China has solved the water issue, I think they will be able to deploy this quite rapidly. As for Europe, analysts are watching the UK because you have the resource and, most important, you have well developed regulation and a stable tax regime. Again, as an analyst, I can say that at today's prices, which are around \$11 per million British thermal units, I believe that the work around shale gas could be done for something like \$7 per million British thermal units. Whether it will be done in the UK will depend on the upstream taxes. I am less optimistic about Poland because there I think that this is more a geopolitical play; it is because the Poles want some independence versus Russian gas. I am not so sure it is going to be done in a profitable way in Poland, and the regulation and the tax regime are not there in that country. I think that the places to watch are the UK and China.

**Lord Lipsey:** As we have you here, could you tell us why fracking is not permitted in France, as I understand it? Is it because of environmentalists, or protection on behalf of existing generators?

**Dr Thierry Bros:** It is very difficult for me to comment on this. Yes, a ban was imposed in France by the former Government and again by the current one. On a personal level, I do not believe that the ban should touch research but, as the Committee has heard, at the moment it is. I believe that the research should be free to go ahead if we want to improve our knowledge.

**Lord Lipsey:** Was banning it a big political issue, or did it just slip by one afternoon while the sun was shining?

**Dr Thierry Bros:** I think that shale started in the wrong place. It was decided to do it in a green constituency, so perhaps that was not the right way of starting shale exploration. The Government made that decision then, and the next one wants to be greener than the former—there is an issue of who wants to be the greener.

**The Chairman:** It was not just public concern about safety and all those other factors, it was much more the green side, was it?

**Dr Thierry Bros:** I believe so, yes.

**Baroness Blackstone:** Do you know what position the energy companies that might have been involved in shale gas exploration took with the French Government? Do you know if they pressed for a change in this complete ban or are continuing to do so, or whether they have just accepted it? Is it because nuclear and other renewables are considered to be the right route in France generally, including by the commercial and industrial community?

**Dr Thierry Bros:** Renewables are viewed as greener—that is a no-brainer. That is where they want to go. Right now there are discussions about nuclear. With regard to companies, I do not sit on a board of an oil and gas company, but what I can see as an analyst is that companies are moving out; they have leases in the UK or Denmark to try to master this technology. If you cannot do it in one country, you try to do it in another. That brings me back to my earlier answer; it is why I believe, as an analyst, that the place to watch is the UK, because that is where this is going to be proven. Whether it will prove to be profitable is another question, but things will start here.

**Baroness Blackstone:** You would see French companies moving to the UK if opportunities for shale exploration and development developed rapidly?

**Dr Thierry Bros:** If my memory serves me right, there is one French utility, GDF Suez, that has acquired some leases in this country.

**Q102 Lord Hollick:** Dr Smith, Shell has announced a £1 billion investment in shale gas in China. What persuaded you that that was the best country in which to spend that sort of money? Was it because of regulatory issues, licensing or the expected low cost of extraction?

**Dr Graeme Smith:** We are a global company and we have investment criteria that we look at. What we are looking for in an unconventional play—as I say, I am an explorer so this is what my job is—is something that has the potential to be very big, so we are looking for scale, and for a place where we believe fundamentally that we can drill and frack the rock so that gas will come out. Remember that all of these plays have very tight rocks, and not all of them produce. That is an important thing to remember. At the moment we are in the exploration phase almost everywhere outside North America, and we do not know whether these rocks will produce. We have a model that we believe in for China, and then we have to look at whether or not there is a robust supply chain—that is, whether or not we can get the kit that we need to drill and construct the well in the first place, and all the logistics and stuff that we need in order to support that and make it happen. In China, again, we believe that those things exist. We believe very strongly in regulation, which is why we have our Shell onshore operating principles; if there are no regulations, we are at least going to do it to a minimum Shell standard. When we add that package together, a country like China has the right conditions for a material investment.

**Lord Hollick:** You make a very important point: you have to actually sink exploratory wells to find out whether you can get sufficient gas released. Does that not rather call into question the more extreme assessments of the amount of shale gas that might be there? Until you have drilled, you do not know. In fact, we have heard from a number of operators in this country that they are unable to say exactly what they can get out with any degree of precision until they have actually done that drilling. So could this be overhyped?

**Dr Graeme Smith:** I cannot comment on whether or not it is overhyped because that is part of the answer to the question. Fundamentally, the rocks are down there and some of them will have hydrocarbons in them—either gas or liquid. The rocks are very tight; that is the fundamental thing. There are very few holes in them and very few connections between the holes. So there is little porosity and little permeability. Right now, at this minute, we can use geological models and we can take samples where rocks have been uplifted, but we are using geological models. Based on a geological model, we will have a range from a small number to a bigger number of the gas or liquid in the rocks. That is the in-place range.



Many of the reports that you see quote very large numbers that describe how much gas might be in place. But we cannot recover all of that. Technically, it depends on the way you drill it and frack it. A subset will come out—if we are lucky, 25%. We cannot access it all, because some of it is under cities or nature reserves or places where we just should not go. So maybe knock out another half—I do not know. Then of course we have to earn more in sales than we spend drilling the well and constructing the facilities. So each time you take quite a big chunk out of that in-place resource. Each of those numbers has an uncertainty. It could be a very big number or it could be zero in any given play, because the gas just might not be there at all.

**Dan Dorner:** Perhaps I could come back to your question on China, in a more general sense. First, it is estimated at this stage that there are very large resources, so of course that will be attractive as an opportunity. There is already a clear policy steer from the Government of China that they want to develop them. They already produce a relatively small quantity of unconventional gas and coal-bed methane: around 10 billion cubic metres. Their target in the latest five-year plan is to triple that to 30 billion cubic metres within the next couple of years. We do not think that it will come forward quite that quickly, but clearly there is a strong policy intention from the Government that they want to develop these resources. One of the other constraints around some of the areas where these resources are in place—Graeme may know more about this than I do—is the availability of the large quantity of water that is required.

**Lord May of Oxford:** I would like to go back for a moment to France. Please correct me if I am wrong, but the interpretation I have put on this is that more generally—GMOs are a good example—the French tend to put more emphasis on public concerns, particularly in the countryside, than on the interests of industry. Personally I think that is admirable, if often irritating. That was what I was inclined to take as the basic explanation for the banning of fracking, whereas here we have the Government tending to line up on the controversy, partly because of all sorts of interconnections of a commercial kind.

**Dr Thierry Bros:** There used to be some gas production in France. Lacq closed earlier this year. There are some pockets of oil and gas production, so I would say the ban is not on the countryside but on the fracking. It is on the ability of people to understand what fracking is. What your Committee heard about was the risk and how it was viewed by people.

**Q103 Baroness Blackstone:** Given what Mr Dorner said about China—that it is not overhyped and that there is an enormous potential supply of gas from shale—I am assuming that Shell is not the only company that is exploring exploitation there. I wonder also whether the Chinese have indicated whether, in growing this industry, they see it as only for domestic consumption or whether they intend to export it, which obviously would affect the international market very considerably.

**Dan Dorner:** Within the time horizon that we look to—2035—we do not expect the volume of unconventional gas in China to be even close to pushing it into an export scenario. The level of growth of gas demand in China is absolutely huge over the coming decades, so even with forthcoming new sources of supply domestically, it will still suck in other sources of supply from around the globe just to meet its own needs.

**Lord Smith of Clifton:** Dr Smith, you said that there were certain areas, particularly ones with great urban density, where you thought you should not exploit and explore. We heard from earlier witnesses who said that the wells could be easily disguised: that you could do this in urban areas and people next door would not know that it was going on.

**Dr Graeme Smith:** Yes, I have a lovely picture that I could supply to the Committee of a derrick disguised as a church spire—unfortunately with an Exxon Mobil service station just across the road. It is a lovely picture. I sent it round to my colleagues and asked, “What is unusual about this picture?” Nobody could tell that there was a derrick. That is absolutely true. In The Hague, where we are, there is a field next door that is surrounded by trees, and most people in The Hague do not know that there is a gas field underneath them. So yes, it is possible.

**Lord May of Oxford:** And you could pass the flame off as a miracle.

**Dr Graeme Smith:** We only do that in the early exploration phase. It is too valuable later.

**Q104 Lord May of Oxford:** Changing the subject, how long is the shale gas development likely to roll ahead in the US? Is it a relatively short-term phenomenon, with each well yielding and then rapidly being exhausted, or is there a lot more to come? I ask the question recognising that the US Energy Information Administration has predicted that in another couple of decades, half of all the US’s gas supply will come from shale gas. Is this feasible, and what are the implications?

**Dr Graeme Smith:** That is fundamentally an economics question that most of the members of the Committee are more qualified to answer than I am. Given the resources in North America, based on current estimates and current levels of demand, there is enough for maybe 100 years of production. Maybe there is an update in today’s *Outlook*. Whether that resource is made available to people depends on the gap between the development cost and the price that I mentioned. It depends on the fiscals and on the costs. Most importantly, it depends on our ability to have a stable investment regime. Even though each individual well produces 50% of its production in its first two years, it still carries on producing for quite a long time. Collecting all that gas is still a large, complex project.

**Dan Dorner:** I would add that the scale of the resources in the US means that it will be able to continue for quite some time. Globally, we see unconventional gas production more than doubling between now and 2035. Obviously, the US currently accounts for by far the largest proportion of that. We see its production increasing from a little more than 400 billion cubic metres now to around 600 bcm in 2035. Later in our projection period it starts to level off. But that is not really to do with a shortage of resources so much as the economics—the demand and the ability to export when domestic demand may not be there.

**Dr Thierry Bros:** What we are seeing is that even though we think that the price today is slightly below the cost of production, US shale gas production is not increasing and not decreasing. So yes, we take what the US DOE is stating as something that can really happen in the years to come.

**Q105 Baroness Blackstone:** How far do you think the development of shale gas will affect the competitiveness of energy-intensive businesses that use gas?

**Dan Dorner:** We have done a new piece of analysis that we published today. It is the first time that we have looked in detail at this subject—driven by the regional differentials in gas prices that have come about from shale gas in the US. What we see over our projection period is that while the gas differentials narrow, they remain significant between the different regional markets. As we know, for all consumers a change in the energy price is important. You would rather have it cheaper than more expensive. But for most people, it is not core to their competitiveness calculation. It is a part of it, but it is not the largest part.

Both in households and most businesses in most countries, you do not see differences in regional energy prices and gas prices being the key driver behind their geographical location or their competitiveness relative to their rivals.

However, in energy-intensive industries—the chemicals sector, iron and steel, pulp and paper, glass and a couple of others—energy costs are a much larger part of the overall equation. In our analysis, we see that the European Union is today the largest player in the international space in terms of its global exports of these energy-intensive products. Between now and 2035, we see that its share of the global export market for those industries will decline.

Japan will also see a decline from where it is today, relative to the global market overall, whereas the US fares better than others within the OECD group. It sees a marginal increase. At this stage, from what we have seen and from what we know now, the jury is still out over the extent to which the US will reap this big industrial reward, even for its energy-intensive sectors. A lot of the growth will happen in those countries where the domestic demand for these industries and products is growing so rapidly—primarily in Asia. Europe faces a real risk here in those sectors.

**Baroness Blackstone:** Does that mean you think that in the sectors you listed, there might be some shift in the location of the industrial activities that are associated with them?

**Dan Dorner:** I think that, over the next 25 years, the global demand for these products will grow, but other exporters will see their share grow more quickly than Europe's. While Europe's share will not shrink in absolute terms—it will still grow in absolute terms—it will not grow as quickly as everyone else's. So it will see its share of the global market gradually diminish.

**Baroness Blackstone:** Who does “everyone else” mean here? Does it mean Canada and the United States? It cannot mean China, because you have just ruled out the Chinese wanting to do anything other than use their gas for domestic consumption.

**Dan Dorner:** It is an important distinction. China, India and other markets in Asia and the Middle East will see their production grow, but primarily to meet their domestic demand for these products, so their products will not get on to the global market.

**Lord Griffiths of Fforestfach:** Given the developments that you talked about in the US, how do you see this affecting the mix between various sources of energy—coal, nuclear, renewables, LNG and so on? Secondly, how do you see it affecting the UK in particular?

**Dan Dorner:** With regard to the global mix, it is fair to say—as I said earlier—that gas will do very well over the coming decades. It will increase more in demand terms than the other fossil fuels combined. When you look at the global energy mix, what that will mean is that the share of gas will increase. It will take share away from the other fossil fuels, and a bit from nuclear. But it will not take away from renewables—their share will grow.

**Lord Griffiths of Fforestfach:** By “gas”, do you mean natural gas plus shale gas?

**Dan Dorner:** I mean all gas—conventional and unconventional. The regional mix really varies. In some markets today, fossil fuels are very dominant in the energy mix, especially in the Middle East, whereas in some Latin American countries, Brazil in particular, there is already a very high share of renewables. So it is difficult to give a generic picture of exactly what will happen, because it really changes from one country to another.

**Lord Griffiths of Fforestfach:** And in the UK?

**Dan Dorner:** In the UK I would expect to see that renewables, supported by the Government, will increase. Gas demand levels, not just in the UK but in Europe, will increase only gradually over the next two and a half decades. In our projections we only expect, as we get near to 2035, that they will get close to the levels that they were at a couple of years ago—because they have decreased over the past couple of years. Unsurprisingly, you will see

the share of coal in the mix decline.

**Dr Thierry Bros:** If we look at the US experience, shale gas had one effect: it killed the nuclear renaissance in the US. That was the first impact. I think that extra shale in Europe, including in the UK, will displace imported gas. That will be one of the first things to happen.

**Dr Graeme Smith:** Remember, most of that discussion has been around the cost implication, but there is a very significant environmental implication—and not just for CO<sub>2</sub> because, significantly, gas has 90% fewer particulates than coal, for example, when generating power.

**Q106 Baroness Noakes:** Following on from that environmental aspect, could we look at the relative environmental impacts of conventional and unconventional gas and oil? Do you think that in environmental terms shale is more dangerous than conventional gas and oil?

**Dr Graeme Smith:** The gas that we are talking about here is methane, so it is exactly the same gas—whether it is shale gas, methane or coal gas—that we used to see in mines. So inherently, no, it is no more dangerous in environmental terms. The technologies, as I mentioned before, are essentially the same as the ones that we have used. It is how we combine them in order to extract the gas that is new, if you like: the combination of horizontal drilling with long hydraulic fracturing. Fundamentally, I do not believe that those are unsafe. I believe that as an industry and in working with the regulators we have regimes that can manage those risks, and I believe that people want to understand better whether, first of all, they can trust us as an industry and the regulator to regulate, and what the impact of scale is, because in order to develop these resources we will need more wells because each well produces less than conventional gas wells. Those are the two questions that we have to answer most carefully.

**Baroness Noakes:** And what is your view of fugitive methane? A lot of concern has been expressed about that, and indeed there have been quite a lot of contradictory views on the quantum.

**Dr Graeme Smith:** DECC produced a report in September, I think, that showed that the quantity of fugitive emissions for unconventional gas was a tiny percentage more than for conventional. There was also a University of Texas study, which came out a couple of weeks later, and I can provide both of those if you need them. Both indicate that the levels of fugitive emissions are incrementally higher than conventional, but small. They are mostly just because of the greater number of wells. Interestingly, certainly the University of Texas study, which I am more familiar with, showed that those emissions were not coming from where we assumed they were coming from, and even though the levels were high they were coming from somewhere that we as an industry were not expecting. So that is a nice area to develop new technologies for and to help fix.

**Dan Dorner:** We looked at this in some detail for our 2012 report, *Golden Rules for a Golden Age of Gas*, and we concluded at the time that unconventional gas can be produced safely but that it is of the utmost importance for the industry and for government to take steps to ensure that the social licence to operate is in place and that they have social

support. At that time we highlighted seven golden rules, which we consulted on with industry, with Governments and with experts at some length—I can share a copy of that report with the Committee—and which we thought should be in place to maintain that social licence to operate. We stated that if the best practices were implemented to the highest standard, it might increase the production cost per well by up to 7%, which should not be prohibitive for the industry in taking forward production.

**Baroness Noakes:** And do you believe that the arrangements that the UK has made thus far achieve a sufficiently high level of regulatory risk management?

**Dan Dorner:** We have not looked in detail at the current regime in the UK specifically. Obviously in the UK it is very early stages. We have, though, put in place a stakeholder forum called the Unconventional Gas Platform, which brings together industry, Governments and regulators from around the world, which the UK is participating in fully. We held the first meeting earlier this year, and the next one will be held early next year, which is specifically about ensuring that best practice is understood and shared globally between government, regulators and the industry.

**Baroness Noakes:** Do you know whether your seven golden rules are embedded in the UK's approach to regulation?

**Dan Dorner:** I have not checked. I suspect so, but I would not like to say for sure.

**Q107 The Chairman:** You said that the UK is still at very early stages. Lord May, when he asked about public hostility, linked it with the GMO issue, which has of course been present in the debate for very much longer. Given that the industry is in the very early stages, that no wells have been developed and that it is a very, very nascent industry in this country, why do you think that it has attracted such public hostility? Admittedly, some of it is in the localities where there is some possibility of drilling, but there has been a bit more hostility generally, and Francis Egan told us last week that the level of scrutiny that shale gas has come under is unprecedented. I think he also meant the determination to make it safe was unprecedented, but there is this problem. Why do you think it exists, and how do you think public acceptance can be achieved?

**Dr Graeme Smith:** Actually, I believe that the public have genuine concerns about what is perceived as a new technology. As you say, it appears to be being introduced in people's backyards. I think these concerns centre around the industry's ability to construct safe wells, as I mentioned before, to protect water and to protect air by reducing the emissions, and of course to protect the environment by keeping the footprint as small as possible. As I said, I strongly believe that we as an industry can do this safely, certainly with help from regulations. Fundamentally, in the end it is about trust that industry will do the right things and that regulators will regulate us. As I mentioned before, the scale is also important.

Those concerns are about fracking, but the public have another worry, which is whether further investment in shale gas will decrease or stop the investment in renewables. I think people are just generally worried about that. They have projections, we have our scenarios. If we look to 2050, when there may be 9 billion people on the planet, there will be a huge increase in the demand for energy, and even with the best ever record of introducing new technologies (e.g. renewables), and even with a 30% improvement in efficiency, we are still going to need 50% or 60% of the energy supplied by fossil fuels. The equation will just not go around otherwise. So we would argue that we fundamentally need some fossil fuels, and we would argue that gas has a significant part to play in that energy mix.

**Dan Dorner:** I agree with Graeme that the public absolutely have legitimate concerns. The US is a much larger country, and it has been living with ongoing drilling for decades, even centuries; it is a much more accepted part of the culture over there. In the UK, oil and gas drilling have been predominantly offshore and therefore out of sight, so there is a little of this “not in my backyard” attitude, which can apply to renewables as well; a lot of people oppose onshore wind.

Also, in the narrative over the past decade or so there has obviously been a lot of focus on trying to explain the need to move to renewables and away from fossil fuels, so this is a little bit of a shift in the narrative, although in terms of the substance it is not a big shift. From the narrative that a lot of people may be hearing, they are suddenly thinking, “We’ve been hearing for a long time how we need to move to renewables and away from fossil fuels, now you’re telling us that we should be drilling down the road to bring forth new fossil fuels”, so maybe there is a little of that attitude creeping in. We also have to remember that just a couple of decades ago we had coal mines operating all over the UK, and people were happy to tolerate that, often because they worked there. So even in the UK we have a history of fossil fuel production onshore in quite a significant way.

**The Chairman:** I was born and brought up in exactly such a place.

**Dan Dorner:** I am from Sunderland.

**The Chairman:** Our witnesses from the industry last week suggested that the regulatory regime in the UK was likely to be one of the toughest and safest and was pretty strict. Would that be your general view?

**Dan Dorner:** Internationally, the UK regime as it stands is very highly regarded, so the regime that we already have in place is considered to be one of the best in the world. Now, obviously, it is predominantly focused on offshore production and conventional production, so there will be a need to review and update it in the light of onshore unconventional production, but where we are now in international comparator terms is very high.

**Q108 Baroness Noakes:** I am going to explore what people really think about it. I think you said, Dr Smith, that people were concerned about renewables. Actually I think people are much more concerned at the moment about the price of energy than where it comes from. If there is a good case to be made that exploiting shale gas in the UK will help to keep prices down—I do not think that anybody can say that it will in absolute terms, but to keep that bottom pressure—attitudes might well change significantly. A lot of the emphasis has been on the environmental dangers and relatively little on the economics, and maybe the economic arguments are the ones that might liberate. I wonder whether you have any views on that. We conduct the argument in terms of climate change and renewables and not in terms of what actually matters to people, which is how much they pay for energy.

**Dr Graeme Smith:** I fundamentally believe that North America is not unique, and is not the only place where we are going to see un conventionals—and shale gas in particular. There is an opportunity for us as explorers to prove that this resource is there and that we can economically extract it to have an impact for the energy security of the country and for jobs and ultimately for economic rent. There is absolutely no doubt about that. In the end, we are still in the very, very early stages of exploration in a number of countries outside North America. Today, I do not know whether or not that will be the case.

**The Chairman:** Is it the impact on price that you are talking about?

**Dr Graeme Smith:** Yes.

**Dr Thierry Bros:** I was going to say that I agree with you. To add to the answer to a former question, I think we have to bear in mind that Europeans—industry and citizens—are overpaying for gas compared with the US price, something like \$130 billion, or 0.8% of GDP. So I absolutely agree with you. If the question was put differently to people, perhaps the answer would be different. First we have to go through the exploration phase and to understand how much it will cost. But you are absolutely right that energy prices matter and that we are overpaying for it.

**Q109 Lord May of Oxford:** First, I declare that I am a member of the climate change committee here. We have primary legislation that commits us to a target, and at the moment we are on trajectory to hit that target by virtue of the recession. The intermediate step in the trajectory is that by 2030 we will have decarbonised the generation of electricity. That is not so much a safety concern but a concern that some of us have. I should also say that even though I start from that perspective, I am of the view that getting natural gas to replace coal on the trajectory to 2030 is to be desired, so I am disturbed by the fact that so much of the discussion proceeds as though we did not have a target and we can forget all that.

Setting that aside, I am keen, hoping that we will stay on the trajectory and will be helped by gas, to see it work, but I find some of the discussion that we have had—not with you but with earlier people—and some of the information, some which I am not sure is accurate, really quite disturbing. There are two things that I will mention to you that come from people in Balcombe, where much of the activity is. They may be inaccurate, but I have checked them with Harry Kroto, a Nobel laureate in chemistry, who has worked on modelling polycyclic aromatic hydrocarbon formation in flames. He knows something about pollution from flaring and he thinks that it is a public health danger. Then I am told—it may be incorrect; we are going to find out—that we differ from the States in that the pollution laws here mean that you do not have to cross a threshold for all the various pollutants, as distinct from each one. We have a more permissive regime, and people who are aware of this, if it is indeed true, feel that this is not being done well. I found the general tone of the discussion with the head of Cuadrillo, Francis Egan, to be, “There is no problem. It’s an uphill public relations battle. We’ve got to win the public over”, rather than addressing the substance of the worries. That was more of an outburst than a question, but I wonder what your reaction to it is.

**Dan Dorner:** I will just pick up some of the elements of your outburst. In our central projections, which we published today, the world is nowhere close to achieving the 2-degree Celsius climate goal that it has set itself. Actually, we have the world on a trajectory that sees long-term global warming in the vicinity of 3.6 degrees Celsius.

**Lord May of Oxford:** But we could be on our trajectory even if the rest of the world is not. I know it would not help us, but we would feel better.

**Lord Griffiths of Fforestfach:** Would we?

**Baroness Noakes:** Would we? Speak for yourself.

**Lord May of Oxford:** Those of us with a capacity for feeling virtuous would feel more virtuous.

**Dan Dorner:** I would make two further points. In the 2-degree climate trajectory that we have modelled, in 2035 the global energy mix is still over 60% fossil fuels. The transition will be a very long and gradual one. The key elements to getting towards and on to that

trajectory are, obviously, the increased take-up of renewables, a much stronger effort on energy efficiency—just using it less and more effectively—and a more wide-scale introduction of CCS, which can mean that fossil fuels can still play a significant role in future. On your point about gas flaring, the UK and a number of other countries that we are talking about today either have very small or zero gas flaring, but we have estimated that the volume of gas flaring in 2010 globally was equivalent to double Nigeria's total gas production in that year—an absolutely staggering amount. When we did our climate analysis in the summer, we highlighted four policy actions that could help to get us a long way towards a 2-degree climate trajectory, and one of those was to take much more serious action to reduce gas flaring.

**Dr Graeme Smith:** I would like to add that as a scientist, I think there are some fundamental questions that we should be asking, and we should be doing research to answer them. A number of UK universities have started such research; just last week, the REFINE project was launched by Durham University—it stands for Research Fracking In Europe—looking at some of the questions that you have just mentioned. It has an independent science board that can ask new questions, which is fundamentally important.

**Lord May of Oxford:** Basically, I would be much more cheerful if you blokes were in charge of it rather than the people who are.

**Q110 Lord Lipsey:** Why is Shell not involved in fracking operations in the UK, and what would get you involved?

**Dr Graeme Smith:** I tried to answer that question slightly earlier, when I approached the question of our global investment criteria. What do we look for? An awful lot of big numbers are bandied around in the first place. As I mentioned, those big numbers go to smaller numbers when you reduce it for the amount that you can technically access and depending on how much we believe the cost model. We have a fundamental uncertainty about the volume of gas that might be available in the UK. That is the first thing. Secondly, we are not sure of the cost models in the UK—again, that is an uncertainty today—and we have investments going on in a variety of other countries, where we committed earlier to start, which meet those criteria. We are a very large company and therefore our investment hurdles and our investments are quite large. However, that does not mean that there is fundamentally no opportunity in the UK—on the contrary, each company can see if there is potential in the UK to invest.

I want to make one last point, which I have made twice before. The UK shale gas industry is still very much in its infancy. We have not yet explored, so the fundamental question is: is there any shale gas resource to exploit and, if so, how much? There are a lot of debates about what the consequences might be in the long run when we get to development, but the first question for me as an explorer is whether the gas is there and if I can develop it.

**Lord Lipsey:** Does that mean that one possible line of argument could be that Britain has a world-class system of regulation that makes it too bloody expensive to get our gas out, and you would rather go to Poland or China to get it out there? Is the cost of the system of regulation not material to your considerations compared with the amount of gas that might be there, and other factors that you mentioned?

**Dr Graeme Smith:** The UK has a world-class set of regulations; it is good, firm and strong, and it addresses most of the golden points. As I mentioned, we have our own Shell onshore operating principles, which are essentially our internal versions of regulations, which we would always apply anyway, so that is not a direct factor. We have to understand exactly



how we follow those regulations and execute them in any given country, but it is not a fundamental question that pushes us away—on the contrary, actually.

**Q111 Lord Griffiths of Fforestfach:** You said that as a company Shell looks at the world and thinks that it is really more attractive to be investing in other places where it is already committed, rather than in the UK. To what extent do you feel that that sentiment is shared by other large explorers?

**Dr Graeme Smith:** I cannot really comment for other explorers.

**Lord Griffiths of Fforestfach:** But you are in the industry; you hear the conversations and so on. Is there a feeling that the UK may have a lot, but that on the other hand to sink a lot of money into it at present would be quite a punt? Do you think that is the sort of view in the industry?

**Dr Graeme Smith:** There are very good examples of the industry starting to invest. Centrica has recently come in as well, as has Gaz de France. So the industry is investing. Each of us has different portfolios and investment criteria, and you should remember that we have different experiences in different parts of the world. It is easier to operate in some places than in others.

**Dr Thierry Bros:** As an analyst, I think it will be more a utility business model than an oil and gas-producing business model. This is also perhaps why we have seen Centrica and GDF Suez entering this. Please remember that utilities are facing tremendous challenges in their historical business model—reselling Russian or Norwegian gas is going to be more and more difficult, as they are selling less volumes and doing so with a lower margin. Being able to produce the stuff in Europe could help them, so that is also something that you should look at.

**Baroness Noakes:** Could I explore that a little further? In simple terms, can you explain why a company like Shell would go to invest in China, which I think you are in a big way, but not in the UK? What is it about the UK that makes you averse, compared with China, which has lots of uncertainties and difficulties? What is the essence of the investment decision that steers you away from the UK and into somewhere like China?

**Dr Graeme Smith:** First, I do not think we are being steered away from the UK. We have invested in China. We have a producing gas field there, Changbei, which we invested in prior to the Beijing Olympics.

**Baroness Noakes:** That is not shale, is it?

**Dr Graeme Smith:** No, it is not shale, but it is a tight gas field. We have some production but it is not huge. As I said, we already have a footprint in onshore China, and have experience of understanding how the supply chains work. There is a combination of factors for a very large company like Shell, and at the moment we have no onshore footprint in the UK. We have offshore investments, of course, and that is where our experience in the UK is.

**Lord Rowe-Beddoe:** There has been a shift in your company, though, has there not? The CFO was saying that it ought to be interested in production, and of course Mr Voser subsequently said so, too. Is it because you are expecting other people to go and do the groundwork and then, once it has been discovered that there are large recoverable deposits, you will come in with guns blazing? Hopefully not.

**Dr Graeme Smith:** Not with guns blazing.

**Lord Rowe-Beddoe:** That is why I said, “hopefully not”.

**Dr Graeme Smith:** As I have said, at the moment this is a very nascent industry in the UK. I think that there is just one well, drilled by Cuadrilla, although there may be more, and we still do not know whether or not it flows on frack. At the moment, we are in an exploration phase. The BGS and others, including, I am sure, the IEA, have estimates of what the potential is. The BGS is just re-looking at the Midland Valley in Scotland. All this at the moment is just a very big uncertainty. The CFO is the CFO; he controls the money, I do not. If he does not want to invest today, that is his decision. My job is to describe the resource base, and that is what I have done.

**Q112 Lord Smith of Clifton:** Do you believe that shale gas exploration and development requires a distinct tax regime?

**The Chairman:** Who is going to take that first? There is silence.

**Dr Graeme Smith:** I will start. At a fundamental level, no. I do not think that unconventionals or conventionals should require a specific tax regime. Obviously, you can use tax regimes to encourage early investment and provide rewards. The oil and gas industry has been around now for well over 100 years, and many of the fiscal regimes, production-sharing contract regimes or whatever around the world have been tuned with certain assumptions in place about how gas or oil are found, appraised, developed and then produced, so there is a certain model that people have in their head. That tuning can create some very strange unintended consequences when applied to unconventional gas projects. There should be adjustments made to the assumptions about how projects are executed. That is an area where we could have a review.

**Dan Dorner:** One of the issues to bear in mind is that no two tax regimes are the same in any two countries in the world, so everyone is very much starting from their own place and it depends where they are beginning from. Unconventional gas is relatively capital-intensive when compared to conventional onshore gas. That may be a distinguishing factor, but in the UK the production debate has been about offshore, which is itself relatively capital-intensive.

**Lord Hollick:** Shell’s enthusiasm for unconventional gas exploration and exploitation in the United States seems to have cooled a little, having invested \$24 billion, and taken an impairment. I think that your chief executive said that there was a strategic decision to slow down. You have referred on a couple of occasions to your international investment criteria. Could you give us a little more insight into why that decision was taken and how it might impact your decision to invest, for instance, in the UK?

**Dr Graeme Smith:** As I have mentioned, we are in an exploration and appraisal phase in almost all the projects outside North America. In fact, we have been in the exploration and appraisal phase in an awful lot of projects in North America as well. Sometimes the geology does not work or the gas or oil is not there; sometimes, when we start to drill and frack, the production levels that we were anticipating in our models are not as high as we thought; and sometimes, when we start to look at the technology that we required to extract the gas at the production levels, we see that the costs are not developing as well as we had hoped. In any oil company, regardless of its size, the normal course of business is that you go through the exploration and appraisal, you get some more information to reduce uncertainty, and then you make a further decision. A portfolio of big capital-intensive projects is a huge capital requirement for a company, even one like Shell, so you cannot do all the projects. You always have to high-grade, and that is what we are doing in North America; we are choosing the ones to high-grade. Let me be clear: we are going to high-

grade and grow those projects. The other ones are less economic for us, but, again, there are people for whom these would still be very attractive projects.

**Q113 Lord Rowe-Beddoe:** Can we turn to tight oil again? I understand that the US has begun the development of tight oil. Do you think that there is the potential for the development of tight oil in the UK from what we know at present?

**Dr Thierry Bros:** I will start with the world picture and leave the UK side to my colleagues. The important thing is to remember that total US oil production is supposed to grow by 30% in the next two years. Again, compare that to US gas, which grew by 25% in the past five years. So shale oil growth is going to be massive in the US. There was a question about perception. I think that shale oil is at least as important, not only for the profitability of the company but also for public perception. I think that people are not much aware of the gas industry—how it works, where the gas comes from—but they are more aware of the oil industry; they know that there is a cartel outside that more or less manages prices, thanks to quotas, and they know that it comes from unstable countries. I am sure that if we do the work to try to explain this to people, it will be easier to go with shale oil than with shale gas. I will stop there.

**Lord Rowe-Beddoe:** The question is whether there is potential in the UK.

**Dr Thierry Bros:** In the US, that is already the case. In Europe, the industry should go for shale oil and gas and explain what it is looking for. Again, I am not a geologist, but if we have the option we should go more for shale oil than for shale gas.

**Lord Rowe-Beddoe:** Thank you, Dr Bros. The department here, DECC, has actually changed its opinion about the Weald and Bowland basins, where they thought that it was too far down, it was within that window and so on and so forth. It is quite unclear. I ask the other two gentlemen: what do you think the potential is?

**Dr Graeme Smith:** Again, I do not know the number. The tight oil starts at the liquids that come out with the gas. It then gets heavier and heavier as it moves towards pure oil, if you like. As it gets heavier, it gets stickier, so if the rock is very tight, with very small holes and few connections between them, the liquids do not come out easily—they get caught inside. The ability to extract that oil is a lot harder; it will be more expensive, and it is extremely difficult to predict how it will behave because even the weight of that liquid can kill the well again so it stops coming out of the ground. There is certainly going to be some potential for these liquids to be in the ground if gas is there because they will have been generated. My job as an explorer for Shell will be to try to highlight those areas where there are those associated liquids because, as Dan said earlier, that improves the economics for us because we get extra revenue from those liquids.

**Dan Dörner:** As Graeme rightly said a few times, in the UK even shale gas development is at the very earliest stages, and my understanding from DECC and the British Geological Survey is that they started by thinking around gas and then started thinking about oil a little later, so the potential for unconventional oil in the UK is even further behind that of unconventional gas. It is very uncertain, is the short answer. Looking at the global picture, you can basically see that light, tight oil went from next to nothing in production terms in 2000 to around 2 million barrels per day in 2012, and it is rapidly pushing up oil production in the US, where most of this is happening, and a little bit in Canada, to the extent that we now project the US becoming the world's largest oil producer from 2015—very soon.

That said, though, there are some important factors. LTO, even in the US sense, is less certain than shale gas in the US. Also, if you look at the comparatives, when it comes to the

remaining recoverable resources, shale gas, in terms of global remaining recoverable resources, is about one-quarter of the total, whereas for LTO the remaining recoverable resources are only around 6% of the total oil that is recoverable—a much smaller share. In our latest projections, whereas we see shale gas production continuing to increase in the US, we see shale oil rising very rapidly to the mid-2020s in the US but then plateauing and even declining slightly by the end of that projection period. There is a lot of uncertainty around that because it is still so early, but we do not think that it will continue for as long or as rapidly as we have seen for gas in the US.

**The Chairman:** Are there any concluding comments that any of you wish to make? Oh, we still have one more question.

**Q114 Lord Griffiths of Fforestfach:** I have a question for Dr Smith. You said very convincingly that in environmental terms you could disguise the head of a well with trees or with a church, which impressed me no end. How much noise takes place when you are actually drilling?

**Dr Graeme Smith:** That is a very difficult question to answer because it depends on the rock that you are drilling through. There is some noise as you are drilling, and then there is a pop as you frack. Nowadays if we are drilling, and in the Szechuan basin in China we are drilling quite close to people's homes, we can put noise-protective, visually protective and light-protective facilities around the rig to ensure that we reduce it. I do not know the absolute decibel figure but I can find that out if it is needed.

**Lord Griffiths of Fforestfach:** I just wondered, because the UK is such a small country with a lot of people and so on, whether that would be one thing that might influence public opinion here.

**Dr Graeme Smith:** I am sure it is. Our experience in other places is that the issues are noise and light and concerns about emissions—or whatever happens as you are flaring in the exploration phase.

**The Chairman:** The church seems to have produced another question.

**Lord May of Oxford:** On the same question of noise, I happen to be quite familiar with the legislation. If you are engaged in any sort of construction here, there are only certain hours in which you can work, and quite strict limits on them. One of the complaints that we heard, which were casually dismissed as just not something to be cared about, was of a 10% rise in the decibel count. This chap—the head of Cuadrillo again—clearly did not understand that decibels work on a logarithmic scale, and I suspect that if we had told him he would have wondered what we were talking about. He dismissed those concerns casually, which I thought was really quite a poor attitude. So it is not as if the rules are adhered to very carefully at the moment—and apart from anything else, it is just stupid not to, in so far as you can.

**Dr Graeme Smith:** Is that a question? I will agree with you to this extent: as I said in answering the question before, I think it is really important that the public develop trust. Our job as an industry is to obey the regulations and the law, and to deliver these wells safely and securely. There is no question about that. The job of the regulator is to enforce those rules, and to act if we or others do not abide by them.

**Lord May of Oxford:** Maybe you need to have a chat with the relevant person.

**The Chairman:** So there are no final comments from any of you. We have had a very thorough session. The fact that it has gone on for so long is a tribute to the quality of the

answers we have been getting and the interest they generated, based on your experience and expertise. I thank you very much for coming.

**Sir David King and Professor David MacKay—Oral evidence (QQ 207-222)**

TUESDAY 7 JANUARY 2014

*Evidence Session No. 15*

*Heard in Public*

*Questions 207 - 222*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witnesses**

**Sir David King**, Special Representative for Climate Change, Foreign and Commonwealth Office, and **Professor David MacKay**, Chief Scientific Adviser, Department of Energy and Climate Change

**Q207 The Chairman:** Good afternoon and welcome to the Economic Affairs Committee. This is the eleventh public hearing of our inquiry into the economic impact on the UK energy policy of shale gas and oil. Sir David and Professor MacKay, you are very welcome. We have seen the DECC report on shale gas emissions, of which you, Professor MacKay, were the co-author. We also heard from two other witnesses from the department and look forward to seeing the Minister for Energy in the very near future. You are very familiar with Select Committee proceedings. Our questions are obviously directed at you both, but if you feel that you do not need to repeat what one or other of you has said, just nod and leave it at that.

Sir David, I know that you are on record as saying that there is a set of issues that need to be dealt with through very careful regulation, and we need to see that all this information goes through into the public domain. It is these issues—the environment, health, water consumption and so on—that we mainly want to explore with you today. Of course these issues have an economic impact, and as we are the Economic Affairs Committee, can you start by clarifying fairly briefly your views about the wider economic input of shale oil and gas? Sir David, an interview you gave to the *Guardian* on 16 September last year had the

headline, “Sir David King warns against fracking”. I understand that you tweeted afterwards to clarify what you actually said. Could you put on record for us what you were warning against? Was it about economic expectations, on which we have taken a lot of evidence, or about regulation and regulatory matters?

Could I just link with that how many exploration and appraisal wells you believe will need to be drilled before we have a clearer view of the UK’s economically recoverable reserves of shale gas? It has run through a lot of our evidence that a lot still needs to be done on the exploration before we can begin to form a clear view of the potential benefits and advantages.

**Sir David King:** Thank you. I am happy to repeat that in the right frame. I was talking about the regulatory framework that is required and which I believe is emerging: a regulatory framework that looks carefully at issues of water contamination and methane gas emissions into the atmosphere in particular—my two concerns.

The other point that I referred to was the high density population of Britain compared with the United States. On the question of the expectation of the number of drills that we are likely to be able to drill, 1,000 or 2,000 wells a year would have an impact on our economics and it would be very difficult to foresee how that would happen in Britain.

**The Chairman:** I will come on to that, but can I just ask you why you think that exploratory drilling is not yet going ahead?

**Sir David King:** That is a very good question and I do not really know the answer. I know that we had a moratorium after the initial Cuadrilla drilling in Lancashire, which turned out to be a very unfortunate event as it got some seismic activity going. I say “unfortunate” because the total number of wells that have generated seismic activity around the world is three, one of them being in Britain, yet the United States is seeing something like 30,000 new wells being drilled every year. In other words, we were extremely unfortunate at that point in time. I do not see seismic activity as a big issue. Working with the British Geological Survey, the Environment Agency can keep a very careful eye on avoiding any induced seismic activity that might cause concern.

**The Chairman:** In that same interview, you appeared to warn of enormous environmental consequences if the UK attempts to replicate the US experience. What do you mean by that?

**Sir David King:** That is not in inverted commas, and if it was I would say that I never said anything of the kind. I was talking about the high-density population of Britain and the difficulty of seeing planning permission being granted on a scale that could come even close to matching the scale in the United States.

**Q208 Lord Lawson of Blaby:** On that last point, you are aware, are you not, Sir David, that the exploitation of shale gas by fracking has occurred in many parts of the United States, including parts where there is a high population density, and it has caused no problems whatever.

**Sir David King:** I think it would be incorrect to say, Lord Lawson, that it has caused no problems whatever. There is quite an outcry among certain parts of the population in the United States, and in one state there is quite a strong move to ban fracking. I think it has caused an outcry when it has moved into higher-density population areas.

**Lord Lawson of Blaby:** There are always some people who object to anything, but you agree that it has taken place in the United States in many areas, including areas of high-population density, and that there has been no ban at all, even though some people may be agitating for a ban, because there is no evidence to support that.

**Sir David King:** I do not believe that there is a comparable situation to what we are looking at in the United Kingdom.

**Lord Lawson of Blaby:** I am puzzled by the importance you attach to that, but can I go on to a more general question? Thinking of the United Kingdom, what is your view—and that of Professor MacKay, because we want to hear from both of you—of the potential for shale gas in this country?

**Sir David King:** Following the previous question, you may be surprised to know that I am all for exploring shale gas in the United Kingdom. I think there is potential there. I see it as a relatively medium-term potential. I do not think it will continue well into the future, but I think there is an economic advantage from the ability to produce a primary energy source within the British Isles, obviating the need to import primary energy, but I would caution on the extent to which this can make a dent on our economics, simply because I do not think that we can frack on anything like the scale that is taking place in the United States. It would take something like 1,000 to 2,000 wells being drilled every year to have the sort of impact that some of us would like to see on our economics.

**Professor David MacKay:** As you know, a very large quantity of gas is estimated to be in place in the United Kingdom, so there is large theoretical potential there. What is extremely uncertain at the moment is what the technical potential, the detailed chemistry of the rocks in the UK and the economic potential will turn out to be. I do not have anything to add to what other experts have said about the high-end forecasts. The Institute of Directors estimated that 32 billion cubic metres could be produced per year in the UK and 70,000 jobs, as well as potential tax revenue, increasing the security of supply from such an operation, and an improvement in the balance of trade because we would be importing less gas from other countries. But even at that high level, the central scenario of the Institute of Directors, it would still be a smaller prize than the North Sea gas output. It would be roughly one-third of the North Sea gas output.

**Lord Lawson of Blaby:** But that would still be quite substantial, would it not?

**Professor David MacKay:** It would certainly be substantial, and it would give benefits in terms of jobs and tax revenue.

**Lord Lawson of Blaby:** Is not your uncertainty, which is perfectly well founded, based on the fact that there has been no exploratory drilling? Until there is exploratory drilling, there is no way in which we can know. The potential might turn out to be very small or very large indeed: we simply do not know.

**Professor David MacKay:** I completely agree. The first 20 to 40 drilling operations will be extremely informative and will help to resolve these questions.

**Lord Lawson of Blaby:** How many?

**Professor David MacKay:** Twenty to 40 is, I think, what the industry has in mind over the next few years, and that seems from a statistical point of view to be exactly the right sort of sample size to shed a lot of light on what is on offer down in the UK.



**Lord Lawson of Blaby:** I do not want to put words into your mouth, but in principle would you be keen to get on with this without further delay so that we know where we stand?

**Professor David MacKay:** I would not want to express a personal view on whether we should be pushing for this. As you know, my position is that we must have an energy plan that adds up. The UK today is heavily dependent on gas. We get at least a third of our energy for a wide range of purposes—electricity, industry, heating—from gas, and our dependence on gas is going to continue. It seems perfectly reasonable to continue to source gas domestically. The alternative will be that we will have a continuing dependence on gas for many decades but with an increasing dependence on other countries, such as Qatar, Norway and Russia, for our gas.

**Lord Lawson of Blaby:** Of all forms of energy, transport costs are bigger in the case of gas because of the need to liquefy and then to regasify than for any other fuel.

**Professor David MacKay:** Yes, there is a significant energy and financial cost in the liquefaction of gas when it comes from Qatar. That is a bigger cost than, say, the cost for the transport of coal.

**Q209 Lord Shipley:** Sir David, first, which state in the US were you referring to when you said that there was one that was considering banning fracking? Are you able to tell us which it is?

**Sir David King:** I want to be accurate so I will tell you in writing.

**Lord Shipley:** That would be fine. Moving to a very general question about carbon emissions, how do you think the development of shale gas will affect UK carbon emissions?

**Professor David MacKay:** In the report that DECC published on the potential greenhouse gas emissions from shale gas extraction and use, we discussed the potential carbon emissions associated with the extraction operations and the subsequent use of shale gas. Whereas in America there have been some reports of very large methane emissions at shale gas extraction sites, our belief was that such emissions would be extremely unlikely to occur in the UK because of the much stronger regulation: the fact that the venting of methane at a shale gas operation would simply not be permitted except in emergency circumstances. Our estimate was that the greenhouse gas footprint of shale gas production in the UK would be quite similar to that of conventional gas—possibly slightly larger—but in life-cycle terms the emissions from shale gas would probably be less than those from the imported liquefied natural gas from other countries. So you could argue that in terms of the global life cycle, there might be a reduction in carbon footprint from using shale gas. All that is based on estimates. Again, real data would be essential. One of the recommendations of our report, which is now being considered by the Secretary of State, is that there should be an independent research programme to monitor and measure methane emissions so we have the ground truth and not simply estimates.

The other thing I would mention about carbon emissions, however, is the long-term impact of putting additional fossil fuels into play. We estimate that the carbon footprint—the emissions intensity—of shale gas is probably similar to that of conventional gas, less than that of imported gas, and, if it is being used for electricity generation, significantly less than that of coal. Another important point is that if we put additional fossil fuel reserves of any type into play, under business as usual there might be a tendency for that to increase cumulative emissions over time.

From the point of view of climate change, what matters is cumulative emissions. If we want to ensure that there is no long-term effect on cumulative emissions, it is important that any substantial development of additional fossil fuel reserves should be accompanied by proportionate action to reduce emissions in a genuinely additional way, through technology such as additional carbon capture and storage, additional reforestation of unforested land, negative emissions technologies for sucking carbon dioxide out of the air, or additional effort to reduce the costs of low-carbon technologies so that they will have a lower cost than fossil fuels, in such a way that fossil fuels eventually are left in the ground instead of being burned.

**Lord Shipley:** You referred to the report that you wrote. Am I right in saying that it used new US studies to estimate the potential for fugitive emissions from shale gas in the UK and then said that what actually happens may vary according to local circumstances? Is it also the case that the original studies in the US did not have any baseline monitoring because there were no figures prior to shale gas production in the US: in other words, nobody quite knew what the fugitive emissions were in the US and therefore any survey or research evidence on the basis of the US could not apply in the UK?

**Professor David MacKay:** Yes, both those things are correct. Our estimates are based on US studies, because that was what was to hand when we were asked to do this study. We recommend additional research to give information for the UK if and when shale gas production develops. Yes, in the USA there are very few actual ground-truth measurement data so the estimates there are based on engineering modelling of the flow of fluids and first-principles modelling of what they believed was going on in their pipes.

**Lord Shipley:** Your report recommended a detailed scientific research programme of methane measurement, and you have referred to that again in your evidence here. You said that you wanted it to be independent and managed jointly between government and industry. Can you say in a bit more detail how you think that process should be managed and what the prospects and timescales might be for it taking place?

**Professor David MacKay:** We think it is essential that monitoring and baselining should take place before the substantial production of shale gas in any location. Whatever the timescale for going beyond exploration to actual production, we recommend that baseline methane monitoring of groundwater and the atmosphere should take place before that production stage is reached.

**Sir David King:** Perhaps I might add very briefly that I have visited the EPA in the United States, and with Gina McCarthy's arrival they are planning a very extensive programme of monitoring methane emissions from fracking.

**Lord May of Oxford:** It is possibly a silly question, but given that we have just been talking about comparisons between the US and the UK, it seems that you have to factor in a certain amount of scaling, in the sense that in the US the population, which is some measure of the demand for energy, is roughly five times that of the UK, but the surface area of the US—if it is some rough measure of how much shale gas you might find, which it may not be—is much, much bigger than five times than that of the UK. This quantifies the early point that Sir David made that any derivation of energy from shale gas in the US per unit of consumption, per capita, has much more area to support it. Secondly, it seems to undercut some of the arguments about comparisons because they are not properly scaled.

**Professor David MacKay:** I agree: you can fit the entire United Kingdom in the Marcellus shale area in the USA alone—many times.

**Q210 Lord Rowe-Beddoe:** Moving to the question of groundwater and the risk of contamination, Sir David, in an article in August you described rational and irrational fears, which I found rather significant and reminiscent of an American politician talking about the “known unknowns” and the “unknown unknowns”. Sticking with the rational fears, you said that the contamination of groundwater was a rational fear. Would you like to expand on that?

**Sir David King:** Yes. First, by way of explanation, because of the origins of fracking, the fracking process is not what we should be concerned about. That is far below the groundwater. The real issue is with the upwell of water. After the fracking process, when the well is still sealed off, as soon as the well is opened there is a big upwelling of water, and that is contaminated water. The question is: what happens to that water? In the United States, still today, the water is pooled. The pools have membranes to prevent the water from going into the ground. I would suggest that membranes are not always trustworthy. The practice in the UK will be different. We will have to tank and purify the water before putting it away. In Lancashire, the water was returned to the Lancashire Ship Canal after it had been purified, and the sludge, which is radioactive, is treated as low-level radioactive waste. That is a critical process. With a good regulatory system and a good monitoring system, we can manage the problem of water contamination. Of course, it is not only a question of a good monitoring system but of where the wells are drilled. The Environment Agency will keep a very close eye on that.

**Lord Rowe-Beddoe:** Thank you. That resonates with what we heard from Lord Smith a couple of sessions ago. It all comes down to the containing and the sealing. Why is it different in America? Why have there been these problems? Is it because the technology is different?

**Professor David MacKay:** I believe it is simply that in some parts of the USA things are permitted that would not be permitted here at all. Open ponds of water that has flowed up from the ground will not be permitted in the UK. Ponds that have just a single membrane will not be permitted either. Upwelling water will be placed in a much more substantial storage container. Another potential source of groundwater contamination could be a failure of the well itself. As the Royal Academy of Engineering and the Royal Society said in their report, the integrity of the wells themselves is of the highest importance to ensure that there is no environmental contamination. That will be very strongly regulated here, probably more strongly than in some parts of the USA.

**Sir David King:** To add a technical detail, the double-walling of the drill well is a critical factor in managing the leakage issue. I am sure that that will be fully regulated here. I also believe that all these issues are now being examined very carefully by the EPA in the United States, but there was a long period when in many places it was virtually unregulated.

**Q211 Lord Skidelsky:** It is obvious, I think, that the extra regulation needed for fracking in the United Kingdom will raise the cost of production. Do you have any idea whether that will be a substantial increase in cost? If you have to have new types of tanking, they would be more expensive, I imagine, than those used in the US.

**Professor David MacKay:** I do not have an estimate of those additional costs. It might be interesting to ask Cuadrilla, for example, what it thinks those costs would be. Perhaps the biggest uncertainty in comparison with the United States will be the actual productivity of the rocks themselves—what fraction of the gas in place can easily be brought to the surface—and that may be an even more significant uncertainty at this stage.

**Lord Lipsey:** Obviously the danger of contamination depends a bit on what stuff they are pumping down there as part of the fracking process. We have heard extremely varied evidence as to whether they use nasty stuff or not, from Viscount Ridley assuring us that there was nothing you would not find in the average kitchen cupboard to a representative of one of the campaigning groups saying that it was stuffed with toxic chemicals, although they could not actually tell us the name of any of these toxic chemicals. Are you able to provide an authoritative and rounded view of how serious the risk is likely to be because this is nasty stuff, or is not likely to be because it is not nasty stuff?

**Sir David King:** There are two sources of contamination. One is the material 5,000 feet down, which returns with that upwelling water. This is where radioactive material comes from. The second source is the chemicals put into the fracking material, the water and sand, effectively to act as a lubricant. Again, the proper approach to this is to regulate which chemicals can be used, and that is exactly what is going to happen here.

**Professor David MacKay:** Yesterday we asked the Environment Agency for clarification of the position in the UK. You have already heard from the Environment Agency. It confirmed that it has the powers to require full disclosure of chemicals used in hydraulic fracturing, so there will not be anything secret. Moreover, the Environment Agency will not allow hazardous substances to be used, full stop. That is a legal requirement. The flow-back fluids will be deemed to be mining waste and will require an environmental permit for management on site. In the case of the operations that have already been conducted by Cuadrilla at Preese Hall, the additives were polyacrylamide friction reducers, which are commonly used in cosmetics and facial creams.

**Lord Lipsey:** That is helpful and reassuring so far as the fracking liquid is concerned, but the other point Sir David made was about what is down there. What kind of controls will there be over what comes out from down there, and to what extent is that under the control of regulators?

**Professor David MacKay:** That will be regulated by the Environment Agency. The levels of radioactivity that we are talking about are not significantly harmful.

**Sir David King:** The point here is that we would not be able to control what comes up from down below in the upwelling water. It is a question of how you remove the contaminant before releasing the water.

**Lord Lawson of Blaby:** Following on from what Lord Skidelsky was asking about—whether the need to have high environmental standards would render the exploitation of shale gas uneconomic—is it not the case that in the United States the regulatory standards vary considerably from state to state, and that although a number of states have very high regulatory standards it has in no way made the exploitation of shale gas there economic?

**Professor David MacKay:** I do not have anything to add to what you have said. I do not know the detailed data on the relative costs.

**Sir David King:** I will just add that the EPA is now turning this into a federal regulatory system.

**Lord Rowe-Beddoe:** Before we leave this, perhaps we could have a comment about the result of the closing-down or abandoning of a well and the likely onward monitoring of any possible contamination of methane emissions.

**Professor David MacKay:** An abandoned well will be regulated as part of the planning, and there will have to be an enduring arrangement for the continued monitoring of abandoned

wells. The responsibility for that monitoring and for taking any required action to rectify any defects would lie with the company owning the licence. DECC is still in discussions with the industry about how best to ensure that we do not end up with any orphaned wells if a particular company should go out of business.

**Sir David King:** This is the major problem: the orphaned wells for which no company is responsible any longer. The first is the issue of monitoring. Across this country 2,000-plus wells have been drilled since 1900 and there is virtually no monitoring of these at the moment. Monitoring is a new part of the process.

**Q212 Lord Griffiths of Fforestfach:** I would like to ask two questions. Sir David, in response to Lord Lawson, you compared unfavourably the potential in the UK with the actual in the US because of the high density of population. My question is: what is the basis of that judgment? In terms of the cumulative, intrinsic difficulties of exploring shale gas in a built-up area, where there is a lot of stuff underground in any case, was it a scientific judgment or was it based on the fact that you think there will be so many objections that there will be delays in the planning process? In a way, that is a judgment that can be made by anyone—you do not have to be a scientist to make that judgement.

**Sir David King:** Presumably a scientist can make that judgment.

**Lord Griffiths of Fforestfach:** A scientist who is a member of the public can. Even an economist can.

**Sir David King:** I understand the question. The correct answer has already been given, in the sense that the British Geological Survey has set out a survey to estimate how much gas there is. Now we need to know how much gas there is that is economically mineable, and that is what the explorations over the next three years will determine. The next question is: to what extent will we be able to frack enough wells in a given year to produce enough gas to have a real impact on our economy? That is the key question. I look at a whole range of issues in trying to answer that question.

First, in the States they are drilling between 25,000 and 30,000 new wells per annum. The reason they are drilling that number per annum is because each well drops in production quite considerably after fracking. The drop-off is exponential, which means that on average each well diminishes output by something like 70% in the first year. They then carry on producing over the following years, but if you want to keep up production you have to keep up fracking. If you want to produce an amount that even begins to approach the tonnage of cubic feet that we import per annum, let alone what the North Sea is currently producing, we would be fracking 2,000 to 3,000 wells per annum in this country. The delivery of water and sand to each of those wells to be fracked, which could involve several thousand vehicles—certainly upwards of 1,000 vehicles for each large well—will slow down production for two reasons. One is social acceptance. In the United States they are finding indirect costs in the damage to roads as a result of the increased traffic, but people are also beginning to object simply because of the number of vehicles going down their roads. It is a combination.

**Professor David MacKay:** It does not necessarily have to be difficult and publicly objectionable. Something that I was surprised to learn in the past few months was how many oil and gas wells there are already onshore in the UK. One of the largest, at Wytch Farm, which is on the perimeter of Poole Harbour in Dorset, is actually at the heart of the largest onshore oil and gas field in western Europe. That was created very sensibly. It is in an area of outstanding natural beauty and very few people are aware that it is there. There

has definitely not been a negative reaction from the local population to a facility that has been there for several decades. I think originally it was created by BP.

**Lord Lawson of Blaby:** It was originally created by British Gas. I privatised it when I was Energy Secretary and it was purchased by BP.

**Lord Griffiths of Fforestfach:** My second question is much simpler. If we have shale gas production in the UK, what is the potential for water shortage as opposed to water pollution?

**Professor David MacKay:** The answer is that there is no potential at all for a shortage. A strategic environmental assessment, including water resources, was published on 17 December. The fact is that planning permission will be granted and permits will be issued by the Environment Agency only when there is a plan that will ensure that the water requirements are sustainable and that there will be no impact on the security of supply to existing customers. It will be managed and there will not be a problem.

**Lord Griffiths of Fforestfach:** Sir David, in your speech at the TUC conference you said that this could lead to water shortages.

**Sir David King:** If you were fracking in a water-stressed area, for example, this would be a real difficulty. When we look at fracking in China, for example, much of the geological stratum that contains gas is in a region where there is very little water. But the amount of water used per fracked well is two to 10 Olympic swimming pools' worth, so it is not a vast amount. Roughly 50% of that comes back and 50% remains way below the water table.

**Q213 Baroness Noakes:** Moving on to another aspect of the density of population in the UK, relating to the extent to which there are health risks to communities that are close to the development of drilling sites, almost inevitably there will be populations close to many drilling sites, particularly in the south of England. What are your views on whether there is a sufficient evidential research base to make any definitive statements on the degree of health risk that might be involved?

**Professor David MacKay:** The health risks were discussed in the strategic environmental assessment that was published in December. Public Health England has also published a review of the potential public health impacts of exposure to chemicals and radioactive pollutants as a result of shale gas extraction. It is fair to summarise both those documents as saying that the potential risks to public health are low if operations are properly run and regulated.

**Baroness Noakes:** We have some studies from the US. One published in December by the University of Missouri School of Medicine found that people living close to fracking sites have a greater risk of infertility problems, and there are Colorado studies that refer to high degrees of carcinogenic elements found. The answer seems to be that we will regulate better than anywhere else. How do we give the people of the UK confidence that that regulatory response is adequate?

**Professor David MacKay:** I imagine that for some people we could describe the mechanism by which any hazard would be conveyed—that it would have to be leakage of a particular fluid from a particular container—and we could describe how design and inspection ensure that such containers are safe. Another approach to giving public reassurance is to have independent people involved in the scrutiny of the arrangements in the UK. I have recently written to a list of academics asking them to participate in a forum that will provide a public service of giving independent views on the scientific, technical and

health information associated with the shale gas industry, and 21 academics have already responded positively to say that they will help with that service.

**Baroness Noakes:** Do you accept that it is a responsibility of government to be clear with the people of the country about what those risks are?

**Professor David MacKay:** The purpose of these strategic environmental assessments is to detail all the potential hazards and describe how they can be managed. That is what the environmental assessments are for. In addition, because the Government's position is that we want an increase in this new activity of shale gas production, we think it is appropriate to try to organise a service of independent academic experts who can provide an independent voice to guide public opinion.

**Baroness Noakes:** What about the communication of that? It is all very well getting a lot of clever people together to agree that there is or is not a particular level of risk, but that does not necessarily strike home to the person living next to a fracking site who has concerns because they have read some material on the internet that suggests there are real problems, say, in the US. What is the responsibility for communicating that to the wider population?

**Professor David MacKay:** The responsibility falls on the companies, in part, to describe what they are doing and how it is safe. The regulatory authorities, as part of their remit, describe what they are doing, what their methodology is and how the inspections and monitoring and so forth are done in the UK. I am sure we will keep these things under review because it is a priority for the Government that public acceptance should be positive.

**Q214 Lord McFall of Alcluith:** From previous witnesses we have heard that this fracking might not go ahead if community support is not secured. Indeed, the boss of Cuadrilla—along with others—who was at our Committee, mentioned that. Sir David, you mentioned on Radio 4 on 10 August on the “Today” programme that there is, “a whole set of ... irrational fears associated with fracking”. I am interested in marrying those two points up. How do we get that community support?

I was interested this morning in the City diary in the *Telegraph*, which mentioned the Celtique Energie company in Fernhurst, west Sussex, and said, “The company has laid down eight ‘ground rules’ for Fernhurst residents hoping for a one-to-one with”—its boss Geoff Davies. Recording the public consultation is, “‘strictly prohibited’, says Celtique, while no ‘formal minutes or transcript of the meeting [may be] produced or published in the public domain’”. Given the comments of the chief executive of Cuadrilla and others, what advice do you have for companies and communities so that they get rid of these “irrational” elements and we concentrate on the facts and the science?

**Sir David King:** Thank you very much for that question, Lord McFall. In a way it raises the same issue that Baroness Noakes has just raised. The first thing I would say is that I chaired a group called ReFINE, and I know that you have spoken to Richard Davies, who is its chief executive. This was a group of academic experts drawn from right across Europe whom we brought together in a way to perform the function you are now describing. It was to see in a perfectly academic way what the risks were, what regulation was required and what the irrational fears were. That is really what I was referring to. A big part of ReFINE's activity is in a sense to give reassurance, but it is coming from a group of people who have no prior commitment to the outcome of their work. This is an academic-led piece of work. That we saw as a very important element of what you are both referring to.

In terms of the private companies, the recognition is that being transparent about all parts of activity and calling for good regulation is the best way to bring the public on board. It is at the point when the public sense that something is happening, they are not aware of it and it is not being put into the public domain that you lose the battle. It is very important to get ahead of the game and get all the regulatory systems and academic knowledge systems in place.

**Lord McFall of Alcluth:** The Royal Society identified five main risks. Are there any other environmental risks that should be recognised?

**Professor David MacKay:** I would not add any to the list.

**Lord McFall of Alcluth:** Lastly, Sir David, in an interview with the *Guardian* on 16 September you appeared to warn of “enormous environmental consequences” if the UK attempts to replicate the US experience. First of all, is that an accurate quotation? If it is, could you expand on what these consequences are? They were not specified in the article.

**Sir David King:** Yes. I did not say it. Needless to say, not having said it and then seeing it in the headline—

**Lord McFall of Alcluth:** These were direct quotes.

**Sir David King:** These are not direct quotes, and not for the first time.

**Lord McFall of Alcluth:** They are just another example of sloppy journalism.

**Sir David King:** As I said right at the beginning to the Chairman, I am happy to be able to say that I did not say that. You will see, I think, that this is completely out of line with everything I have been saying, and had already been saying, to the media before that interview. What was picked up, expanded and turned into something else were my comments about public acceptance. I am keen to see a transparent process and that we acknowledge that local communities might find difficult the dislocation that could occur in their vicinity.

Let me just add this point. When the fracking is done, what is left on the ground is something like a metre and a half high, and it is quite difficult to find these if there is wild grass around them afterwards. The actual visual impairment arising from these wells is pretty minimal. I was referring to the activity in the fracking process itself.

**Q215 Lord Lipsey:** I just wanted to press you, if I may, Sir David, about this idea that transparency is the solution to everything and that the companies are transparent people or are coming around. I must say that I do not think that really accords with the experience. We had Cuadrilla before us and they have appeared at many public meetings in Balcombe, but we have not managed to locate many of their statements. One or two were clearly misleading, although on the whole they seemed to be trying to be open. On the whole, the public, in the local area certainly, seem to have made up their mind before hearing the arguments, including making up their minds not on matters of genuine concern, such as the pollution of water, but on things that are really pretty fantastic, such as some of the stuff that has been said about seismic dislocation. Is PR really a possible solution to this or are we looking at a deeper public problem with the acceptance of science as a basis for making decisions in a democratic society when they also have a direct impact on people’s local areas?

**Sir David King:** Yes. You are making a very important point. We cannot always win. I will make a very quick point about Cuadrilla. They have been very keen to see that there is



good regulation. My understanding of that is that a big company such as Cuadrilla will act responsibly and openly. The problem is the smaller companies that might slip in and would not be keen on good regulation because they might like to operate in a way that would obviate the most difficult issues.

**The Chairman:** In a way, as you have been making clear to us, Sir David, there is a great temptation for a lot of the media simply to highlight in the way in which they present things, the sensational and the difficult, and the ones that are likely to create local opposition and local problems. Cuadrilla I think it was—it was certainly one of the companies—made the point to us that they think that the Government and the regulatory agencies should do a lot more to reassure the public. Would you agree?

**Sir David King:** Yes.

**Professor David MacKay:** Could I add one more thing on transparency? You are right that if we look at a single issue one at a time, and if there are people who do not want shale gas, additional information may make no difference. They will still just say to the question, “Shale gas, yes or no?”, “Well, “I’ll choose no, thank you”. Maybe a thing to add to transparency, which I think is essential, is comprehensiveness, and this is something that the Government can help with. Instead of taking issues one at a time and saying, “Do we want wind farms, yes or no?”, “Do we want nuclear, yes or no?”, “Do we want energy saving, yes or no?”, there is a comprehensive approach where we say, “We need a plan that adds up and here are all the options on the table, including shale gas, wind farms, nuclear power and energy saving”. That can actually engage the public and ensure that the lifestyle that people want can be supplied from a source that they are content with and energy from a source that they are content with. This is something that we have worked on for four years now in the Department of Energy and Climate Change with an open-source tool called the 2050 calculator, which describes a large number of possible energy sources, including fossil fuels and many low-carbon sources. We try to depict as openly and clearly as possible the consequences of a chosen lifestyle, a type of energy demand and a chosen combination of energy sources so that people can see what the carbon emissions and the costs are, complete with arrow bars, what the import dependence is of their chosen plan, and what the spatial land footprint is of their choice. Something that I hope could be added to this open tool in due course is other environmental indicators. We have included air quality. We do not yet have vehicle movements in there, but that is something I would like to see added.

At the moment there is no explicit shale gas lever. When we release version 4, which I hope we will be able to do in the next year or so, we hope there will be an explicit shale gas lever so that this option is there explicitly in the mix.

**Sir David King:** Chairman, do you have room for a comment on the acceptance of what scientists say? I want to make a very general comment, and this obviously comes from somebody who feels a bit frustrated about this. The scientific community can put an enormous amount of effort into getting things right, whether it is developing new vaccines or whatever. Lord May predicted the HIV/AIDS outbreak, for example. How many people actually rejected the prediction at the time? A vast number. Then there is the GM debate—all these issues. What I am getting at is that, surprisingly, people who think that science is good when the arguments of science support them can also selectively argue against what the science says when it does not seem to support their instincts.

**Lord McFall of Alcluth:** Is that happening in the case of climate change?

**Sir David King:** I think it is.

**Q216 Baroness Blackstone:** Throughout a lot of our discussion this afternoon we have kept coming back to regulation as the solution to quite a lot of the problems that the fracking of shale gas and oil might lead to. What I am not clear about, and I do not think we have really discussed this in so many words, is whether the current regulatory framework as it stands is going to be adequate or whether it needs to be changed. If it does need to be changed, what needs to be done?

**Professor David MacKay:** The position of the Department of Energy and Climate Change and the Environment Agency is that existing regulations are adequate for shale gas operations and there is no need for any additional legislation.

**Baroness Blackstone:** Do you agree with that? Is that your view as well?

**Professor David MacKay:** I do not disagree with that. The view in DECC is that the most that is needed across Europe would simply be some clarification of how existing regulations should be applied to shale gas operations across Europe.

**Baroness Blackstone:** Some commentators have said that the regulations are actually very complex, that a lot of different issues have to be examined and that there is perhaps a need for some simplification and an overriding regulatory system that will allow the public to understand the issues rather better and to decide whether the things that concern them are in fact being properly dealt with.

**Professor David MacKay:** The system certainly is complex. DECC recently published a short document of roughly 12 pages that attempts to summarise the entire system for all countries in the UK.

**Baroness Blackstone:** Do you think that will be convincing for a number of the public or groups that are being got together who are extremely anxious about this process? If it were widely distributed, do you think this would provide the reassurance that those sorts of groups, and indeed individuals, need?

**Professor David MacKay:** I do not know. I am sure that DECC will keep this under review, because it is keen that people should feel reassured.

**Sir David King:** I will, if I may, refer again to the group ReFINE, which is well funded to look right across Europe and includes most of the major experts in the academic world who were working on geological aspects of fracking et cetera. They will report in a year's time, and I think it would be very useful to return to your question once their report has been made available.

**Baroness Blackstone:** That is quite a long time to wait.

**Professor David MacKay:** The document I was referring to was called *Developing Onshore Shale Gas and Oil—Facts about 'Fracking'*. It was published in December.

**Lord Hollick:** Professor MacKay, does DECC have a programme of going out into relevant communities and explaining the science and its views? Is it part of your remit, for instance, to go out and explain your findings and try to tackle the issue that Lord Lipsey and Sir David have been talking about—trying to get the facts out in front of people?

**Professor David MacKay:** I believe that DECC staff participate in local public consultations that are organised by the relevant companies. Personally, I have not been involved in any of those, but as I said earlier I have been assisting the Office of Unconventional Gas and Oil by writing to academics, asking them if they will help with this service—I call it a forum—to provide independent scientific and technical comment. I have helped to that degree. I believe

that the sort of service those experts will be asked to provide is precisely to turn up in person to local meetings to answer people's questions, and to answer questions through other means such as over the internet in web fora.

**Q217 Lord Skidelsky:** Residents of Balcombe and Fylde have shared concerns with us about the level of self-regulation in the industry. Do you share those concerns and do you have confidence that the operators can carry out the required monitoring operations effectively? The motive for the question, given the level of public opposition to fracking, is whether it is a good idea to allow the monitors to be employees of the operators, which apparently they can be. Peter Baker from the HSE said that this is not unusual in minor-hazard industries, but if you are trying to create confidence in the process of monitoring, you do not want the monitor to be an employee of the operator, do you?

**Professor David MacKay:** I believe that they are following a pattern that has been developed for the offshore oil and gas industries, where the goal is to put the full cost of all the monitoring and regulation as much as possible on the companies that are getting the benefit from the work. It should be emphasised that the Health and Safety Executive retains an overall role. It is not the case that all aspects are monitored by people who are employed by the company. There are many aspects where monitoring will be inspected and verified by the HSE and, I believe, the Environment Agency. In answer to your opening question, I do not share those concerns but I agree that we need to explain better to the public how the regulation actually works.

**Lord Skidelsky:** There may be a conflict, may there not, between the laudable aim of putting as much of the cost as possible on to the operator and creating public confidence in the monitoring system, given what we have heard about the initial hostility among many people to fracking?

**Professor David MacKay:** I am sure that what happens in practice is that the Health and Safety Executive will scrutinise very closely the work done by the independent body that is paid by the company. If there is any evidence of those independent monitoring services not being done to the appropriate standard or being done in any way dishonestly, there would be severe consequences.

**Lord Skidelsky:** The bias may be very subtle and may not involve any kind of dishonesty. If somebody is paid by a company to do a report and the company wants to do the operation, that is not the best basis on which to submit an independent assessment, is it?

**Professor David MacKay:** I understand what you are saying. This is really outside my expertise as a scientist. These are questions more for the Health and Safety Executive, since this is a system that it is comfortable with.

**Lord Skidelsky:** But you are comfortable with it, as far as you can be?

**Professor David MacKay:** Yes, but I understand the concerns you are raising about the potential perception of a conflict of interest.

**Q218 Lord May of Oxford:** As a peculiar preamble, I will respond to the HIV thing, which does have some read-across. At the time I was in the States and I was working with Roy Anderson, who was here. The UK dealt with the science and ignored those who felt that it would be evil to be distributing needles so that people would be less likely to transmit, whereas in the States much attention was paid to the voice of the people, predominantly religious movements, who felt that HIV had been visited upon evil people by God. The result of course was that the UK had one-10th the incidence of infection that still

prevails in the US. It has a bit of a read-across to this in that you really want to work out what the scientifically correct thing is to be doing, and try to think of persuading people to do it rather than be guided by what uninformed opinion wants.

In that context, if we believe the *Telegraph*, shale gas companies operating across Europe are likely to face a tough new package of legislation which the European Commission is preparing to publish next month in the form of an unconventional fuels directive. Understandably, the Prime Minister is not very keen on it and the industry has pointed out that if this happens it will delay investment going into this. What do you think about this? If true, if this European Commission idea is a fact, is it a good idea or a bad idea?

**Professor David MacKay:** As I said earlier, DECC's position is that this is not a good idea, that existing legislation is adequate and that all that is required at most is a clarification of how existing regulations apply across Europe. As you heard in the evidence from the Environment Agency last year, it also supports that position.

**The Chairman:** But the danger is that it might come. We are talking about some of the opposition that comes from people who perhaps have not studied all the evidence or are not convinced by the evidence here. In some other countries they have prevailed and put very heavy obstacles in the way of fracking and so on. Sir David, you talked about ReFINE. What is it doing to try to get a sensible scientific approach across the community as a whole?

**Sir David King:** Chairman, you have picked up the point I wanted to make. Clearly, we would like other European countries to follow the very good regulatory procedures that we are setting out. But the question is: what if they do not? I would be concerned if that was to happen. Where is the fracking in the rest of Europe likely to happen? I would say Bulgaria, Romania and Poland. If one of those countries allowed it to happen in the way it happened in the early days in the United States, it is not good for any of us. There is a broader issue here that is a European Union issue.

**Lord Lawson of Blaby:** The problem that I think the Chairman is alluding to is completely the opposite. The problem, which seems likely to be quite a real problem, is that if there are countries that do not wish to frack—for example, France, which has made it clear that it does not want to because the nuclear lobby is very strong in France and maybe there are other pressures as well—it is tempting under the guise of environmental policy to dictate an energy policy, despite the fact that under the terms of the European Union energy policy is not a community responsibility but remains with the nation states. The danger is not the Poles doing something in a way of which Sir David would disapprove; the problem is a much more fundamental one.

**Professor David MacKay:** The hope of the Office of Unconventional Gas and Oil in DECC is that no additional directives will emerge, although we would agree with you that if there were such directives it would be likely to hamper progress of the development of shale gas in the UK. It would introduce some delay.

**Q219 Lord Hollick:** I want to ask you both about the extent to which the development of shale gas will help the UK to meet its targets for reducing carbon emissions. I do so against the background of a number of comments made today and by other witnesses. Professor MacKay, you made the point that in generating electricity, gas puts out half as much carbon as coal does. We have heard from other witnesses that one of the perverse effects of the shale gas boom in the United States has been that it is now a major exporter of coal, and we are one of the major beneficiaries of coal. We now have record levels of

electricity being generated by coal. There are other concerns that if we develop shale gas, that will put off the achievement of the carbon targets because there will be no incentives to invest. Against that background, how do you see the development of shale gas? Another data point: assuming that it is a viable and significant contributor to our energy requirements in the near future, it will not really come on stream until 2022 or 2023.

**Professor David MacKay:** If shale gas proved to be economical to produce in the UK and if it were produced in large quantities, it seems reasonable to expect that even at quite large scales of potential production there would be only a very small downward pressure on prices, since we are so well coupled to the European gas system. Prices would not be significantly influenced at all. Therefore, there would not be a very significant effect on the generating mix on the UK. The consequence would simply be that the source of the fuel would change. There would be a displacement of imported gas—for example, LNG from Qatar or gas from Russia—by shale gas. That means that the effect on emissions in the UK would be extremely small.

Looking at the bigger picture, there could be knock-on consequences, as you said. If a fossil fuel is put into play, other fossil fuels might get redirected and continue to be brought out of the ground and burnt by other people elsewhere in the world or at another time. As I said in my opening comments, if we want to ensure that that does not happen and we do not end up with a cumulative increase in global emissions, we need to ensure that any increase in shale gas production goes hand in hand with other efforts to ensure climate change action, such as additional effort on carbon capture and storage and on carbon-negative technology that sucks CO<sub>2</sub> out of the air such as reforestation and artificial trees, and additional effort on driving down costs of low-carbon technologies. These things need to go hand in hand if we want to be sure that shale gas is a consistent part of our low-carbon transition plans.

**Lord Hollick:** Sir David, do you want to add to that? You are nodding in agreement.

**Sir David King:** Yes, I am nodding in agreement.

**Q220 Lord May of Oxford:** As everybody knows, one of the things that primary legislation did was create the climate change committee to recommend a trajectory whereby by 2050 we would have an 80% reduction in the amount of fossil carbon that was being put back into the atmosphere compared to the 1990 baseline. Currently we are on course to meet that so-called legally binding—whatever that means—commitment, but we are on course partly by virtue of the recession. My own view is that gas from fracking is a helpful part of the intermediate stage of that, but the notion that it might persistently be important in the UK right through to 2050 is flatly inconsistent with the Climate Change Act. I just wonder what your comments are about that.

**Professor David MacKay:** I would be happy to quantify what we have said in the 2011 carbon plan, which is one of the requirements of the Act.

**Lord May of Oxford:** May I supplement that question by saying that the trajectory in question has us completely decarbonising electricity by 2030. How does that fit with this?

**Professor David MacKay:** In the 2011 carbon plan we described how government intends to meet the requirements of the Climate Change Act in the short term and all the way to 2050. One way in which we did that was with a numerate open tool, the 2050 calculator, which I mentioned earlier. We described a collection of scenarios that outline the corridor of trajectories that government at the moment intends to keep open. There is a range of pathways rather than a single pathway because of all the significant uncertainties about

future fossil fuel prices, acceptability and costs of various technologies and the embracing of energy reduction.

**Lord May of Oxford:** And how good we will be at maintaining the recession.

**Professor David MacKay:** Yes. I can tell you how much gas was used in that collection of scenarios. In 2010 we were using approximately 930 terawatt hours a year of gas for all purposes, not just electricity but industry and heating. In the range of scenarios we describe in the carbon plan, all of which leads to an achievement of the legal target in 2050, the gas consumption rate in 2030 is between 511 and 760 terawatt hours per year, which is roughly 55% to 82% of today's levels. That is 16 years from now. In 2050 those scenarios all had gas being consumed but to a lesser level than today—namely, between 77 and 297 terawatt hours per year—which is between 8% and 32% of today's levels.

How does that square with the requirement to reduce emissions as you described? In the higher scenarios the gas is being significantly used in carbon capture and storage power stations, so the emissions are being eliminated to a large degree by burying CO<sub>2</sub> in the North Sea.

There are still some non-zero emissions of carbon from gas because some of the gas is being used in those scenarios for industry as well as electricity generation. It is not all going to be abated. Even in the most stringent reduction in gas use, we still have 8% of today's levels being used in 2050.

**Q221 Lord Lawson of Blaby:** As Professor Dieter Helm pointed out when he gave evidence to us, we are going to approach this target by driving all energy-intensive industry overseas, which does not seem terribly clever either in economic terms or in terms of what you, Professor MacKay, pointed out a moment ago: that what matters, even if you are concerned with carbon emissions, is global carbon emissions and not UK carbon emissions.

**Professor David MacKay:** I agree that offshoring of energy-intensive industries would be a strong concern. Government has recently taken action to try to ensure that energy-intensive industries are not driven away by our current policies. Obviously in the long term our low-carbon trajectories will be deliverable only if other countries are taking similar action, or else there would have to be something equivalent to border tariff adjustments to ensure that the offshoring of carbon-intensive activity did not become incentivised by our policies.

**Lord Hollick:** Following on from Lord Lawson's question, has there been any attempt to look at the trajectory that you described earlier on for the reduction of carbon emissions, with its impact on the UK economy and its competitiveness versus other major economies?

**Professor David MacKay:** I believe it is true to say that in the 2011 carbon plan we included an assessment of the economic impact of low-carbon policies up to the fourth carbon budget period. Beyond that, we did not do detailed economic modelling out to 2050 in the carbon plan, but we went as far as 2030. The 2050 calculator includes some estimates of some of the costs of the alternative scenarios as well. When you look that far in the future, many of the costs have significant uncertainties, because there is a strong dependence on the success of innovation and research and development in bringing down costs.

**The Chairman:** We have almost come to the end. Are there any other points that either of you would like to make?

**Professor David MacKay:** No thank you.

**Q222 The Chairman:** Can I just return to the European question, because it happens that next week one of our witnesses is a representative of the EU Commission's environment directorate. Going back to some of the earlier comments that you made, you made clear, Sir David, that when making comparisons with the United States we should bear in mind not only the scale of production that they can have but the fact that they had a much weaker environmental regime in the earlier days and perhaps have even today. A lot of our evidence has suggested that we have a very strong regulatory environment here and very strong rules all around it in comparison with many other countries. Have you any view as to how our regulatory environment and our general approach compare with other EU countries?

**Sir David King:** I think it is far too early for me to say. The whole issue is moving with time. I believe that the ReFINE report, when it comes out in a year's time, will have details of that.

**The Chairman:** Gentlemen, thank you very much indeed for your evidence. It has been very helpful. You have one last comment.

**Sir David King:** I wish to add quickly to save myself coming back to you that the state in America where there have been significant objections is Colorado.

**The Chairman:** Good. Thank you very much.

**Lambert Energy Advisory, Liberium Capital and Peter Hughes Energy Advisory—Oral evidence (QQ 196-206)**

TUESDAY 10 DECEMBER 2013

*Evidence Session No. 14*

*Heard in Public*

*Questions: 196 - 206*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord McFall of Alcluith  
Lord May of Oxford  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky

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**Witnesses**

**Philip Lambert**, Lambert Energy Advisory, **Peter Atherton**, Head of Equity Research – Utilities, Liberum Capital and **Peter Hughes**, Peter Hughes Energy Advisory

**Q196 The Chairman:** Can I welcome all of you? We are obviously under some pressure today with the number of witnesses we are seeing, so can I ask you to be as brief as you possibly can while making your points? I am going to start with a very general question: could you give your view of the potential impact of shale gas on the UK?

**Peter Hughes:** The answer is positive, but in a rather limited way, would be my assessment. Clearly there is going to be an impact in terms of jobs and investment. You have already heard that there is a lot of dissent and disagreement in terms of to what extent that will be the case, but there will be a positive impact from that. Where there will be possibly less of an impact is in terms of the potential to reduce the UK's energy bill in a significant manner. The cost structure of producing shale gas in the UK is likely to be quite high. There is a huge question mark over the likely volume to be forthcoming from shale gas, so all in all I think it is very unlikely to reduce the UK's energy bill in any significant manner. What it will have, which is not economic in that respect, is a geopolitical benefit in terms of every molecule produced in this country reducing our dependency on imports, which is increasing as we go forward.

**Peter Atherton:** We can break that down in to two sets of answers. First is what is going to happen to the UK with the unconventional energy revolution that is happening worldwide. The biggest impact in the UK will be what happens in the global energy markets where we actually extract a molecule of shale gas ourselves. Those implications are already happening. The cost of LNG is substantially cheaper today than it otherwise would be because the US has removed itself from the demand. The US will soon be exporting, and that will have a huge dislocating effect on the LNG market potentially over the next several



decades. We are already seeing the price of coal on the world market has fallen 60% relative to gas, which means all the coal fire power stations in Europe are burning coal as fast as they possibly can. As the rest of the world develops unconventional oil and gas, there will be a huge impact on the energy markets, and also geopolitically. I was at a US event only recently where several US Senators were talking about bringing the Fifth Fleet home from the Eastern Mediterranean. It was not if they do that, but when, so I think globally there are huge implications here. Whether the UK actually fracks itself and taps into this resource is irrelevant to those issues. In my view, it would be incredibly sensible for us to do so, and it could make a significant difference to our economy and jobs if we were to do so, but the big impacts are actually on a global basis.

**Philip Lambert:** We have to look at the US precedent. Shale gas has revolutionised the US economy. It is creating half a million jobs.<sup>145</sup> If you look at the correlation of the gas price to the performance of the US stock market, it is almost exactly an inverse proportion. By now, the US was meant to be importing up to 100 billion cubic metres of LNG a year.<sup>146</sup> The whole Qatari gas machine was built up because Exxon and George Bush had taken the belief that the US would be importing huge amounts of LNG from the Middle East. Actually, now we are faced with potentially the US exporting rather than importing up to 100 BCM of gas per annum within the next few years. It has transformed everything in the American energy market. The US now produces more gas than Russia. It was just incredible only 10 years ago to have predicted that.

When you look at the scale of the volumes that are being predicted by the British Geological Society and even Cuadrilla itself, and the 1,300 TCF of gas that has been predicted to be in place, and you just take 10% recovery, that is 130 TCF. The overall conventional gas offshore in the North Sea estimated to be ultimately recoverable is 130 TCF, of which we have extracted about 85 TCF, so we are talking about something on that figure that could be as big as the North Sea. That has obviously transformed the UK economy. Even if you take the Cuadrilla number of 200 TCF, and you took a 10% recovery factor, that is 20 TCF. That is more than the amount of remaining recoverable 2P gas reserves offshore in the North Sea. I think the answer to the question, though, is that we do not know. We simply do not know. We have not yet had an onshore horizontal fracking well drilled into the shale gas formations in the UK, and we have not any idea what it is going to do to the UK economy. The only issue is that, on behalf of the British people, we have to see if we can expose that sort of potential for the UK economy, as long as it is done in an environmentally sensitive way.

**Q197 Lord Lipsey:** As well as quantum, there is an issue of timescale for two reasons. One is the fears that are reasonably expressed that we may be getting perilously near to a moment where the lights get turned out; and, secondly, many of the people who see a big role for shale see it as a transitional fuel, enabling us to make progress on the climate change agenda, but not in the long-term the most environmentally successful fuel. When is therefore terribly important here. What are your views on when that is likely to be?

**Peter Hughes:** It seems unlikely to be a very rapid process, to be fair. The biggest single reason for that is we simply do not have the factors, in particular the service industry infrastructure in place, in this country that enabled the US revolution to take place. I read this morning that the active rig count for the whole of Europe at the moment is 137. In the States there are hundreds—I think between 2,000 and 3,000 active rigs with crews available

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<sup>145</sup> <http://www.ihc.com/info/ecc/a/unconventional-gas-report-2012.aspx>

<sup>146</sup> Based on the US Energy Information Administration's 2007 Annual Energy Outlook

to support the industry. In Europe, and certainly in this country, we do not have the active support infrastructure and service industry to enable this to happen very quickly. I think there will be a question about the speed at which that infrastructure could be built up. It could be built up, but it is not there today, so I think the process is liable to be a wee bit leisurely.

**Philip Lambert:** If this was Texas we could say that it would be up and running in five years. That was the sort of history of the Barnett, or perhaps a little bit longer. The Haynesville was about four or five years from start to actual production, and meaningful production. I think here you cannot believe that that is going to be the case. They have to drill 20 to 30 wells just to know what the producibility of the Bowland and other UK shale formations are. On the current timetable that is likely to take a very long time; we are into 2020/2025. The idea that shale gas is going to save the UK energy economy from brown-outs is laughable, to be honest, because it just cannot get there quickly enough.

Our only fear is that shale gas deflects from the real issue at hand, which is that the UK offshore gas industry is in terminal decline unless it is rescued, so it is not necessarily in terminal decline. If we think that shale gas is going to rescue us, we take our eye off the real ball, which is making sure that the UK offshore gas production is maximised, and it is not likely to be maximised under the current fiscal regime or political will. There is infrastructure in place that is empty: pipelines and terminals. The fields themselves can produce much more than is currently forecast. Seismic is being revolutionised offshore. There is a huge prize to go for offshore. If we rely on shale gas to save us we will actually take our eye off the real ball that is there, and it is producible gas at, in our view, \$40 a barrel of oil equivalent, which is extremely economic in today's energy environment. Shale gas is also likely to be economic at around the \$60 a barrel mark once there are sufficient economies of scale.

**Q198 Lord May of Oxford:** How do you see the future UK energy mix as being changed by the advent of the UK shale gas as it comes on line? I would appreciate it if you could, in discussing that, also include the effects of our commitments under the climate change legislation, and how you think that will play in as well.

**Peter Atherton:** If we retain the Climate Change Act and the decarbonisation strategy that flows from it, in 2030 the UK power system will reflect this: it will be overwhelmingly renewable and nuclear, and we will have about 40,000 megawatts/40 gigawatts of gas-fired power plant, but they will be highly restricted in terms of their output to a load factor of about 50%. That is set out as a requirement of the fourth carbon budget. Whether we have very cheap and abundant domestic gas is not going to make any change to that whatsoever. Equally, on the heating side, the fourth carbon budget requires 50% of industrial heating and 30% of domestic heating to be electrified by 2030 as well, so it is not going to have an impact on that either.

Ironically, if we have a very abundant domestic gas industry in 2030 because of shale or for whatever other reason, we will probably be exporting most of it.

**Q199 Lord Hollick:** Do you think the development of material volumes of shale gas will require or force any significant change in UK energy policy? Secondly, do you think we have the option to sit this out and have a very vibrant fracking industry overseas, which we can then benefit from by the importation of shale gas? Thirdly, if shale gas is going to have the effect that I think you, Mr Hughes, said was positive but in a limited way, and I assume you meant in terms of price as much as anything else, what is the merit of the Government

entering into an agreement on Hinkley Point, which is going to saddle future generations with a gas price twice the current level indexed to inflation?

**Peter Hughes:** In terms of the energy mix, I share the views expressed. I do not think the energy mix will change at all. The benefit of shale gas, as, when and if it is produced in significant quantities, will be to back out imported quantities of gas. We are rapidly increasing our import dependency year by year as the North Sea continues its decline. I share Philip's views completely that it would be a genuine area of interest to try and prolong the productive life of the North Sea, and to examine and think very deeply about the measures to do that, including of course the fiscal and regulatory regimes in question. However, the impact of shale gas will be to reduce the import burden of gas as we go forward, which is increasing steadily. I do not think it has any impact on the energy mix per se in that respect.

In terms of power generation, there was an interesting debate about renewables versus gas earlier. My point of view is renewables and gas are complementary, and there is obviously a very important role to play for renewables going forward. However, renewables are intermittent and therefore need a backup generation capacity, which is best provided by gas-fired capacity, so there is a complementarity there that I think is often overlooked.

In terms of the Government's decision on nuclear, I think I will refer that to my colleagues.

**Philip Lambert:** The core issue on that question is that the UK needs a base-load fuel. We are having an energy debate as if it was all homogenous. We have backup fuels, we have base-load fuels, and without a base-load fuel the lights go out. The fact is that under the current EU Large Combustion Plant Directive, the shutdown of our coal-fired plant is going to be accelerated possibly even to next year. For some of the plant that was meant to only come off at the end of 2015, I understand the permits will have been used up by next year.

The new nuclear policy does nothing for base-load over the next 10 years: Hinkley Point will start producing around 2025; the next few around 2030. That is a base-load fuel but it is not going to be on stream and the existing old nuclear is coming off in the next five to ten years. The coal is shutting down; that is the existing base-load. The old nuclear is the second base-load; that is coming off stream over the next five to ten years and our gas fleet is running at 20% to 30% load factor. We need to have a base-load fuel. If it is not going to be coal and it cannot be new nuclear until 2025, it has to be de facto gas. Whether that is imported gas, offshore gas or shale gas, the UK needs to have a base-load fuel. It is as if that debate is not happening today.

**Peter Hughes:** It is worth making the point that I think Philip made earlier, which is that shale gas will not address that particular issue because shale gas will not come on in sufficient volume and productive capacity. Gas-fired capacity has a role to play in that respect. The real benefit of shale gas going forward, in terms of energy policy, is that it will reduce our vulnerability and our dependency on imports at a time when that dependency will otherwise be rising fast, and that gas-fired power has an increasingly important role to play in this country for the reasons that you mentioned.

**Peter Atherton:** The impact it has on UK energy policy is back to my sort of global issue and the European energy policy, which is premised on two factors. The first is that climate change is real and is happening and is an existential threat to mankind. Fine, but it is actually sold to the public predominantly on economic reasons, based on two premises. Firstly, fossil fuels are scarce and becoming scarcer, and therefore are going to become increasingly expensive and volatile. Secondly, if we are on the vanguard of going ex-fossil fuel and low carbon, then we will gain tremendous economic benefit for being the first mover. There is a

cost obviously associated in that transition. The political argument to the public is that that cost is worth paying because we avoid all these problems in the future, and there is a great economic benefit to be had 10 years down the line. If, however, Europe is sitting here in 2018, 2019 or 2020, the world is enjoying abundant and relatively cheap fossil fuels, and very few of our major competitors have followed us on the decarbonisation strategy, so all the public is seeing is the costs and none of those benefits, it will be extraordinarily hard for policymakers to hold the current line on European energy policy.

**Q200 Lord Skidelsky:** I think there is a confusion, or at least in my mind, from the evidence that we have been receiving. On the one hand, shale gas exploration has been justified by a number of witnesses as a pathway to decarbonisation. However, from what we have heard today, there is very unlikely to be any change in the energy mix in the timescale that the Government has set for decarbonisation. That is one conflict: it is not going to make any difference to that. Secondly, we have been told that the reason why we are progressing so slowly in the development of shale gas is that we lack the service infrastructure. On the other hand, others have said that it is actually because of delays in the planning process. Obviously all these things can be reconciled at some higher level, but I would like the witnesses' views on both of those questions.

**Peter Atherton:** I will take the second because I did not get a chance to answer Lord Lipsey's question. From my talking to people involved in the industry and my own experience in other industries, the finance is in place, the engineering skills are in place or can be brought in without any great problem. If you think about this in stages, the first thing we need to do is get to the point where we have done the development wells, we know the flow rates; in other words we are at the cusp of going then to commercialisation. From an engineering and finance perspective, that can be done within three years very straightforwardly. What is stopping it is due process and political will, for very good reasons, effectively. We do not have to invent a load of new technologies here. These technologies are well-established now. The skill base is well-established. We might have to bring in those engineers to begin with, but they can easily be brought in. There will be a cost involved in that of course, but they can be easily brought in. We can go from where we are today to the cusp of commercialisation within three years if we wanted to. More likely it is going to take five years plus.

**Lord Skidelsky:** Despite the lack of service infrastructure.

**Peter Atherton:** I do not see that there is a huge amount of infrastructure needed. To do, let us say, 100 test wells, we can fly the rigs in from the States if we need to. They are not huge things; you can put 50 on a ship or you could fly them in on a plane. We are not talking about going to commercialisation where we would need hundreds of active rigs and thousands of our own engineers in the 10 to 15-year timeframes. Obviously that will take time to build up. Where we need to get to, though, is the position where we know it is commercial. The shale gas industry in the UK is very simple. If we can bring this stuff to market at about \$8 per MMBtu, it is a very commercially viable industry. If it is going to take us \$15 to bring it to market, then it is not viable until the world gas price goes to \$20. So let us find out whether we can bring it to market at \$8 or \$15. We could do that within three years if we had the willpower to do it.

**Peter Hughes:** I share that view entirely. I do not think the service infrastructure is an issue; it is an issue about the speed at which we could scale up. At the moment we have not even got going. That is the key issue, so the absence of a service infrastructure of the scale we see across the pond is not an issue in terms of getting going. The issue in terms of

getting going, I think you heard in the previous session, is a hearts and minds issue, and that battle is being lost at the moment by the industry.

**Lord Skidelsky:** The scaling up is necessary to make a real difference to the energy mix, and then as it affects decarbonisation.

**Peter Hughes:** It would be, absolutely, but we are not there yet. We have not even got going. I think the industry would actually put in place a service infrastructure fairly rapidly if there was a bit of momentum, but the industry needs to seek the incentive to do so from the initial exploratory work and development. That is not happening because of the hearts and minds issue.

On the carbon issue, it would replace imported gas, so I do not see it would make a huge deal of benefit. One thing that is often overlooked, in my opinion, is the fact that the gas-fired generation offers significant possibilities for carbon capture and storage. Gas is often referred to as a bridge fuel, but if it existed in the scale that we hope it will, it could be a destination fuel when allied to carbon capture and storage, or sequestration, if that can be brought to scale at a commercial level.

**Philip Lambert:** Could I just answer the question? I think it depends when your decarbonisation target is. There are 2030-type decarbonisation targets, and I think shale gas has got a chance to play a role in that target. What I was saying was I did not think it would do anything for the 2020 carbon targets; certainly by 2050 it could.

In the USA, the shale gas revolution has had an almost instant effect on carbon levels. The move of gas in generation from c. 20% in 2008 to 30% in 2012, cutting coal's share down from 50% to 37%, has led to US carbon emissions just tumbling. There is no doubt, if the shale gas revolution was here and it was upon us and happening, whether it is shale gas or North Sea gas or even Norwegian gas coming and replacing coal, the effect would be very, very quick. The fleet of CCGT plants in the US was run at a very low load factor, as it is in the UK today. Without any investment at all really, if gas moves coal out of the mix, and that load factor moves from 20 to 90 and replaces coal, the effect on carbon emissions over a five-year period is enormous, before you have to build any new combined cycle or gas turbine plant. To me, it does not really matter what sort of gas it is as long as it is economic. If it replaces coal it has an instant effect on carbon.

**Q201 Lord McFall of Alcluith:** Philip, you said that offshore UK gases are in terminal decline. I have not heard it as dramatic as that. Could you give us an estimate of what you mean by "terminal decline", and when it will take place?

**Philip Lambert:** I qualified it by saying that at the moment it is terminal but it could be rescued by Government policy and real will. To show the extent of the decline, at the turn of the century we were producing 100 billion cubic metres of gas from the UK North Sea. It was an enormous success story, up at almost 2 million barrels a day oil equivalent. We became a gas-fired economy, we were even exporting gas. It allowed us to decouple from oil way ahead of anybody else on the Continent, so we have had very cheap gas prices because we have not been linked to Russian-oil-price-linked gas as Germany, France and others have.

That has now come down to 40 BCM in 13 years, and it will come down very quickly to lower levels unless something is done to arrest it. Our own view, and obviously we are quite close to players who would put it into effect, is that there are a lot of molecules in the southern gas basin, which is probably the area of the UK that is in most terminal decline, the big old province that has been allowed to rust far too quickly. Then there is the central

North Sea, which is a very promising area. The northern North Sea is probably not so much a gas province, and then you have the west of the Shetlands, which is in its early pioneering days. What is so exciting is, in a way, as the US have shown with shale gas, human ingenuity is transforming our industry. In the North Sea, the key thing that would transform the gas industry is seismic. People are just seeing gas reserves on seismic so much more clearly than they ever could. There was even quite a big discovery in the southern gas basin the other day.

The problem is—sorry to labour the point—the tax rise three years ago was an oil tax rise. It was qualified on the premise of all prices having risen above \$75 a barrel, and this was effectively a windfall tax on oil. There was a huge increase, 50% to 62%. In percentage terms that is a huge increase. It affected gas production as well as oil. It was a homogenous hydrocarbon tax offshore. The gas price is well below \$75 a barrel and has never been through that, so it was a windfall tax on something that is not getting a windfall. If you wanted to kill the offshore gas industry, that was the best way to accelerate its death.

**Lord McFall of Alcluith:** Was that the decision that was taken the day before the budget?

**Philip Lambert:** I do not know.

**Lord McFall of Alcluith:** Yes, that was the one that was getting advertised, I think.

**Philip Lambert:** The fact is that that tax change has crippled the recovery of the gas industry. I know shale gas is getting all the tax breaks. My view is that that is fine but as to the offshore gas industry, with let us say a 30% flat tax, you would see gas production in the UK soaring again. There is a third phase gas revolution offshore to take place. If we leave it underground, the pipelines and platforms will be removed. The three major terminals on the east coast of England will be decommissioned, and we will leave it there forever. That would be a pity.

**Lord McFall of Alcluith:** That was revealing and very helpful. On regulation, previous witnesses have said that regulation for offshore is pretty good but regulation for onshore is not so good. You heard the witnesses before us for the communities. They were talking about self-regulation by the companies. Is there a gigantic step needed in terms of regulation and self-regulation aspects for the future given some of the comments we have heard?

**Peter Atherton:** I am absolutely no expert on regulation. As a layman—I am a financier—it strikes me that, if you look at the environmental impact of extractive industries, and you have got opencast mining as a 10, shale gas cannot be more than a two. It really is just at the very, very low end of environmental impact at a local level. Even the big NGOs and environmental groups do not really complain about it. They accept that the risks can be relatively straightforwardly dealt with.

**Lord McFall of Alcluith:** My point was about regulation. Peter, have you got any points?

**Peter Hughes:** Objectively you would have to say that the regulatory regime probably is fit for purpose and is okay. We have had onshore production in this country for a long time. I worked for the Wytch Farm project in the early 80s, so there is an onshore industry and policing of the industry. Objectively, it is probably okay. The issue of course is the word that was used earlier, which is reassurance. There is probably a need for a step up in the regulatory regime, and one that is communicated to people in such a way that it will reassure them. The biggest challenge we face at the moment as an industry is reassuring the people and winning hearts and minds.

**Philip Lambert:** The propaganda has been very successful in unsettling people about the shale gas industry. Therefore, early on anyway, the regulatory regime has probably got to be more interventionist to give people the comfort on the main issues: the footprint above surface, the aquifer issues, the tremor issues; just the whole edifice of shale gas worries people. To be honest, now they are probably right to be worried because they have heard so much. The regulatory regime has to be there to give local people the confidence that the above surface is not going to be damaged; that the rural environment, the aquifer and the overall environment are not going to be damaged from the fracking process. Wytch Farm is one of the great examples worldwide of an onshore oil development.

**Lord McFall of Alcluith:** Some of our witnesses from the industry have said that if they do not get community accord and engagement and one spirit it could have an adverse effect and perhaps fracking would not go ahead. Would you share that view?

**Philip Lambert:** I think at the moment it is very unlikely.

**Q202 Lord May of Oxford:** Can I just quickly follow that up by saying I did not hear you really give a definitive answer to the question? Many of the local residents have no confidence, or little confidence, or trust that the people doing this are going to do a good job of self-regulation, and you think that is unfair.

**Peter Hughes:** It is very fair that they have not got that confidence because I think the industry has done a lousy job of providing the reassurance that is necessary. Objectively the regulation regime, as I said earlier, is probably okay.

**Lord May of Oxford:** It is not whether the regulations are; it is whether they are doing it.

**Peter Hughes:** I think the word “independence” came up earlier, so I would say it would be better not to have a perception that the regulatory regime is based on self-regulation, as the industry at the moment is not gaining the benefit of the doubt and it will not do for some time to come. I share the views expressed that the regulatory machine probably has to go beyond what is objectively required in order to win that confidence back.<sup>147</sup>

**Philip Lambert:** Without crippling the costs in the process.

**Peter Atherton:** I was going to say, as long as it does not push it to \$15 per BTU, and we kill the industry stone dead.

**Q203 Lord Hollick:** Can I ask whether Mr Atherton and Mr Hughes share Mr Lambert’s enthusiasm for the potential for further offshore gas exploration?

**Peter Hughes:** I do, absolutely. I tried to say so earlier. Absolutely; I think there is a huge potential there that needs to be incentivised.

**Lord Hollick:** The impression we got from the answers so far was that it was significantly greater potential than onshore gas.

**Peter Hughes:** That remains to be seen. We do not know yet. There is a huge potential, and I think it is more of a known quantity offshore and this industry has much greater

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<sup>147</sup> Peter Hughes later submitted the following clarification: “I think the word “independence” came up earlier, so I would say that a perception on the part of the public that the regulatory regime is based on self-regulation, rather than on independent external oversight, is probably not helpful, as the industry at the moment is not gaining the benefit of the doubt from the general public and will not do for some time to come. I share the views expressed that the regulatory machine therefore probably has to go beyond what is objectively required in order to win that confidence back.”

experience, whereas the onshore, the unconventional, is a completely unknown quantity. We do not know what the cost structure onshore is going to be. You heard figures earlier about the size of the resource base. The resource in the ground is enormous. The big issue is how much of that is going to be recoverable and at what cost, and we simply do not know.

**Peter Atherton:** I would agree. I think there is a fantastic opportunity still left in the North Sea, providing we can get the taxation regime right.

**Q204 Lord Griffiths of Fforestfach:** We have seen in the US the revolution in shale gas; it is very successful. We are looking at the UK, and frankly we are struggling to convince the public that even if the resources are there we could really have anything comparable. What has the US done, which in some sense is right, that we are not doing? What do we learn from the US? Is it that they communicated much better? Is it that they have a different regulatory regime, which is better? Do they have incentives for exploration and production that are better than we have?

**Peter Hughes:** I think it is the latter. If I had to point at one single factor it would be mineral rights. Individuals and landowners are incentivised not to stand in the way of this because they own the mineral rights. A lot of people in the US have made an awful lot of money by virtue of owning land under which there was considerable shale gas. There are all sorts of issues of population density, land and so on, but the mineral rights are the incentive. In this country, if you play that across to the UK case, there is a complete asymmetry in the balance of risk and reward in terms of people's perceptions. People see all the risks that you heard about earlier, but they see no reward because landowners do not have the mineral rights. There is a complete asymmetry in their mind between the perceived risk and the perceivable rewards. I use the word "perceived" advisedly of course.

**Philip Lambert:** I would agree with that in one way. Obviously in the US the thing that incentivised it was that it was basically an entrepreneurial industry that grew very fast because landowners wanted it, the industry wanted it, and actually the state is not that strong in terms of its control over the energy industry in the US. If that was replicated in the UK and the landowners did own the mineral rights, I still do not think it would help. It might even deter because we have seen in the onshore wind industry, quite rightly, one of the real antagonisms, in my view of something that is considerably more environmentally damaging than shale gas, is that it has rewarded the landowner at the expense of the locals. In shale gas, if the UK landowners were the main beneficiaries, there would be even more hostility to shale gas.

Shale gas has got to bring the local communities with them. The big difference with the US is that the UK rural environment is treasured. Industrialising anything onshore in the UK at the moment, whether it is coal, wind or shale gas is going to be difficult. In the US it is not difficult to do this sort of thing in Texas or Dakota. It is more difficult in Pennsylvania. That is the key difference, and in a way it is right it should be the key difference.

**Peter Hughes:** I beg to differ slightly, because I do think personal interest, as always in life, is a rather key factor here. There are the issues of local communities, the density of population and the issue of winners and losers. The real crux of the issue is how to incentivise communities, be that individuals or collections of individuals, to support this development.

**Lord Griffiths of Fforestfach:** Can I just put words in the mouth of our previous witnesses? If they were to say to you, "Is there any area in America comparable to the



Fylde coast which has had successful exploration and development?” could we say to the objectors previously, “Well, we have evidence here; it has worked in the US with the population density as it is, and therefore it is apples and apples”?

**Peter Hughes:** There are certain areas of outstanding natural beauty in the US where the developments are taking place, but they are not heavily populated.

**Philip Lambert:** I am not currently involved with the shale gas industry really in the UK, but if I was going to point the people of Britain to something that has worked, it would not be in the US. It would be to Wytch Farm, because actually fracking is a very emotive term. Horizontal drilling in Wytch Farm has gone much further than anything that is going to be done by the shale gas industry. They have planted a million trees. Broadly they have brought the locals of the Poole Bay area, which is an immensely beautiful area, with them and produced 100,000 barrels a day of oil at its height. They have drilled offshore into Poole Bay without people being disturbed by that, and it has brought enormous benefits to the UK. In my view, once they have decommissioned the wells, it will probably be better off with a million trees than it was before. That is where I would point the shale gas industry, to emulate that.

**The Chairman:** You have made a very good point, in terms of political acceptability as well.

**Peter Atherton:** I would add two other things about the US psyche. One is that in the US public mind-set and political discourse, energy costs are really very important. When you go to the US and turn on the TV, leading on the news is gasoline prices. Having sources of energy that bring costs down gets great public sign-in very quickly. Also energy security is like that as well; Americans are very conscious of energy security. I think there is a great public desire to see the US have abundant, affordable cheap energy and great energy security. That is a debate that we in the UK do not quite have. Another example of Wytch Farm actually is nuclear.

Nuclear is often disliked 20 or 30 miles away but as you get closer and closer to the nuclear plant it is often very popular because it brings very high-quality jobs for long periods of time, and great wealth to the local community. One of the issues around shale gas is the dispersal of the pain. In a way that is good because you have lots of pads spread all over the place, but also in our situation it might be better if we could condense the work into a few areas that do benefit greatly from the jobs and the community benefits.

**Q205 Lord Shipley:** Can I just explore very briefly the issue of prices of gas and energy generally as a consequence of shale gas? Mr Hughes, you said at the start as I recall that there would not be much reduction in prices as a consequence of shale gas. I was not clear whether that was UK production of shale gas or whether you had included the impact of US production and export, and conceivably China or indeed elsewhere. Could you just clarify what you meant by the statement that there would not be much reduction?

**Peter Hughes:** I will try to do so. I think the answer is both. In the UK we simply do not know how much this is going to cost. Everything points to the fact it is going to cost considerably more than it does in the US. Can you imagine if it came in at \$8 dollars an MMBtu? It would be highly beneficial because our opportunity cost at the moment is to import gas at \$10 to \$11, and it would back out those imports. Will it be able to meet that cost structure? We do not know yet. That will be a function of the permeability and porosity and a number of things we do not yet know about, and will not know about until the drilling takes place.

In terms of US shale gas, the Henry Hub price is about \$4; the NBP price today is \$11; does that mean there is going to be a bonanza when US LNG comes on and starts being exported? I do not think so. In the first instance we will have to compete for that LNG with the Asian market, which is traditionally prepared to pay much higher prices - it is currently paying, \$18 to \$20 for spot cargoes of LNG, whereas the UK spot price is \$11. That is a competitive factor, and there is a cost structure issue here, which means by definition it will be much more expensive when delivered into foreign markets. There is the cost of liquefaction in the US, which is about \$3. There are losses in the process, which is about 15%, which adds another \$0.5 to \$1, and then the shipping cost. There is basically then a structural cost difference. You have to add \$4 to \$5 to the US Henry Hub price before you get it delivered into Europe, and a lot more into Asia. So if the Henry Hub price today is \$4, then probably it could be landed here at around \$9, but it will not be because the Asians will pay much more for it.

**Q206 The Chairman:** We are running out of time unfortunately, but unless colleagues have got other questions they want to ask, can I ask you to summarise what I think has been a vein through the whole of this hearing with you? That is, leaving aside the mineral rights question, which I think is a political leap too far, what are the main issues that you would pursue in order to encourage the acceleration of shale gas here?

**Philip Lambert:** The key thing is, even if it is limited, we have to drill 20 to 30 wells, to find out whether we have a vast resource in the Bowland and other UK shale deposits. I would call them pilot wells. It would be an exploration for the British people as to whether we sit on no TCF, 20 TCF, 130 TCF or something bigger. That is almost an obligation; it has to be done in a very focused environmentally friendly way. With 20 to 30 wells, you are trying to find the sweet spot, so it probably only needs about two or three locations. It should not be really left just to the companies. It is almost a national issue, trying to find out what we have got.

**Peter Hughes:** I could not agree more. We have to find out. We owe it to ourselves to find out; we would be fools not to. In terms of the ability to find out, we must win hearts and minds. That is the battle the industry is losing. We are way behind and playing catch up, so that has to be a prime task, to provide that reassurance.

**Peter Atherton:** I agree completely with my colleagues. However, I think there are some hearts and minds that cannot be won, and the wider public interest must prevail.

**The Chairman:** You do not think things like planning and other issues are actually delaying the process?

**Peter Atherton:** I am sure they are. As I say, the financial technical engineering skill and the asset base could be in place to do those 30 or 40 wells within three years, easily. It is the local issues that are holding it up and the fear that the companies have. These are small companies. Cuadrilla is a small company. It has some big partners, but it is a small company. They are not equipped to take on the legions of environmental protestors. The state has to step in at some point and say, "No, this is definitely in the public interest, and we are going to do it."

**Lord Hollick:** Mr Lambert, could you give us a note on the changes you would like to see made to the tax regime to encourage exploration and exploitation of offshore gas?

**Philip Lambert:** Of course I will.

Lambert Energy Advisory, Liberium Capital and Peter Hughes Energy Advisory—Oral evidence (QQ 196-206)

**The Chairman:** I am sorry it has been such a quick session, but we have in fact covered a lot of ground. Thank you very much indeed.

Liberium Capital, Peter Hughes Energy Advisory and Lambert Energy Advisory—Oral evidence (QQ 196-206)

**Liberium Capital, Peter Hughes Energy Advisory and Lambert Energy Advisory—Oral evidence (QQ 196-206)**

Transcript to be found under [Lambert Energy Advisory, Liberium Capital and Peter Hughes Energy Advisory—Oral evidence \(QQ 196-206\)](#)

## **Dr David Lowry, Environmental Policy and Research Consultant— Written evidence**

### **Fracking's radiation risk**

Along with many banners saying 'Could you kindly Frack Off', 'Police say no to fracking!' 'For a frack-free future', protestors at Balcombe, Sussex in August highlighted their concerns over contamination of the local water table, fugitive emissions of fracked methane gas that could exacerbate climate change dangers, and worries over community disruption from many lorries that will have to come to areas hosting fracking platforms with toxic liquids used to flush out shale gas.

Earlier this year, also in August, in an article in the Daily Telegraph, The Prime Minister, David Cameron tried counter concerns over prospective environmental hazards such as water contamination by referring to a "stringent regulatory system." ("We cannot afford to miss out on shale gas", 12 August 2013, <http://www.telegraph.co.uk/news/politics/10236664/We-cannot-afford-to-miss-out-on-shale-gas.html>)

Mr Cameron's coalition partners also give cautious support for shale gas in a motion debated, and endorsed, at the LibDem conference in September 2013 saying limited shale gas extraction should be allowed, provided that "regulations controlling pollution and protecting local environmental quality are strictly enforced, planning decisions remain with local authorities and local communities are fully consulted over extraction and fully compensated for all damage to the local landscape".

But neither of the Coalition partners, nor indeed the protestors in Balcombe, make any mention of radioactive risks arising from fracking.

However, Mr Cameron's own Health minister, Anna Soubry, has told Labour MP Paul Flynn in a written answer in May that Public Health England (formerly the Health Protection Agency) is preparing a report identifying potential public health issues and concerns, *including radon (release/emissions, my emphasis)* that might be associated with aspects of hydraulic fracturing, also referred to as fracking. The report is due out for public consultation in the summer. Once released for public consultation, the report will be freely available from the PHE website." (Hansard, 20 May: Column 570W)

PHE have told me they now do not expect their report to see the light before the end of the year, which is hugely disappointing considering its prospective importance to the public debate.

PHE is concerned to evaluate the concerns raised over potential risks of radon gas being pumped into citizens' homes as part of the shale gas stream. Unless the gas is stored for several days to allow the radon's radioactivity to naturally reduce, this is potentially very dangerous.

Radon is unquestionably the leading cause of lung cancer in non-smokers. A report produced by the HPA in 2009, Radon and Public Health. (Report of an independent Advisory Group on Ionising Radiation: Docs RCE 11, HPA 2009: [www.hpa.org.uk](http://www.hpa.org.uk)) states:

“Radon is a naturally occurring colourless and odourless radioactive gas that can seep out of the ground and build up in houses, buildings, and indoor workplaces. Epidemiological studies have established that exposure to radon is a cause of lung cancer, with a linear dose-response relationship. Exposure to radon is now recognised as the second largest cause of lung cancer in the UK after smoking and analysis for the Health Protection Agency indicates that about 1100 UK deaths from lung cancer each year are caused by exposure to radon (most caused jointly by radon and smoking)”.

Initially radon released from its virtually sealed underground locations will be in monatomic suspension, but then it accretes onto dust particles, pipework, etc, and some of it may remain suspended in the gas and come out in our cookers.

### US concerns

The current concern about how much radon is likely to be piped into people's kitchens was spurred by a report last year by Dr Marvin Resnikoff, of Radioactive Waste Management Associates (<http://rwma.com/aboutus.htm>). Dr Resnikoff estimated radon levels from the Marcellus gas field - the nearest one being exploited to New York - as up to 70 times the average. Dr Resnikoff's group, now based in Vermont, used to be based in Brooklyn, New York, hence its work on shale gas being piped to New York consumers. RWMA's suggest some shale gas deposits contain as much as 30 times the radiation that is found in normal background. (<http://gdacc.org/2012/01/10/radon-in-natural-gas-from-marcellus-shale-by-marvin-resnikoff-radioactive-waste-management-associates/>). New scientific evidence on these concerns was published in the US journal Environmental Science & Technology in September 2013 (“Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania,” <http://pubs.acs.org/doi/abs/10.1021/es402165b>)

Moreover, Professor, James W. Ring, Winslow Professor of Physics Emeritus, Hamilton College in New York State (<http://www.hamilton.edu/index.cfm>) stresses: “The radon and natural gas coming from the shale mix together and travel together as the gas is piped to customers. This is a serious health hazard, as radon—being a gas—is breathed into the lungs and lodges there to decay, doing damage to the lung's tissue and eventually leading to lung cancer.”

Radon has a half-life of 3.8 days. Using the general rule of thumb of 10 half-lives to decay to 1/1000 of original concentration, that would be 38 days, or roughly one month, depending on how radioactive it was to start.

Fracked gas would thus need to be stored for at least a month before being distributed to peoples' homes, to allow for this radioactive decay of radon.

The Radon Council, formed in 1990, is an independent non-profit making self-regulatory body for the radon protection industry. Its formation was welcomed in the Interim Report of the Parliamentary Select Committee on Indoor Pollution, which called upon industry to provide a solution to the radon problem. The first objectives were to identify the “cowboy” operators and dubious training courses then in practice. Later there followed a first edition of a training manual and an agreed Code of Practice for the industry.

It does not seem ministers have read any of the Radon Council's literature, so keen are they to press ahead with fracking, as the Prime Minister and Chancellor's speeches at the

Conservative Party Conference on 30 September and 2 October 2013 –backed up by the Mayor of London - respectively demonstrated.

At the end of July 2013 the Communities Department published its *Revision of building regulation policy on radon*. In the impact assessment it explains the reason for the revised regulation is:

“Radon is a naturally occurring radioactive gas linked to lung cancer. Alongside a health and awareness programme and testing and remediation of existing buildings, current Government policy includes targeted intervention through the Building Regulations which requires radon protection in new buildings in areas of elevated radon risk. We intend that the Building Regulations and supporting statutory guidance is clear on current radon risks, and ensures buildings are fitted with proportionate measures to prevent the ingress of radon and thus reduce radon-related lung cancers. ”

It later adds “The respective cumulative risks of lung cancer [from radon exposure] affecting people by age 75 years in the UK at 100 and 200 Bq m<sup>-3</sup> are 0.42% and 0.47% for non-smokers and 17% and 19% for continuing smokers.”

([https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/225640/Radon\\_IA.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/225640/Radon_IA.pdf))

It also states boldly: “The chosen policy will maintain a targeted regulatory intervention (aligned to the most up-to-date radon maps), to ensure that all buildings in higher-risk areas incorporate appropriate radon measures.”

*In light of this clear precautionary approach, it is odd that all ministers seem to be uncritically cheerleading for expanded fracking, despite its possible radon risk.*

In January 2012 the European Commission Energy Directorate released a 100-page report on ‘Unconventional Gas in Europe,’ primarily assessing the situation in France, Germany, Poland and Sweden. It has a section on environmental liability, but no mention of radon pollution.

([http://ec.europa.eu/energy/studies/doc/2012\\_unconventional\\_gas\\_in\\_europe.pdf](http://ec.europa.eu/energy/studies/doc/2012_unconventional_gas_in_europe.pdf))

### Nuclear waste too

In addition, both RWMA in the US and the internationally respected Norwegian environmental consultancy, DNV (Det Norske Veritas) have identified radioactive waste contamination as one problem with fracking, arising from contaminated rock cuttings and cores to which have the potential for exposure to radioactivity on health. Risks relating to NORM (naturally occurring radioactive materials) contaminated downhole and surface equipment should also be considered, both suggest.

(Risk Management of Shale Gas Developments and Operations January 2013 DNV-RP-U301; <http://www.dnv.com>)

The Commission report also records that in Sweden, the handling of radioactive shales requires a permit in accordance with the Radiation Protection Act and the Radiation Protection Ordinance. This is the case when the uranium content exceeds 80 ppm (parts

per million), it points out. This permit is granted by the Swedish Radiation Safety Authority. “Non-compliance with the permit can lead to it being revoked and, if done intentionally, the responsible person can be fined or even imprisoned,” it warns.

It adds that in Sweden, the possible occurrence of radioactive materials (NORMS), heavy metals or saline brines is taken into account by the permit for the environmentally hazardous activity, required for the disposal of waste water.

Green MP Dr Caroline Lucas, who was arrested as a result of her protesting against fracking in Balcombe during August 2013, initiated a wide-ranging Parliamentary debate ([www.publications.parliament.uk /pa/cm201314/cmhansrd /cm130718/ hallindx/130718-x.htm](http://www.publications.parliament.uk/pa/cm201314/cmhansrd/cm130718/hallindx/130718-x.htm))

on fracking on 18 July 2013 in Westminster Hall, drew attention to the radon risk and the outstanding PHE report. She asked the minister, Michael Fallon, pointedly: “Will the Minister explain the delay in publishing this research report when the public debate over fracking is moving ahead apace?”

Mr Fallon replied to several of Caroline Lucas’ questions on environmental hazards of fracking, but gave no response to her queries on radon risks. I wonder why?

*October 2013*



Professor David MacKay and Sir David King—Oral evidence (QQ 207-222)

**Professor David MacKay and Sir David King—Oral evidence (QQ 207-222)**

Transcript to be found under [Sir David King and Professor David MacKay—Oral evidence \(QQ 207-222\)](#)

## Professor Robert Mair CBE—Oral evidence (QQ 69-75)

TUESDAY 29 OCTOBER 2013

*Evidence Session No. 6*

*Heard in Public*

*Questions 69 - 75*

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord May of Oxford  
Lord McFall of Alcluith  
Lord Shipley  
Lord Smith of Clifton

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### Witness

**Professor Robert Mair CBE**, Cambridge University

**Q69 The Chairman:** Professor Mair, from the University of Cambridge, may I welcome you? We note that you chaired the committee that oversaw the Royal Society and Royal Academy of Engineering's joint report on fracking. We have all just been acquiring a copy of that report, but for the benefit of the inquiry as a whole, for those who are listening in and for the transcript I wonder whether you could summarise briefly the key findings of that report.

**Professor Robert Mair:** Yes. The Government's Chief Scientific Adviser, who was then Sir John Beddington, commissioned the two academies—the Royal Society and Royal Academy of Engineering—to review the science and engineering evidence to inform government decision-making. The terms of reference for that review can be summarised in the following key questions. First, what are the major risks associated with hydraulic fracturing as a means to extract shale gas in the UK, including geological risks such as seismicity and environmental risks such as groundwater contamination? That was the first key question. The second key question was: can these risks be effectively managed, and if so how?

To summarise very briefly, the key findings of our report were, first, that the risks associated with shale gas exploration can be managed effectively in the UK, similar to the risks of existing onshore oil and gas activities, so long as operational best practice is followed and enforced through strong regulation. The second key finding is that the risk management will require competence and capacity for doing so both in the operator and in the regulator, and attention must be paid to how risks may well scale up should an industry develop nationwide, in which case regulatory co-ordination and capacity will become more crucial.

In a nutshell, our report said that we believe that the risks can be managed effectively provided that operational best practices are enforced.

**The Chairman:** Thank you. We will start to look at some of these points in greater detail.

**Lord Smith of Clifton:** Professor Mair, some commentators believe that shale gas development might contaminate water supplies or cause local water shortages. Could you comment on those two criticisms?

**Professor Robert Mair:** First, I should say that our report concluded that the probability of contamination via fractures penetrating upwards from great depths and encountering aquifers is very low indeed, provided that the fracking is undertaken at great depth, typically kilometres below the ground surface. The maximum vertical distance of artificially created fractures by the fracking process in the USA—of course, we are very much drawing on USA experience—was found to be 600 metres at the very most. So given that the fracking operation is likely to be at much greater depths than that, the probability of contamination through that process of fractures finding their way up to aquifers is very low indeed. A much more likely source of potential contamination is poorly constructed wells, so well integrity is paramount. That is a key point that we make in our report.

There is no question that there have been some instances of contamination of water supplies in the USA, but we found no evidence that any of that was due to the fracturing process itself, in other words, through fractures penetrating from great depths up to encounter aquifers. It is much more likely that those instances of contamination were due to faulty well construction and surface spillage. This is about the whole process of managing the operations well. Like any industrial operation, any spillage or that kind of event can lead to contamination.

Your second point was about local water shortages.

**Lord Smith of Clifton:** Fracking requires volumes of water, does it not?

**Professor Robert Mair:** It does, and we recommend in our report that the techniques and the operational practices must be implemented to minimise water use and to avoid abstracting water from supplies that might be under stress, in other words, where fresh water supplies might be limited. Water stress can be avoided by using alternative sources of water.

I think the Committee heard from Professor Muller earlier on that there are some really quite exciting technological developments, such as the use of saline water from deep aquifers, which is being tried in some parts of the USA: in other words pumping water from a great depth where water is saline and of no value. Using that for fracking operations would be a hugely important technological leap forward. Other options are being experimented with, and I believe there are going to be huge advances in the coming years where the fracturing fluids might not even involve water; they could be gels and carbon dioxide and nitrogen gas foams. There are ways of minimising the demand on fresh water.

**Q70 Lord Griffiths of Fforestfach:** In the second source of contamination that you mentioned—faulty wells, leaks and surface spillages—what is the evidence from the US that that is quite a serious problem?

**Professor Robert Mair:** It is a serious problem in that any contamination of freshwater is serious. The evidence from the US is rather hard to unravel, I have to say, not least because of the absence of baseline monitoring. You have already heard quite a lot about that. That is a very important part of the conclusions of our review: that unless you have very clear baseline monitoring so that you know what the situation is before you even start any operations, the evidence is hard to unravel. Certainly, in the USA, there is no question that

that there are some areas where the geology is such that methane naturally bubbles up into the groundwater. It can be very misleading to imply that that is all down to hydraulic fracturing and shale gas extraction.

**Lord Hollick:** A smallish earthquake in Blackpool, which is associated with drilling and fracking, has entered the public consciousness. Your report says, “The risk of seismic events is minimal”. Could you please elaborate on that? Why, if the risk is minimal, has this been allowed to go unchallenged in the public debate?

**Professor Robert Mair:** I hope that the public debate can put that sort of issue right. Let me just go back to what we found about seismicity. The first point to make is that here in the UK there are very good records of natural seismicity going right back to many hundreds of years ago, even if some of those records were associated with people’s descriptions of the event rather than actual scientific measurement with modern equipment. We know that natural seismicity in the UK never exceeds magnitude 5, and coal-mining activities, of which there were many until relatively recently when the coal-mining industry was much greater, can produce seismic tremors up to about magnitude 4. We concluded looking very carefully at the information that we had that it is very unlikely that any shale gas fracturing operation would ever produce more than magnitude 3. You will all appreciate, I am sure, that these are logarithmic scales, so 3 is roughly one-tenth of the effect of 4, and 4 is one-tenth of the effect of 5. The key point is that magnitude 3, in terms of what people actually feel, is no worse than a heavy lorry driving past the house. If you look really carefully you might see a glass of water just trembling, so magnitude 3 is not significant. Of the two events that caused the worry in Lancashire, one was a magnitude of 1.5 and the other was a magnitude of 2.3. These are very, very small events. So we are quite clear that there is no material risk from earthquakes—we really prefer the term “earth tremors”—in the context of hydraulic fracturing. Nevertheless, we recognise that if you inject fluid right alongside or close to an active fault—and we do have faults in many parts of the UK—there is always the possibility of creating some activity of that fault. Therefore, we recommended some kind of traffic light system where a level of seismicity is defined and during the fracturing if there is any indication from the measurements that it is being approached, you alter the process. In a nutshell, we really believe that seismicity is a minor issue in comparison to the potential contamination issue.

**The Chairman:** Even given that, the DECC spokesman appearing in front of us earlier told us that the measures announced last December are now “the most stringent anywhere in the world for induced seismicity”. Do you agree?

**Professor Robert Mair:** I do. They are very stringent.

**Q71 Lord May of Oxford:** I would like to raise the question of methane emissions, which have been raised by those who are critical. As you know, the NGOs cite research from Princeton, which suggested that you get the benefits only if the methane leakage from national gas production is below something like 3%. Conversely, Professor Muller, who seems to me in general to be as relentlessly upbeat as the NGOs are relentlessly downbeat, has suggested that that is more like 18%. I personally, having spent a dozen years of my life as vice-president of research at Princeton, am inclined to trust the Princeton figure more than Professor Muller, but I would like to hear you on the subject.

**Professor Robert Mair:** I have to say that the jury is still out on the precise quantities of methane emissions during the actual process of shale gas operations. I think that Professor Mackay’s report, which was produced last month along with Dr Stone, is excellent in addressing these points. It is the same point related to the baseline monitoring point in that

we need to make very careful measurements of methane escape, if there is any, into the atmosphere, and take all possible steps to minimise that. Probably the most significant part of the operation is when the flowback fluid comes back out of the well from great depths, having done the fracturing, and that is likely to have dissolved methane in it. If that fluid is allowed to be stored in an open pond, that will naturally lead to more methane emission, whereas if it is properly contained and the gas is very carefully trapped, all the evidence suggests that the emissions can be reduced to much smaller amounts. But the jury is out on the precise quantities.

**Lord May of Oxford:** If I understand it, you are saying that the jury is out both on the precise percentage you can retain and on what the safe percentage is anyhow.

**Professor Robert Mair:** I think the answer is yes to both those two points, exactly.

**Baroness Blackstone:** Following on from that, if those who are developing shale gas follow the advice of your report, would you be able to conclude in a one-line answer on the “Today” programme—

**Lord May of Oxford:** That is an oxymoron.

**Baroness Blackstone:** If you were able to conclude that it is in fact safe to extract shale gas in the UK without damage to the environment—you talked about the dangers of contamination in your answer to the previous question but one—what would your conclusion be if pushed on this?

**Professor Robert Mair:** If all the right safeguards are applied—that is an important proviso, but there is no reason why they should not be adhered to—then, yes, I believe that shale gas can be produced safely without any significant risk of contamination.

**Baroness Blackstone:** What are the circumstances in which the safeguards might not be adhered to?

**Professor Robert Mair:** We are talking, I suppose, about any complex technical operation. You could say that flying an aeroplane would be the same: that if the operators make a mistake—

**Baroness Blackstone:** So human error?

**Professor Robert Mair:** Human error, yes. One of the really important points that we drew out in our report was the role of the independent well examiner, who is there explicitly with the task of ensuring that the well design has been properly executed. To our mind, it needs to be ensured that that system of independent well examination really works. If that can be made to work, and we believe that it can be, the answer to your question is what I said earlier: that the risks are very low.

**Baroness Blackstone:** What about cutting corners to save on costs?

**Professor Robert Mair:** That has to be absolutely avoided, and it is important that the regulators ensure that that does not happen. It would not be in the operators’ interests to do that.

**Q72 Lord May of Oxford:** Let me ask you quickly, in the context of the environment, a slightly different question, which I asked the previous group. As you know, our targets are to decarbonise electricity by 2030. I think that shale gas has a really important part to play on the trajectory to that. On the other hand, if you take that ambition seriously, what in your opinion is likely to be the impact on the industry if it is looking at a finite point when it is going to be out of business?

**Professor Robert Mair:** You have obviously heard a lot of other witnesses talking about this. The question of where shale gas sits in the whole energy market and how that relates to the whole decarbonisation of our economy is not something that the Royal Society and the Royal Academy of Engineering committee examined. That is not to say that we did not think it was important.

**Lord May of Oxford:** Very sensible.

**Professor Robert Mair:** We just felt that it was outside our remit.

**Lord McFall of Alcluith:** You mentioned the well examiner. How independent will that person be? Who will employ them?

**Professor Robert Mair:** That is something that we expressed some quite strong views on in our report. We believe that the current guidelines need to be clarified to ensure that the well examiner really is independent from the operator. In some cases, under existing practice, that well examiner can be an employee of the operator's organisation. We felt that that was undesirable and that the well examiner should be truly independent.

**Lord McFall of Alcluith:** But you never called for new regulation? Do you think that that should be incorporated into any additional regulations?

**Professor Robert Mair:** Whether or not it needs to be incorporated into any additional regulation is, I think, debatable, but we certainly think that the various government organisations that are overseeing the shale gas operations should ensure that the well examiner is truly independent.

**Lord McFall of Alcluith:** Do you think there is a need for further regulations? You made no comment on that in your report.

**Professor Robert Mair:** About that particular issue, or just generally?

**Lord McFall of Alcluith:** Just generally.

**Professor Robert Mair:** I think it is important to distinguish between there being clear guidelines for good practice and introducing new regulations. The Government, understandably in our view, does not wish to provide regulatory requirements that are too prescriptive: all risk management should be the responsibility of the operator. In this context there is the crucial role of the environmental risk assessment. That is absolutely the responsibility of the operator, and it should be mandatory for all shale gas operations. The regulators need to ensure that the environmental risk assessment has been undertaken. That is slightly different from saying that there need to be more regulations.

The answer to your question is that there are no specific new regulations that we identified as being necessary. We made 10 major recommendations in our report, and I am pleased to say that the Government has accepted all 10 of them. So the Government has accepted the need for the regulators to strengthen the guidelines for good practice and to ensure that the well examiner is independent.

**Q73 Lord McFall of Alcluith:** In the financial services industry, with the financial crisis, it was shown that the regulator did not have authority, and it is this lack of authority that was absent, for example, in a number of cases where wrongdoing was undertaken. Regulators mentioned that when they examined the institution, the trail went cold: in other words, they could not get to the person who was responsible. How do you think minimum regulation will ensure that that authority is there, that there is an identifiable responsibility for individuals, and that at the end of the day it will not be “nothing to do with me”?

**Professor Robert Mair:** We drew attention in our report to the need for there to be one overseeing part of the Government that deals with shale gas. At present, as you all know, there are a number of different organisations involved. There is DECC, there is the HSE, there is the Environment Agency. We said that there should be one organisation that oversees the whole process. We also distinguished between exploration, which is a relatively small part of the whole operation, and full-scale production, and we said that if the shale gas industry were to move into full-scale production, those with regulatory responsibilities would have to address capacity very carefully. That, I think, answers your point that the people involved would have to be doing their job properly, ensuring that the whole process is being carried out as it should be.

**Lord Griffiths of Fforestfach:** Do you think that there is any reason to restrict geographically the development of shale gas?

**Professor Robert Mair:** No. Obviously the whole operation depends on the local authorities granting planning permission, and there may well be issues in certain parts of the country such that the planners simply will not accept that the operation should take place. But we do not believe that there are any technical or scientific reasons as to whether there should be a restriction on shale gas in certain parts of the country.

**Lord Griffiths of Fforestfach:** But you would basically allow a negotiation between the operators and the local authorities?

**Professor Robert Mair:** Yes. The key point is the environmental risk assessment, which is of overriding importance. The environmental risk assessment, which is the responsibility of the operator, should engage the local communities at the outset of its preparation. It needs to embrace all the local concerns. If that is done properly and those concerns are addressed, the whole path will be much smoother.

**Q74 Lord Griffiths of Fforestfach:** So much attention has been given to middle England, and one suspects that Scotland and Wales will also get some of the benefits pretty soon. Is your judgment that the companies really want to develop England first and then go elsewhere, or will there be more even development?

**Professor Robert Mair:** I really cannot comment on that. I think it depends absolutely on the individual cases, the geology, the local community and so many other things that it is really impossible to give an answer to that.

**Lord Shipley:** I think the Government have broadly welcomed and endorsed your report. Is that a fair conclusion for us to draw?

**Professor Robert Mair:** Yes, that is a fair conclusion.

**Lord Shipley:** You said a number of things about co-ordinating the regulatory bodies. Is DECC acting on those recommendations for the better co-ordination of regulation?

**Professor Robert Mair:** The Royal Society and the Royal Academy of Engineering have had subsequent follow-up discussions with DECC, and the answer to your question is yes, DECC is acting on our recommendations.

**Lord May of Oxford:** One very quick question. In your report, if my memory is correct, you ended by saying that there are a lot of unanswered questions and research to be done that will naturally be done in the first instance by the parties who are interested in developing this, but that it would be a good idea if it were done in a more independent way so that the research was not being carried out wholly by people who had a stake in and that

the research councils could be engaged where appropriate. I wonder what success you have had with that, and how that has gone.

**Professor Robert Mair:** So far, that has not developed to any significant extent. We made contact with the research councils. The time is absolutely right, now, given what has developed and the way things have moved since our report was published last year, to go back to EPSRC and NERC in particular and to make the case again because, as we said in our report, there is a strong argument for there being some interdisciplinary cross-research council research into shale gas.

**Lord Lawson of Blaby:** Were you sitting at the back when our previous witnesses were here?

**Professor Robert Mair:** Yes I was.

**Lord Lawson of Blaby:** I thought you were. Was there anything that either of them said that you like to comment on, whether it is to disagree with something that they said or whether to endorse something that they said? Do you have any observations of any kind?

**Professor Robert Mair:** I do not have any particular observations. Most of what they said seemed to be reasonably sensible. There was nothing that made me sit up and say, “That is not correct”.

**Q75 Lord Hollick:** You referred to the evidence that we received from Professor Muller last week. One bit of that evidence painted quite an optimistic picture about the increased rate of productivity. I think that was the expression that he used; I cannot quite find it at the moment in the transcript. It was going to double over a two or three-year period and then possibly double again—so double the point at which we are now over the next four or five years. Our point of entry, if you buy serendipity, would appear to be rather promising, because we are coming in at a time when the levels of productivity and, I think he implied, safety within the industry were, thanks to the American experience and American investment, likely to increase significantly. Do you agree with that?

**Professor Robert Mair:** I cannot comment on productivity, but I agree that a huge amount has been learnt from the American experience about what can go wrong and why such things go wrong. The potential for improvement at the moment is probably very good. A lot of lessons have been learnt, in particular this question about the paramount need for monitoring. Much of the controversy around some of what has gone wrong in the US has been simply because there have been no measurements. That is a lesson that everybody is in full agreement with, including the Americans. So, yes, like Professor Muller, I am optimistic that the experience from the US has been invaluable to draw upon. We, the Royal Society and the Royal Academy of Engineering, are now in contact with other academies in Australia, Canada, the USA, China, South Africa and France. All these academies agree—drawing very much on our report, I am pleased to say—that the American experience has been extremely useful. So I think Professor Muller is right about the technological developments that are now going to take place.

**The Chairman:** That is a very good note to end on. This is clearly a very important area of our inquiry, and we are most grateful to you, Professor Mair, for coming to the Committee and sharing with us your work and your own expertise.



Phelim McAleer, Viscount Ridley and Nick Grealy—Oral evidence (QQ 134-152)

**Phelim McAleer, Viscount Ridley and Nick Grealy—Oral evidence (QQ 134-152)**

Transcript to be found under [Nick Grealy, Phelim McAleer and Viscount Ridley—Oral evidence \(QQ 134-152\)](#)

## Professor Richard Muller, Professor of Physics, University of California, Berkeley—Written evidence

1. Environmentalists should and must support the development of shale. Their opposition is ill-informed and needs to be reversed. Other than energy conservation, fracking is the most essential approach towards mitigating and reversing the emissions of greenhouse gases and air pollutants. The salient arguments are these:

**Greenhouse** emissions of natural gas are 1/3 to 1/2 those of coal

**Pollution** of local water pollution can be controlled with regulation and fines

**Earthquakes** can be avoided by recycling flowback water

**Fugitive (leaked) methane** is less of a problem than often portrayed

**Killer smog** can be drastically reduced by using natural gas in place of coal

The UK needs to set an example that the developing world can afford to follow.

2. I will now discuss each of these reasons in more detail.

3. **Greenhouse** gases and Global Warming. Anybody who believes greenhouse emissions need to be mitigated must recognize that there are two very big steps that can be taken.

The first is increased energy conservation. The second is a switch from coal to natural gas. For the same energy produced, carbon (the main component of coal) produces *twice* the CO<sub>2</sub> that does methane (the main component of natural gas). The reason is simple: every molecule of C, when burned with oxygen (O<sub>2</sub>) produces CO<sub>2</sub>. But methane is CH<sub>4</sub>. Every molecule of carbon comes with four of hydrogen, and half of the energy comes from the burning of hydrogen to produce harmless water vapor, H<sub>2</sub>O. (Although water vapor is a greenhouse gas, so much is available from evaporation from the oceans and rivers that its level in the atmosphere is not affected by human emissions.)

4. The advantage of natural gas can be even greater, since methane can be used with 60% efficiency in electricity generation (in a combined cycle power plant), whereas coal efficiency is at best about 44% (in a pulverized supercritical plant). This means that natural gas can reduce greenhouse emissions by almost 2/3.

5. I emphasize that natural gas's potential to reduce greenhouse gases is very important, and has not received the attention it deserves. Moreover, it has the capability of doing this around the world, not just in the UK. As a consequence, it would be proper for every environmentalist who is concerned about future global warming (and I consider myself to be in that list) to be enthusiastic about the substitution of natural gas for coal wherever and whenever possible. Although there are other environmental issues, as I will detail below, most of them are relatively easy to handle compared to the very difficult one of reducing greenhouse gas emissions. (One that is not easy to handle is air pollution, but that too is most readily addressed by a switch from coal to natural gas.)

6. **Pollution** of local water in the US has been the result of flowback water spillage in states that had insufficient penalties. (Note that these pollution problems have affected only surface water, not aquifers.) Since the proximate cause is the company's attempt to reduce expenses, the issue can easily be halted with suitable regulation, monitoring, and heavy fines for transgressions. If all companies followed what is known as "best practice" then the spillage would be eliminated. Would that all environmental problems be so easily solved.

7. **Fugitive (leaked) methane**. The leakage of methane into ground water has been

Professor Richard Muller, Professor of Physics, University of California, Berkeley—Written evidence

inaccurately portrayed in the movie *Gasland* and that has led to outrage among uninformed environmentalists. In fact, as is well documented, the “flaming faucets” shown in the movie are a phenomena that pre-dated fracking, and are known to be the result of generation of “biogenic methane” by bacteria in the soil that gets into well water. These facts are readily verified. Nonetheless, the widespread misbelief that the flaming faucets are due to fracking can present a political challenge. Passions are high, and not all opponents of fracking are open to correction.

8. One way to respond to those misinformed by *Gasland* is to encourage them to see the movie *FrackNation*. *FrackNation* is also a compelling movie, but it exposes the misleading information in *Gasland*, and even shows in a interview with *Gasland* star, writer and director Josh Fox, that he was familiar with the fact that the flaming faucets were not caused by fracking.

9. Note that surface pollution from coal residue is a very serious problem all around the world. Coal ash has highly poisonous and carcinogenic components, including arsenic, lead, and mercury. Accidents with coal ash are common; I am most familiar with those in the US, including a 2008 coal ash dam collapse in Tennessee, and a recent landslide into Lake Michigan. In the US, nearly 200 communities have suffered water contamination from coal ash. In contrast, natural gas leaves behind no ash or residue.

10. **Earthquakes** are produced both by fracking and by the reinjection of flowback water into deep storage formations. An excellent review of this issue appeared recently in SCIENCE magazine (reference W. L. Ellsworth, Science 341, 1225942 (2013). DOI: 10.1126/science.1225942).

11. The earthquakes caused directly by fracking are very weak. For example, the 2012 Blackpool earthquakes had a maximum magnitude of 2.3, detectable by instruments but hardly noticeable by most humans on the surface.

12. In contrast to the tiny fracking earthquakes, larger earthquakes induced by injection of wastewater into deep strata or basement formations are of concern. A magnitude 5.5 earthquake that damaged homes and buildings in Oklahoma in 2011 may have been triggered by injection of wastewater into a deep storage well.

13. The dangers of wastewater earthquakes from fracking can be eliminated by the requirement that flowback water be recycled, that is, that rather than being stored at a new formation, the wastewater be substituted for fresh water for additional fracking. The technology for doing this has been developed; Shell Oil says it hopes to be able to recycle essentially all of its wastewater in this manner.

14. **Fugitive (leaked) methane** has about 70x the potency of CO<sub>2</sub> as a greenhouse gas, kilogram per kilogram. This has led many people mistakenly to think that even small leakages of a few percent negates the value of natural gas over coal. However that estimate is not correct. Methane has a short lifetime in the atmosphere, and when the calculations are done carefully it can be shown that even if the leakage is as high as 18%, natural gas still reduces greenhouse emission compared to those of coal. See the discussion in the New York Times: <http://dotearth.blogs.nytimes.com/2013/08/01/two-climate-analysts-fault-gas-leaks-but-not-as-a-big-warming-threat/>

Professor Richard Muller, Professor of Physics, University of California, Berkeley—Written evidence

15. **Killer smog** is a horrific issue in China, India, and the developing world. It is arguably the greatest environmental threat in the world today; at least in the short-term it even outranks global warming. According to an article published last year (Lancet 2012; 380: 2071–94), 1.2 million people die in China each year from the air pollution. According to a more recent article in the Proceedings of the National Academy of Sciences US ([www.pnas.org/cgi/doi/10.1073/pnas.1300018110](http://www.pnas.org/cgi/doi/10.1073/pnas.1300018110)), the average loss of life in north China from coal-induced air pollution is 5.5 years. The UK is, of course, familiar with the issue of coal and air pollution, dating back to the industrial revolution and more recently the London killer smog of 1952.

16. A key and affordable way to address the air pollution problem is wide scale conversion in the affected countries from coal to natural gas; doing so can reduce the dominant pollutant, particles less than 2.5 microns in diameter, by a factor of 1/400. A switch from coal to natural gas was a major part of the solution to London's 1952 smog.

17. Of course, currently the worst pollution is taking place in China, not the UK. Nevertheless, the development of shale in China has been very slow, undoubtedly in part because of the example being set by countries such as UK and France stalling its development due to the concern that fracking is potentially dangerous. The UK cannot support and encourage fracking in China when it stifles it at home. The UK should and must set an example that it will not slow the replacement of coal with natural gas.

18. Some will argue that the developing world should switch to renewables. Yet the growth of renewables is very slow, largely due to the high expense. Last year China installed 7 GW of solar, but that number is misleading. By convention, solar is described in terms of its peak power, that is, when the sun is bright and directly overhead. When nights and cloudy weather is included, the 7 GW of peak power is less than 1 GW average. Over the last few years, China has been adding 50 GW of coal power every year; thus solar is not only hopelessly behind, but its capacity is being added far more slowly than that of coal. The problem is that renewables still need to be subsidized (with the exception of hydro, which causes other horrific environmental problems). Technologies which are not profitable are not sustainable, particularly in the developing world.

19. Renewables are ideologically attractive, and likely to be a large part of the long term solution. But we should not wait. Natural gas, substituting for coal, provides a rapid solution for the immediate future, and gives the renewable technologies time to develop and drop in cost. Subsidizing renewables in the UK and the US provides an example that China, India, and the rest of the developing world cannot afford to follow. And although the developed world has been responsible for most of the global warming so far, according to all projections, it is the developing world that will be the source of most of the greenhouse gases in the future.

*August 2013*

**Professor Richard Muller—Oral evidence (QQ 47-57)**

TUESDAY 22 OCTOBER 2013

*Evidence Session No. 4*

*Heard in Public*

*Questions 47 - 57*

Members present

Lord MacGregor of Pulham Market (Chairman)  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord Lipsey  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witness**

**Professor Richard Muller**, Professor of Physics, University of California, Berkeley, and Scientific Director of Berkeley Earth

**Q47 The Chairman:** Thank you very much indeed for coming. I know that you have also given us some written evidence, which I am very grateful for, which we have all seen, and in particular for coming all the way that you have. In terms of some of the answers that you have just heard it is very relevant to have your experience as Professor of Physics at University of California.

Could I start by asking you if you would like to comment on some of the evidence you have just heard in our session, in particular some of the comments that were made about American experience, for example, in relation to fresh water, or the United States not being an effective regulatory regime? Perhaps after that you could also talk to us about what view you take about some of the NGOs' other concerns about shale gas development in the UK.

**Professor Muller:** Thank you very much for the honour of inviting me to come here and speak. I did enjoy that last session. I thought the questions were particularly very thoughtful and on point, and I did disagree with many of the answers I heard. I did not keep track of all of them—my piece of paper was not big enough—so I hope you will remember to ask me some of them.

Let me make just a very brief statement. Today's newspaper has a story about what has happened in the last few days in the city of Harbin in China and it is horrific. The levels of air pollution there, which are attributed to the turning on of coal for heating in Harbin, are reaching a level that has now surpassed the incredible level that was in Beijing last January.

I looked up the air quality index in London this morning, it was somewhere around 25; it varies from place to place. If it gets above 50 people in the US get deeply concerned. Last January in Beijing it went above 800 and in the last couple of days in Harbin it went above 1,000. One knows how to calculate the effect of this on health—there have been some very good studies on that—and for Harbin I did the calculation this morning: we expect about 650 people to die just from one day of that air pollution in the city of Harbin.

Let me also mention that my expertise, unfortunately, is not in the UK on shale gas but I have been doing a great deal of work trying to understand shale gas in the United States. I have been close to several very large, and some small and medium, companies looking over the procedures of what they have done. The other country that I am now familiar with is China. I have had two trips to China in this last year, one just last month when I spent time in the gas fields of China, got to observe their fracking operations, got to talk to them in some detail about what they are doing about environmental concerns and also how well they are doing. So I have familiarity with both of those.

I got into this business because of a three-year study I co-led on global warming. Three years ago I was quite the sceptic and now I believe global warming is real and caused by human emissions of greenhouse gases. That is not the topic today but having done that work I became concerned about what we could do to slow it. If you look at it in an objective way and ask what are the big things you can do and what are the little things you can do, the biggest thing is energy conservation and I think everybody in this room is in favour of that. It is a win/win and there is a huge amount that we can do. The second biggest practical thing we can do is to shift the world away from coal to natural gas. I have written a book on energy; it was published a couple of years ago, I looked at solar, I looked at wind, I looked at a tidal, I looked at everything. I looked at it as a problem solver, not as someone who has an agenda. I believe the only two big things we can do are to switch energy conservation, in a worldwide switch, from coal to natural gas. That will not solve global warming but it will double the time.

If we think that we are going to get to a bad situation in 30 years from now, if we could switch all future plants to natural gas—not even the past ones—then we double the time to get there, maybe even triple it. So I believe that any environmentalist who is thinking globally must support helping China switch from coal to natural gas. That is so much bigger than anything else. Certainly I hope that the US example is serving as a strong example. I would love to see the example set in the UK also serve as an example for this. Again, if one is somewhat ideological and says we have to go as soon as possible to zero emissions, then I believe you will not find the solution.

I brought some charts, and I made copies of these I can leave here, of emissions in the future. This is if the Copenhagen Treaty had been signed. This chart appeared in an article I wrote in the *Wall Street Journal*. It shows here the emissions of the US going down, here the emissions of the Kyoto developed countries going down, and here are the emissions of the developing world going up because they are in the developing world. I want them to develop, I want this kind of economic growth but this is the plot that you get if you assume they are doing 4% conservation per year. If you are concerned about global warming then you must focus on the developing world. Anything you do must be something that can be adopted in the developing. If you are going to set an example you have to set an example of something that is profitable, not subsidised, because if it is not profitable it is not sustainable.

So my main interest in China initially was to slow global warming and I felt that the way China goes the rest of the developing world will go. But once you have visited China—and it is not just Beijing, it is not just Chengdu, I have been all throughout the China—you know

that the pollution is everywhere and it is not nearly at the level that it is going to be in 10 years. So given the sort of things that we are seeing every year, with new pollution levels being set, the reason we should be interested in helping China shift, and setting an example, from coal to natural gas is because firstly it is profitable to do so, as was shown in the United States. I know a lot about the shale in the United States. Secondly, for humanitarian purposes they need to do something right away; they need to develop this as quickly as they can because according to the most recent estimate in 2010 1.2 million Chinese died of respiratory illness caused by their air pollution. 1.2 million. That is not a speculative number put out by environmental groups; that is a solid number published in the proceedings of the National Academy of Science based on a joint study between China and the United States.

Then of course there is global warming. Do not forget the word “global”. In the United States there is so much pressure to do little things in your own backyard but the United States is simply not going to be a major contributor. We can do those things but I have spoken many times against the introduction of expensive electric cars simply for the reason that we are not setting an example that the developing world will be able to afford to follow. Shale gas is a wonderful thing that has happened.

I looked very carefully at the long list of environmental concerns—again I made a copy of this I can leave behind—all the things that people mention. Many of them are mistaken,. Some of them are valid but can be addressed in a relatively straightforward way through regulation and heavy fines for people who do this.

You asked about the status of regulation in the United States? Part of it has been local, there are no national regulations on fracking. There are state regulations and many of the bad stories of things that occur came about in the early days when people were very sloppy. We call that the wildcatters. What I saw in China was in dramatic contrast. They are using industry best standards. When you do industry best standards then most of these problems go away. There are some problems unique to shale gas. The fresh water one: I spent some time visiting Apache, which developed the sixth largest formation in North America, their Horn River formation. They chose to use only salt water. It is basically the same salinity as you get from sea water. They did not want to use fresh water. Their reason for this was that it is in Canada and in the winter the fresh water freezes more easily. So they use saline water. They are one of the great innovators in this field and they are operating one of the biggest regions in the field. Their policy is to move everything to saline solutions.

Saline solutions, by the way, are abundant all over the US and China. I do not know how abundant they are here but there is a good geologic reason why they are abundant. In the same formations where you have shale, you have an impervious region, which is why the shale gas got trapped. You collect water and if it is 100 metres down it is fresh water and you use it for farming or for wells. If you get down 300 metres and below, that tends to be too saline and it has no value—no commercial value until today, because it is relatively shallow, well below the fresh water and you can use that for fracking. I have talked to Shell Oil’s top people; one official with responsibility for their unconventional gas programme, says his ambition is to move from fresh water to saline water where that is feasible.

The issue of earthquakes is related to the issue of waste disposal. The other thing they are doing—and they are already doing this in China and they are beginning to do it more and more in the US—is to recycle the water. When you pump the water down it comes back and it is highly saline when it comes back and it used to be just let out to evaporate and then trucked away; now they recycle it for the next frack. They can do this and they have been doing it. Basically you take the water, 30% of it comes back out, you can recycle 90%

of that and then you truck away that last 10% of the 30%. So you truck away 3% of what you put in.

So there are good technical developments. It is developing incredibly rapidly. A belief by the experts in the United States is that the efficiency of fracking is going to double in the next few years and in the next 10 years will double again. The UK and China has this enormous advantage that you can now build on our—depending how you count it—30 years or realistically 15 years of horizontal drilling, multi-stage fracking in the United States. So I believe it could go very fast if the resources in the UK are as good as people hope. Sorry for the long statement.

**Q48 The Chairman:** Thank you very much for that, and particularly for your opening comments. As you realise we are focusing entirely on shale in this particular inquiry and we are particularly interested to have your experience of what is happening in the United States.

I do not know if you want to say any more about the regulatory system before we move on to other issues?

**Professor Muller:** Let me just say that the idea that you can regulate with heavy fines really does work. The thought that the regulators cannot cope with the huge number of wells that are being drilled is easily handled by whistle-blowers and sufficiently rewarding people who detect this. Let me also say that there were some very mistaken comments made about fugitive methane. There have been excellent studies done, I give a reference to one of them in my notes. Yes, there were many early studies which raised a red flag and got people very scared. I wrote an article about this in the *New York Times*, and nobody disagrees with me, that the level of fugitive methane that can escape before it becomes as bad as coal is 15%, not 3% or whatever was said here earlier. It is 15%. I can go through that number for you in writing very carefully. It has been published.

Secondly, the studies show that in the fracking itself the average amount that is leaking from the actual fracking—from the wells in the United States, and 140 wells were measured—was 0.4%. The report that came out I also have referenced in the letter that I wrote. So I believe that issue of fugitive methane is simply going to go away. Of course, what the public knows about are the flaming faucets and that also has now been clearly disproven to have come from hydraulic fracking. There is even a good movie, which I recommend, called *FrackNation*, that is almost as enjoyable to watch as *Gasland*, which has Josh Fox caught saying, “Well, of course, I know that there were flaming faucets decades before anybody did any fracking.” “Well, why did you not include that in your movie?” “I did not think it was relevant.” I believe that the terrible exaggerations and distortions of *Gasland* that grabbed the public make it very difficult for you or for any Government to act in a rational way. But there is a short lifetime when people are so deceptive; the public does not like to have been fooled.

**The Chairman:** We were going to ask you about *Gasland* but you have already answered that question.

**Q49 Lord Lawson of Blaby:** Professor Muller, it is very good to meet you and to hear you. You have answered most of the questions that I had. I would just like to underline, perhaps in the form of a question, one thing you said and also clarify something else.

All the evidence that we have seen, or I have seen anyway, is that the geology, certainly in the bit that has been surveyed by the British Geological Survey, in this country is very



similar to that in the United States. The main difference is that the seams of shale seem to be thicker in this country than they are in most of the United States, which is rather a good thing. So all we need to do, as I understand from what you are saying and I would like your clarification, is to learn from the American experience as to what best practice is both commercially and environmentally. Is it not the case there is no reason why we should not learn from the experience of the United States as to what is the best practice commercially and environmentally and then go ahead on that basis?

**Professor Muller:** I agree completely. These are not proprietary, they are not patented; it is widely shared in the industry. The people who work in this business know what is meant by best practice. There are issues, for example, on how much do you cement your wells and how do you it, how many layers? It is straightforward and, yes, the US will be happy to share that information with you.

**Lord Lawson of Blaby:** There is just one other point. You spoke very feelingly about the appalling levels of pollution in the major Chinese cities, and you are absolutely right. But is it not the case that this has nothing whatsoever to do with carbon dioxide as such? The pollution is sulphates, nitrates and other particulates and it is possible to prevent those to a very large extent getting into the atmosphere, even if you are burning fossil fuels—your carbon dioxide. Of course, as Lord May said in the earlier session that you may have heard, carbon capture and storage is all very well in theory but it is not with us at the moment and goodness knows whether it will be, and if so what would it cost.

We had in this country in the 1950s the Clean Air Act and this had a miraculous transformation on the level of pollution in this country. We have continued to burn coal. It is still the major source of—

**The Chairman:** It is still worse in London than it should be.

**Lord Lawson of Blaby:** Maybe, but nobody is dying. It is not remotely like China. The fact is that it is important, is it not, to distinguish between the issue of pollution, which needs to be addressed—which, as I say, is sulphur particles, nitrates and other particulates—from the issue of carbon dioxide that is so far from being a pollutant its main effect is to stimulate plant growth?

**Professor Muller:** I agree with everything you said. In China there are a widely known number of all new coal plants—it varies from year to year, but it has been averaging 1 gigawatt per week, which is in every seven weeks they build the equivalent of an entirely new New York City. This is just for coal. So this is what they have been building. All of their new plants have exquisite and very effective scrubbers added in. A study that I can give you the reference to—

**Lord Lawson of Blaby:** Such as we have here.

**Professor Muller:** Yes, they are really good. The problem in China is soon after the plant is commissioned the local people who run the plant turn those scrubbers off. The reason is economic. This has been well studied and China is aware of it. It is very hard to fight, partly because of the corruption in China, which makes it difficult to inspect these things, partly because there is no local benefit to turning the scrubbers on. In any one plant the contribution to the air pollution is small enough that they cannot spend the money; they do not want to spend the money. So it comes down again to the extent that natural gas offers a cheaper alternative—the key number in all of this pollution, I am sure you know, is called PM2.5, particulate matter 2.5 microns or smaller. This is what gets into the lungs; this is what dominates the air pollution around the world. Natural gas produces 1/400th the PM2.5

compared to coal. 400. So this is a local issue but it is to our advantage around the world to lower the carbon dioxide in China. You may not agree with me that carbon dioxide is a dangerous thing for the future; it does have some benefits. My own thought is that it is something that we should control and at least limit the growth of it while we find out better whether it is beneficial or not.

**Lord Lawson of Blaby:** I am aware of that opinion; all I was trying to say is analytically that is a separate issue. That is the point.

**Professor Muller:** Yes, it is a separate issue. The main reason—I have spoken to many people in China, local people, Government officials, what is driving them I believe—is the need to reduce their air pollution. It is not just reducing it, but stabilising it. They are worried that it is going to get up so large that the kind of events we just saw today are going to become very common. That threatens their Government.

Our reason, other than humanitarian, for doing this is because it is the biggest contributor to global warming in the future.

**The Chairman:** You have already given us some responses to reassure us on American experience, I think what we would like to do, while we have you here, is to probe a little bit further in some of those particular areas and gain the benefit of your knowledge of American experience.

**Q50 Lord Shipley:** Can I use the word “safety”? You said earlier you did not know too much about the UK situation, not least because we are not doing what China and the US are doing yet. But there are a whole set of possibilities. I just wondered if there were things that you think we ought to look carefully at in terms of safety on the basis of the US experience. Are there things that you think might be particular risks in this country? Are there things that on the basis of US experience you think we ought to be very careful about?

**Professor Muller:** The major true environmental issues in the United States came from the dumping of the flowback water into the local region, polluting streams and such. For earthquakes, they came about not from the fracking. Fracking produces tiny earthquakes, magnitude 1 or 2, that cannot be felt on the surface by a human but can be measured scientifically. The larger earthquakes that were produced in the United States came from storage of flowback water in specialised sites and pumping far more water down into those than should have been done. That can be avoided by regulating the use of the flowback water and how that is done with regard to particularly earthquakes. Again, recycling should help with that very much.

The main issues for my mind are making sure the flowback water is handled properly, making sure it is not dumped into the environment.

**Q51 Lord Rowe-Beddoe:** In a radio interview last year in the United States you emphasised the need for “developing and devising methods for clean fracking”. How do you define clean fracking and where are we in this particular development that you suggested?

**Professor Muller:** At that time I was worried about many issues. One of them was the fugitive methane issue, for which there were some very frightening stories. I believe that issue has now been settled. The fear was not based on calibrated measurements and now that those have been done I think we recognise that the danger is not so much.

By clean fracking I refer specifically to the handling of the flowback water and also the piping, although only 0.4% of the methane leaks from the well site, including from the flaring. There

is problems with the piping and the storage of natural gas; it might be another 1% at least there. So that has to be looked at. I believe what I was most worried about, because a year ago we did not have the new data, was the fugitive methane. I do not think that now is a serious problem.

**Lord Rowe-Beddoe:** Can I just ask you something else? You heard I think, as I saw you sitting there, what our previous witnesses were saying about the water and the water problem. If I recall correctly, none of them mentioned the word “saline”, the use of saline water. Is this because they would not know about it or they chose not to talk about it?

**Professor Muller:** No, it is because they did not know about it. I found in the United States that you go to Apache and they are planning to use only saline, I go to the experts at Shell and they have worked out what kind of additives are needed to be put in when you are using saline water versus fresh water, but I go to a different division of Shell and they say, “Well, of course there is a problem; we do not have enough fresh water in many of these formations”. This is relatively new. It is getting a lot of public attention. There are some excellent books that have talked about this. I have even asked people in the industry who know about it, such as Apache, “Would you object to a law that said no fresh water could be used?” and they said, “Well, we would not object but the local farmers would”. The ranchers in Texas make extra money by selling their water and so they are not interested in the saline. But there are large areas of China. The whole Tarim basin, which may be one of the best areas in China, has very little fresh water. I have a map of buried saline in China that I was able to find, and I have shown this at their research institutes, and even in China they did not know anything about this. So I think it is just really new. Quite frankly, about three years ago almost nobody in the United States had heard of fracking. So I do not think it was done on purpose.

I am looking at each one of these issues and trying to see how we can solve them. So I am trying to find solutions to make fracking work.

**Q52 Lord May of Oxford:** I have read your response to the call for evidence and have enjoyed what you have just said, which as you will understand is more or less what I was saying to the three people who preceded you—that gas is a lot better than oil. However, you are completely silent, both in your letter and today, on the fact that the ultimate problem is we are putting roughly a million years’ worth of fossil fuel deposited carbon into the atmosphere each year at the moment and it is having consequences. I would have hoped that you would have some thoughts on it also. You do not present it the way I think—that shale gas is a helpful intermediate on the road to decarbonising energy generation. You are silent on that. Is that because you think it is hopeless?

**Professor Muller:** No, because that was not what I was asked to write about. I believe in the 30 to 50-year timeframe, there is enormous potential for affordable photovoltaic solar. It is improving very rapidly, in part because of subsidies. I believe subsidies work in wealthy countries as a way of inspiring innovation, and it has worked in California. I believe that wind has an enormous future. The main objection now is coming from environmentalists who do not want the landscape to be industrialised. That is the term they used. I think they are beautiful but I understand that issue.

Nuclear power: I wrote an article in the *Wall Street Journal* on Fukushima, I can update that now. I calculated, rather carefully and I have shown this to experts and they nod their heads, the number of deaths expected from radioactivity leakage at Fukushima is—best estimate—28. 15,000 died from the tsunami and they are not erecting a 100-metre seawall all around the island of Japan; they are basically doing very little to prevent that from happening. What

are they doing? Their coal use has been shooting up in Japan. In Germany the coal use is shooting up. This will kill more people than any nuclear reactors would ever kill. So nuclear has a great future. I like the fourth generation nuclear reactors; these currently cannot be used in the United States because of regulatory barriers; current Nuclear Regulatory rules have not been updated to match the designs of these new reactors. Within 30 or 40 years we may have a breakthrough in controlled fusion. Other things: geothermal is not going to work; waves are not going to work; tidal was too specialised. I could go through any one of those. But I am very optimistic about solar.

**Lord May of Oxford:** Thank you very much for an answer to my question. Incidentally the 28 presumably include the people who were killed in decommissioning Fukushima?

**Professor Muller:** All who will die. These are in future from long-term cancers because of the radiation spread. I would be happy to give you the details.

**Lord May of Oxford:** Interestingly, to reduce the carbon associated with aviation we would do better to widely advertise that our chief scientist went and visited Fukushima and he wore a radiation badge as he flew across to Japan and then he wore it during the day he was visiting and he got roughly an order of magnitude more exposure in the aeroplane.

**Professor Muller:** I liken it to something I call the Denver Dose. The Denver Dose is what you get if you live in Denver for a year. Denver is a location in the United States with a lot of granite and there is radon that leaks out and so you get about—forgive the old-fashioned units—100 millirem a year from living in Denver. Much of the area evacuated around Fukushima—not all of it, some of it is still somewhat radioactive but much of the evacuated area—is below the Denver Dose. So either we should let them move back in to that area or we should evacuate Denver.

**Q53 Baroness Noakes:** Could I probe a little bit more on fugitive methane? You have given us a figure of 0.4%, which was new. Where does that figure come from?

**Professor Muller:** The reference is D. Allen et al., 2013.<sup>148</sup> This was a large study that chose 190 wells in the United States. They went to the wells and injected a tracer so they could tell what fraction they were getting out. Then they went to the environment and measured it. By measuring it with respect to the tracer, they could get the absolute number for the leakage. No experiment like that had been done before.

**Baroness Noakes:** So 0.4 was an average. What was the range? Did some have large amounts?

**Professor Muller:** I am afraid I do not remember but I have the article on my computer and we can look it up.

**Baroness Noakes:** It is one of the areas that the EU is citing—fugitive methane—as one of the reasons to stop shale.

**Professor Muller:** Let me say that misinformation was given here by a prior witness; he said 3 percent leakage destroyed the advantage of natural gas over coal. That was based on a simple calculation you can do that is mistaken. The global warming potential is how much global warming is caused by a kilogram of methane versus a kilogram of CO<sub>2</sub>. That number, if you average it over 100 years, is something like a factor of 30 or worse. The number has changed with time but I think the recent IPCC report puts it at around 30. Many people then mistakenly take that number and say only 3% can leak because it is 33 times better or

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<sup>148</sup> Available online at [www.pnas.org/cgi/doi/10.1073/pnas.1304880110](http://www.pnas.org/cgi/doi/10.1073/pnas.1304880110)

worse. What they are missing is that the global warming potential is usually given in terms of kilograms. What you need is the global warming potential of a molecule, because if a molecule of methane burns, it produces one molecule of CO<sub>2</sub>. It turns out that molecule of CO<sub>2</sub> is very heavy but it means you did not have as many kilograms of methane. This is well known.

Even in the famous article that scared everybody by Howarth, in his appendix, which was online, you could find that he had that correct. This is not a controversial issue. I talk about it in the *New York Times* article. The number turns out to be more like 15% to 18% has to leak before it is as bad as coal.

**Baroness Noakes:** That is because of the molecule rate?

**Professor Muller:** It is the molecule and also the fact that natural gas can be burned more efficiently for electricity production than can coal. The plants just work better because you have a gas in the first place and that gets you another factor. So the fact is, no one is going to let anywhere near that much methane leak because it is uneconomic.

**Baroness Noakes:** So if the EU use a methane argument to clamp down on fracking in the European Union, that would be a false reason?

**Professor Muller:** That was a mistaken number that he gave of 3%. It depends on whether you are assuming new plants or old plants what sort of efficiency you put in, but I would stand by the number of 18%. It just means methane is much, much better than coal for any conceivable plants that you build and any conceivable leakage.

**The Chairman:** Lord Griffiths. I think we have done *Gasland*.

**Q54 Lord Griffiths of Fforestfach:** Yes, absolutely. I was going to ask a question about the pace of technological change. In some things I have read about when it comes, for example, to shale gas production in terms of hydraulic fracturing and—I do not understand this—drillable bridge plugs, things like that, and also what you talked about recycling water, presumably in the next three, five, eight years we are going to see tremendous technological change in this area.

**Professor Muller:** Yes, it is happening.

**Lord Griffiths of Fforestfach:** We are now in 2013, but say by 2020, in which ways will technology change and make the case that you are putting forward even stronger?

**Professor Muller:** I think the economic case is going to get better. The cost of fracturing at great depths is going down—not that the cost is going down but the methane, the natural gas that you get back, will increase. I mentioned earlier improved efficiencies. Let me say a word about the geology of this because if you have the surface typically there are cap rocks and deep below that is the shale. The shale we think of as the source rock. Leakage from the shale has been caught in these cap rocks, accumulated, and that is conventional gas. It is like the gold rush where originally people found by panning, but where was this gold coming from? It was coming from “them thar hills”. It was coming from the quartz, where the mother lode was. This is the mother lode. What you do now, you drill down and then you have a kick-off point, you start drilling horizontally. These pipes are flexible enough that you can then curve the pipe and drill horizontally. The typical number is go down three kilometres and then you may go three kilometres horizontally. Then they set off an explosive gun and fracture the rock a little bit, put down pressurised water and sand and that causes the fracture and the fracture grows, typically in a plane because of the way the

rock is. It will grow in a plane. Then what they will do is they will pull that out, they will plug it right here, send in the fracturing gun again and do another plane. So these are the stages.

Many wells now have five or seven stages; some of them are having 20 stages. We already know that not all the stages produce equally well and there is great value in changing that. Why is that the case? We will find out and that will be improved.

Where do you do the fracturing? Right now they just do it equally spaced, and the real experts I know do not think that is optimum but the first gold panners knew that the optimum stuff was up in the hills but the easy stuff you go for first. So we are going to understand that better. When they put in the plugs they drill them out eventually so that everything flows together, but when they are fracturing they put a plug in so the water will only fracture this one and not go into the final frack. When they drill it out that is what they refer to. I have a wonderful movie I can show you on that that helps you visualise what is going on.

What most people do not appreciate is you are down three kilometres and the fresh water is at 100 metres. All you have to do is use decent piping techniques up there and you will not get leakage into the water, unless you dump it on the surface, which is where I believe much of the initial pollution concerns came from.

**Q55 Lord Lipsey:** Could I just ask an off-piste question? In Britain we have just seen one exploration attempt abandoned because of the number of demonstrators who were on the site, marshalled no doubt by some of the people from organisations we had up earlier. Was there a phase in America when similarly fracking was the subject of huge controversy, environmental demonstration and all sorts of problems, or was the wider population spread and the fact it was a long way away from most people keep all that under control?

**Professor Muller:** Fracking developed very rapidly in the United States before the environmentalists became fearful of it. Now we have a serious problem because the environmentalists are now raising issues, many of them valid issues. The issue of the fugitive methane came about because of some early papers that suggested it could be very bad. That was a valid issue to be raised but I believe it has now been answered.

There were issues raised by the movie *Gasland*, which was designed to frighten you. That is still the strongest thing. I go to meetings with environmentalists in Berkeley and I explain the environmental benefits of natural gas, but I also hear people talking about how the movie *Gasland* and the flaming faucets have really given them something to fight for. Quite frankly, it has also been what in the US we would call a cash cow. I do not know what the term is in the UK. But for many of the environmental groups their opposition to fracking has resulted in huge inflows of money, largely I think because of *Gasland*, Josh Fox is considered a great hero in *Gasland*. Just as Ralph Nader was for nuclear power, Josh Fox is taking that.

I have the sense it has been building in the United States and probably the opposition is now the strongest that it has been over the last 15 years.

**Lord Lipsey:** Is there any big corporate support for the opposition from other industries, for example the coal industry, which might think of gas as a threat?

**Professor Muller:** I do not know the answer but I do not think so. I think most of this comes from well-meaning people who found an issue in which they can fight and they believe it is an early stage for fracking so they can exert leverage and really do something and accomplish something, and they have misinformation and are doing it sincerely.

**Q56 The Chairman:** Can I ask you—it may not be exactly your area—do you think the United States will become a significant exporter of gas, and how soon?

**Professor Muller:** I do not know the answer to that. I know, of course, with LNG selling at \$12 to \$18 for a million BTU that could revive—but let me back off a little bit. There is a story that you probably do not know about why the price is so low in the United States. It came about because the leases were written in a way that you had to produce gas within three years or you would lose the right to do that. Meanwhile, there was a rush to buy up these leases and then companies like Chesapeake—who are most famous for this—brought huge numbers of leases. They are still the dominant company in the Marcellus but they had to produce. The price of gas started going down because the demand was not there. Long-term demand is there but the immediate demand did not grow as quickly as this and so the price crashed down below \$2. At this point it was uneconomical to do any more drilling and Chesapeake had a great problem. Almost half the cost comes from the fracking, half of the cost comes from the drilling. Once you have done that it just sits there and just spews out the gas. So we have this great excess of gas and several of the facilities built around the United States were import facilities, and they quickly made plans to turn them into export facilities. In the last two months two of these have now been approved, one of them on the east coast, one in Texas. There is going to be one in Los Angeles.

Meanwhile in the United States petro chemical companies have moved their facilities to Qatar and to the Middle East, because that is where the natural gas is—natural gas is not easily transported, it has to be liquefied and that is expensive and it is energy expensive. So there are some technologies developing on that too to make it less expensive, to store the heat energy that you extract when you cool and then use that. So there is a lot going on there. Qatar had built a huge fleet of exports and now the US petro chemical companies want to move it back to the US and take advantage of the low price, which is still in my mind artificially low. I did not look it up today, I should have, but the price has been around US\$3.75 per million BTU. I am glad to be able to use BTU in a place where it originated—British thermal unit, the energy to raise one pound of water one degree Fahrenheit. But that is the unit that is used and I expect the price, which is now \$3.75, to go up to around \$4.50 and more or less stabilise there.

Whether the US is going to be using that internally for their petro chemicals, whether it is going to be exporting it, depends on whether the rest of the world develops their natural gas. There is a huge thirst for this. It is not just China that has air pollution—India too. So the way that is going to develop, I do not have the vision to know.

**Lord Lawson of Blaby:** There is certainly an indication, as far as I am aware, that the petro chemical industry and other similar industries that would use this as a feedstock are moving to the United States, away from Europe, in order to take advantage of this.

**Professor Muller:** Yes.

**Lord Lawson of Blaby:** So obviously they have taken the view—they may be wrong—that a fairly low price is likely to persist, because they would not go through all the hassle of moving their production to the United States if they did not think that.

**Professor Muller:** I say I thought the price would go up from \$3.75 to \$4.50. I am not an expert on this by any means but I read articles by experts who do not ignore any clear issues and that is what they say. I think \$4.50 would still make sense to move to the United States.

**Q57 The Chairman:** Professor Muller, are there any concluding thoughts that you would like to leave us with?

**Professor Muller:** Well, right now we are fighting misinformation, and there is a huge amount of it. We are fighting some doctrines and one of the problems is that the general public finds all of energy to be too complex and certain things such as fracking have many little facts that confuse them. So they are looking for a simple principle. Several of these environmental groups have come up with one, which is to oppose all fossil fuels. That simplifying principle is one that is easily adopted by someone who wants to do the right thing and it sounds plausible.

We are in a situation where that simple mantra breaks and not all fossil fuels are equivalent. For global warming natural gas is much better than coal. The pollution issues with coal are terrible. I resigned from the Sierra Club in 1984 over the issue of them deciding to oppose nuclear. The letter I wrote, which unfortunately I do not have a copy of, mentioned global warming because I knew Roger Revelle personally and I knew all about that issue, and said, “This is going to drive the United States to far, far more use of coal”. When I talked to the Sierra Club about this they said, “No, it is going to drive us to solar”. I knew solar was enormously expensive back then and they had this dream that you create this market and the price of solar will come crashing down and it will all happen. I call this optimism bias. For some reason people who are opposed to natural gas imagine the regulators will not be able regulate, and that the local people will allow the fugitive methane. They are very pessimistic about natural gas.

I look at natural gas and I compare it to coal. Any engineer who wanted to solve the environmental programme, given coal or natural gas, would say that natural gas is just 400 times easier. But the public lumps them together and that is what we are up against. There is a great deal of information here but there are some very effective propagandists who are exploiting the public fear, as they did with nuclear. We in fact did not develop solar in the 1980s, but I am hearing similar things now. We are much closer. As I said, I am optimistic on solar in 20, 30 years.

One of the biggest oppositions privately from the environmental groups—it was mentioned here today—is the fact if we have a cheap alternative then there will be less of an incentive to develop solar. My answer is the same as it was in 1984, I said, “If we do not develop natural gas then it will be coal that will come in”. I have mentioned the rate at which Japan and Germany are both expanding coal now, and China of course continues to go for coal. China are very proud of the fact that they get 20% of their power from renewables. This is often cited. That 20% of renewables means Three Gorges Dam. This is a nice number, you will see this in the literature. 1.2 million Chinese citizens volunteered to leave their homes and towns so the Three Gorges Dam could be built. It is a wonderful thing they can get that kind of consensus in China. They have many more dams in mind.

**Lord Skidelsky:** I have one off-the-record remark, and that is about the environmentalists. I think they want energy prices to rise because they want growth to stop. That is really at the bottom of it, I think.

**Professor Muller:** Certainly some environmentalists are that way.

**Lord Skidelsky:** Not all.

**Professor Muller:** Jeremy Rifkin, when cold fusion was invented, was quoted in the newspaper saying, “This is the greatest disaster of all time”. Cold fusion would be completely clean and turned out to be completely wrong, but he was very upset this would



mean more energy was available. I am much more optimistic about the future. Our population seems to be settling down. It will get up to 9 billion. With energy efficiency increasing 2% per year, which I think we can do, we can have the entire world population living at the European standard of living in the year 2100 and be using less energy than we are now. So I am very optimistic about it.

**Lord May of Oxford:** Can I give you one counterfactual? HSBC has been trying to trying to reduce the carbon footprint of their employees, per person carbon footprint. They have succeeded in every country except the United States.

**Professor Muller:** Interesting fact.

**Lord May of Oxford:** It has gone up year on year for the last 10 years. Do not be too optimistic.

**The Chairman:** I think on that interesting note, we have run out of time. Thank you very much indeed for a stimulating appearance. Thank you for coming.

**Professor Muller:** Thank you very much.

## National Grid—Written evidence

### • Introduction to National Grid

- National Grid owns and manages the grids to which many different energy sources are connected. In Britain we run systems that deliver gas and electricity across the entire country. We hold a vital position at the centre of the energy system. We join everything up.
  - National Grid is at the heart of one of the greatest challenges for the UK energy industry - to deliver low carbon energy in an affordable, secure and sustainable way. This is an industry wide challenge that will require an estimated £200 billion of investment up to 2020 to transform the UK's energy infrastructure. Ensuring the development of an energy system that can underpin our economic prosperity in the 21st century.
  - We develop scenarios, based on extensive industry and stakeholder feedback, which present pathways to decarbonisation. These scenarios are detailed in our **UK Future Energy Scenarios**<sup>149</sup> (**FES**), the latest version of these were published in July 2013.
  - These scenarios are used as a reference point for a range of modelling activities, enabling us to identify strategic network investment requirements for the future. Our scenarios do not predict the future. They explore a range of plausible outcomes and the complete scope of potential drivers that might have an impact on that outcome. This year we have developed two scenarios:
4. **Gone Green** has been designed to meet the environmental targets; 15% of all energy from renewable sources by 2020, greenhouse gas emissions meeting the carbon budgets out to 2027, and an 80% reduction in greenhouse gas emissions by 2050.
  5. **Slow Progression**, where developments in renewable and low carbon energy are comparatively slow, and the renewable energy target for 2020 is not met (Slow Progression reaches this level sometime between 2020 and 2025). The carbon reduction target for 2020 is achieved but not the indicative target for 2030.

### • Shale Gas Overview

- As explained in our Future Energy Scenarios<sup>150</sup>, shale gas is natural gas that is found trapped within shale formations. It can be recovered through a process called 'fracking' which involves drilling wells deep into the dense shale rocks that contain natural gas, then pumping in at very high pressure quantities of water mixed with sand and chemicals. This opens up tiny fissures in the rock, through which the trapped gas can

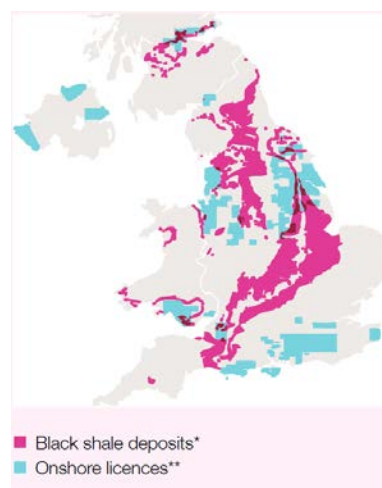
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<sup>149</sup> <http://www.nationalgrid.com/NR/rdonlyres/A3A03257-3CCC-40DD-99C8-500A149D997D/61591/UKFES2013FINAL1.pdf>

<sup>150</sup> <http://www.nationalgrid.com/NR/rdonlyres/A3A03257-3CCC-40DD-99C8-500A149D997D/61591/UKFES2013FINAL1.pdf>

then escape. It bubbles out and is captured through the wells that bring it to the surface, where it can be piped off.

- Shale gas has become an increasingly important source of natural gas in the United States of America since the start of this century. In 2000 shale gas provided only 1% of US natural gas production; by 2010 it was over 20% and the United States government's Energy Information Administration (EIA) predicts that by 2035, approximately 50% of the United States' natural gas supply may come from shale gas. The evolution of shale gas production in the USA has altered the market dynamics of America's domestic gas market (downward pressure on wholesale gas prices) and global energy markets (US coal exports making gas-fired power stations the marginal fuel source for electricity generation in Europe).
- Given the impact of shale production on the US domestic gas market, other countries, including those in Europe, have been investigating their indigenous shale gas sources. In the UK in 2010, a British Geological Survey/DECC Shale Gas report identified significant potential areas of shale gas reserves in northern England, including Widmerpool Gulf near Nottingham and a large area centred on the Elswick Gasfield, near Blackpool. The illustration below shows the potential shale formation across the UK.



- However there are considerable uncertainties regarding the development of UK gas supply, these include:
  1. Further clarity on UK shale gas reserves
  2. Government policy and initiatives
  3. Test drill results
  4. Environmental and planning consents
  5. Structure of UK gas market
  6. Production economics
  7. Supply chain logistics, for example availability of drilling rigs.
- If UK produced shale gas can be developed economically then it is recognised that the shale gas reserves could provide a material contribution to the UK gas supply mix in the future.

- When considering shale gas from a networks perspective, it is important to note that existing network arrangements for gas entry to the National Transmission System (NTS) and Distribution Network (DN) will apply to shale gas, as they do for all gas sources. Therefore, shale gas injected into the network must meet UK thermal energy regulations and gas quality criteria.
- The application of the current regulations and requirements to new sources of gas will continue to be reviewed, and updated where possible. For example, a class exemption for oxygen content has recently been issued by the Health and Safety Executive.
- Fundamentally shale gas should be considered as being no different to other gas produced; hence developers need to follow the existing arrangements for gas entry that apply to all gas sources.
- As such National Grid believes that network entry to the NTS and DN (subject to meeting existing arrangements) should not be seen as a barrier for UK shale gas development.
- If shale gas becomes a significant contributor to UK gas supplies, this would represent an important development that we would need to take account of in relation to future network investment - potentially in relation to both the NTS and DNs, therefore it will be important that developers provide us with a clear understanding of the scale, timing and locations of potential shale gas developments.

- **Questions posed by this Inquiry**

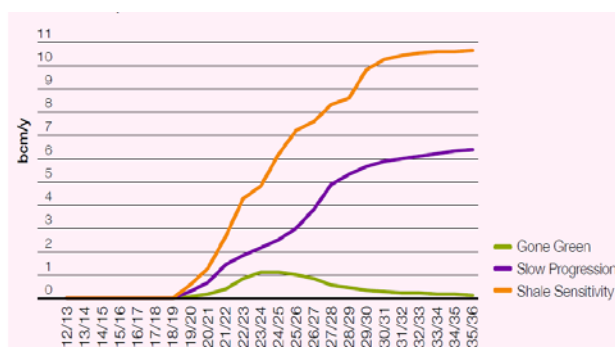
- **How much scope is there for shale gas and oil to be used in the UK? Over what timeframe?**
- The exact volume of shale reserves within the UK is subject to a considerable amount of uncertainty. A recently published report<sup>151</sup> from the British Geological Survey (BGS) in association with DECC, stated shale gas reserves in central Britain<sup>152</sup> of 1,329 trillion cubic feet (tcf), equivalent to over 37,000 bcm. It is anticipated that only a modest proportion of these reserves may be extracted, ranging from 10% to 30%. At a conservative recovery rate of 10% and annual UK gas consumption rates of about 80 bcm, this could provide 46 years of gas supply. However, none of this has yet been developed so there is no UK based evidence on which to draw.
- In our FES Slow Progression scenario we assume that wells will be drilled in line with the public projections of shale developers. We then assume that production from each well will be similar to the average performance from wells in the US, the only market where significant development has taken place. In this scenario production rises to around 6 bcm/yr by 2035, around 15% of total gas demand. In the Gone Green scenario there is less demand for gas so there is less incentive to develop shale gas. In this scenario the total production from shale peaks at around 1 bcm in the mid 2020s but declines to zero by 2035.
- It is recognised that the development of shale gas reserves could provide a material contribution to the UK gas supply in the future, and as such as part of FES we have

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<sup>151</sup>[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/209021/BGS\\_DECC\\_BowlandShaleGasReport\\_MAIN\\_REPORT.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209021/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf)

<sup>152</sup> An area between Wrexham and Blackpool in the west, and Nottingham and Scarborough in the east.

considered a specific sensitivity case study for shale gas alongside core scenarios. We have developed high shale sensitivity in which more wells are drilled and in which the rate of production from each well is in line with the best seen case from US operations, rather than the average. In this sensitivity shale production rises to around 11 bcm/yr by 2035. It must be stressed that due to the uncertainty of shale developments, even this sensitivity may not capture the full development potential. Our scenarios do not include any assumptions about shale oil production.



- **What forms of electricity generation is shale gas likely to displace and by how much?**
- The effect that shale gas will have on the UK gas price is not clear, but at the volume included in our scenarios, where even in the high shale sensitivity, shale makes up around 15% of the total, the price is unlikely to be depressed to the same extent as has been seen in the US.
- At this level of production it is more likely that the gas price will be strongly influenced by the price of gas on the European market and by the price of LNG on the world market. Currently the relative prices of coal and gas mean that coal fired generation earns a much better return than gas fired generation, so that gas is now the marginal fuel for generation. In the short term there would need to be a 50% fall in the price of gas or the international coal price to double before gas became the favoured fuel for generation. In our scenarios with common fuel prices, gas remains more expensive than coal as far as 2035. In the Gone Green scenario the Carbon Price Floor, introduced in April 2013, shifts the balance back towards gas from coal, but by the time there is a significant volume of shale gas available it is likely that most of the coal fired generating capacity will have closed under the Industrial Emissions Directive (IED). Shale gas is therefore unlikely to displace coal fired generation.
- As part of the Electricity Market Reform (EMR) low carbon generation will be supported by contracts for differences. It is therefore not clear to what extent cheaper shale gas could displace low carbon generation.
- **Will shale gas and oil increase UK energy security?**
- Gas produced in the UK can increase security of supply, hence if UK produced shale gas can be developed economically then it is recognised that the development of shale gas reserves could provide a contribution to the UK gas supply mix in the

future. However, as detailed previously, there is considerable uncertainty as to how much shale will be developed in the UK.

- **What lessons can be learnt from the US experience of shale gas and oil?**
- Anecdotal evidence from the venture capital and cleantech communities in the US who we work with closely suggests that the emergence of shale gas has had a negative impact on cleantech investments. Business cases for new and emerging clean technologies are based on the high cost of traditional fossil fuels. As this falls, the business case for cleantech erodes and they find difficulty in attracting investors. As the corollary to high and uncertain gas prices driving investment in alternative fuels and solutions, it appears low and sustained gas prices have the opposite effect.
- A number of venture capitalists, in the US, seem to be shifting their investment trends towards smaller more distributed technologies and looking for oil and gas technologies to replace traditional renewable technology investments. They believe the risk associated with large scale renewable technologies and projects is too great against the backdrop of a shale gas dominated energy future, in the US.
- Shale gas and low carbon generation can co-exist providing there is certainty in policy around overall carbon emission targets and that the majority of fossil fuel generation has carbon capture and storage.

*October 2013*

Oxford Institute for Energy Studies and Durham Energy Institute—Oral evidence (QQ 127-133)

**Oxford Institute for Energy Studies and Durham Energy Institute—  
Oral evidence (QQ 127-133)**

Transcript to be found under [Durham Energy Institute and Oxford Institute for Energy Studies—Oral evidence \(QQ 127-133\)](#)

Rt Hon Owen Paterson MP and Dr Tony Grayling —Oral evidence (QQ 268-287)

**Rt Hon Owen Paterson MP and Dr Tony Grayling —Oral evidence (QQ 268-287)**

Transcript to be found under [Dr Tony Grayling and Rt Hon Owen Paterson MP—Oral evidence \(QQ 268-287\)](#)



Peter Hughes Energy Advisory, Lambert Energy Advisory and Liberium Capital—Oral evidence (QQ 196-206)

**Peter Hughes Energy Advisory, Lambert Energy Advisory and Liberium Capital—Oral evidence (QQ 196-206)**

Transcript to be found under [Lambert Energy Advisory, Liberium Capital and Peter Hughes Energy Advisory—Oral evidence \(QQ 196-206\)](#)

The Petroleum Exploration Society of Great Britain (PESGB) and Geological Society of London (GSL)—Written evidence

**The Petroleum Exploration Society of Great Britain (PESGB) and Geological Society of London (GSL)—Written evidence**

Submission to be found under [The Geological Society of London \(GSL\) and the Petroleum Exploration Society of Great Britain \(PESGB\)—Written evidence](#)

## Policy Exchange—Written evidence

### Introduction

- Policy Exchange is one of the UK's leading think tanks. We are an educational charity whose mission is to develop and promote new policy ideas that will deliver better public services, a stronger society and a more dynamic economy.
- Our vision is for climate and environment policies that are sustainable - achieving society's environmental goals at least economic and social cost. Scientific evidence shows the natural environment is under considerable pressure from human development. This poses risks to both the variety of nature and human prosperity. Environmental challenges need to be tackled while minimising adverse impacts on living standards. The social and economic needs of the present should be met without compromising the ability of future generations to meet their own needs. A pluralist approach usually provides the best way to achieve outcomes for society. Well-designed, regulated markets – with competing decision-makers given the freedom to innovate, respond to new information and fail – have been far more successful in achieving benefits for society than private or government monopoly decision-making.
- In 2012, Policy Exchange published *Gas Works? Shale gas and its policy implications*. Much of the material in this submission is based on the findings of that report.<sup>153</sup>
- Shale gas, and gas more generally, has the potential to serve as a transitional fuel while remaining consistent with required emissions reductions. However, commentators who argue with great certainty that shale gas is the answer to future energy needs fail to recognise uncertainty about the future and neglect the importance of developing zero carbon technologies to meet long term emissions reduction goals. But gas sector developments do present the prospect of gas becoming a cheaper than previously expected transition fuel to a low carbon future.

### Specific questions

- ***How much scope is there for shale gas and oil - from domestic and overseas sources – to be used in the UK? Over what timeframe?***
  - At present, the prospects for shale production in the UK remain unknown. The work carried out by the British Geological Survey and others has demonstrated that the resource in the ground is substantial. However, establishing the economic viability of those resources requires commercially-oriented exploratory drilling, which is only just getting started. It is simply too early to say whether the abundant resources can translate into ample production.
  - The industry has moved relatively slowly and painstakingly so far. While undoubtedly frustrating to those who advocate in favour of shale gas as a solution to UK energy policy challenges, and to the companies concerned in exploration, it may prove beneficial for the industry's development that it take these early stages with great caution. Problems or mistakes while the industry is still in its infancy can be amplified, and long-term prospects potentially jeopardised if public opinion is lost.

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<sup>153</sup> Moore, Simon; *Gas Works?* Policy Exchange; 2012; [http://www.policyexchange.org.uk/publications/category/item/gas-works-shale-gas-and-its-policy-implications?category\\_id=24](http://www.policyexchange.org.uk/publications/category/item/gas-works-shale-gas-and-its-policy-implications?category_id=24)

- The UK gas market could also experience consequences of shale development in other places. The US shale glut has had a dramatic impact on the energy market – the USA has moved from being a major consumer of LNG to eliminating LNG imports. That this coincided with Japan’s recovery from the 2011 tsunami and the Fukushima nuclear disaster meant that the rapid increase in Japanese LNG demand could be handled by the market without too much disruption. As new sources of gas supply (including shale sources) reach the market, and as national markets become increasingly interconnected via LNG shipments, developments in other parts of the world have an increasing bearing on each other. While the cost of LNG shipping probably mitigates against the LNG market becoming as comprehensive as the oil market, it does mean that ‘gas islands’ are increasingly scarce. The UK market will be influenced more by changes to demand and supply patterns overseas.
- The size of the global oil market, and of UK shale oil resources, means UK shale oil production is less likely to have a noticeable effect on prices overall. Nonetheless, if domestic production can be cost-competitive, it may help, to a small extent, to alleviate security of supply concerns, or provide spare capacity that can be produced in the event of an extended disruption to overseas supplies (such as a prolonged conflict in the Middle East).
- ***How will the costs, including those on the environment, of accessing the UK’s shale gas and oil deposits compare to those of other sources of energy?***
- Without any indication of the cost of shale production in the UK, a definitive answer to this question is not possible (indeed, I would be suspicious of anyone claiming to know exactly how cheap or expensive UK shale production is going to be – they’re usually trying to sell something).
- Many of the local environmental problems cited with shale gas are perhaps better understood as problems with the featherweight regulation prevalent in parts of the US. Future production in Europe (and elsewhere) will be able to learn from the US, not just about best and safest production practices, but also about appropriate regulation. Industry could also do more: perception that the shale gas industry is a bad neighbour is likely to hinder its ability to secure drilling sites.
- Concerns about risks from shale gas production in relation to water quality, seismic activity and water scarcity need to be taken seriously, but, on the basis of current evidence, do not justify imposing a moratorium on shale gas production. Government and the industry should focus on effective and more rigorous regulation than has been seen in parts of the US. Groundwater protections and waste treatment regulations are stronger in the UK. Likewise, requirements about chemical disclosure are much more forceful.
- The costs of complying with such regulation should be a price worth paying for the industry, to protect investments in exploration and production, and something that the industry should actively seek where there are any gaps. Looking to the future, it is important that the UK maintains a strong and effective regulatory regime, which addresses any new issues that arise, and enables a safe shale production sector to develop.
- ***What is the potential impact of shale gas and oil on the local economies in areas where development is possible?***
- It is difficult to assess precisely the direct impact of shale gas and oil for local communities, which could range from extremely minimal to the more significant

(particularly if the drilling takes place in small villages). However, it is important to stress that local communities should benefit more directly from new development, such as shale, in their area. This depends on the planning structure that is put in place. Currently, the UK has great difficulty in building any type of new infrastructure, be it new housing or new energy infrastructure. This is partly the result of restrictions on how we use different pieces of land. But it is also the result of our failure to properly incentivise communities that are affected by new development to accept it. Our current system provides 'community' benefits, but often fails to provide direct benefits to those who lose out economically through new development (perhaps through reduced house prices). We should be more comfortable with incentivising people to welcome and encourage development near them. This is particularly the case for new energy development, such as shale or windfarms. The government has made some sensible steps in this area, but it remains limited.

- ***What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?***
- At present, the gas generation (plus carbon price) is cheaper than any other major generation type except coal (again, plus carbon price). Despite sharply rising gas costs over recent years (at least in the European market), and falls in the costs of some renewable technologies, they have yet to reach the point where they can out-compete gas generation in an unsubsidised market. Nuclear, meanwhile, remains a mystery, as cost estimates cannot be deemed reliable until demonstrated by a real-world project –the ongoing uncertainty around the state of the Hinkley Point project does little to support the idea that nuclear offers a definitively cheap electricity source.
- The impact of shale on this is, once again, uncertain. In the US, shale gas has had a drastic impact in reducing prices (cutting them from over US\$10/tcf at their 2007 peak to around \$4/tcf today), to the extent that much existing coal and some nuclear generators have been driven to closure. If the most optimistic appraisals of the UK potential were to come true, then a similar scenario could be seen in the UK. A more modest price impact would have a more modest impact on the fortunes of gas generators and their rivals. At this stage, it is impossible to judge the scale of the impact of shale on UK gas prices, and consequences for the generation market. The best approach would be to ensure that the generation market remains flexible enough to take advantage *if* shale reduces gas prices significantly (or, for that matter, if the costs of other technologies change). The Government's EMR programme, however, looks likely to have the opposite effect, making the market less flexible and more dependent on Government projections of future technology costs.
- ***Will the UK electricity market be easily able to incorporate shale gas in future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?***
- The Government's Electricity Market Reform programme has seriously undermined the ability of the UK electricity sector to adapt to changing circumstances in the future, including, for example, significant shale gas production. The sector will be much more reliant on central government decision making, about the size of the generation sector, the technologies that will operate in it and

the prices different technologies (and even different power stations) will be able to earn. The Government will need to decide how many Contracts for Difference (CfDs) it is willing to offer to different low-carbon generation types. These decisions will affect how much of the market remains for conventional generation, including gas generation, which will also be supported in the capacity market simultaneously created under EMR. The complicated interaction of the different arms of EMR then combine with the price of carbon emerging from the ETS and the commodity prices of coal and gas as generators attempt to work out how much gas generation capacity to invest in, and how much of it to run. In the last couple of years, depressed prices for coal and carbon have combined to leave gas generation out of the money and often idle, while coal generators use up the hours they have remaining while profit margins are highest (before they have to close due to EU regulations).

- The Government portrays its choice of CfDs as being a way of reducing risk, by reducing exposure to future high (and volatile) gas prices. But if gas prices fail to rise by as much as the Government has anticipated, its preferred approach to Electricity Market Reform will impose very large additional policy costs on the public, on top of unnecessarily high carbon reduction policy costs already in place in the Renewable Energy Strategy. Using DECC's own figures, opting for CfDs exposes bill payers to potential policy costs more than £10bn higher, if gas prices are low, than a carbon pricing approach would if gas prices turned out instead to be high. As such, it represents a gamble on gas prices a decade and more from now - one being made with bill-payers' money.
- The Government's preferred (CfD) approach also carries another important type of risk. The approach requires a central decision maker (government or a quasi-government agency) to take decisions on capacity levels, generation mix and prices paid, instead of the market. This substantially reduces the market's role in responding to price signals and new information as that emerges, including about fossil fuel prices, technology costs. Such new information should be feeding into market decision-making in a timely way, so that market players can begin to respond by altering investment and innovation plans and portfolios, and operation decisions. Instead, a central planner has less information and fewer incentives to make and adapt decisions in a way that minimises the costs of keeping the lights on and reducing carbon.
- The Government's proposals for Electricity Market Reform based on Contracts for Difference are unsuited to a world of considerable uncertainty, in particular about future gas prices. They gamble with bill-payers money on a high gas price future and risk imposing a high policy cost on consumers if that does not materialise.
- As long as the UK is part of the EU ETS, no unilateral action to drive faster UK electricity decarbonisation, including CfDs, will result in lower EU emissions than set by the ETS cap. All it can do is to alter how much of the burden for meeting that cap is borne within UK borders. Higher UK-only carbon prices and all other national emissions reduction policies in industrial sectors covered by the ETS, have zero impact on overall EU carbon emission up to 2020.
- So, given the assumption that the ETS will continue and the desirability of a geographically broad carbon market, the right policy should be to focus on bolstering carbon pricing using the ETS mechanism. Focusing on a strengthened EU ETS would, if gas prices turn out to be cheaper than previously expected, allow gas generation to play a substantial role as a transition fuel, while ensuring required emissions reductions are achieved. Lower gas prices could feed through to lower

energy costs. And lower energy costs enable more resources to be devoted to stimulating the low carbon innovation needed to achieve 2050 carbon targets.

- **What form of electricity generation is shale gas likely to displace and by how much?**
- It is too early to say whether shale gas will have any material effect on UK electricity generation patterns. However, if we assume that UK shale can be produced cost-effectively, the answer to the question of how it should be used will depend on the state of energy policy. Ideally, a strong carbon cap or price would steer electricity production from using coal to gas. Similarly, a policy based on carbon pricing rather than target-based support for particular technologies would be unlikely to develop as much of expensive renewable technology options such as solar PV and offshore wind. With widespread low-cost gas availability, reliance on these cost-ineffective decarbonisation options could also be reduced or scrapped.
- **What impact will shale gas and oil have on household energy bills?**
- As with most other questions, it is simply too early to be able to meaningfully quantify the impact shale gas will have on energy bills. All that we can say at this stage is that, if shale production can be achieved economically (a big if), it is displacing some more expensive source, (at the moment LNG imports are the most expensive marginal supply source). In other words, if it is more expensive than any other way of getting gas, then shale gas will not be produced. So, in that sense, shale gas production will lower prices, at least compared to what they would otherwise have been. However, the extent of the price reductions is unknown.
- **What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**
- In our report *Gas Works?* we surveyed the range of research that had been carried out on emissions from shale gas compared with both ‘conventional’ gas production, and emissions from coal. The report concluded, that while fugitive emissions from shale gas production meant a very slight increase on ‘conventional’ gas production, claims that shale gas was ‘worse than coal’ (most prominently made in arguments by Cornell University researcher Robert Howarth) were not justified.<sup>154</sup> Further analysis, including the recent report by DECC Chief Scientific Advisor David MacKay supports our findings.<sup>155</sup>
- The more important questions are whether shale gas (and increased use of gas more broadly) is compatible with climate change objectives, and how policy can best enable it to be. The best tool for achieving this is the EU’s Emissions Trading System. A sufficiently tight cap on emissions (i.e. one that is in keeping with both UK and EU stated ambition for emissions reductions by 2050) is very likely to see gas generation displace coal generation in the short term. In the longer term, the ever-tightening cap would also provide a clear signal to investors in gas generation as to how long they can expect to operate before they too will need to close. A reformed ETS should provide the policy to ensure that gas functions as a transition

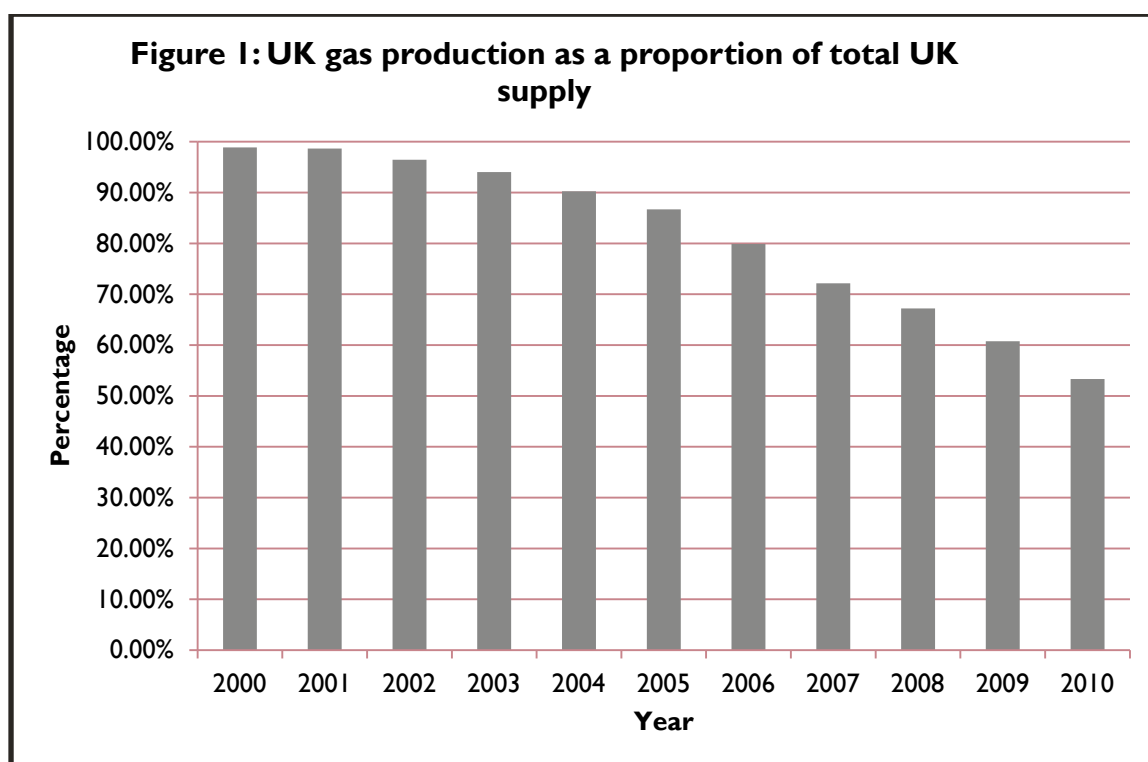
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<sup>154</sup> Moore, pp 39-44

<sup>155</sup> MacKay, David and Stone, Timothy; *Potential greenhouse gas emissions associated with shale gas extraction and use*; DECC; 2013; [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237330/MacKay\\_Stone\\_shale\\_study\\_report\\_09092013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf)

fuel, by providing both the short-term signal needed to bring in into the mix, and the longer term signal that will eventually lead to it coming out again.

- If gas prices reduce as a result of shale production, savings in energy costs from utilising gas generation could provide a large pot of resources that society can choose to deploy. Invested in effective innovation support – research, development and demonstration, and early stage deployment of a range of low carbon technologies with global potential. The climate impact could be far greater than spending the money mass deploying hugely expensive offshore wind, which seems unlikely to become a cost-competitive major global contributor to carbon reduction. Carbon emissions from electricity, under the EU ETS cap, would be the same under either approach.
  
- **Will shale gas and oil increase UK energy security?**
- Arguments about energy security – and security of gas supplies in particular – have tended to be overplayed in the UK policy context. Responding to the rapid decline in North Sea gas production (Figure 1), the liberalised gas market has delivered a 500% increase in import capacity over the past decade, all built privately.<sup>156</sup> Access to LNG imports gives the UK great diversity of supply sources (Table I). In the event that one supplier proves to be unreliable, or is forced offline, many others can fill the gap.



<sup>156</sup> HM Treasury; *Energy Market Assessment*; 2010; p. 12



<b>Table 1: UK gas sources in 2010<sup>157</sup></b>	
<b>Country (LNG if specified)</b>	<b>Volume (bcm)</b>
UK production	57.1
Norway	26.6
Qatar (LNG)	13.9
Netherlands	8.1
Trinidad and Tobago (LNG)	1.6
Belgium	1.3
Algeria (LNG)	1.3
Nigeria (LNG)	0.4
Yemen (LNG)	0.3
USA (LNG)	0.2
Egypt (LNG)	0.1
<b>TOTAL</b>	<b>110.7</b>
<b>TOTAL MINUS EXPORTS</b>	<b>95.1</b>

- Concerns about the behaviour of Russia and some of its neighbours, while troublesome for some central and eastern European countries, with less access to alternative sources of supply, have little direct consequence for the UK. The UK is not a destination for Russian or Caspian volumes. The countries at the other end of our major gas pipelines – Norway and the Netherlands – are not prone to capricious interference with their energy exports.
- Of course, the UK gas market is linked to other European markets and may thus to a degree be affected by those markets. The main effect to date has been for UK gas exports to Europe to rise in recent years, despite decreasing North Sea production. The UK has become Europe's 'Western Gas Corridor'. Domestic shale gas production (and deeper European integration of gas markets) would further solidify this position.
- DECC, in its response to a 2011 House of Commons enquiry into shale gas, said it "does not believe that security of supply considerations will be the main driver of policy in relation to the exploitation of shale gas in the UK".<sup>158</sup> It would be reassuring if a similarly measured approach were taken in relation to wider political debate and energy policy formation.

<sup>157</sup> BP; *Statistical Review of World Energy 2011*; London; 2011; pp. 22-28

<sup>158</sup> Department for Energy and Climate Change; Shale Gas: Government Response to the Committee's Fifth Report of Session 2010-12; London; 2011;  
<http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1449/144904.htm>

- ***What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help to ensure sufficient UK energy supplies? How will this investment be financed?***

No response

- ***What changes to public policies are necessary to maximise the potential of any shale gas development?***
- EMR presents significant barriers to shale gas development. By undermining the responsiveness of the market to changes in technology costs, it reduces the incentive to lower costs in several areas, including in gas prices. However, despite our reservations, it looks like EMR is going to be introduced. The next important step is to try and navigate a way back to a competitive, liberalised market as soon as possible. This is not straightforward, but is a necessity if the UK is not to lose the benefits that privatisation and liberalisation bought. The centrally-planned approach of EMR is also less likely to deliver the kind of cost-effective decarbonisation efforts that are imperative if we want other countries to follow the UK's example and reduce risks from increased carbon emissions.
- There also needs to be an increasing focus on credible, consistent and long-term carbon pricing frameworks, which enable gas to play a positive role as a cheap, lower carbon transition fuel, but ensure that investors have clear signals about the long-term carbon reductions needed. Given that the UK and other member states are going to continue with the ETS, their focus should be on creating a longer term, more certain carbon cap. Creating effective banking and borrowing mechanisms should also have the effect of bringing permit prices up today – one of the objectives of those arguing for a tighter 2020 cap. There should at all times be clarity about the cap or price at least 15 years in advance. Work should begin immediately on establishing the Phase IV cap, with the intent to establish that cap through to at least 2035 at a level in accordance with scientific understanding about required emissions reductions. If, after Phase IV negotiations, it becomes clear that the political or market design challenges to the ETS have not been overcome, and the ETS, in the wider policy context, remains inadequate to the task of providing a long-term, credible carbon pricing framework, then the arguments for shifting to an EU-wide carbon tax are likely to become stronger. Either way, the key is to have a credible long term pricing framework.
- ***Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?***
- The simple answer is, yes, if the UK were to produce shale gas or oil in any quantities they would almost certainly displace imports, some of which may come from “less reliable” countries. However, the more complex answer is, yes but it doesn't matter much.

34. The amount of gas the UK presently imports from Russia is negligible. Russian gas supply interruptions can have knock-on effects for the UK market, as supplies to Central Europe from the East tighten, exports from the UK to the Continent can rise, with some consequence for price. However, as the UK still has decent amounts of domestic (conventional) production, access to reliable pipeline supplies from Norway and the Netherlands, and copious LNG import capacity, it is very well-placed to withstand supply interruptions even in the absence of shale production. A hypothetical low-probability high-impact disruption that shut off access to a key LNG exporter (Qatar being the most obvious

example) would have consequences for global LNG prices, which would certainly rise. Again, with its diverse range of sources, the UK would be comparatively well-placed to withstand such an event (although costs would rise in the UK as well as for other LNG importers). While gas use in the electricity sector may be able to be substituted by other generation technologies, industrial and heating uses are less easily switched at short notice. The best protection against such a possibility would be ensuring the widest possible range of gas supply is available to the world market, which may be achieved through overseas shale production as well as expanding LNG liquefaction facilities. Increased domestic production (conventional or unconventional) would help, but this should not be the main driver behind shale policy.

**13. What lessons can be learnt from the US experience of shale gas and oil?**

35. There are many lessons to be learnt from US experience, both positive and negative. They include:

- In the right circumstances, shale gas can help reduce greenhouse gas emissions while simultaneously lowering energy costs. In this sense, it is a hugely beneficial technological breakthrough and one that should be welcomed.
- Regulation matters. Much of the regulation of shale gas in the US occurs at the state level, meaning there can be significant variations in environmental compliance. Ensuring that environmental protections are rigorous and that well engineering is state-of-the-art is important, both for the environment and for public confidence in the industry.
- Public relations matter. Especially early on in an industry's development, small problems can take on outsized significance. As an example, unwillingness to disclose the composition of fracking fluids (for commercial reasons) gave the impression of an industry with something to hide, which has only belatedly been recognised and only partially been addressed. While UK operators have been more open, the damage done by US practices has not been fully repaired.

## Policy Exchange Environment & Energy Unit

What we stand for

**Scientific evidence shows the natural environment is under considerable pressure from human development.** This poses risks to both the variety of nature and human prosperity.

**Environmental challenges need to be tackled while minimising adverse impacts on living standards.** The social and economic needs of the present should be met without compromising the ability of future generations to meet their own needs.

**A pluralist approach usually provides the best way to achieve outcomes for society.** Well-designed, regulated markets – with competing decision-makers given the freedom to innovate, respond to new information and fail – have been far more successful in achieving benefits for society than private or government monopoly decision-making.

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*September 2013*

**Poyry International Consulting Engineers and Professor Alan Riley  
—Oral Evidence (QQ 1-16)**

TUESDAY 8 OCTOBER 2013

*Evidence Session No. 1*

*Heard in Public*

*Questions 1 - 16*

Members present

Lord Lipsey (Chairman)  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord May of Oxford  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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**Witnesses**

**Professor Alan Riley**, City University, and **Richard Sarsfield-Hall** and **John Williams**, Poyry International Consulting Engineers

**Q1 The Chairman:** Gentlemen, welcome to this first meeting of the Lords Economic Affairs Committee on the subject of fracking. You are our very first witnesses. We will gain at least some credit for having chosen a subject that has suddenly become immensely topical, so it is good to start with very expert witnesses this afternoon. Copies of members' entries in the register of interests are available in the room, if there are any. Could you please speak loud and clear, not only for the shorthand writer but because you are on television? We will see how many of the striking statements will be used, but you and we are on television. Our questions will be addressed mostly to you all, but if you agree with each other, there is no need to say so. A forceful nod will suffice and satisfy the cameras too. Could you, therefore, please keep up your voices? Would anyone like to make a brief opening statement?

**Professor Riley:** I could start by making a few observations about the potential economic impact. Would that be agreeable?

**The Chairman:** That would be very helpful, because we have not yet had written evidence.

**Professor Riley:** We really begin with the US experience. No one expected the shale gas revolution in the United States. Even as late as 2008, the US Energy Information Administration was saying to American policymakers and the incoming Obama Administration that the US would have to import large amounts of liquid natural gas to deal with the supply gaps, and this would potentially create another energy security issue for the United States. In addition to being dependent on oil, they were going to be dependent on gas from around the world. Therefore, the shale revolution came as a shock to American

policymakers, never mind the rest of the world. It is a shock that you would have to describe as one that is almost entirely positive to the United States. You see enormous amounts of investment going into the US economy, not just directly into the role shale gas and shale oil plays but in terms of the pipeline infrastructure and the energy services industries. What is really interesting is the scale of the investment in energy-intensive industries: chemicals, where gas is not just an energy source but also a feedstock; fertilisers, where natural gas is 80% of the substance of artificial fertilisers; and steelmaking. You see a resurgence of US manufacturing and the onshoring of US manufacturing being brought back from China and elsewhere. That is reinforced partly by rising Chinese labour costs. You have rising Chinese labour costs and falling US energy costs. At the moment, the differential is about \$3.50 to \$2.70 MMBtu—millions of British thermal units—whereas in Europe we are paying about \$10 to \$12 MMBtu. That gives you some sense of the scale of the difference.

The question is: how easy is it to repeat that in Europe and the rest of the world? There are lots of differences. The Americans have a well-developed industry. They have developed over time large numbers of companies that can deal with this, both small and large; the energy services industry to support it; and very open markets. One of the major factors is that the land owners and not the Crown own the subsoil rights, so that creates substantial incentives to develop. There is also a regulatory industry that is very familiar with all the technology in many of the states that deal with this, such as Texas or Pennsylvania. That gives the US immense advantages.

Having said all that, there are lots of other parts of the world that will be interested in developing the resource base. One of the major points is that the resource base is very large indeed in other parts of the world. Traditionally, for Russia, which is supposed to hold the largest conventional resource base in the world, one takes the figure of 47 trillion cubic metres. According to the US Energy Information Administration, China has 36 trillion cubic metres of recoverable shale gas. Recoverable is not the same as proven, but it gives you a sense of the scale of what potentially the Chinese could pull out of the ground. Argentina has about 20 trillion cubic metres; Mexico has a similar figure. There are large numbers for Australia, South Africa and Ukraine, and there are questions about how much is available in Europe as well.

The geo-strategic point worth making here, which reinforces the incentives to develop, is that for the past 30 to 40 years we have lived in the 80:10 ratio world. Some 80% of all the oil and gas in the planet is in OPEC and Russia, and 10% in OECD countries and China. Essentially, the shale revolution potentially implodes that ratio and changes the geo-strategic energy balance of the planet. Although it is geo-strategic, it creates huge incentives to development outside the United States, particularly in China and elsewhere.

**Q2 The Chairman:** That was extremely helpful. Perhaps we may now go into questions. As it happens, my first question follows from that and is perhaps best directed at you. To put it very simply, how much of this stuff does Britain have, and how much might be economically exploitable?

**John Williams:** In terms of how much Britain has, the British Geological Survey recently reported that, on their central case, there were 1,300 tcf of shale gas in place. How much of that is technically recoverable? The range of what is technically recoverable from the gas in place varies. It may be between 10% and 20%, or a little more or less. It is uncertain. All we have to go on is the evidence and experience of the States. We have not drilled sufficient test wells anywhere in Europe to have a good understanding. As Alan said, all

shales are different. Although we know that gas is there, it is difficult to know how easy it is to get out; what it will cost to get out, and whether you can achieve commercial flow rates once you have fracked the rock and gas is flowing.

However, if you take 10% of the BGS figure of 1,300 tcf, GB demand is about 2.83 tcf a year. Although it is the wrong analogy to use, there is enough to meet GB demand for 50 years. It is not as simple as that, because you cannot get it all out in 50 years; the time frame is much longer than that. There is plenty there. If it proves to be technically and economically recoverable, it could play a role in the GB mix.

The question that follows from that is whether in GB and Europe as a whole we can replicate the experience we have seen in the States. Our view is that we cannot replicate the impact on prices. The GB price is made up of a number of sources of gas. The marginal source of gas sets the price. We see that the marginal source at the moment and into the future is likely to be LNG. In order to displace LNG imports, plus Norwegian imports, for GB to become self-sufficient you would have to approach a level of production far in excess of what we think is realistic.

We published a report at the end of last year. We are now hoping to revisit that, but it is the most up-to-date analysis that we have. Most of you should have a copy of that. This analysis was based on a production profile supplied to us by Cuadrilla. That saw the production of shale commencing in 2014-15, ramping up relatively quickly and reaching a production level of 20 BCM by 2034-35. That would represent about 25% of GB demand. We ran that profile through our models and looked at the potential impacts on gas and electricity wholesale prices. We saw a marginal reduction of between 2% to 4% on average across gas and electricity wholesale prices. Therefore, even with an indigenous resource supplying 25% of national demand, we still saw only a marginal price reduction.

**The Chairman:** Is that 25% of the demand for gas or of the total energy demand?

**John Williams:** The demand for gas.

**Richard Sarsfield-Hall:** The charts are on pages 4 and 5 of Pöyry's 2012 Point of View on the potential impact of Lancashire Shale Gas on the UK Energy Markets, if that helps to visualise it. If you look at page 4, in the chart at the bottom left the light blue element of the gas is the amount of shale that would be forthcoming from that production profile. That is a "what if that happens". There is a lot of uncertainty about whether you can achieve those levels, but if you did, it would represent about 25% of our demand.

**The Chairman:** If this does eventuate, is this a complete turning over of the British energy scene, as it were, so all sorts of things come into question, like whether or not we need a nuclear programme, or is it a useful but not fundamentally revolutionary change to the energy scene?

**Professor Riley:** I can see what Poyry are saying and they may well be right, but the real difficulty—the American experience suggests this can be the case—is that we just do not know the scale of the resource base. A couple of exploratory wells have been drilled. Until we have a significant degree of exploration, we cannot tell what the scale is. We need commercial drilling at some scale—a few hundred wells—before there is any sense of the direction in which this is likely to go.

If you look at some of the recent developments in the United States, there have been surges of gas production. At the moment, production is being suppressed only because there are not enough pipelines to move the gas. The jury must be out on scale. Clearly, if we start talking about a scale as large as 10 BCM, it will start to have a significant effect on prices.

We just do not know. It is probably quite sensible to take a conservative view. One of my overall observations on all this is that at the moment government policy should be focusing on creating a scheme, perhaps starting with the Bowland shale, that encourages a significant degree of exploration, even if that means having a special licensing round for that shale to get it going. Rather than sitting here talking about hypotheticals, we would have some data.

**Q3 Lord May of Oxford:** It is my impression that some aspects of the shale gas deposits in the US are significantly different from those in the UK, and I understood you to affirm that. To what extent does that undercut comparisons between estimates in the US and here?

**John Williams:** That is absolutely right. All shales are different. Until you start drilling and testing, you do not know; there is so much uncertainty. For instance, an example is the Bowland shale, which is meant to be about 1,000 to 1,200 metres thick, compared with the typical US shale, which is perhaps a fifth of that. Some of the shale developers tell us it means they can do a number of laterals from one vertical well at different thicknesses, so more gas can be extracted from the same physical footprint on the surface. However, we do not know. There is so much uncertainty at the moment about what can be extracted commercially. Until there is more evidence and it is not just conjecture, the jury is out.

**Lord May of Oxford:** The Chancellor of the Exchequer with great enthusiasm has announced very generous tax breaks for companies developing shale gas fields. On the other hand, Ed Davey, Secretary of State for Energy, has expressed himself in a slightly more equivocal way and talked about “safe and responsible exploration of shale gas in the UK in line with the UK’s climate change targets”. Is the Government policy and regulatory framework suited to encourage early and substantial development and use of shale gas and oil in the UK?

**Professor Riley:** One of the difficulties here is that we have never done shale gas before. It is quite different. First, apart from places like Wytch Farm in Dorset—which, would you believe, is western Europe’s largest onshore oil field, not that you would notice it was there—other minor developments and coal mining, we have very little experience of onshore fossil fuel developments, certainly for oil and gas. In addition, the nature of what we have to do involves many more wells. You are extracting from much greater depths and there is more disturbance. Therefore, there will be questions about the extent to which our regulatory systems for oil and gas development, which in modern times are based largely on our North Sea offshore development, fit for what we are going to be doing onshore. There are lots of different questions. One issue is whether the Petroleum Act 1934, which I believe transferred oil and gas rights from landowners to the Crown, is sufficient to carry out shale and oil development at scale. Although the Crown owns the oil and gas development, the question is: to what extent can you drill through the shale without the permission of the land owner? In a sense, have we properly transferred the legal rights to the land to the Crown sufficient to exploit the oil and gas underneath it?

There are broader legal insecurities about how far all the permitting regulations apply to underground developments; there are issues about the seamlessness of how you run the Health and Safety Executive’s and Environment Agency’s analysis and the planning permission in one go without creating very serious regulatory red tape problems for the industry, while providing significant rights to local communities and others to make their presence felt in the process. All those issues are there.

The other major issue is community benefit and the extent to which communities should be engaged with it. The Government have started down this line, but one of the questions is



whether 1% of the revenue for local communities and £100,000 is sufficient. Should there be a greater sense of ownership? Should there be an equity stake in the shale gas companies for local communities in some way? How should local authorities then be involved in economic development? One of the issues from the American experience is that it is not just about shale gas development: it is the potential for actual economic development and the multiplier effect. How in regulatory terms do you provide for that and engage with communities in local economic planning? All those issues are there and need to be explored and developed, and I do not think we are ready for that yet.

**Q4 Lord May of Oxford:** Let me add to that a meta-level question. As you surely know, we have primary legislation that commits us to a trajectory of 2030, and then 2050, of playing our fair share in ameliorating the threat of climate change. That is based essentially on decarbonising the energy supply, preferably by 2030 or shortly after. That is flatly inconsistent with whacking more carbon into the atmosphere. Primary legislation is supposed to set legally binding targets. Nobody has ever been able to tell me what they mean by “legally binding”. My suggestion was that you fire the Chancellor who did not get there. My opinion—I am not joking—is that we are on trajectory to the 2030 target but by virtue only of the recession, and we will certainly not be on trajectory to 2050 unless we perpetuate the recession. I have asked in questions downstairs: does that explain some of the Chancellor’s policies? Do you think there are substantial arguments going on between the Chancellor and Secretary of State for Energy? How does the juxtaposition of primary legislation’s assertions of what we are doing—decarbonising things—sit with this opportunity?

**Professor Riley:** The answer to that question is that the Climate Change Act was developed quite reasonably in a different era prior to shale.

**Lord May of Oxford:** Shale is better than coal, but it is still putting out carbon.

**Professor Riley:** The fundamental problem is that when we started to look at this back in 2006 and putting in place these structures and the renewables strategy that would decarbonise the economy, it made a lot of sense both environmentally and commercially. We saw what appeared to be a structural increase in demand for fossil fuels from China, so there was no harm in Europe going down the direction of expensive renewables because fossil fuels were going to be expensive as well and, what is more, there would probably be a shortage. Therefore, the policy we adopted to create an expensive, subsidised renewable strategy to decarbonise the economy made sense. What we did not expect was that the shale revolution would transform the energy paradigm, so we are now in a situation where we will have access to enormous amounts of resources as the US are pumping out not just shale gas but shale oil. The latest Belfer Center study from Harvard is saying that by 2017 the US will be producing 6 million barrels of shale oil a day. Last year the US imported 8 million barrels of crude a day. The effect is that the US will be dumping or displacing enormous amounts of oil on to global markets between now and 2018, which will significantly force down the oil price. That is before we talk about anybody else in the world following the US path, if you leave Europe out of this.

The effect is that the ability to maintain the expensive and subsidised renewable strategy is not sustainable. To quote John Maynard Keynes: “When the facts change, I change. What do you do?”. The great challenge with climate change is that we have to be able to reconcile climate change objectives with the shale gas era. There are ways of doing it, but we have to create a different sort of climate change strategy to get where we want to be. In the short to medium term, this means moving in a direction of cutting out coal and using

more gas to get the cuts in CO<sub>2</sub> emissions, but we have to create alternative approaches to cutting CO<sub>2</sub> emissions beyond that phase. I agree that at the end of the day we have to decarbonise fully, but with the strategy we have at the moment it is going to be increasingly difficult to work because of the amount of existing fossil fuel resources worldwide and the effect that will have on price. That is where we are.

**Lord May of Oxford:** As I understand it, you have said that because other people are not doing their share, we should abandon any attempt to fulfil our legally binding legislation. I have some sympathy for that, but it seems to me that is what you said.

**Richard Sarsfield-Hall:** You have mentioned decarbonising energy primarily by 2030 when our obligation is about trying to achieve dramatic reductions on the electricity side. We must not forget that currently 20 million homes are heated by and use gas for cooking. That demand cannot be displaced, and is not assumed to be displaced, over that period. That is why when we are considering the analysis we showed you earlier, we are looking at what seems to be a sensible projection as to gas usage. Gas is also going to be needed in the power mix in the future. Some of our colleagues have previously made presentations to different Committees here about the impact of no wind and too much wind. The power system will have to react to all that, so gas will need some mix in the future on the electricity side. Effectively, we all have a choice: do we want to import shale gas from America or elsewhere via LNG, or do we want to produce our own shale gas for heating homes, even if not so much of it is needed on the power side?

**Q5 Lord Hollick:** Professor Riley, you gave us a fairly long list of complex policy and regulatory challenges that need to be addressed. Do you have any recommendations on how those should be addressed, and any particular policies that you think that need to be addressed radically if we are to move forward?

**Professor Riley:** I have two stages to this. At the very beginning of my opening statement, one of the points I was making, which my colleagues have made as well, is that there are too many unknowns in all this. We do not know the scale of the resource; we do not know how easy it will be to get it out of the ground. All these things are true. Rather than having all this speculation, one very valuable step would be to try to encourage a rapid degree of exploration, perhaps creating an exploration Act simply for the Bowland shale. Licences have not been awarded for the whole area of the Bowland shale. The next onshore licensing round is the 14th. Let us have a 13.5 just for the Bowland shale and get some exploration going and some data and, if necessary, create it in some sort of structure as a national planning priority to find out. This is not to drill and to produce: it is merely to explore and create a regime to do that quite quickly. If there is a lot of resource available, we can at least have a national discussion about what we do with it, because at the moment we do not know. The issue is having some information about it and the need to do something to get that information.

**Q6 Lord Griffiths of Fforestfach:** I should declare my interests, which are published in the Register of Members' Interests, particularly as a board member of Goldman Sachs International, which is wholly owned by Goldman Sachs New York and which may advise companies in this field, but I have no personal interest in this area of the bank's work. I have little technical knowledge of shale gas. When you started, you gave the impression that there is enormous uncertainty about the physical side of this and how you get gas out of the ground from various kinds of shales and so on. We do not know; we need a scale to do it. When will we have certainty as to what we would be able to do, if we wanted to do it?

**John Williams:** That question depends on how many wells are drilled. For instance, in the past two years China has drilled about 130 wells and found that only four or five had anything like potentially commercial volumes. Poland has drilled wells. There is now one shale gas-producing well in Poland, but a number of others have shown disappointing results from the test drilling. I do not think I can answer your question about how long it would take and how many wells would be needed. They could hit a good one first go; they might hit it on the 40th, 50th or 100th go. Some of the evidence from either the Marcellus or Barnett shale play in the States is that it was not until hundreds of wells had been drilled that they realised they could produce in commercial quantities. In answering your question, it depends on how quickly the developers, Cuadrilla, IGas or anyone else, are able to carry out these tests and exploratory drills.

**Richard Sarsfield-Hall:** The fact that Centrica have invested £40 million, with a proposal to invest another £120 million, in exploration implies that at least technically they think there must be something there. You would not make that level of investment without having some expectation of success. It does not guarantee success, but maybe that is an encouraging sign.

**Lord Griffiths of Fforestfach:** We would expect to see that over, say, the next two years or so.

**Richard Sarsfield-Hall:** Absolutely.

**Professor Riley:** This takes me back to my essential point that we need to encourage more exploratory drilling to know what is there. If we were to have several hundred operations, we would get a much greater sense of what is there, and then we can make decisions about what we want to do.

**Q7 Lord Shipley:** I would like to pursue the regulatory framework with Professor Riley. You made a statement about US states having a much clearer regulatory framework; there was a public framework that everybody understood. Then you referred to ours and some of the criteria to be followed, which are based well in the past. Do you have any view about what should be done to the regulatory framework in the UK, driven partly by the potential for shale gas and, more generally, concerns being expressed in other fields about the regulatory framework in which people have to operate being a little out of date, for example particularly in marine areas? Have you produced anything that could help us on what might be done, or what we might think about doing, to improve that regulatory framework within the UK?

**Professor Riley:** I have lectured on some of this but not written about it. There are a number of issues. The major problem is what I referred to earlier. The entire approach to oil and gas has been focused on offshore. Recalibrating for onshore will be a major task. I do not think we have entirely captured what that involves. We can learn a lot from the American experience. One of the major differences, for example, is scalability. You start off perhaps with 10 wells and then go to 100; you may go to 1,000. You must have the regulatory capacity to deal with that, but you also have to look, for example, at the availability of back-up water treatment facilities to deal with the different types of waste that come out of developing shale. We have not been used to that, and it would be quite a new feature of the operations.

The other issue is that you can have many more wells and you need to secure them. One of the problems with the movie *Gasland* is that it rather missed the point. The problem is not the focus on fracking but the traditional oil and gas problems: security of the wellhead

and ensuring that flow-back waters cannot seep into the ground. All this is known by the regulators, but we have never had to deal with it on any scale onshore. We will have to get to grips with scalability and work out how to build it into our regulatory systems. I do not think that has been thought through or appreciated yet. That is quite understandable. We have not gone to scale, but we need to think about it and look at a lot of the American experience.

**Q8 Lord Rowe-Beddoe:** A large part of my question has been touched upon already but not answered specifically. I understand that there are many “what ifs”. What in your opinion would be the timeline for such an appraisal of what could be there, and when it could be brought into production? In other words, what is needed to get this thing moving? If I may make a non-political point, successive Governments have glorified themselves in not taking decisions on our energy requirement until it is almost too late.

**John Williams:** We are looking at some analysis at the moment. It is not yet finalised, so I cannot say anything concrete, but we are looking at a best and worst-case scenario in terms of licence application through to development. We are talking about the very start of the process, and even in the best case, potentially it is about five years.

**Lord Rowe-Beddoe:** From now.

**John Williams:** No; that is from licence application. We are already some way down the line with the Bowland shale, but if things go well, bearing in mind Cuadrilla will not now be drilling until 2014, we would still be looking at best case two years following that before anything is produced, but it is more likely to be three to four years after that. That is making a lot of assumptions about things going well. A lot of things could happen in the process to delay that further.

**Lord Rowe-Beddoe:** The Secretary of State for Energy said in a speech last month that it would not be until the 2020s, which is a decade.

**John Williams:** That was regarding seeing any significant volumes produced. I think that is right.

**Lord Rowe-Beddoe:** Is that the beginning or end of the decade, because it is a large time span?

**John Williams:** I will hedge my bets and say it is about the middle.

**Professor Riley:** I am not sure I wholly agree with that. One of the factors we have to take into account is that the US experience, which we are looking at, is of an entirely experimental industry, starting way back with George Mitchell in 1981. This is an industry where you have immense development of technology with a fantastic technology curve and innovation going on all the time, reducing costs, increasing production and using new seismic technologies to work out where the sweet spots are and so forth. There is a period in which you have to get to grips with shale and work out how it works, but once you have got through that and begin to know how it works, you have at least the potential of significant growth in production in a relatively short period of time. You can see that in some of the modern shale developments. A lot of the recent work has been on shale oil, but you can see production starting off in 2010 in Eagle Ford. I have to check these figures, but it was from the very low base of 10,000 barrels a day. By 2013, it is about 500,000 barrels a day. The US can do it much more easily because they have the rigs and the service industries to deliver this, but it gives you a sense of the ability to ramp up production. There is the technical and physical ability to do it and there is the regulatory system to

support it, but it can be done. We are unlikely to be able to replicate that in the UK, but it shows what can be done. We may be able to take adaptations and learning from that to get to a point where we obtain production more quickly, but unfortunately there are a lot of what ifs with all this.

**Lord Rowe-Beddoe:** I am sure we will take the experience of America. Do you think that, with all these unknowns but a potential that could be quite extraordinary, we should delay or look again at decisions, for example Hinkley Point, which is no nearer to being resolved than it was yesterday, last year or three years ago? I have a feeling that the lights might be going out quite shortly while we still wonder and ponder.

**Richard Sarsfield-Hall:** It comes back to my point about the difference between what is needed for the electricity system and what is needed from a gas perspective. There is no doubt that on the electricity side we are going to see continued reduction of capacity from coal stations closing under various directives and nuclear stations coming to the end of their lives, so there will be a need for new generation. The electricity market reforms are designed to do several things all at once, including promoting a decarbonisation agenda, but if anything is delayed, building new gas-fired generation can happen quite quickly.

**Lord Rowe-Beddoe:** How quickly is “quickly”?

**Richard Sarsfield-Hall:** It takes only about two to three years to build a gas-fired power station. A lot of them have got planning applications, and the economics just need to be there to do that.

**Lord Rowe-Beddoe:** Do you think Hinkley Point ought to be hurried along a little just for security?

**Richard Sarsfield-Hall:** Hinkley Point is designed to help in the next decade; it will not be built in the next couple of years. If you are worried about the lights going out in the next couple of years, it will not help you one way or the other.

**Lord Rowe-Beddoe:** What would then?

**Richard Sarsfield-Hall:** Personally, we are not convinced that the lights are going to go out.

**Lord Rowe-Beddoe:** But if they were to go out?

**Richard Sarsfield-Hall:** A lot of capacity is currently mothballed, for example gas-fired capacity, and there is always the option of reversing some of the coal plant closures, potentially those that are going closer to that point, but that would be a bit of a doomsday scenario.

**Q9 Lord Smith of Clifton:** Professor Riley has already touched on this. Shale gas output in the US has already led to significantly reduced gas prices there. In terms of the impact on the UK, would exports of shale gas from America affect the energy market in the UK and elsewhere regardless of what happens with shale gas development in the UK?

**Professor Riley:** That is very interesting. I understand that at the moment over 20 LNG liquefaction plant permits have been put into the US Department of Energy. If all that was brought on stream, we would be talking about 200 billion cubic metres of capacity. This year the Russians exported only 160 billion cubic metres of gas, so it gives you a sense of the scale. There are restrictions in the US on the sale of gas abroad, but if the Transatlantic Trade and Investment Partnership agreement is signed and ratified by the US and the European Union, all those restrictions disappear. Aside from the actual environmental planning required by the Federal Energy Regulatory Commission in the US—FERC—all

those could go ahead. No longer would any export licences be required, so TTIP could act as a real motivator for the development of light LNG. Enormous amounts of LNG are available. A series of studies in the US suggests that it would have very little effect on US pricing. There is a sense that this could be done and delivered, and perhaps all 20 liquefaction stations could go ahead. The question is: at what price? The current US price is around \$3.70 MMBtu. We will not get gas at \$3.70 MMBtu, because you have to liquefy it, transport it and regasify it. There are different numbers. The gas would probably come into the market at around what we get it for at the moment, which is about \$8 to \$10 MMBtu, but it would be a significant alternative source of supply. One of my observations is that if Europe decides not to develop shale gas, potentially it could end up being an American LNG-Russian pipeline play in a liberalised market, which would not be too bad. There would supply diversity and some degree of competition.

The other argument is that all this gas is all very well but it will go to Asia. I am not sure that is necessarily the case simply because there is going to be so much gas available in Asia from Australia, the Canadian west coast, possibly Alaska and also east African offshore. All that creates a significant source of supply into Asian markets anyhow. A lot of that gas will probably end up in European markets rather than elsewhere.

**Richard Sarsfield-Hall:** While 200 BCM sounds like a very large number, whether there is sufficient gas to support that export is not always clear, bearing in mind that it will be used in North America first before it gets exported. Linked to that, a lot of people may apply and do a lot of this work with the expectation that it gives them options as to whether they do or do not do things. They have built 130 BCM of regasification capacity on the expectation that that is what America needed. It transpired that it did not. This is another way they are trying to get a return from that investment. We are not convinced that all those would proceed by any stretch.

**Q10 Lord Hollick:** Natural gas currently accounts for about a quarter of electricity generation. Do you see shale gas increasing or maintaining that? Is that the main use of shale gas, or will it be available domestically?

**John Williams:** In the UK there are two debates going on. There is a debate about natural gas and its role in the future energy mix, whether that is power generation, households or industry. There is another debate going on about shale gas. The anti-shale lobby focuses very much on the environmental and safety issues, but the gas debate focuses on the role of gas in the mix. There is no distinction between the different types or sources of gas. If we produce shale gas in GB, it could go to power generation or households. It is not a specific type of gas that will be pigeonholed for one use or the other; it is just natural gas that will be in the mix along with other sources of natural gas, whether that is the remaining UKCS gas or imports via LNG or Norway. Once it is in the transmission system, it is all the same. Gas demand is gas demand; gas supply is gas supply, and they tend to match each other regardless of the source of demand or supply.

**Lord Hollick:** In light of the potential for significant exports of LNG from the United States, why do you think Centrica decided recently not to proceed with a £1.25 billion gas storage facility?

**Richard Sarsfield-Hall:** That comes down to how you need the gas to be produced and stored. Once you have liquefied natural gas and put it on a ship—there are lots of ships out there, so it can go to lots of different parts of the world—it can be transferred to different parts of the market at different locations. Great Britain already has a great diversity of supply, with gas from Norway and links to the continent and links via liquefied natural gas to

the rest of the world. You do not necessarily need lots of gas for security of supply or storage but just to balance everything out. Liquefied natural gas can come to this country in the winter and go to other markets in the summer, for example. You do not necessarily need lots of storage to do that, especially with those other links. UK shippers already access storage via the links we have with the continent, so we have different options.

**Lord Skidelsky:** If the price of gas is going down and the price of other sources of energy is going up, presumably the proportion of UK power generation for which gas will account will go up. That is the expectation. It is now 24%. I am just asking an obvious economic question.

**Professor Riley:** The issue is scale. If it is a couple of billion cubic metres, it will have a marginal impact on prices and use. If it is larger, it will have an impact on prices and use. My initial thought is that we end up pushing a lot of coal and probably also other sources of energy that are expensive out of the mix. We may have regulatory structures to look after certain types of renewables. From the American experience of shale gas, it is interesting that you had a very significant increase in US production from shale, but renewables have largely remained in place and have risen in use because of the subsidy structure put in place to keep a lot of renewables.

**Lord Skidelsky:** That depends on subsidy, but we are talking here of the world price.

**Professor Riley:** The world price is different.

**Lord Skidelsky:** Given that growth in demand for electricity is relatively slow in the UK, what other sources of power will be displaced: nuclear power, wind, coal?

**Professor Riley:** Coal and nuclear. We have seen in the US the mothballing or closure of coal-fired power stations, and a lot of the plans to build new nuclear have just stopped.

Another point we have not touched on is the potential, if there is gas available at scale, for it to be used also for other purposes apart from power. In terms of the multiplier effect, there is its use in the chemical and steel industries and for artificial fertiliser. If you have a lot of cheap gas—this is one of the tremendous American potentials—you have a significantly expanded gas market where you use it for natural gas vehicles. That could provide a very significant new use for gas. It has a CO<sub>2</sub> impact in terms of reducing overall emissions and it will remove a lot of particulates from the air, which is a great positive human health benefit as well. In the US, the advantages are so great at the moment that, if you have a compressed natural gas vehicle, the cost is roughly \$1 instead of \$4 a gallon. You can see the incentives to use it.

**Lord Skidelsky:** Why do you think it has had the effect in the United States that, on the one hand, there has been huge investment in shale, but, on the other hand, investment in renewables continues at the rate it does?

**Professor Riley:** I think it is because the federal and state subsidies for renewables have remained in place and they have been structured in such a way as to encourage their continual deployment. One of the ironies of the situation is that because overall you have got a cheaper fossil fuel source, the burden of renewables on the overall economy is far less, and you can take the subsidies.

**Lord Skidelsky:** That subsidises them.

**Professor Riley:** Yes.

**Richard Sarsfield-Hall:** It is not just the case in the United States; China installed more offshore and onshore wind than anybody else last year, for example. Wind is getting traction in lots of different places that are developing other sources of energy. That reinforces the point that developing shale gas does not necessarily mean you displace any other forms of electricity generation per se. Electricity generation in that mix will be subject to its own policy objectives, in particular what the electricity market reforms are trying to achieve in terms of both delivering the low-carbon agenda as well as delivering affordable and secure sources.

**Q11 Baroness Noakes:** A related question is whether the UK's marketing policy framework is sufficiently flexible to absorb large amounts of shale gas. We have talked about renewables continuing, but they continue because of the subsidy structure. The question is: if large amounts of shale come into the market, does that put pressure on the structure that supports renewables? Will we expect to see the market itself having to evolve because of the impact of shale gas, or is it simply going to be absorbed and the subsidies will be left in place?

**John Williams:** In my view, it will be absorbed. It comes back to the point I was trying to make earlier about the debate on gas in the overall energy mix in GB. If gas remains a primary fuel source in GB for power generation in whatever form, whether that is filling in in the next few years because of a risk of low-capacity margins or providing a back-up to power generation, for households, industry or new sources of demand like CNG, it will continue to play a role. At the moment, our indigenous UKCS gas is declining and will continue to decline over however many years until it runs out. Shale gas will replace that UKCS and may, if it is produced at scale, push out some of the imported gas and reduce import dependency. Shale gas, even if it is produced at levels of 50 or 60 BCM, which in our view is quite optimistic, would simply displace imported gas and would not fundamentally affect the energy mix in the UK.

**Baroness Noakes:** Is there a level at which you would expect a market impact?

**John Williams:** We and Alan may have different views on this. Our view is that the price of gas in the UK is set by the marginal source. In order to have a significant impact on the price of gas in the UK, you would need to be displacing that marginal source, so you would need to be knocking out all the LNG, the Norwegian gas and imports from the continent. We think there will be a reduction. If you think of the marginal source as being built up like a stack, as more shale gas comes in, it knocks the marginal sources and more expensive ones off first. That is why we think we will see a reduction in prices. However, we do not think there will be a significant reduction in prices, or anything like we have seen in the States, unless we see a similar situation whereby the UK became self-sufficient once again, which would imply production to meet not only GB demand but also the demand of the interconnectors that could export to the continent. You would probably be looking at production in excess of 80 to 90 BCM to see a very significant price impact.

**Richard Sarsfield-Hall:** The only caveat to that, as Alan was saying, would be if you saw a major transformational effect of shale gas being developed worldwide, and that is not going to happen in the near term. If a lot is developed in China, Russia, Argentina and across the world, you may see a major global transformation of gas prices and the effect in the United States being repeated elsewhere, but that is a lot of ifs, and it is not going to happen in the short term.



**Q12 Baroness Noakes:** Professor Riley, Mr Williams suggested that you might not agree with him. Is that the case, or not?

**Professor Riley:** The issue comes down to the capacity of the resource base. I am not sure I agree entirely with the numbers. You might get a market response well short of 90 or 100 billion cubic metres. If you look at the Norwegian response to liquidity in the marketplace, unlike Gazprom, which was willing to take loss of market share, it cut prices to respond and gained market share. The Norwegians have replaced the Russians as Europe's greatest gas supplier, which most people do not seem to have noticed.

If you had a situation where a substantial amount of supply was being provided from the Bowland shale, say 50 billion cubic metres—well short of the 80 my colleagues have talked about here—I suspect you would get a Norwegian response, which would be to cut prices to maintain market share. Even without a full-scale global development of shale gas, you could imagine a situation in which there was supposed to be more LNG liquidity after 2015. If that were the case, they may well be willing to compete in the open British market with lower prices.

With all this, the difficulty is that one is trying to guesstimate the response of market operators in a situation that currently does not exist. If you look at the Norwegian experience and their response to additional supply in the European market, they were willing to respond to it and break the link between oil and gas in long-term supply contracts and offer better deals.

**Richard Sarsfield-Hall:** We are talking about when shale gas hits scale, which is the middle of the next decade, and that just happens to be at a time when the Norwegian supplies start to decrease unless they can find a lot of new gas. They may well look to use their existing offshore infrastructure perhaps to go after shale. We have been talking today about onshore, but there is a great potential offshore that has not really been investigated. You already have a lot of infrastructure out there. People would love to be able to extend the life of their existing kit offshore, maybe by going after shale under the North Sea, so that is another factor we have not really looked at.

**Professor Riley:** One of the really interesting issues is about putting some research money into R and D for offshore UK shale. I suspect that enhanced ultimate recovery techniques are being carried out to some degree offshore already. That is probably a form of fracking going on offshore anyhow. The industry does not want to talk about it too much to avoid attracting attention, but probably normal enhanced recovery techniques are going on to some degree anyhow, but there is that potential.

The other thing is that we are an island. One of the advantages of being an island is that we may be able to do inshore drilling from the shore outwards quite significantly. That may be an R and D opportunity for the UK to develop. There may be real opportunities there, and if we look at that as well, it reduces a lot of the effects of disturbance.

**Baroness Noakes:** Who would you expect to do that R and D?

**Professor Riley:** I am not suggesting City University's engineering department gets the entire R and D budget, but I am sure we would be bidding if that were available.

**Q13 Lord Griffiths of Fforestfach:** I go back to the earlier discussion. Am I right in thinking that gas is gas wherever it comes from, and there is no such thing as cleaner, richer or better gas from, say, Norway, the States or somewhere?

**John Williams:** Quality specifications do vary.

**Lord Griffiths of Fforestfach:** Just like oil.

**John Williams:** No. The transmission systems have parameters within which the gas quality must fall. Part of that is so that when it is burnt in domestic appliances, the gas is of sufficient quality so the pilot light does not go out and it does not cause safety issues. Different gas has different quality specifications. For instance, some of the LNG imported from Qatar needs to be ballasted with nitrogen to bring it within the UK specification. Once it is within the national transmission system, all gas is the same, but some of it might require some processing before it is put into the national transmission system.

I go back to the discussion earlier about not knowing about shale gas until you test it. We really do not know what the quality of that gas will be like, so potentially some of the shale gas produced in the UK might require processing before it is put into the transmission system.

**Lord Griffiths of Fforestfach:** Could different standards be applied by different countries as to the quality of gas they put into their transmission systems?

**John Williams:** We already have differences in gas quality.

**Lord Griffiths of Fforestfach:** Is that between countries?

**John Williams:** Yes, across Europe for instance. A lot of work has been done by the European Commission looking at the potential for harmonising the gas quality standards across Europe. A big cost-benefit analysis was done last year. We have not yet heard the definite outcome of that. We were involved in some work going back a number of years that looked at change in the GB spec. One of the implications of that was that every household appliance would need changing if we harmonised with the European continental quality. One of the issues is that some of the gas imported through the interconnectors would require treatment before it is put into the NTS. The question becomes: if it requires treatment, who pays for it? Do the importers or exporters pay for it? Those kinds of issues have never been fully resolved.

**Lord Griffiths of Fforestfach:** If you are looking at different qualities of crude gas, presumably you have different prices.

**John Williams:** Not really. If you were producing gas that was not of the UK spec and wanted to deliver it into the UK, it would have to be treated. There is no separate market, for instance, for off-UK spec and in-spec UK gas. Once it is delivered to the NTS, all the gas has to meet specific quality requirements and entry conditions of National Grid. The market for gas in the UK is based on the NBP, which is the national balancing point. That is a notional point within the national transmission system. It is not a physical point; it is a notional point at which all gas is traded. All that gas is assumed to be at the same specification because it is within the NTS. One of the big successes of the gas industry in the UK has been the development of that national balancing point. As a trading hub, it is by far the most liquid in Europe. It is one of the trading hubs other networks are trying to emulate and it is the benchmark of European trading.

**Q14 Lord Griffiths of Fforestfach:** What do you think has been the impact in the States on the economy, projected GDP growth, job creation, revival of manufacturing industry and so on as a result of shale?

**John Williams:** To give some broad figures, which are not ours, it is estimated that about 600,000 jobs, direct and indirect, are currently involved in the shale industry. These are the people on the drilling rigs, plus all the other service industries supporting that. I think a

study was done last year by PwC and Citi to look at the potential for new manufacturing jobs as a result of lower energy prices, increased industrial competitiveness and growth of the manufacturing sector. That came up with the figure of about 1 million jobs that could be created as a result.

**Lord Griffiths of Fforestfach:** In the UK.

**John Williams:** In the US. As to the UK, I do not think a comprehensive study has been done yet. We have recently been looking at some work, which again is not yet finalised. In terms of direct and indirect jobs in the UK, we would probably be looking at between 40,000 and 60,000 if we got into the shale-at-scale scenario of about 20, 30 to 40 BCM. In terms of adding induced jobs, you would be looking at a much larger number.

**Lord Griffiths of Fforestfach:** Would the direct jobs be for relatively highly skilled, semi-skilled or unskilled people?

**John Williams:** The evidence from the States has been that the jobs created as a result of shale gas have been quite highly skilled and highly paid.

**Lord Griffiths of Fforestfach:** It could easily lead to greater inequality between service workers and knowledge workers. In saying that, I am not making a judgment, but it would certainly be an issue of public debate.

**John Williams:** I am not sure I can comment knowledgeably on that, but if you were in a scenario where you created 40,000, 50,000 or 60,000 skilled jobs in the UK, that has knock-on impacts on induced job creation as well, and all that then has an impact on GDP and tax revenues, so you create a virtuous cycle, if you like.

**Richard Sarsfield-Hall:** Although historically we do not have an onshore industry in terms of development, we have had a very successful offshore industry. I am sure that industry must be looking at the great onshore opportunities to leverage off some of that skill base.

**Professor Riley:** You may convert a lot of low-skilled people on fairly low wages into high-skilled workers. To some degree, that is what happened in the British North Sea. It could have potentially a positive impact in terms of equality. The other factor is the potential knock-on effect in terms of the multiplier. One of the issues is the potential for a lot of British manufacturing industry, which has been hit by very high energy costs, to benefit from lower energy costs, particularly the chemical industry. That has the potential to grow the industry. The other factor is simply the scale of investment coming in. A recent report by McKinsey talked about a loss of capital investment in Europe between 2008 and 2011 of about €350 billion. Although with shale you are talking traditionally about a relatively small part of the economy, the scale of capital investment to develop the resource base for gas and potentially oil and the secondary industries to support it, with the potential for chemicals, steel and artificial fertiliser, means that you have a very significant investment focus and hot spot within the economy that is much greater overall than the traditional size of the oil and gas industry in the UK. That can be very valuable in kick-starting broader economic growth across the British economy.

**Q15 Lord Hollick:** With the dramatic impact of a 60% fall in gas prices in certain sectors of the US economy—you have already referenced chemicals, but there are a number of others—the benefit not only to the United States but the whole of the NAFTA group surely gives it a competitive advantage when it comes to high-energy manufacturing, which must elicit a response from other countries. China, like other Asian manufacturing countries, will be reluctant to see all those jobs go to the United States. Is there not going to be a

scramble in response to that for the economic well-being of those countries, and does not the same analysis apply to the UK manufacturing industry?

**Professor Riley:** Yes. Recently the American Chemistry Council produced a list of a number of investment projects in the chemicals industry in the US over the past couple of years. They posted that as \$71 billion worth of investment in the US chemicals sector. If you look at the list, a whole host of European companies are investing in the US rather than in Europe. The scramble really worries me. The one great worry I have for both the UK and Europe is that there is so much fossil fuel resource available that the traditional view of fossil fuels and the relationship between the resource holders and capital is reversed. The traditional view has always been that capital chases resources. My worry is that resources now chase capital. The difficulty is that if the UK delays and ponders, it will not find anybody willing to invest on the scale necessary and we will only be importing it. We can import it from the US or elsewhere in the world, because essentially there is so much available; there is no point in investing. The positive side of this is that in future the not very pleasant petro states may well find themselves in a much more difficult position. If they do not behave responsibly and respect property rights and their own people, they may find themselves in a situation where nobody goes to their countries. There could be a quite positive upside to this, but there is an issue for the UK and Europe, in that we could end up with a stranded resource base.

**Richard Sarsfield-Hall:** Do not forget that the United States chemical industry has been one of the biggest opponents of the potential export of LNG from the US because of its competitive position.

**Lord Hollick:** There is a surprise.

**Richard Sarsfield-Hall:** It is still vigorously objecting to the report done for the US Department of Energy that said that, in its opinion, in all circumstances the United States was better off exporting gas. It is still vehemently opposing that and does not believe that. It has not stopped some of the permits now being approved, but there is still a big political debate in the United States about keeping that benefit for themselves and not exporting it.

**Q16 Lord Shipley:** Could I ask specifically about manufacturing? In the UK, the Government are very keen to see manufacturing expand. In the US, which has developed shale gas faster than here, is there any sign that the lower cost of energy is going to feed through perhaps into the repatriation of manufacturing from elsewhere outside the US? Are there any examples, or is it too early to say? In terms of the UK, it is probably too early to project the numbers of jobs and so on, but do you have any feel for what the impact might be, even though costs might be different, on manufacturing in the UK?

**Richard Sarsfield-Hall:** The United States has already seen a repatriation. I have seen pictures of plant that originally went down to Brazil on boats and has been put back on boats and sent back to the United States. There is a lot of reindustrialisation of an industry that was fairly badly damaged in the 1990s and is now taking off. There are lots of examples of investment in energy-intensive industries in the States where shale gas has given them a massive advantage, hence their objection to the risk of that price competitiveness disappearing quite quickly. Whether it does that to the UK or Europe depends ultimately on where we are going to go and how successful we are at developing that shale resource.

**The Chairman:** To conclude, earlier you made some remarks about security of energy, pointing out that the UK was blessed by multiple sources of supply that gave it much

flexibility. Will shale gas development add greatly to that security, or is it only at the margin?

**Professor Riley:** We come back to the issue of scale. We just do not know. Potentially, it could have a significant effect on our security of supply and that of many of our neighbours as well. If Europe develops even a moderate degree of shale resource development in addition to all the LNG that will be available after 2015, it is unimaginable after such a development that something like the gas cut-off that resulted in eastern European states having a degree of energy stress in the winter of 2009 could ever happen again.

**Richard Sarsfield-Hall:** We did some work for the Government a couple of years ago that looked at the security of gas supply. We identified that broadly because of its diversity, it looked very secure. Any further improvement of indigenous production of shale will definitely improve that position.

**The Chairman:** Does anyone have any final remark that we have completely left out of our questioning? Thank you, gentlemen. It has been a most rich session that has got us off to a very good start. We are most grateful for all the thought you have put into it.

Remsol Ltd, Residents' Action on Fylde Fracking (RAFF) and Institute of Directors—Oral evidence (QQ 185-195)

**Remsol Ltd, Residents' Action on Fylde Fracking (RAFF) and Institute of Directors—Oral evidence (QQ 185-195)**

Transcript to be found under [Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking \(RAFF\)—Oral evidence \(QQ 185-195\)](#)

## **Remsol Ltd—Supplementary written evidence**

Dear Chairman,

### **Supplementary Written Evidence to the House of Lords Economic Affairs Committee, inquiry into the Economic Impact on UK Energy Policy of Shale Gas and Oil**

Thank you for inviting me to give evidence to the Economic Advisory Committee inquiry into the potential development of a shale gas industry in Britain. In addition to the oral evidence given to the Committee, I wish to submit further written evidence for consideration.

#### **Well failure rates**

During the evidence session on 10 December 2013, and in response to questioning by Lord Lawson of Blaby, the witness Ms Tina Rothery made reference to concerns about well failure rates, quoting a report by oil field services company Schlumberger as saying “one in six or one in nine failed in the first few years”.

I believe this to be a 2003 report that discusses wells located in the Outer Continental Shelf (OCS) in the Gulf of Mexico, but which specifically excludes data from land based wells.

The report makes it clear that conducting repairs to OCS wells is difficult because of the operating environment, but does not make this same observation of onshore wells (which are clearly much more accessible). The report also discusses the improvements in borehole construction, drilling fluids and cementing techniques that have been developed in order to reduce the prevalence of Sustained Casing Pressure (SCP). Consequently, I don't feel it is possible to rely on the 2003 Schlumberger report as a predictor of land based well failure rates. The 2003 Schlumberger report can be found [here](#).

#### **Flaring**

As part of the same response to Q186, Ms Rothery referred to ‘methane burn-off’. Much is made of this, but it seems it is little understood and the facts are often misquoted. Methane burn-off refers to the action of flaring unwanted natural gas.

During the exploration phase, and particularly during the extended well test when there is no commercial route to market for any gas that might be extracted (and, in fact, the Petroleum Exploration and Development License specifically forbids the ‘getting and sale’ of any extracted gas) it is necessary for it to be flared as a safer and more environmentally responsible alternative to venting.

In Cuadrilla's case, methane is combusted in a muffled and shielded flare stack with an operating temperature across the flame designed to exceed 800 degrees Celsius. Combustion at this temperature will convert the methane to less harmful oxides of carbon and water vapour, with an efficacy greater than 98%. During the extended well test, flaring may be necessary for approximately 30 days. It is likely that all operators will use flares of

similar design, and that the flare systems often seen in refinery applications (featuring a long, visible flame) will not be used.

In production, flaring should not be necessary on a regular basis. It is used for safety reasons in the event that maintenance on the well needs to be conducted and the flow of gas into the transmission system has to be interrupted.

Comparisons are often made with the United States, where night time images taken from above show scenes of mass illumination from gas flaring. This has to be viewed in context, however, because there are particular peculiarities evident that are unlikely to be repeated here in the UK. For instance, many of the examples shown are of the Bakken fields in North Dakota where operators are searching for shale oil and are typically not set up to deal with the natural gas that they may also encounter. Lacking the necessary pipeline infrastructure to get the gas away, operators instead flare it.

The flaring of natural gas in the UK is regulated by a number of Statutory Instruments, including the Environmental Permitting (England and Wales) Regulations 2010, SI 2010/675 as amended and, if exceeding 10 tonnes per day, in accordance with the Industrial Emissions Directive, 2010/75/EU.

### **The treatment of shale gas wastewater by United Utilities, Davyhulme**

In answering Q187 from Lord Shipley concerning the arrangements for disposing of wastewater from shale gas extraction, the witness Mr Roberts said “We know that it was going to the treatment plant at Davyhulme for a time, but our understanding is that that plant became overwhelmed with the quantity, toxicity and radioactive nature (of the waste).”

It is incorrect to say that the Davyhulme treatment plant was compromised in this way, or unable to continue treating the waste for any technical reason.

The facts are that, from 1 October 2011, and as a result of a change in legislation, the operator of the Davyhulme wastewater treatment works, United Utilities plc, was required to apply for an additional permit under the Environmental Permitting (England and Wales) Regulations 2010, as amended, covering the accumulation and disposal of radioactive waste. For purely commercial reasons, United Utilities chose not to apply for such a permit at that time. My enquiries of United Utilities confirm that treatment of the wastewater was completed successfully and without any identified detriment to the treatment process.

### **Transporting chemicals and spill risks**

When answering Q188 posed by Lord Lipsey, the witness Ms Rothery referred to the transport of chemicals to the wells, saying “[...] but the spillage from that when it is travelling raw and undiluted on agricultural roads would be a huge risk.”

The concerns expressed about transporting undiluted chemicals on agricultural roads are, of course, understandable. However, the UK has in place very robust controls on the carriage of dangerous goods by road that implements the European agreement known as ADR. The UK has a history of successfully transporting very highly hazardous chemical substances with relatively few incidents. It should also be noted that agricultural chemicals, such as liquid



fertiliser, sheep dip and Sodium Hypochlorite disinfectant, are routinely delivered to farms using our rural roads.

### **Shale gas and renewable energy**

Twice during the evidence session (in response to Q185 and in closing statements), the witness Mr Roberts made the case for renewable energy, presenting the argument as an ‘either / or’.

It is my belief that domestically produced shale gas can not only co-exist alongside renewable energy sources, but that it must. Not only is it the case that wind farms do not generate electricity when there is no wind, and solar panels do not create electricity at night, but we continue to need natural gas in home and industrial heating, which is where most of it is currently used.

If we accept that climate change is real, and that it is influenced by human activity – particularly the use of fossil fuels in energy creation – then it is right that we should strive to decarbonise the UKs electricity grid. Renewables alone are unlikely to achieve this though, partly because they are inherently intermittent, and so we will need an additional and more stable supply of low-carbon electricity to meet our baseload requirements, and new nuclear power stations could supply this.

However, there remains the question of how we will deal with peaks in demand under a renewables and nuclear scenario, with which it is not easy to rapidly supply additional load to the network at times when it is needed most.

I therefore see a role for an indigenous supply of natural gas from shale as a companion to nuclear and renewable energy in electricity generation, and as a source of home and industrial heating.

Far from derailing investment in renewable energy, I also see an opportunity for shale gas to act as an enabler, particularly in the case of small scale anaerobic digestion (AD). Typically, micro AD schemes have been uncommercial because of the need to harvest the gas on site and produce electricity with it rather than simply export the gas to the grid (the additional equipment needed to produce electricity adds to the overall capital cost of the project). But a 2013 relaxation of the rules governing the oxygen content of biogas produced by AD plants has changed this, meaning it is now possible to inject biogas into the national transmission system. The hope provided by the Health and Safety Executive’s decision could be amplified if sites are co-located on or in close proximity to shale gas pads, because they could then utilise shared infrastructure such as roads and pipelines in more remote locations.

### **Which forms of electricity generation is shale gas likely to displace and by how much?**

In the Call for Evidence, I note the Committee’s intention to try and answer the question concerning which forms of electricity generation shale gas is likely to displace and by how much.

I think the question that we ought to be asking is “What do we want shale gas to displace, and how do we best secure that outcome?” and the obvious answer would seem to be coal.

Currently, 40-50% of our electricity is supplied by burning coal – widely accepted as the most polluting form of electricity generation, responsible for releasing significant quantities of carbon dioxide (CO<sub>2</sub>), oxides of Nitrogen and Sulphur (NO<sub>x</sub> and SO<sub>x</sub>), heavy metals and harmful particulate matter.

Burning natural gas, by comparison, reportedly produces around half the CO<sub>2</sub>, significantly less NO<sub>x</sub> and SO<sub>x</sub> and virtually no PM<sub>10</sub> and PM<sub>2.5</sub>

If we are serious about reducing Britain's contribution to global CO<sub>2</sub> emissions, and improving air quality for millions of people, then it would seem sensible to increase the role natural gas plays in our electricity mix whilst continuing to invest in sources of renewable electricity and new nuclear power and phasing out the use of coal-fired power generation.

I hope you find these additional remarks of some use. If you would like me to clarify any of the points I have made, or if I can be of any further assistance, please do not hesitate to contact me.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Lee Petts', with a stylized flourish at the end.

**Lee Petts MCIWM**  
**Managing Director**

*January 2014*

Residents' Action on Fylde Fracking (RAFF), Institute of Directors and Remsol Ltd—Oral evidence (QQ 185-195)

**Residents' Action on Fylde Fracking (RAFF), Institute of Directors and Remsol Ltd—Oral evidence (QQ 185-195)**

Transcript to be found under [Institute of Directors, Remsol Ltd and Residents' Action on Fylde Fracking \(RAFF\)—Oral evidence \(QQ 185-195\)](#)

## Viscount (Matt) Ridley, British Scientist and Journalist—Written evidence

- My name is Matt Ridley. I am a writer who has covered science, energy and climate issues for more than 25 years for The Economist, the Telegraph, The Times and the Wall Street Journal. My interest in shale gas was first sparked in 2010 as I began to read about its effect on coal use in the United States. As somebody with an indirect interest in coal mining in Northumberland, I decided to look into the issue in greater depth. In early 2011 while in the US, I travelled to Pennsylvania to research a column for the Wall Street Journal and a report for the Global Warming Policy Foundation (for which I refused payment) about the potential of shale gas and its environmental costs. This was the beginning of my interest in shale gas. See [http://www.thegwpcf.org/images/stories/gwpcf-reports/Shale-Gas\\_4\\_May\\_11.pdf](http://www.thegwpcf.org/images/stories/gwpcf-reports/Shale-Gas_4_May_11.pdf)
- I quickly concluded that shale gas represented a greater threat to the coal industry worldwide than any renewable energy technology. Although it was against my interests, I wrote that shale gas promised three benefits to humankind: lower energy prices, lower carbon emissions and an end to the threat of peak gas. All this at an environmental cost far lower than either coal or renewable energy. I wrote that “a surge in gas production and use may prove to be both the cheapest and most effective way to hasten the decarbonisation of the world economy, given the cost and land requirements of most renewables.”
- The opposition to shale gas, I concluded after looking into the evidence, was based almost entirely on myth making, driven by special interests including conventional gas producers, coal producers, renewable-energy champions and environmental organisations with an eye to publicity and fund raising.
- Throughout 2011 and even 2012 it was hard to interest British newspaper editors in articles about the technology. This changed in 2013.
- The shale gas revolution has demolished the widespread belief that supplies of natural gas were about to run out. This belief has a long history. In 1922 President Warren Harding’s US Coal Commission, after interviewing 500 experts over 11 months, stated: “Already the output of [natural] gas has begun to wane. Production of oil cannot long maintain its present rate.” In 1956, M. King Hubbert predicted that gas production in the United States would peak at about 14 trillion cubic feet per year sometime around 1970. In 2002, an Exxon executive pointed out that US gas discoveries had peaked before 1980. All of these predictions proved greatly misleading. Yet energy policies in the UK are still assuming a rising gas price caused by increasing scarcity.
- That most natural gas originates in shales – formed on the beds of stagnant seas, then compressed and heated – is not news. “Conventional” natural gas reservoirs were created when this gas seeped into porous rocks. Until the late 1990s, however, it had not seemed possible to make shales sufficiently porous, even by fracturing, to extract gas from them. This changed with the development of slick-water fracturing combined with horizontal drilling, developed by Pinnacle Technologies for Mitchell Energy in the Barnett shale. Within five years the Barnett shale, in and around the city of Forth Worth, was producing half as much gas as the whole of Britain consumes. And the Barnett proved to be a baby compared with other shales. In 2004, the first results from the Marcellus shale in Pennsylvania caused a sensation with realization that the field was possibly as big as those in Qatar.
- The cost of drilling for shale gas and the recovery rates have both improved steadily

in the past 20 years. The time taken to drill and fracture a well is now about one-third of what it was initially. The yield from a typical shale gas well has been climbing steadily. Britain therefore has the opportunity to learn from all the pioneering development that has occurred in America.

- The impact of shale gas on the American economy is immense. It is estimated that residential, commercial, industrial and electricity-generating customers of natural gas have saved \$250 billion over just three years as a result of lower gas prices. By cutting the cost of gas far below the cost in Europe or Asia, the shale gas revolution has dramatically increased investment in chemical plants, manufacturing plants and all energy dependent sectors. No reputable economist denies that shale gas is a major factor in these trends. See more at: <http://mjperry.blogspot.co.uk/2012/05/shale-gas-boom-slashes-co2-emissions.html#sthash.2ZTyLvLx.dpuf>
- It has been argued that shale gas would not have a similar effect on gas prices in Europe, because there is a single European gas market linked by pipelines. This makes little sense, because the US also has an integrated gas market with pipelines. One paper argued that the benefits of UK shale gas would be shared across Europe and the Bowland shale would only shift Europe's gas prices downwards (or prevent them rising) by 4%. But 4% savings for 150 million households for people is £7.5 billion per year. And in practice, as in the US, proximity to the source of shale gas will mean much greater gains for British consumers from British gas. Indeed, manufacturers and chemical firms have tended to cluster round shale gas centres in the United States. See <http://www.adamsmith.org/blog/energy-environment/about-the-effect-of-the-uks-shale-gas-on-prices>
- Shale gas replacing coal as a fuel in electricity generation is the chief reason for the steep fall in America's carbon dioxide emissions over recent years. Energy related carbon dioxide emissions in the United States have now fallen back to levels last seen in 1994, and per capita emissions to levels last seen in the early 1960s. This is probably the fastest fall in emissions in any part of the world. See <http://www.aei-ideas.org/2013/04/energy-fact-of-the-day-us-co2-emissions-per-capita-in-2012-were-the-lowest-since-1964-main-reason-shale-gas/>
- Gas is also starting to replace oil as a transport fuel in buses and trucks. United Parcel Service and other truck fleets are converting to gas, and gas consumption for transport has trebled in a decade in the United States. Gas-fuelled trucks are cheaper to run, produce less pollution and have a smaller carbon footprint. This trend is likely to continue. [http://www.nytimes.com/2013/04/23/business/energy-environment/natural-gas-use-in-long-haul-trucks-expected-to-rise.html?pagewanted=all&\\_r=1&](http://www.nytimes.com/2013/04/23/business/energy-environment/natural-gas-use-in-long-haul-trucks-expected-to-rise.html?pagewanted=all&_r=1&)
- Gas prices nowadays behave quite differently from oil prices. Because gas is costly to transport by sea, America's shale gas revolution is a threat to the British economy. America's gas prices, which used to be similar to ours, are now consistently one-third to a quarter of ours; oil prices, by contrast, are similar in the two countries. America's shale-oil revolution is less of a threat to us because of the global oil price. That is to say, we can sit back and gather the benefits of others exploiting shale oil, but if we try to do so for gas, we will destroy jobs in this country. Developing domestic shale gas is vital if other countries are developing theirs. The shale gas revolution is therefore either a boon to our economic competitiveness if we join in, or a threat to it if we do not.
- Based on the British Geological Survey's estimates, Britain's shale gas reserves are immense, even compared with those of Pennsylvania. The Bowland shale is similar in

organic content and physical properties to the Marcellus shale but much thicker, perhaps five times as thick in many places. This implies that more gas can be produced from fewer well pads because of the possibility of horizontal drilling at several depths.

- Shale gas production is proving to be safe and clean in the United States. All of the environmental objections are proving to be either mythical or greatly exaggerated. In evaluating claims, it is necessary to remember that the renewable energy industry, the Russian gas industry and the fund-raising arms of the environmental movement all have strong incentives to exaggerate in this area.
- Tens of thousands of shale gas wells have been drilled and two million fracking operations completed, yet there has been not a single proven case of groundwater contamination as a result of hydraulic fracturing. (Failure of well casings may have contaminated water in some cases, as with conventional gas production.) Case after case has been alleged and found to be untrue. The Environmental Protection Agency closed its investigation at Dimock, in Pennsylvania, concluding there was no evidence of contamination; abandoned its claim that drilling in Parker County, Texas, had caused methane gas to come out of people's taps; and withdrew its allegations of water contamination at Pavilion in Wyoming for lack of evidence. Two recent peer-reviewed studies concluded that groundwater contamination from fracking is "[not physically plausible](#)." The movie Gasland showed a case of entirely natural gas contamination of water and the director knew it. Ernest Moniz, the US Energy Secretary, said earlier this year: "I still have not seen any evidence of fracking per se contaminating groundwater." <http://www.propublica.org/article/epas-abandoned-wyoming-fracking-study-one-retreat-of-many> <http://thehill.com/blogs/e2-wire/e2-wire/315009-energy-secretary-natural-gas-helps-battle-climate-change-for-now>
- The claim that shale gas production results in more methane release to the atmosphere and hence could be as bad for climate change as coal is also false. Study after study has refuted it. As a team from Massachusetts Institute of Technology put it: "It is incorrect to suggest that shale gas-related hydraulic fracturing has substantially altered the overall [greenhouse gas] intensity of natural gas production." [http://iopscience.iop.org/1748-9326/7/4/044030/pdf/1748-9326\\_7\\_4\\_044030.pdf](http://iopscience.iop.org/1748-9326/7/4/044030/pdf/1748-9326_7_4_044030.pdf). And a 2013 study by the University of Texas found that leakage was just 0.42 percent of all produced gas.
- The claim that fracking uses too much water is highly misleading. In the United States as a whole 0.3% of water use is for hydraulic fracturing -- less than is used by golf courses. Farming is by far the biggest user. <http://theenergycollective.com/jessejenkins/205481/friday-energy-facts-how-much-water-does-fracking-shale-gas-consume>
- The use of chemicals in "fracking fluid" is also greatly exaggerated. Fracking fluid is 99.51% water and sand. In the remaining 0.49% there are just over ten chemicals, all of which are highly diluted and can be found in higher concentrations in your kitchen, garage or bathroom: citric acid (lemon juice), hydrochloric acid (swimming pools), glutaraldehyde (disinfectant), guar (ice cream), dimethylformamide (plastics), isopropanol (deodorant), borate (hand soap); ammonium persulphate (hair dye); potassium chloride (intravenous drips), sodium carbonate (detergent), ethylene glycol (de-icer), ammonium bisulphite (cosmetics), petroleum distillate (cosmetics). <http://www.redriversecurities.com/fracingchemicals.htm>
- As for earthquakes, Durham University's definitive survey of all induced earthquakes over many decades concluded that "almost all of the resultant seismic activity [from

fracking] was on such a small scale that only geoscientists would be able to detect it” and that mining, geothermal activity or reservoir water storage causes more and bigger tremors.

- In conclusion, the shale gas revolution offers a huge opportunity to the British economy and its hard pressed energy consumers if we choose to exploit it, but if we decide not to exploit it, a major competitive threat. Precautionary resistance to new technologies has proved a big mistake in the UK in recent years. For example, it has prevented Britain leading the genetic modification of crops, in which it was once a pioneer, with the result that yields are almost certainly lower, pesticide use is higher and the environmental impact of agriculture is worse than it would otherwise have been. This illustrates the flaw in the precautionary principle: that it weighs the costs but not the benefits of innovation. For the sake of Britain’s pensioners, employers and working people, it is vital that we at least try to find out if the Bowland shale can lower gas prices, lower carbon dioxide emissions, and create jobs.

22 September 2013

Viscount Ridley, Nick Grealy and Phelim McAleer—Oral evidence (QQ 134-152)

**Viscount Ridley, Nick Grealy and Phelim McAleer—Oral evidence (QQ 134-152)**

Transcript to be found under [Nick Grealy, Phelim McAleer and Viscount Ridley—Oral evidence \(QQ134-152\)](#)



Professor Alan Riley and Poyry International Consulting Engineers —Oral evidence (QQ I-16)

**Professor Alan Riley and Poyry International Consulting Engineers  
—Oral evidence (QQ I-16)**

Transcript to be found under [Poyry International Consulting Engineers and Professor Alan Riley—Oral evidence \(QQI-16\)](#)

## Alan Seatter—Oral evidence (QQ 238-250)

TUESDAY 14 JANUARY 2014

*Evidence Session No. 16*

*Heard in Public*

*Questions 238-250*

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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### Witness

**Alan Seatter**, Deputy Director General, Environment, EU Commission

**Q238 The Chairman:** Mr Seatter, deputy director general of environment in the EU Commission, I thank you very much for coming. I know that you have to leave at six in order to catch an aeroplane, so we will try to be as quick as we can with our questions to you. Can I start with your view of the developments there have been in the past few days to the effect, as we understand it from the press reports here, that there will no longer be specific legalisation on shale but that, of course, the existing environmental legislation et cetera will apply? Can you bring us up to date?

**Alan Seatter:** I can go a little beyond six o'clock if that is helpful to you.

**The Chairman:** That is very helpful. Thank you.

**Alan Seatter:** In the interests of my mental health, I do not think I would be well advised to comment on anything that has been in the press recently about this particular topic. The Commission has not yet taken any decision as to what proposals we will put on the table, so that is going to be planned for next week. We have looked at options which include a full range from doing nothing as compared with the existing legal framework right through to doing a specific regulation about shale gas, and there is a whole range of things in between, including guidance, recommendations and the like. So we have been looking at those options. Of course, there is quite a lot of environmental regulation that currently applies, so it is not really a question of regulation or not regulation. What we have been looking at is whether our body of regulation is fit for service, what kind of service we could offer member states that wish to exploit shale gas, whether the rules are clear enough, whether

the risks are identified and managed and whether there any obstacles to shale gas in our current legislation. Those are some of the questions that we have been looking at.

The Commission is intending to table some proposals next week, together with the whole climate and energy package that is being discussed at the moment, but no decision has been taken exactly on which way to go. I can go into a little more detail about that if you like.

**The Chairman:** There have been one or two developments in the European Parliament which I think are public. Could you just say a word about that?

**Alan Seatter:** One of the pieces of legislation that applies to shale gas and any other kind of development of that nature is the environmental impact assessment directive. The Commission made some proposals to streamline that directive about a year and a half ago. Those were discussed by member states and the European Parliament recently, and some members of the European Parliament put forward proposals to make an environmental impact assessment mandatory for certain phases of the development of shale gas. The rules as they stand at the moment are that it is mandatory if the flow of gas per day exceeds 500,000 cubic metres. The other relevant point is that for any deep drilling project member states must screen that project to see whether they consider an environmental impact assessment to be necessary. The European Parliament proposed to make it compulsory to have an environmental impact assessment for shale gas. The Commission did not take any position on this, so that proposal is unlikely to go through.

I hesitate to predict anything about how the plenary of the European Parliament will vote on this, but the committee that has been discussing that has been led to the conclusion that that proposal will not be retained. The Commission did not take a position on that, largely because we did not propose it in the first place, and secondly because we are coming forward with some proposals about shale gas shortly. We did not think it was appropriate to deal with it only through that particular piece of legislation.

**Q239 Baroness Blackstone:** You quite understandably do not want to comment on the changes that the Commission is considering making, but could you give the Committee an outline of the existing legislation that is relevant to shale gas and oil production and exploration and how it affects member states? If you have a fairly concise description, it would be very helpful.

**Alan Seatter:** I am happy to go into the ideas that we are going to put forward. I can give you a little bit more detail on that later. At the moment, if you look at the broad areas of environmental legislation that are relevant for shale gas they are: first, as I have mentioned, the environmental impact assessment; secondly, water and the abstraction of water, particularly in areas that are subject to water stress; thirdly, the risk of pollution and air pollution legislation, in particular as that applies to gases that are coming up from shale gas installations; fourthly, waste management—what happens to the waste products that come up from exploration and the production of shale gas—and finally chemicals. Those five broad areas already exist. That is the broad picture.

There are one or two aspects of detail in respect of those regulations. I mentioned the question of the environmental impact assessment thresholds. Certain things are obligatory; others are at the discretion of local authorities in member states.

There is a question about whether you can inject flowback water into underground installations. Our interpretation is that that is not permitted by the water legislation and therefore would need to be dealt with by the mining waste legislation. We published a legal opinion on that at the end of 2011.

There are still a number of questions relating to the existing legislation and, as I said at the beginning, we are looking at to what extent there are any obstacle there and to what extent that legislation is fit for purpose to handle the potential for shale gas. Those are the broad areas of existing legislation, and there are one or two question marks related to that.

Picking up a couple of points that Chris Wright made in his evidence, for example, there are no rules about the public disclosure of chemicals; and on the integrity of the cement casings of wells, there is nothing on that either. So we have been looking at existing legislation to see whether there are any points that need to be clarified.

**Q240 Lord Smith of Clifton:** The 2014 Work Programme for the European Commission contains a new initiative for a “framework for safe and secure unconventional hydrocarbon extraction”. This is being led by your department. Could you please explain what this initiative is and what the objectives are?

**Alan Seatter:** We call it an enabling framework. The objective is to enable the safe production of shale gas by addressing two factors. The first is the degree of public acceptance: is existing legislation adequate to identify and manage environmental risks and can the public be assured of that? The second objective is: does the framework provide a clear and predictable framework for investors in this industry? Those are the objectives that we have put forward in what we call the enabling framework that we are working on, consistent, as I said at the beginning, with our overall climate change objectives. My department is leading that, but we are working jointly with the energy and climate departments, so it is a three-department-led process. We are looking at whether the legislation is fit for purpose, what lessons we can learn from the United States and from places where there has already been a significant amount of drilling—for example, Poland—and what member states can learn from each other and from the United States experience. We have been in regular contact with the United States and we have visited shale gas sites in Poland. We are trying to put forward an enabling framework for the safe production of shale gas.

**Lord Smith of Clifton:** On the first point where you are trying to make it acceptable to communities and so on, how do you operationally go about that to, as it were, guarantee that people will not be worried by your protocols?

**Alan Seatter:** We carried out a public consultation when we were doing an impact assessment for these proposals. A number of factors emerged quite clearly from that which point to the public perception—I say “perception” because that does not necessarily correspond to reality—of a certain number of risks to water and air and risks from chemicals et cetera. Since our legislation already covers those, we feel that we have to be very clear to the public about whether those risks can be managed adequately by this legislation so that people feel reassured that it is possible to have safe extraction of shale gas. We see demonstrating that the risks are covered by legislation and are being managed as one way of securing public acceptance of these technologies.

**Q241 The Chairman:** You heard what Mr Wright said in his evidence to us about the risks to investment, for example, in the UK, as a result of uncertainties and delays in all this legislation. When do you think you will publish these proposals and what do you see as the timetable?

**Alan Seatter:** We are hoping to come forward with proposals next week. I do not know whether the Commission will succeed in meeting that objective. We originally planned for

the end of last year, but we think it is going to be next week, together with the climate and energy package.

I would distinguish between the exploration phase and the production phase. At the moment, quite a significant amount of exploration is already being carried out.

**The Chairman:** Not in this country.

**Alan Seatter:** No, but almost 200 concessions have been granted in 11 member states in Europe. There are more than 40 wells being drilled in Poland, and there are some cases of wells that have been hydraulically fractured. I am not saying that this is the appropriate pace, but that exploration has started in a range of member states under the current rules. So the broad framework is there for a number of factors that are important for shale gas.

There are uncertainties surrounding a number of points of detail. I mentioned one or two of them at the beginning, and if you like I can go into more detail about what these uncertainties are and what we could usefully do to clarify them. We have published guidelines already, but we feel that it would be useful to take those a step further and make sure that we cover the key elements that may still be uncertain for investors in the industry because we think it is very important to clarify that as soon as we can.

**Q242 Lord Hollick:** Can you explain why in the first place the Commission decided to investigate this area? We have heard from many witnesses that the steps being taken in the UK are very good. There is a significant level of confidence from the relevant regulators, academics and various societies who follow this, who have all come to the same conclusion. Why is it necessary to do this?

**Alan Seatter:** I can give you some substantive reasons for why we are doing it, and I can give you a formal reason as well because both are relevant.

On the substance, what we look at is our overall energy and climate change policy. Within that context, if there were to be significant development of shale gas right across Europe, it seems to us that there would be benefits in terms of security of supply of energy. There are a number of member states who have their gas cut off in the middle of winter, where there are no interconnections with the energy market. It would be interesting for them if it were possible to develop shale gas safely and securely. There would be benefits in terms of the security of their energy supply.

The second reason is that we are trying to put forward a package of proposals for the energy market in general in Europe which aim to connect it up and liberalise it. If there were to be shale gas production on a significant scale, there could be benefits in terms of getting the best prices for consumers within our overall climate change and energy objectives. There is controversy about how big the price effect is but, however big it is, there could be benefits to make sure that consumers are getting the best prices within that whole framework.

For some member states which depend on coal, if shale gas were to substitute for coal, that could be an interesting pathway, but maybe a second best pathway because shale gas is still a fossil fuel. It could be beneficial for them to use it to substitute for coal and therefore achieve their climate objectives quicker and more easily.

We think that if this were to develop right across the European market, there could be a significant innovation potential for the supply chain of this industry in Europe. There are benefits that we think are interesting to try to develop.

There are a lot of ifs in what I have said. That is why we are looking at it. If we can reassure people that the legislative framework is sufficient to address environmental risks, then there is a potential to secure those benefits, so the two together are the reasons that motivate us to look at this.

The formal reason is that heads of government in the European Council of February 2011 asked for an assessment of unconventional shale gas in Europe to be done, so we are following up that request.

**Lord Hollick:** Does the responsibility for energy policy rest with the United Kingdom or the European Union?

**Alan Seatter:** The choice of energy is a purely national decision. It is nothing to do with the European Union. The European Union is trying to make sure that the benefits of having a bigger and more integrated energy market, particularly in relation to security of supply, prices and the things I mentioned, are there for member states to take advantage of.

**Lord Hollick:** Is it not that that is something that the market will dictate and that there will be a proper regulatory framework under the European Union to ensure that it acts in the interests of the consumer?

**Alan Seatter:** Yes, that is what we are trying to promote. At the moment, there are obstacles to the market in energy in Europe.

**Lord Hollick:** We have heard from the previous witness that uncertainty is possibly one of the greatest ones.

**Alan Seatter:** As far as energy markets are concerned, we have already put forward our proposals, so there is no uncertainty about that. On the shale gas issue, we are going to come out with proposals very soon to try to clarify the pieces of the regulatory framework that are uncertain. As I said, there is a basic framework that has already allowed investors to invest in exploration. We think there are still some points to be clarified in order to get the benefits right across into production.

**Q243 Baroness Noakes:** A couple of times you said that the work that you are doing is in order to reassure people. You also told my colleague Lord Hollick that energy is a matter of national competence. I am not quite sure which people you are reassuring because, certainly as far as the development of shale gas in the UK is concerned, I am not sure I can identify any people who will look to what the European Commission will be doing in order to facilitate the development of our resources. Indeed, many of the things that you cited may have some resonance for some parts of the European Union, but I do not think many of the things you said have any relevance to what we are doing in the UK. Is this something that ought to impact the UK or should we be allowed to maintain our national competence in this area?

**Alan Seatter:** Our objective is to reassure people. Our objective is to provide an assurance that whatever regulation exists is adequate to manage environmental risks. People may or may not be reassured by that but if, for example, we are able to say that if the following best practice, as we call it, is followed in this industry, we believe that environmental risk can be adequately dealt with, that seems to us—

**Baroness Noakes:** Who are you reassuring?

**Alan Seatter:** We would be reassuring, first, investors in the industry, and secondly, member states which have a number of questions about the interpretation of existing

legislation and about whether there are any gaps that have not been addressed. Our duty is to make sure that the legislation for which we are putting forward proposals is clear and is adequate to manage risk. I think we would be prepared to say that, if we clarify a number of gaps and uncertainties that remain. We regard that as part of our duty and of the service we are offering to member states and to investors in this industry. We have to be absolutely clear that the framework is there for those risks to be adequately dealt with and managed.

**Baroness Noakes:** So you do not see yourselves as a creator of uncertainty in this area?

**Alan Seatter:** As I said, there is an existing body of legislation which has not prevented any exploration taking place. It may not be at the pace that is required to assess the potential of shale gas, but that has not prevented that. We believe that we need to clarify a certain number of things now in order to make sure that the full benefits, as you move from exploration into production, are there.

**Q244 Lord Lawson of Blaby:** I would like to follow on from what Baroness Noakes was saying when she referred to the evidence given by the previous witness, Mr Wright, who pointed out that the biggest danger to development of Europe's—or the United Kingdom's, which we were talking about then—shale resources is delays and that if we cannot get the exploration going and there are huge delays, nothing is going to happen. The industry is going to go elsewhere.

Now, I am sure that the EU and the Commission have no interest in there being delays but nevertheless, if you are seeking to get agreement between 28 different countries, that is almost certainly going to produce delays with the best will in the world. That is what gives me considerable concern, and it puzzles me too because, as you said in answer to Lord Hollick, energy is a national competence, first and foremost, and as far as the environment is concerned, what we do in this country to our own environment, particularly as we are an island, does not affect the environment anywhere else in the European Union. We have, in fact, very high environmental standards in this country—quite rightly so. Under the doctrine of subsidiarity, which is very important to the European Union, should it not be the case that we should be able to go ahead, providing we have environmental standards or even if not, and should not be obliged to wait until there is a Europe-wide agreement which—it is no fault of yours—might take a very long time to reach? It may well be the case that there are some countries—I shall not mention any names—which will deliberately seek to delay the process of getting agreement.

**Alan Seatter:** There are quite a number of points in your question, Lord Lawson. What I would say first is that for the exploration phase, there has been no delay in respect of European legislation. I would not agree that any delay on the European side has led to problems in exploration. Where we do have to be careful is that unless a number of uncertainties are clarified, we may find ourselves at risk of having a delay when it comes to production. That would be the reason that we would come forward with our view as to how those could be clarified and what, essentially, best practice in the industry could be promoted. That may or may not involve decisions being taken by other member states in the European Parliament because it may or may not involve legislative action. That question has not been decided by the Commission. We have not decided in what form we would put forward these proposals.

As I said, we are looking at a range of options from whether we need to do anything in the first place right through to a comprehensive regulatory framework which would be

specifically designed for shale gas. In between, there is a range of possibilities which make sense to look at.

Just to give you some examples of the sorts of issues we believe need to be clarified, as Chris Wright mentioned, the question of well integrity is important. The question of public disclosure of chemicals is another issue. The question of the baseline that is being measured and then monitored is another issue that seems to be very important for reassuring investors and the public that risks are being properly dealt with. Those are issues on which the environmental regulations are either silent or not entirely clear. The service that we feel we could provide is to clarify those aspects so that investors and member states are certain what our view is and it is clear that a number of these environmental risks can be dealt with in an adequate manner.

**Baroness Noakes:** I still do not understand why we need the Commission's view on things if under subsidiarity we have national competence and we actually have a very extensive and robust framework in the UK, via our Environment Agency, for addressing most of the matters that you have just addressed. I am not quite clear why the Commission feels it necessary to do whatever it thinks it is going to do next week.

**Q245 Lord May of Oxford:** I am going to come at this in a slightly off-piste way. I was the first Chief Scientific Adviser in this country, appointed as a Permanent Secretary and brought into the Civil Service. I was astonished and fascinated to meet a totally different culture that very frequently mistook careful, conscientious process and endless reports and meetings for actually getting something done. My further engagement with the European Union, particularly the formation of the European Research Council, which has ultimately been a big triumph, brought that message home in spades, so when I read what is coming out of all this that we have just been talking about—the 2014 work programme that says that the initiative type is legislative/non-legislative and sets out all sorts of options—it leaves me feeling slightly exasperated and coming to the point we have just had. Why not let the member states do it—do you really think they cannot sufficiently manage the associated environmental risks by themselves?—rather than hanging around until this endless catalogue, beautifully and conscientiously elaborated, is put out to dance around?

**The Chairman:** Just to finish that on the same point, the environmental risks—particularly in our case, as an island—are very often contained perfectly well by legislation and regulations that we have. It seems to be an area where subsidiarity really does apply.

**Alan Seatter:** This legislation already exists. I am not talking about it in respect of the areas I mentioned at the beginning. The legislation already exists. This is European legislation, and that is why the Commission feels that we have the duty to clarify it where it is not clear. We are only giving our view, but if we say nothing about it, a number of investors have said to us that that is not good enough for them. They would like to have clarity on this. That is the service we think we can provide because it is already European environmental legislation. This is about the environment. The choice of energy is totally up to member states. What we do not want is what Chris Wright and Lord Lawson mentioned: delays that frustrate this process. At the moment, in the exploration phase, we do not believe that there have been any delays as regards European legislation or anything to do with the European Union, but we believe that unless we put forward some clarification of European environmental legislation, there is a risk that this process will be frustrated.

We have never had in mind coming out with some beautifully comprehensive thing that is going to take a very long time to discuss and decide. What we have in mind is picking the core elements that the industry says need to be clarified for it to invest and the issues in



relation to environmental risk that require assurance that they can be handled. So that is the reason that we have become involved in this because it is European environmental legislation and we have a duty to clarify it. We can clarify it, and people can say, “Who cares what the Commission thinks?”, but certainly investors will ask for that to be done, and that is what we are prepared to do.

**Lord Lawson of Blaby:** So at the present time it is not clear. Is that it?

**Alan Seatter:** There are one or two aspects where investors have said to us, “Look, what does apply? Can you clarify that?”. So that is what we are prepared to do.

**Lord May of Oxford:** In January 2012, the European Commission published a study on the licensing and permitting procedures for shale gas. It concluded that “neither on the European level nor on the national level have we noticed significant gaps in the current legislative framework”. Does the Commission believe that gaps have arisen since January 2012?

**Alan Seatter:** First, the next sentence in that study went on to say that it was based on an assessment of the early exploration phase, so it confirms what I have just said: in that phase, there were no particular obstacles or gaps to be addressed. That is the first point. The second point is that that study also identified a number of areas which needed to be clarified, particularly regarding environmental impact assessment and underground geological selection. It did identify those.

As we go on, as we look into the production phase, we have to try to make sure that there are no obstacles in that framework or uncertainties that are going to impact on the production phase. That is how I try to explain the apparent contradiction. For the exploration phase, that is correct, but we need to clarify to make sure that there are no delays in the further development phase.

**Q246 Baroness Noakes:** Shifting on to the review of the regulatory provisions, which I believe the Commission commissioned, which was published in September 2013, could you tell me why the Commission went to look at the regulatory provisions in all member states and outline the Commission’s findings in relation to the UK?

**Alan Seatter:** This study was of a selected number of member states that had been involved in shale gas, for which it is important to see whether shale gas can be developed in their country. The first reason we looked at that was to try to connect with what is important at national level to make sure that there are no European obstacles to that and that we have a clear understanding about where different member states want to go on this and how we can support that process. We did not do any kind of assessment of the legislation. We just looked at what issues are being covered there. We have a working group of member states which meets quite regularly to learn from each other, which we believe has been a helpful process. This was one of the—

**Baroness Noakes:** Is the UK part of that?

**Alan Seatter:** Yes, absolutely. We have been in very close contact with the UK, which has a long tradition in this area and robust environmental regulation. We have learned a lot from that, and that has been very beneficial.

**Baroness Noakes:** And the findings in relation to the UK?

**Alan Seatter:** It was just a factual report. There was no assessment. There was no purpose to do any kind of assessment. We think that on a number of issues that I have

mentioned UK legislation is already quite clear and very robust in respect of environmental impact assessments, well integrity and baseline monitoring. We did not carry out an assessment; it was an information exchange to make sure that we understood what was important for member states when they look at their own situation.

**Baroness Noakes:** Even though it is a national competence?

**Alan Seatter:** It is not a national competence when it comes to environmental regulation. It is a national competence when it comes to the choice of energy mix, and what we need to make sure of is that we are providing an enabling framework for member states that wish to exploit this and that there is nothing there that is going to prevent that happening.

**Q247 Lord Rowe-Beddoe:** Has the Commission assessed the recommendation of the International Energy Agency with regard to the golden rules for a golden age of gas? If the Commission were to make any proposals, would you expect them to be based on those recommendations?

**Alan Seatter:** Broadly speaking, yes. My commissioner, Janez Potočnik, gave a speech in London on 21 August in which he outlined his approach to this enabling framework. He referred to the International Energy Agency's golden rules as something that we would be trying to follow as closely as possible. The proposals that we are working on are very much based on those ideas of having a limited number of minimum standards. That has been a source of inspiration for our work.

**Lord Rowe-Beddoe:** A witness from the International Energy Agency told us, "Internationally, the UK regime as it stands is very highly regarded". Would you endorse that?

**Alan Seatter:** It is very highly regarded, and it is very robust in respect of the core ideas that everybody agrees need to be dealt with.

**Q248 Lord Shipley:** Can I just pursue the issue of delays and EU Commission involvement and so on? I understand the British Prime Minister David Cameron wrote to Commission President Barroso last month to say that he was not in favour of new legislation. Providing clarity on how existing EU frameworks might apply to shale gas is one thing, but new legislation, he said, was another. I am not clear what other member states have said. Have others said similar things? France has declared it is not going to go into the area at all. What have others said?

**Alan Seatter:** When we do an impact assessment which we have been carrying out for this initiative, we consult member states on a range of options from doing nothing, which is the one we always start with, to guidance, regulations, specific legislation and clarifying existing legislation through amendments. Some member states prefer the amendment route. They say that if something is not clear in the legislation, you can say what you want but we will need to decide in the end how to clarify it, so they are in favour of amendments to existing legislation to clarify it. Some member states are against any kind of new legislation. Some are in between. They have not all expressed a view.

**Lord Shipley:** Which ones have said they are not in favour of new legislation?

**Alan Seatter:** The only way I could answer that is by referring to the member states that took a position on the European Parliament's amendments to the environmental impact assessment directive. There was what we would call a blocking minority of member states which were opposed to that amendment, and one could assume that they would be

opposed to any form of new legislation. So certainly Poland would be. A range of member states held that view.

**Lord Shipley:** I am really looking for names. Which countries are we talking about?

**Alan Seatter:** There was the UK and on that particular issue, Poland and a number of countries in central Europe. I do not know that they have publicly expressed this view, which is why I am being a little bit reticent because the way that they have taken a position in respect of certain amendments in Parliament is up to them. A range of member states were against. That is why the debate has narrowed: from looking at doing nothing to legislation; to a range of things in between. We understand that the British Government would welcome some clarification from our side. A number of other Governments would. Some Governments would prefer certain forms of legislation, and others are against it. We have a range of views here which we have to try to accommodate.

**Q249 Lord Lawson of Blaby:** I am trying to make sense of this very interesting evidence that you have given to us this afternoon, which I must say I find alarming. I am sure you too are alarmed. I think there is agreement on all sides that delay and uncertainty are no good for the industry, the peoples of Europe or any of us. Yet trying to reach agreement among 28 countries is going to be very difficult. How do we cut the Gordian knot? You said that the reason that you are engaged in this is that although there is European legislation in place—incidentally, it seems to me that it is absurd that environment should be a European Union competence rather than a national one, given the doctrine of subsidiarity—and there are one or two areas where there is uncertainty and you want to end that uncertainty. I am not entirely sure where there is uncertainty, but I take your word for it; it may be that there is. What is wrong with a decision that, where there is uncertainty, each country should legislate or regulate to end the uncertainty in those particular areas so that the countries that want to go ahead can do so and a country such as France—where I happen to live—which has taken the decision that they do not want to go ahead, do not. What is wrong with that?

**Alan Seatter:** There is nothing wrong with that. That is one of the options we are looking at. What we have to be clear about is whether that is sufficient for the industry to operate throughout Europe. What a number of companies have said to us is: “Be clear and predictable”. What is the best way that we can provide that clarity and predictability? That is one of the options that we are looking at. A lot of this legislation, although I say it is European legislation, is implemented by member states in the way that they chose within certain parameters, so it is national legislation. It may refer to certain standards that have been set by all member states together in Europe because they want a level playing field in this area, but it is up to them how they implement these principles. So we are talking about principles and standards, not detailed provisions, but there is nothing wrong with that option, which is one of the options that we are looking at to see whether, if we can provide clarification, that will help member states take the decisions they need to take and reassure investors that there is a predictable framework. Let us try it and see. That is one of the options that we are looking at.

**Lord Lawson of Blaby:** That is very helpful. In principle, you will put forward your proposals next week. They may or may not reach immediate agreement. If they do not, there is nothing whatever to stop, say, the United Kingdom, saying that we are going to go ahead to make what at present may be slightly unpredictable predictable so that companies that are interested in developing the shale resources of the United Kingdom can go ahead

confident that they do not have to wait for agreement among the 28 countries of the European Union.

**Alan Seatter:** A range of countries already have legislation in place to deal with some of these core risks. That has not been prevented by the European Union in any way. There is no delay on that. Where there have been question marks is over certain grey areas, and there are also question marks—

**Lord Lawson of Blaby:** For instance?

**Alan Seatter:** For instance, on the question of whether you can inject fracturing fluids to store them underground. What is the legal regime that applies to that?

**Lord Lawson of Blaby:** That is a fair issue, that is absolutely right, but that is surely something that an individual country can decide and legislate for on its own.

**Alan Seatter:** If companies are operating across the market in Europe, they would expect to have more or less the same principles. I am not saying the details, but the same principles, because this is about existing legislation. That is why member states have said to us: what is your view of this position? We can clarify that, and hopefully that settles the matter and there is no further problem, but there are certain aspects that are very important for investor certainty that are not dealt with in environmental legislation. They are in the UK and in some other countries, so what we could do is simply clarify what is best practice so that those countries which wish to develop shale gas have the means to do so and have the certainty that that can be done over the long term without investors being discouraged.

**Lord Lawson of Blaby:** So you can leave it to each individual member state?

**Alan Seatter:** It depends what. Within certain parameters that everybody has signed up to there is already national legislation that respects certain minimum standards, if you like. Member states are then free to do what they want if those principles are respected. That is what we are talking about here.

**Baroness Noakes:** What could not be left to individual countries to do by themselves?

**Alan Seatter:** A lot of issues are dealt with purely on a local or national basis. For example, European legislation says that in certain circumstances you have to do an environmental impact assessment. What you do with that is a matter for national and local decision. For example, decisions on things like noise or traffic—you have been hearing quite a lot of evidence about that—are dealt with by member states.

**Baroness Noakes:** Is there anything that has to be decided at European level?

**Alan Seatter:** Has to be decided in respect of what? They have already been decided.

**Baroness Noakes:** That would impact on the way in which—

**Lord Lawson of Blaby:** Like the injection of fluids, for example.

**Alan Seatter:** That is already the subject of European legislation. Member states all agreed to certain provisions in the water directive that do not allow that and make it covered by another directive for which you need national permits and things. That is already there, and the question is: if there is some uncertainty about that, what is the best way of clarifying it that does not involve delay? That is what we are looking at, and what Lord Lawson said is one of the options that we have been considering. A decision will be taken by the Commission very soon about the best way to go on that.

**Q250 The Chairman:** We have two more areas to explore with you, and I hope we can get through them fairly quickly before time is up. The Commission's 2014 work programme that you referred to earlier also contains a new initiative for a 2030 framework for climate and energy policies. Can you tell us what this initiative will cover? There have been some press reports speculating that it will cover shale gas. Is that so, and is there any overlap with the unconventional hydrocarbons initiative?

**Alan Seatter:** Our plan would be to put what we are doing on the unconventional hydrocarbons—shale gas—initiative within that framework. There is already a framework on climate change, greenhouse gas emissions targets, renewable energy and energy efficiency. The Commission has reviewed this framework and will be coming out with some proposals next week about how to improve it. As part of that, we would like to put the shale gas issue within that context because that is the context in which a lot of member states have been discussing it. Is it good for energy security? Will it help replace imports of gas? Will it help them switch from coal to less damaging fuels? That is the area in which we think it is good to put this initiative, which is why we are putting it into that package. Our idea is that it should be part of that package.

**Lord Hollick:** When agreement was reached last month on revisions to the environmental impact assessment directive, did the Commission approve of the introduction of mandatory environmental impact assessments for shale gas operations?

**Alan Seatter:** As I mentioned at the beginning, we did not take a position on that. We did not make a proposal to make environmental impact assessments mandatory. That was put forward by some groups in the European Parliament. We did not take a position on that proposal.

**Lord Hollick:** What now happens?

**Alan Seatter:** That proposal is unlikely to go through the legislative process. There will be a vote in the plenary of the European Parliament shortly on that. We understand that there is no majority in Parliament in favour of making that change and there was not a qualified majority in the Council either. The Commission did not make that proposal, so we did not take a position on it, partly because we are coming forward soon with our ideas on the enabling framework for shale gas.

**The Chairman:** I was pushing on towards the end because I realised that we might have a vote and I also realise that you have a plane to catch. Is there anything else you would like to say to us before we conclude?

**Alan Seatter:** It is very helpful for us to understand the views that you are putting forward. I think there is a certain amount of confusion about what is a national or European competence. I hope I have been able to clarify that the choice of energy mix is purely for member states to decide. Our work has been directed to the objective of what we can do to enable shale gas developments to happen in Europe in a way that reassures people that the environmental risks can be dealt with and reassures investors that they have a clear and predictable framework. The reason that we are involved in that is because it is already European legislation and we have to try to help clarify it in a way that takes account of best practice in member states and the industry. It is an enabling framework. I have not been able to be clear about whether we are proposing legislation or not because that decision has not been taken—it will be taken by the Commission next week—but I have tried to give you an indication of the kinds of things that we have been thinking about to clarify the situation without creating delays or uncertainty and to make sure that investors are clear and that the environmental risks can be managed.

**The Chairman:** Well, Mr Seatter, thank you very much. I think you will be aware from the tenor of our questions that we are concerned with two particular aspects here: one is the principle of subsidiarity and the other is what we are hearing from quite a lot of our witnesses about the desirability of investors and the industry being much clearer about the environment in which they are hopefully going to invest. These are the two areas that we have been particularly concerned about. It would be helpful if you could give us a note after the meeting next week because we will not be completing our report for a little bit yet. It would be very helpful to have a note of what happens at the meeting next week to which you have frequently referred. If you have any other thoughts that you feel you would like to convey to us, please do so. Meanwhile, we will find it very interesting to study the evidence you have given us today. Thank you very much.

Shell, Société Générale and International Energy Agency—Oral evidence (QQ 96-114)

**Shell, Société Générale and International Energy Agency—Oral evidence (QQ 96-114)**

Transcript to be found under [International Energy Agency, Shell and Société Générale—Oral evidence \(QQ 96-114\)](#)

## **David K. Smythe BSc, PhD, Emeritus Professor of Geophysics, University of Glasgow—Written evidence**

### **Brief CV**

1. I am a geophysicist and structural geologist with forty years' experience. I was with the British Geological Survey before taking up a new Chair of Geophysics at Glasgow University in 1988. I worked closely with the Department of Energy on oil and gas prospects during these years, and also prepared briefings for F&CO. At Glasgow I organised and led a complex multinational experiment near Murmansk in the USSR (now Russia) in the winter of 1992 to image the earth's crust at the world's deepest borehole, the aim being to characterise possible fluid layers.
2. I then worked on radioactive waste disposal, carrying out a large research contract for Nirex at Sellafield. This was the first-ever three-dimensional seismic image of a potential disposal site. But in the light of what I discovered about the complexity of the geology I appeared against Nirex as an expert witness at the Local Planning Inquiry of 1995-96.
3. I retired in 1998 following the closure of the earth science department at Glasgow. I pursue scientific research and occasionally consult for the oil and gas industry. In the last two years I submitted geological evidence to the DECC Managing Radioactive Waste Safely programme, and also delivered several public lectures in West Cumbria, showing why the geology of that entire region is unsuitable for siting a radioactive waste repository. This helped to persuade Cumbria County Council to withdraw from the MRWS process in January this year. I have also been studying the pertinent geology of shale gas basins in the USA, UK and France, with a view to understanding why the European experience will be different from that of the USA.
4. This submission is made in a personal capacity. I have no interests to declare. I am at the disposal of the committee to be examined as a witness.

### **Summary**

5. \*The geology of the US shale basins is fundamentally different from western Europe.  
\*The UK shale basins are heavily faulted, from the shale layer right to the surface, in contrast to those of the USA.  
\* Pre-existing faults provide a potential fast-track pathway for fracking fluid and produced gas to escape upwards into drinking water aquifers and even to the surface.  
\*This fault-leak problem associated with fracking has been recognised in France and Germany, but not in the UK.  
\*The current UK regulatory regime is ill-equipped to deal with this problem.  
\* Fracking for gas or oil should be banned in areas of complex faulted geology; in effect this means an overall ban in the UK.  
\* There will be no 'shale gas revolution' in the UK because in complex geology the production process is uneconomic.

### **Why geological faults are crucial**

6. The Royal Society report<sup>159</sup> into hydraulic fracturing ('fracking') concentrated on the risk of induced earthquakes. The problem of pre-existing faults was barely discussed, even though it

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<sup>159</sup> Royal Society and Royal Academy of Engineering 2012. *Shale gas extraction in the UK: a review of hydraulic fracturing*. DES2597. Available online: [www.royalsociety.org/policy/projects/shale-gas-extraction](http://www.royalsociety.org/policy/projects/shale-gas-extraction)



was introduced as a subject for concern by the Geological Society of London.

7. Faults are roughly planar surfaces separating one block of rock which has been displaced relative to the other. They do not continue *ad infinitum*; as a rule of thumb the displacement (the 'throw') at the centre of a fault may be about one-tenth of the fault length in the vertical or horizontal dimension. The end of the fault (the tip) may grow as the fault moves. This normally happens in small jerks - such sudden displacements are earthquakes. The fault surface is composed of crushed rock, surrounded by fractured rock in the block on each side. Faults are important in our discussion, aside from causing earthquakes, because they can act as conduits for fluids.
8. Faults are mapped by field geologists. Identification at depth requires geophysical methods, of which imaging by the seismic reflection method is by far the best. Two-dimensional seismic profiles can image faults with a throw of about 30 m or more. So the 'resolution' - the finest detail that can be seen - is at least 30 m in length. The 3D seismic technique improves the resolution to the order of 4-5 m.
9. Faults are often missed even when a vertical well is drilled. This is because the drilling process grinds up the rock, which is identified only by the cuttings coming back up with the returning drilling fluid. So it is not surprising that a fault, which is characterised in detail by ground-up, crushed and fractured rock, often cannot be seen. Even if the well is cored, which involves the taking of a solid intact cylinder of rock from the inner zone of the drilling, faults can be difficult to recognise with certainty.
10. Permeability is a general term applied to fluids (liquids and gases); it is a measure of how easily a fluid can flow through the medium. There are dozens of academic research groups and oil-industry service companies working on the problem of whether faults act as *conduits* or as *barriers* to fluid flow. The default position in the hydrocarbon industry is the conservative one, that faults do not act as seals; in other words, they are leaky (permeable) unless proved otherwise. In conventional oil or gas exploration, if a fault is wrongly judged to be a seal when in fact it is permeable, no damage is done, other than to the bank balances and share prices of companies and individuals. However, in the case of shale gas exploitation, the consequences of assuming that faults act as seals may be extremely damaging to the environment.

### **US shale basins**

11. I have investigated the geological structure of the four principal shale gas basins in the USA: the Marcellus, Barnett, Eagle Ford and Woodford shales. In total these contain over half a million fracked wells. A Halliburton study<sup>160</sup>, which has been widely quoted in support of the environmental safety of fracking, aims to show that the upward propagation of the new fractures created by fracking in these four basins is limited, and that, in all cases of the approximately 10,000 fracked wells used as a database, the highest fracture height lies well below the deepest water well in each county. Therefore Halliburton argues that fracking *per se* cannot affect near-surface groundwater resources. Halliburton also claims that its database includes areas of “*exceedingly complex geology*”.
12. I find that there are only about twenty wells out of half a million which lie within 1 km of a geological surface-breaking fault. So the Halliburton claim may apply to occasionally complex

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<sup>160</sup> Fisher, K. and Warpinski, N. 2012. Hydraulic-fracture-height growth: real data. Society of Petroleum Engineers Annual Conference Paper SPE 145949, Denver 2011. *SPE Production & Operations*, February 2012, pp 8-19. This paper has to be purchased. It is unlikely that many UK research institutions will subscribe to this journal. However, a conference presentation coming to similar conclusions can be found online.

geological structure at the level of the fracking, but essentially *no pre-existing faults from the fracked levels extend up to the surface*.

13. The Royal Society report accepted uncritically the Halliburton study discussed above, as did a DECC report<sup>161</sup>. This uncritical attitude towards an industry publication is surprising, given that:

- Halliburton has not published its database, which remains confidential
- The paper appears in a Society of Petroleum Engineers journal; as with conference abstracts, it is 'grey' literature, having been given only low-level peer review
- Wells are only located by county, and individual wells cannot be identified
- We do not know whether inconvenient results have been omitted
- We do not know how complete is the database
- There are no wells in areas where pre-existing faults break the surface.

14. Even if we accept Halliburton's main thesis at face value – that creation of new fractures by fracking has a natural upward limit above the horizontal wellbore of around 500 m, perhaps 1000 m at the most – the story is erroneous at several places:

- Plotting fluid flow by microseismic monitoring is incomplete. Microseismic events can jump 'silently' up a fault plane to another level<sup>162</sup>. Therefore microseismic activity does not record the passage of fracking fluid up a fault.
- Such leakage up faults can be a slow process<sup>163</sup>, not necessarily occurring at the time of fracking.
- The authors argue that if faults were conduits all the gas would have leaked away by now. This is clearly false; the whole point of fracking is to release gas or oil which is trapped and therefore unable to migrate.

15. In conclusion, the Halliburton study is severely flawed, even when considered on its own terrain of US geology. It is certainly inapplicable to the UK.

### **UK shale basins**

16. The crucial difference between the US and UK shale basins is that the latter are *pervaded by faults extending from the shale layer all the way to the surface*. Another fundamental difference is their basin dimensions, both vertically and horizontally. In general the UK shales are 5 to 50 times thicker than the US basins, but 10 to 100 times smaller in surface area. The Weald basin shale is 2 to 100 times smaller in area than the US shale basins, but between 3 and 8 times thicker than any of the US shales.

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<sup>161</sup> Green, C.A. et al. 2012. *Preese hall shale gas fracturing review & recommendations for induced seismic mitigation*. Report to DECC.

<sup>162</sup> Pettit, W. et al. 2009. Using continuous microseismic records for hydrofracture diagnostics and mechanics. *Soc. Explor. Geophys. Ann. Meeting Expanded Abstracts*. Note: a step change in level of fracking was seen where the level of microseismic activity jumped upwards by 100m, with no intervening tremors to mark the passage.

<sup>163</sup> Borchardt, D. et al. 2012. *Abschätzung der Auswirkungen von Fracking-Massnahmen auf das oberflächennahe Grundwasser – Generische Charakterisierung und Modellierung* (Assessment of the impact of fracking operations on the near surface groundwater – Generic characterisation and modelling). [full report, in German, available at [www.dialog-erdgasundfrac.de](http://www.dialog-erdgasundfrac.de)]. Note: this report includes modelling of a fault zone, showing that under certain feasible conditions, fracking fluid can extend upwards from 1300m depth to the surface in 30 years. It also concludes that fracking in faulted areas should be banned.

17. The depths at which fracking has taken place in the US, compared with the depth at which fracking either has or will be undertaken in the UK, are as follows:
- US shale basins: 1000-4300 m depth; 90% of wells greater than 1600 m depth
  - UK Kimmeridge Limestone (tight oil, perhaps gas): 730 m (Balcombe), 1200 m (Wisborough Green)
  - UK Bowland Shale, Lancs.: vertical well tested between 2300 and 2650 m approx.
18. Therefore the current Weald exploration is taking place at a much shallower depth than in the USA, with correspondingly thinner cover rocks above the fracked horizons.

### **Migration of fluids up faults and through overlying rock**

19. The US oil industry advises that faults, sometimes present at the fracking level, are to be avoided if possible, because they reduce the effectiveness of the fracking treatment. Furthermore, re-activated faults are usually conduits to fluid flow<sup>164</sup>. But the problem of environmental contamination by fugitive methane and/or fracking fluids reaching the surface rarely arises in the USA, because there are essentially no faults which extend from the fracking level up to the surface.
20. Controversy over contamination in the USA due to fracking operations has therefore concentrated on the problem of faulty well construction, which can lead to fugitive methane emissions. In the scientific literature there are industry-sponsored papers purporting to show that methane emissions are 'natural' (pre-dating the advent of drilling, and/or negligible). One example of this is a newly-published paper<sup>165</sup> purporting to show low methane emissions – but the sites, pre-selected by the industry, are confidential. This has been immediately criticised on the ground that other independent studies report methane emissions ten to twenty times higher<sup>166</sup>.
21. An equally recent (non-industry) study of drinking water wells in Pennsylvania<sup>167</sup> shows that elevated (including dangerous) methane levels correlate with nearness to well sites, at a probability level of well under 1% (i.e. the chances of this correlation being by random chance), *and* the characteristic signature of the methane shows that it originates in the fracked Marcellus Shale, and is not a shallow biogenic product. In the Pennsylvania study area there are no geological faults breaking the surface. Even if the source of the methane leak is due to poor drilling techniques, the interesting fact remains that fugitive methane is not found just at some wellbores, but also up to several kilometres away. This suggests that the cover rocks above the Marcellus Shale, which here is at depths of 1500 to 2100 m, do not make a perfect seal.

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<sup>164</sup> Baker Hughes 2013. *Fault Seal Analysis: Improve reservoir understanding with fault seal analysis*. Web page available at: <http://www.bakerhughes.com/products-and-services/reservoir-development-services/cosulting-services/geomechanics/fault-seal-analysis>

<sup>165</sup> Allen, D. et al. 2013. Measurements of methane emissions at natural gas production sites in the United States. *Proceedings of the National Academy of Sciences*. Available at [www.pnas.org/cgi/doi/10.1073/pnas.1305880110](http://www.pnas.org/cgi/doi/10.1073/pnas.1305880110)

<sup>166</sup> Howarth, R. 2013. *Cornell University press release September 11 2013 re Allen et al. paper in the Proceedings of the National Academy of Sciences*. Note: this critique of ref.7 says that it shows that industry can do a clean job, but until all the data are made available there are good reasons to mistrust the veracity of its conclusions.

<sup>167</sup> Jackson, R.B. et al. 2013. Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction. *Proceedings of the National Academy of Sciences Early Edition*, available at: [www.pnas.org/cgi/doi/10.1073/pnas.1221635110](http://www.pnas.org/cgi/doi/10.1073/pnas.1221635110)

22. How much rock is required above a fracked zone to seal it? In the East Irish Sea Basin at least 600 m of Mercia Mudstone Group is required for it to be an effective hydrocarbon seal<sup>168</sup>, although the same rocks make a good cap for the Wytch Farm oilfield in Dorset. In the Wirral, natural gas seeps<sup>169</sup> either passed up through 1500 m of mudstones and sandstones (poorly and very permeable, respectively), or else *via* faults.
23. In short, there is no perfect cap-rock seal. If fracking takes place on an industrial scale over large areas, it is likely that in areas of complex geology fugitive methane and perhaps fracking fluid will eventually contaminate aquifers. This contrasts with onshore UK oil and gas fields, which are only a few square kilometres in area.

### **The UK regulatory regime (onshore)**

24. I have sat on both sides of the table at DECC interviews for licence awards. The applicant's technical proposals are heard politely, but the decision on whether or not to award the licence is based essentially on how much funding will be committed. This is a robust system, widely used elsewhere, and leaves the detail of the geological prospects to the licensee.
25. In my view the weakest point of the regulatory process concerns the Environment Agency, which is asked by the planning authority to comment on planning applications. This reduces to commenting on the applicant's Environmental Statement (ES), meaning that the EA is dependent upon information furnished by the applicant. It is a reactive rather than a proactive system. The EA is ill-equipped to cope with the new demands of unconventional hydrocarbon exploration. Two geological examples illustrate this weakness:
26. The EA response to Celtique Energie's current ES for West Sussex County Council is weak:  
*“The content of the reports are satisfactory and we agree with the conclusions and recommendations. As stated in the reports, the site lies on a non-productive aquifer and the risk to water resources is low.”*
27. My analysis<sup>170</sup> shows that the geology of Celtique's ES is misleading in places. The seal is *ineffective*, even with 1200 m of overlying rock, and therefore a contamination risk. In addition, an attempt to drill a water well some 500 m NE of the proposed site found saline water at 39 m depth. This commonly suggests a fluid connection to depths of at least 500 m, where saline water is to be found.
28. Greenpark (now Dart) Energy's ES for Becklees Farm coal bed methane development (Cumbria) states:  
*“The site is situated over an area of Triassic and Permian Sandstones which act as a major aquifer. However, because there is a layer of overlying drift, the Environment Agency have designated the local groundwater as having a low vulnerability to potential pollution because of the protective properties of the overlying drift.”*

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<sup>168</sup> Duncan, W.I., Green, P.F and Duddy, I.R. 1998. Source rock burial history and seal effectiveness: key facets to understanding hydrocarbon exploration potential in the East and Central Irish Sear Basins. *Am. Ass. Petrol. Geologists Bull.* **82**, 1401-1415.

<sup>169</sup> Selley, R.C. 2012. UK shale gas: the story so far. *Marine and Petroleum Geology* **31**, 100-109. Note: Professor Selley has unrivalled knowledge of the UK shale gas scene.

<sup>170</sup> Smythe, D.K. 2013. Planning application by Celtique Energie to drill at Boxal Bridge, West Sussex: Critique of environmental statement in the context of relevant geology and hydrogeology. Submission to West Sussex County Council. Available on the WSCC website and at <http://www.davidsmythe.org/fracking/fracking.htm>.

29. The site is located where the major aquifer is overlain by a mere 5 m of 'overlying drift' (post-glacial till)<sup>171</sup>. The only conceivable explanation for the EA approval is that it was narrowly considering the risk of pollution from spills at the surface possibly penetrating down to the aquifer. It evidently did not consider upward migration of pollutants from depth into the aquifer, *via* the drill bore and/or faults.
30. The EA appears to have insufficient in-house expertise to respond to planning applications in this area. But instead of strengthening the expertise, government is planning a 15% staff job cut. The EA states, furthermore, that from February next permits will be issued within 1-2 weeks. It is difficult to see how this haste can be reconciled with “*taking into account the views of local communities, environmental organisations and other stakeholders*”<sup>172</sup>.
31. The current regime is, in effect, one of self-regulation.

### **Critique of some current unconventional operations**

32. I am unimpressed by the technical competence of some shale gas/oil and CBM operators who hold current UK exploration licences, as viewed through the prism of their planning application documents. Some of my findings are discussed and/or published in more detail elsewhere<sup>173</sup>; here is a summary:
33. Cuadrilla licence PEDL244 (Balcombe, West Sussex):
  - 8) Licence boundary on application map out of place by up to 1200 m
  - 9) No account taken of the BGS surface geology maps showing faults surrounding the drill location
  - 10) Poor subsurface structural interpretation due to omission of the BGS fault dataset
  - 11) Lateral (horizontal) drilling at Balcombe was done 'in the dark' (no seismic image).
34. Celtique licence PEDL234 – proposed drilling near Wisborough Green, West Sussex:
  - 13) No effective sealing (cap rock) layer
  - 14) Misleading description of regional groundwater flow
  - 15) New 2D seismic data acquired, but no 3D, necessary for lateral drilling
  - 16) Saline water in water well drilled 500 m NE of proposed drillsite not mentioned.
35. Dart Energy PEDL133 - proposed CBM development at Airth, Stirlingshire:
  1. Inappropriate geological cross-sections supplied in ES (both outside area of proposal)
  2. Five major faults omitted from these cross-sections
  3. Misleading and very incomplete discussion justifying faults as barriers to fluid flow
  4. Internally inconsistent maps of a major fault (>300 m throw; biggest in whole region)
  5. This fault unaccountably absent over development location, but present either side
  6. Misleading discussion of sealing cap rocks above coal formations
  7. No 3D seismic survey.

36. Cuadrilla licence PEDL165 (Lancashire):

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<sup>171</sup> McMillan, A.A, et al. 2011. *The Quarternary Geology of the Solway*. British Geological Survey Geology and Landscape (Scotland) Programme Research Report RR/11/04. Note: freely available online.

<sup>172</sup> Environment Agency 2013. *Commitment to streamline and simplify environmental regulation of onshore oil and gas exploratory activities*. Webpage available at <http://www.environment-agency.gov.uk/news/148476.aspx> [updated 27 Sep 2013].

<sup>173</sup> Smythe, D.K. 2013. Website page: Faulting and fracking. <http://www.davidsmythe.org/fracking/fracking.htm>.

- 1) Interpretations based on poor-quality reprocessed 2D seismic data
- 2) Classification of faults into two types A and B is unjustifiable
- 3) Interpretation (late 2011) of major Thistleton Fault wrong, and mismatches BGS maps
- 4) Explanation of seismicity and future magnitude mitigation steps depends on this wrong interpretation.

37. My overall impression of the work done to date is that it is frequently hurried and based upon poor-quality data and interpretations. The most serious failing is that the faulting which pervades all these licensed areas has not properly been taken into account. Equally serious is the fact that the companies seem to be getting away with presenting such work.

### **Discussion and conclusions**

38. France has confirmed its ban on fracking while in Germany it seems probable that the new coalition government will adopt a moratorium on fracking pending further investigation of health and environmental issues. In large part, these decisions have been based on unacceptable local environmental risks due to complex geology.
39. Chevron has withdrawn from Poland, citing over-complex geology. On the purely commercial front, US industry is reporting that fault zones should be avoided because fracking becomes inefficient – simply too much energy and fracking fluid is wasted sending it up (or down) faults.
40. New methods have been tested for fracking without using water, including propane gas as the proppant fluid, and electric shocks. Total concludes that the latter is a failure. The use of propane (in liquid form under high pressure) will mitigate water consumption, but introduces new dangers and does not solve the fault-leak or insecure cap-rock problems which can lead to aquifer contamination.
41. In view of the local environmental risks due to complex geology, together with the likely concomitant uneconomic nature of fracking in the UK, I therefore see no sound reason for the UK to continue to promote shale gas.

11 November 2013

Société Générale, International Energy Agency and Shell—Oral evidence (QQ 96-114)

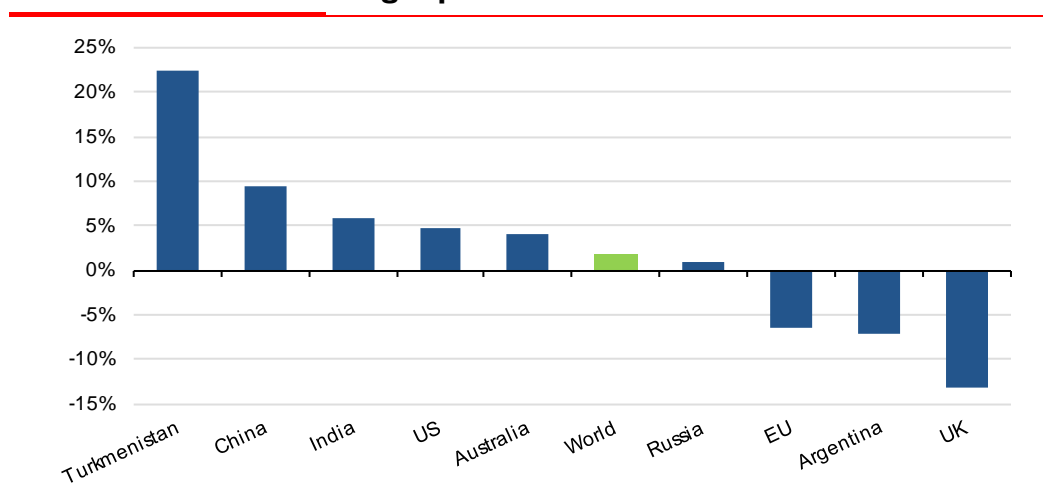
**Société Générale, International Energy Agency and Shell—Oral evidence (QQ 96-114)**

Transcript to be found under [International Energy Agency, Shell and Société Générale—Oral evidence \(QQ96-114\)](#)

## Société Générale—Written evidence

**The option to develop shale in the UK comes at a time of falling hydrocarbon production, increasing imports and reduced oil & gas tax revenues for HM Treasury**

**2002-2012 CAGR of gas proven reserves in selected countries**



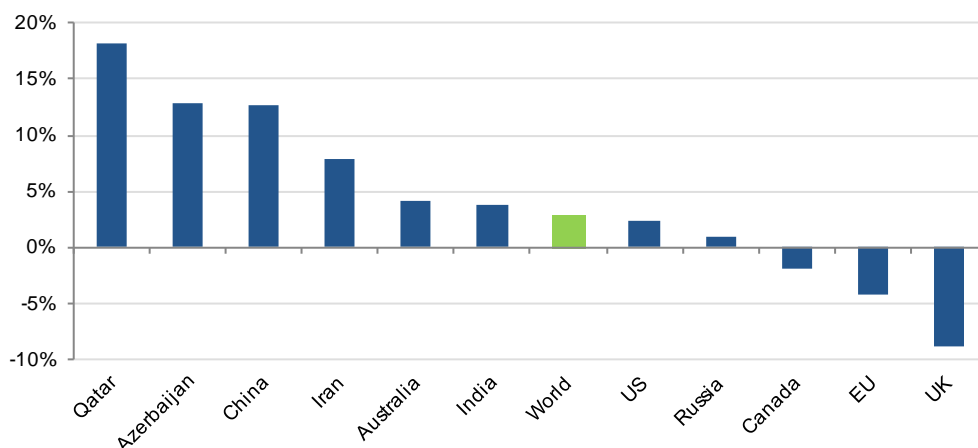
Source: BP Statistical Review

US growth, more than twice the world average, comes from the unconventional gas resources that have now been deemed recoverable thanks to innovative technologies. This high growth has allowed the US to overtake Saudi Arabia as the fifth-largest reserves holder in the world. Turkmenistan’s huge growth comes from an area in the country that wasn’t explored much under the Soviet regime and that is estimated to hold the world’s second-biggest gas reservoir. Albeit from a very low level, China’s high gas reserves growth is laying a solid foundation for the further expansion of its domestic production. Australia’s growth is recent (2008) and comes from the huge capex private companies are dedicating to new LNG projects. The EU (and particularly the UK with -13.1% CAGR) saw its gas proven reserves reduce over 2002-2012 as it was producing more gas than it was finding reserves. The world record for the largest decline in gas proven reserves is held by the UK, beating even Argentina, where the government decided in 2012 to nationalise the local oil company (YPF).

For the top-four reserve holders (Iran, Russia, Qatar and Turkmenistan), the reserves-to-production ratio (R/P) is over 55 years. Then comes the US where the R/P is ‘only’ 12 years. This is because, in the US, private companies are geared towards monetising resources rapidly; hence, there is less time between booking and production than anywhere else. This doesn’t mean that in 13 years the US won’t have any more gas reserves because by then some resources should have been booked into reserves thanks to companies’ capex programmes. For the EU, the R/P is 12 years but, if the EU continues to fail to replace its gas production, this could mean that in 13 years’ time, EU domestic production could be insignificant.



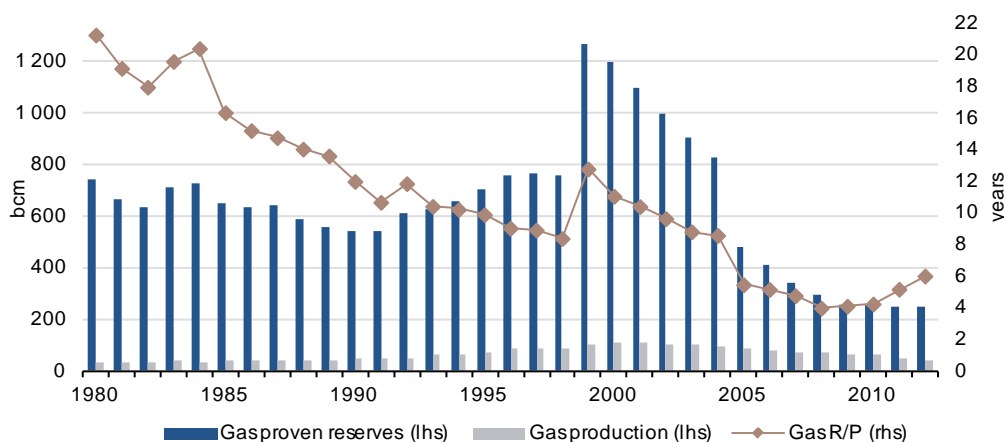
### 2001-2011 CAGR of gas production in selected countries



Source: BP Statistical Review

For the UK, the R/P gas ratio is just six years. This ratio has been growing in the last five years thanks solely to the fast decline in gas production as the proven reserves have gone down steadily.

### UK gas proven reserves (R) & gas production (P)



Source: BP Statistical Review

Between 2002 and 2012, the CAGR for UK gas production was -8.9% with record drops witnessed in 2011 (-20.3%) and 2012 (-14.1%). With a further fall of 15.4% in Q1 13 vs Q1 12, we expect UK gas production to continue to decline in the years to come, even if new conventional fields are anticipated to come onstream thanks to record offshore capex spending.

### North America to become the third-largest LNG exporter thanks to shale gas

Between 2005 and 2012, US gas production increased by 30% thanks to shale gas, which today represents more than 40% of total domestic production. To access new markets to balance this supply (and to benefit from low US gas prices), many companies want to build

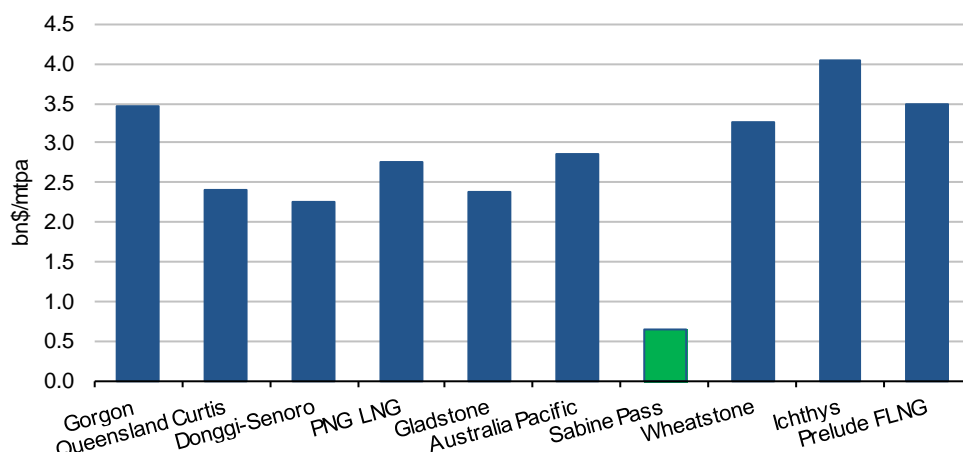
liquefaction facilities to export Liquefied Natural Gas (LNG). However, a wide range of authorisations are needed before a liquefaction facility can be built in the US, including:

1. An important one granted by the US Department of Energy (DoE) to allow exports, as all nation states have permanent sovereignty over their natural resources. The US DoE can grant authorisation either to countries with which the US has a free trade agreement (FTA countries are Australia, Bahrain, Canada, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Singapore and South Korea) or to all countries with which trade is not prohibited by US law.
2. One granted by the US Federal Energy Regulatory Commission (FERC) to site, construct and operate facilities for the liquefaction and export of domestically-produced natural gas. This process takes more than a year and costs tens of millions of dollars.

Cheniere was the first company, in May 2011, to be granted all export authorisations. It has managed to sell 16 mtpa (22 bcm/y) of LNG under a US spot-linked (Henry Hub) formula (LNG delivered Free On Board: 115% HH + fixed fee). The 115% HH covers the gas sourcing (100% at the hub), the cost of fuel gas needed for the process (10%) and additional costs of transportation to the liquefaction terminal (5%). The fixed fee is for the remuneration of the liquefaction plant, which will therefore operate as a tolling plant. As Cheniere took a Final Investment Decision in July 2012 on Sabine Pass Phase 1 (and in May 2013 on Sabine Pass Phase 2), LNG should be in production in the US as early as 2016e.

In August 2013, the US DoE authorised Lake Charles to export US LNG to non-FTA countries from its terminal in Louisiana at a rate of 15 mtpa (20 bcm/y). The US DoE granted a further authorisation, in May 2013, to Freeport in Texas at a rate of 9 mtpa (12 bcm/y). Lake Charles and Freeport are still waiting for the FERC authorisation. Several other projects with a total capacity of around 200 mtpa (270 bcm/y) have filed applications seeking export authorisation. So our estimate of 50 mtpa (67 bcm/y) in exports in 2020e from North America (US and Canada) is now very likely to materialise.

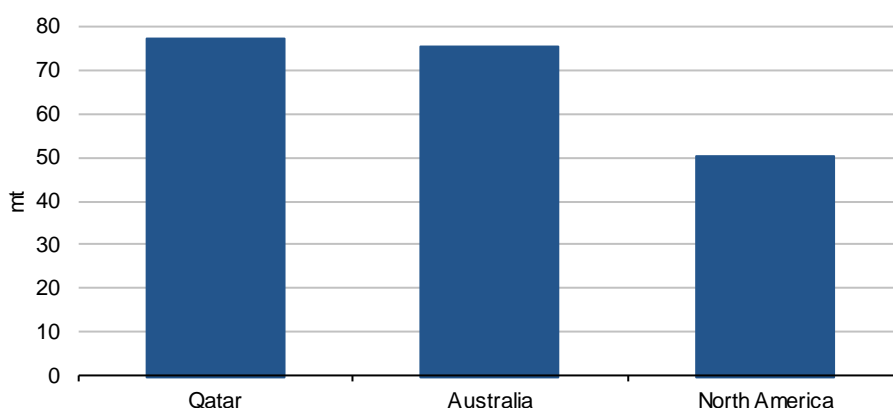
### Disclosed capex of sanctioned LNG projects



Source: SG Cross Asset Research, companies data

Thanks to unconventional gas, Australia is set to become the next growth area for LNG from 2015e. Its current 24 mtpa (33 bcm/y) capacity is set to grow, as 53 mtpa (71 bcm/y) capacity is already under construction. But Ichthys could be the last greenfield LNG project sanctioned in Australia because, with rampant cost inflation and faced with an increasingly price-sensitive customer base, these large-scale, expensive projects simply look cumbersome and out-dated in the context of intensifying global competition. As a result, Australian projects are being priced out of the market by US ones that are much cheaper as: 1/ the upstream, transportation and LNG infrastructure (jetty, tanks) are already there; and 2/ the cost of labour is lower than in Australia.

### 2020e LNG production: three largest producers



Source: T. Bros, After the US shale gas revolution

### Markets could be linked via the cost of LNG arbitrage

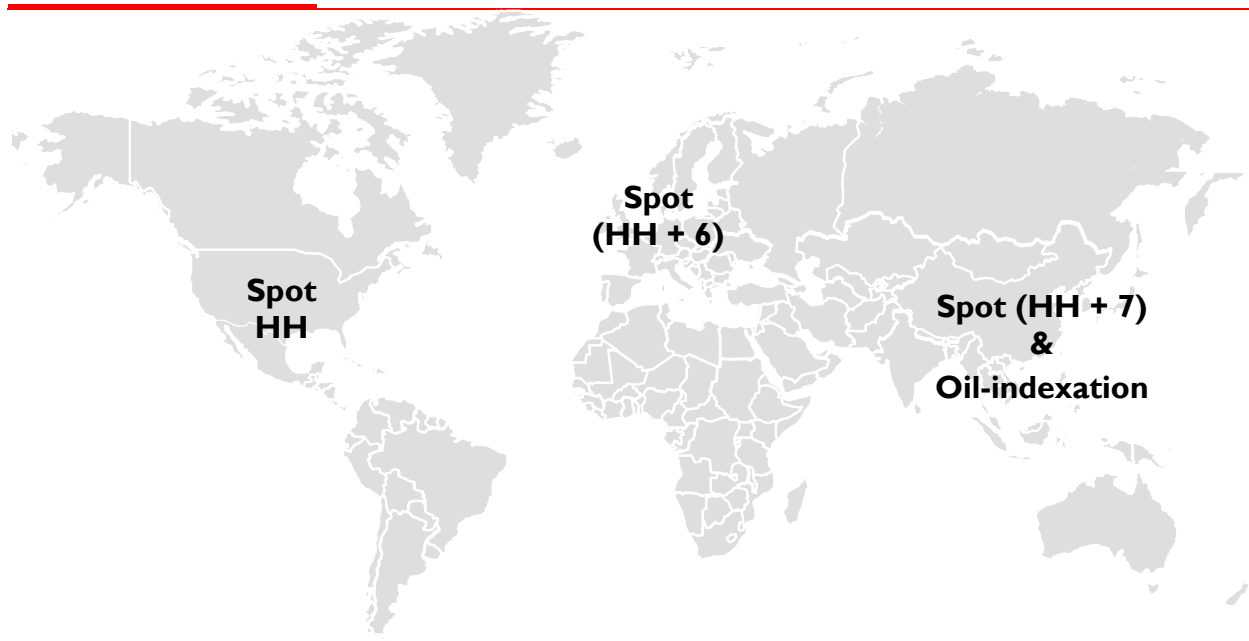
By directly sourcing US LNG priced under an HH formula, Asian customers are cutting out the middle man, the LNG aggregator. And, if the US becomes a major LNG producer as we

believe, then this change in business model could start to reduce oil indexation in Asia, as we are seeing in Europe.

If we assume no other country can replicate, before 2020e, the US's success, the US could remain the cheapest gas market at least for the rest of the decade; other markets will be linked via the cost of arbitrage (liquefaction, transport and regasification). For a unified global gas market to be achieved, all countries will need to follow the US path by producing their own domestic shale gas, something that looks improbable before 2020e.

In 2012, the difference between US and European gas saw Europe paying \$130bn (or 0.8% of GDP) more for its gas than it would have if it had paid US prices. This spread is there to stay for this decade as Europe will not be able to produce shale in any significant quantities before 2020. The low level of European shale production should therefore have only a limited impact on European prices (be it wholesale or at the residential level).

## Overview of gas prices in 2020e (with estimated spreads in \$/MBtu)



Source: T. Bros, *After the US shale gas revolution*

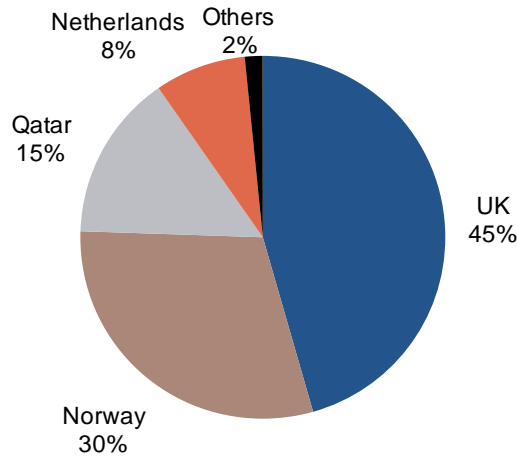
### UK: a leader for shale gas in Europe

Like any human activity, shale needs a 'social licence' to operate and the industry should be aware that its least successful player, in the eyes of the general public, defines the industry as a whole. The way the industry operates in the first countries to allow fracking will have a major impact on further shale oil & gas production throughout Europe. A tightly regulated production process, with a systematic programme for the disclosure of chemicals used in unconventional gas production, could help the industry to expand in Europe. The International Association of Oil and Gas Producers launched in June 2013 [www.ngsfacts.org](http://www.ngsfacts.org) to provide information concerning hydraulic fracturing of natural gas from shale wells and other issues, including voluntary disclosure of chemical additives on a well-by-well basis in the European Economic Area. This site includes wells which have been hydraulically fractured since January 2011 by participating operators (six wells in Poland so far). This is in line with the wider US [www.fracfocus.org](http://www.fracfocus.org) initiative. A comprehensive disclosure programme allows citizens and communities to consider the technology. Only this can lead to informed discussion about environmental protection and risk management, and the potential benefits of shale development in Europe. Any environmental issue would have a dramatic effect on shale production throughout Europe. Thanks to its long history of conventional exploration and production, the UK has well-established rules on the environmental issues that could help local acceptance.

Tighter environmental standards will mean that this business will not be as profitable as conventional gas production in major resource-holder countries, but the risks (financial, security, etc.) are much lower in Europe than in other gas-producing countries. The UK industry is a pragmatic price taker, which means that it will proceed with shale gas production only if it perceives it could be profitable. The above map shows that if the full cost to produce 'green' shale gas in the UK is less than HH +6 \$/MBtu then it should go ahead as it will be profitable for private companies to extract it. As in hydrocarbon

production, taxes are very high, therefore the tax regime will have an impact on the level of investment (and hence the production). It is too early to estimate the amount of UK shale production but it is possible that the UK will produce some as soon as 2020e.

### Split of 2012 UK gas supply

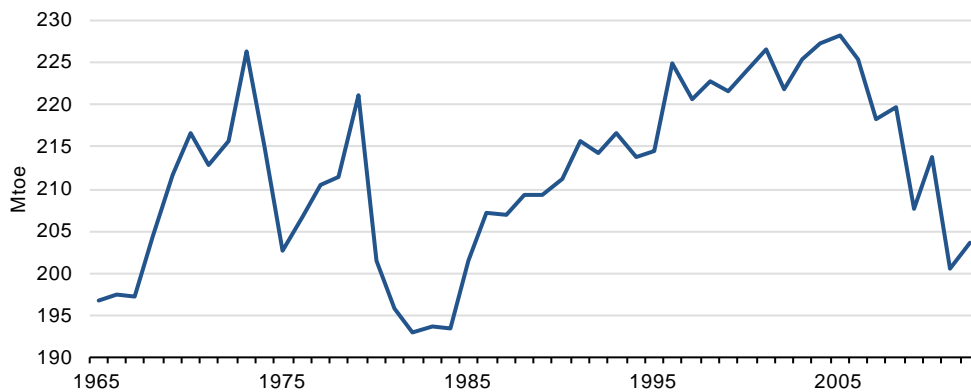


Source: BP Statistical Review

Until the shale gas revolution, net importers were fated to become more and more energy dependent. The shale gas revolution changed this dependency paradigm forever and is offering an alternative. The US has chosen to reduce its dependency on foreign oil & gas. China will try to use it to mitigate its growing gas dependency. The UK (like Poland) could use it to mitigate its growing dependency on importation of gas, leading it to displace Qatari LNG, whereas Poland could displace Russian pipe gas, which is viewed by the Poles as not fully reliable. In the UK, shale gas could lead to a useful diversification of supply which would boost energy security and have a positive impact on jobs and the trade imbalance.

If this is done successfully in the UK, other European states that actually ban this technology could follow with production after 2020e (to curb their own deficits). With shale gas development in its early stages in Europe, the resource is unlikely to play more than a marginal role in helping to meet Europe's energy requirements in the next decade. European shale gas production could also be the only answer to the ill-functioning EU gas market in which four foreign national oil companies (Gazprom from Russia, Statoil from Norway, QP from Qatar and Sonatrach from Algeria) control c.50% of supply, allowing the wholesale price to be way above the marginal cost of production. And when market participants view material shale gas production in Europe as possible (meaning around 25 bcm or 10% of domestic supply or 5% of demand), the price curve could move down to reflect this new world.

### UK primary energy consumption



Source: BP Statistical Review

UK primary energy consumption peaked in 2005. Since then, consumption has declined by 1.6% pa. Such a peak in primary energy consumption is also visible for the US (2007), Japan (2006) and the OECD countries as a whole (2007) as well as for Russia (1989). Poor economic growth, high fuel prices and greater energy efficiency should continue to cap UK primary energy consumption. This tends to show that, like other OECD countries, the UK has entered a new world where energy efficiency has kicked in. The question now is no longer how much consumption of each energy fuel is going to grow, but which one is not going to decline for the foreseeable future. In this context, the inter-fuels competition that currently favours renewable (on the policy side) will exacerbate the decline of other types of fuel. So this 'new' gas will displace imported gas first and could be used in power generation but also in transport (either via LNG, CNG or electric vehicles powered by gas-fired power stations). It could also lower wholesale gas prices thanks to increased competition. UK/European shale oil if produced could, after 2025e, mitigate a growing dependency on the less reliable Middle East.

9 September 2013

## Professor Paul Stevens—Written evidence

*Professor Paul Stevens Distinguished Fellow, Chatham House; Emeritus Professor, University of Dundee; Visiting Professor, University College London (Australia)*

### **INTRODUCTION**

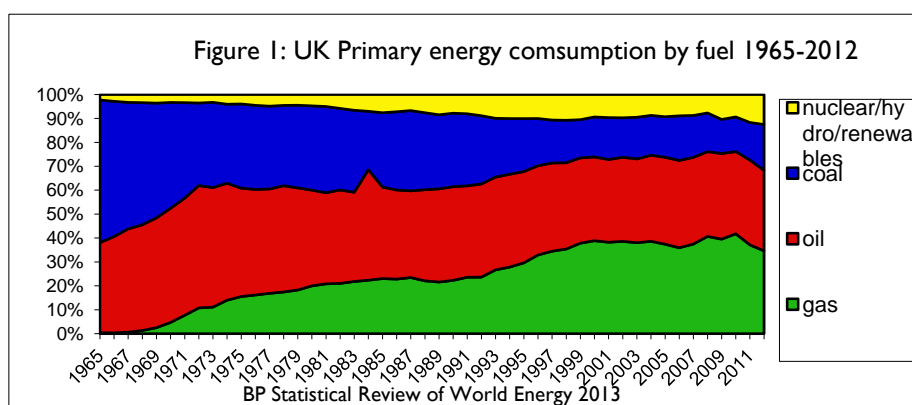
1. The call for evidence lists 13 questions that are to be addressed. This paper addresses a number of them listed below. While the inquiry includes shale oil, this paper concentrates only on gas. For further details, there are two reports by this author already published by Chatham House that may be of interest. These are

Paul Stevens The “Shale Gas Revolution” Hype and Reality. A Chatham House Report. Chatham House, London. 2010.

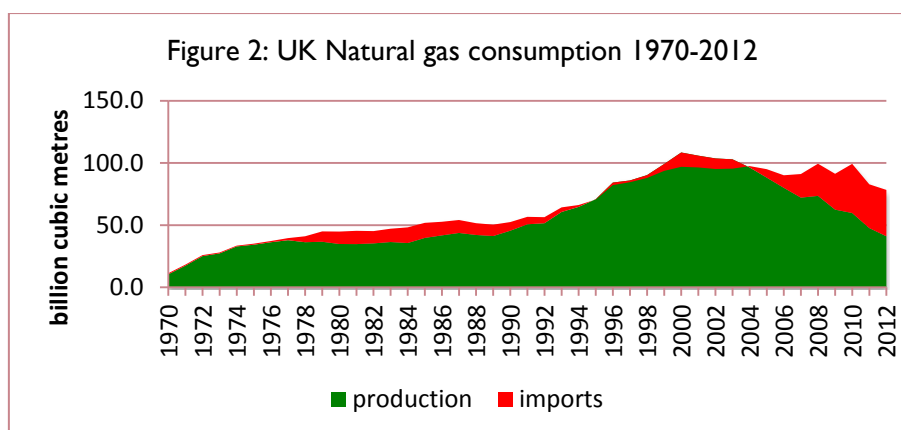
Paul Stevens The ‘Shale Gas Revolution’: Developments and Changes. Briefing Paper, Chatham House, London. August 2012

### **WHAT IS THE SCOPE FOR SHALE GAS TO BE USED IN THE UK?**

2. As Figure 1 shows, the consumption of natural gas in the UK has doubled since 1990.



However, as can be seen from Figure 2, domestic production of conventional gas has declined leading to a significant increase in gas imports. Of these imports, in 2012 5 percent came from net pipeline imports from Europe and 95 percent from Liquefied Natural Gas (LNG) largely from Qatar.



In such a context there is a clear potential market for natural gas produced from shale operations.



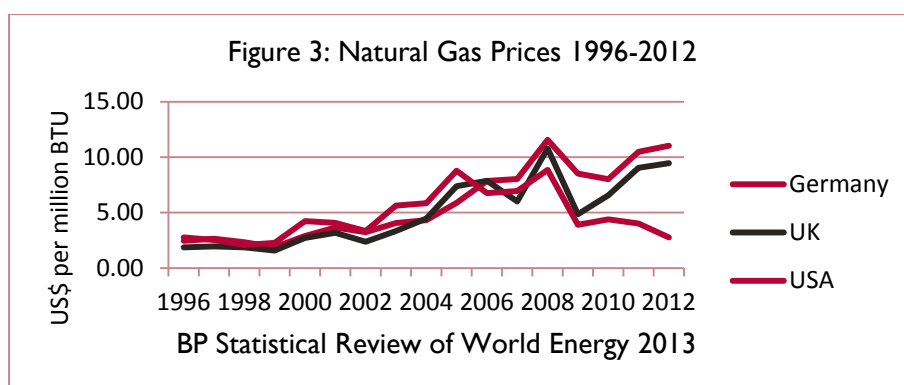
### **WHAT ARE THE COSTS OF ACCESSING SHALE GAS COMPARED TO OTHER ENERGY?**

3. There are considerable uncertainties over the cost of producing shale gas in the UK. Hard information is very difficult to find. The two key determinants of production costs are the geology of the shale plays and the state of the service industry to undertake the horizontal drilling and the hydraulic fracturing. Currently knowledge of the geology of shale plays in the UK is in its infancy. Furthermore shale gas operations are notoriously differentiated. Not only are shale plays very different, so too are wells on the same play. Also costs change as the shale gas operations move down the learning curve. This uncertainty is compounded because of uncertainty over the externalities of environmental damage that may be associated with shale gas operations. This should be accounted for in the “cost”. While all the evidence suggests that hydraulic fracturing is environmentally safe if well regulated and done properly, little is yet known about the level of fugitive methane emissions. This represents a potentially significant addition to greenhouse gas emissions. However, in the absence of data it is impossible to value this in order to internalize the costs.

4. The state of the service industry in the UK to undertake onshore shale operations is very weak with few drilling rigs and even fewer units that can hydraulically fracture. In the US Barnett shale play at the height of the operations in 2008, 199 rigs were drilling while in 2010 there were only 34 rigs in all of Western Europe. Estimates in Poland, where the service industry is in a similar state to the UK, suggest a shale well costs three times more than in the U.S. The relative costs of energy alternatives are equally uncertain. The future of the nuclear industry in the UK is uncertain and the future of LNG markets is very controversial, because of the fall-out from the shale gas revolution in the US and its potential replication elsewhere.

### **WHAT MIGHT BE THE IMPACT OF SHALE GAS ON THE UK GAS PRICE?**

5. Views on the impact on gas prices have been strongly influenced by the U.S. experience seen in Figure 3. The dramatic fall in domestic prices since 2008 has given a major boost to U.S. manufacturing industry, especially petro-chemicals. It is clearly the prospects of replicating this experience in the UK that has made the Treasury such a fan of UK shale gas.



6. However, such optimism is seriously misplaced. The UK is physically linked into the Continental European gas market via the Bacton Interconnector. If UK prices fall, once the gap with higher European prices is large enough, gas begins to flow to the higher price market pushing up UK prices. This type of arbitrage can be observed in Figure 3. In the case of the U.S. there is no market for lower priced gas so the price stays low. This could

change if the U.S. begins to export substantial quantities of LNG. Equally, the large gas suppliers in the UK are very unlikely to leave any money on the table for consumers. The idea that a shale gas revolution in the UK would lead to significantly lower gas prices is a myth.

**WHAT MIGHT BE THE IMPACT OF SHALE GAS ON CARBON EMISSIONS?**

7. Methane is a far more potent greenhouse gas than Co2 – something like 70 times more potent over a twenty years period. Therefore if fugitive emissions from shale operations are high, this could impact climate change policies. Producing shale gas, because it is more energy intensive, will produce more Co2 than conventional gas but studies by the Tyndall Centre at the University of Manchester suggest the extra is insignificant at only 4 percent more. The key issue is what energy source might be replaced by shale gas. If coal or oil is replaced, given methane emits less Co2 than either - roughly half the emissions of coal for the same energy content - obviously this would reduce the UK’s carbon footprint. This has already been seen in the U.S. where shale gas is pushing out coal from power although it is the replaced coal is being exported to and burnt in Europe. However, there is a serious danger that UK consumers, growing increasingly concerned about their domestic energy bills, may press for shale gas to substitute for renewables which they see (probably incorrectly) as being responsible for these higher energy bills. This would be bad news for carbon reduction targets if it impacted the drive for renewables. Ultimately, methane produced by shale gas operation is a hydrocarbon and while it emits less than coal or oil, it still emits Co2.

**WHAT MIGHT BE THE IMPACT OF SHALE GAS ON ENERGY SECURITY?**

8. Clearly this depends upon the amount of shale gas produced and over what period. There are two ways in which energy security –defined as physical access to energy sources – can, at least in theory, be enhanced by shale. First it represents a diversification of gas supplies away from offshore UK production and imports of gas by pipeline or LNG. Furthermore, the potential of significant shale gas supplies can enhance the bargaining power of the UK when negotiating for long-term gas supply contracts. In economics, the theory of contestable markets suggests the threat of market entry is often sufficient to force monopoly suppliers to behave as though they were in a more competitive market. If the threat of significant supplies from shale is credible this could allow UK buyers to secure more favourable terms. Second, shale gas represents a domestic source of energy. It is always tempting to assume domestic supplies are more secure than foreign imports. This may not be the case as successive miners’ strikes in the UK and threats of industrial action by French nuclear engineers suggest.

**WHAT LESSONS CAN BE LEARNT FROM THE US EXPERIENCE WITH SHALE GAS?**

9. The shale gas revolution of the U.S. happened because of a coincidence of characteristics that were present. The main ones are listed in Table I

**Table I: Factors creating the ‘shale gas revolution’ in the United States**

<b>I. GEOLOGY</b>	Compared to the UK?
1. Large shallow, material plays, implying large technically recoverable resources. Also much of the shale had low clay content, making it easier to fracture.	Reported to have a higher clay content
2. After many years of oil and gas drilling, there were plenty	NO

of drill core data publicly available to allow explorers to find the 'sweet spots' on the plays.	
3. The shale gas had a high liquids content, which greatly enhanced the economics of the operations, especially at a time when gas prices were low.	Not known at this stage
<b>2. RESEARCH</b>	
1. In 1982 the US government began extensive funding of R&D by the Gas Technology Institute into 'low permeability hydrocarbon bearing formations'. The results were widely disseminated to the industry.	NO
<b>3. REGULATION</b>	
1. 2005 Energy Act explicitly excluded hydraulic fracturing from the Environmental Protection Agency's Clean Water Act – the so-called 'Cheney-Halliburton Loophole'. Much shale gas operations were done with little environmental impact assessments.	Strong environmental legislation
2. The 1980 Energy Act gave tax credits amounting to 50 cents per million BTUs. It also introduced the Intangible Drilling Cost Expensing Rule, which covered (typically) more than 70% of the well development costs, crucial for small firms with a limited cash flow. These economic incentives were very important in the early stages of the industry, based upon small, relatively cash strapped, entrepreneurial companies.	The UK government is claiming to introduce some tax break
3. Property rights in the United States make the shale gas the property of the landowner, creating a strong financial incentive for private owners to permit the disruptions associated with shale operations. Also, the population is used to being in proximity to oil and gas operations.	NO
4. The system is used to licensing large areas for exploration with fairly vague work programme commitments, which is what is needed when dealing with shale plays.	NO
<b>4. THE NATURE OF THE GAS MARKET</b>	
1. Pipeline access is based upon 'common carriage', so gas producers have at least some access to pipelines, transforming the economics of shale gas production. The U.S. also has a very large and extensive gas pipeline grid.	NO Access by Third Party Access.
2. The U.S. is a 'commodity supply gas market', i.e. a lot of buyers and sellers and good price transparency. Gas is easy to sell.	Not as easy as the US
3. The US domestic gas market experienced strong rising prices in the period after 2002, culminating in a price over \$10 per thousand cubic feet (mcf) in May 2008.	See Figure 3
<b>5. INDUSTRY</b>	
1. The industry was dominated by small, entrepreneurial companies, the so-called 'momma and poppa' companies.	NO
2. The majority of the work was done by a dynamic, highly competitive service industry. At the height of the Barnett Play in 2008, 199 rigs were operating.	NO

10. A key point is that the American “revolution” in reality happened over a very long period of time – over 20 years - although it is only in the last five years or so that the share of shale gas in domestic production increased significantly. It also happened because of a unique coincidence of conditions that will be difficult to replicate in the UK.

### **WHAT CHANGES TO PUBLIC POLICY WILL BE NEEDED TO PROMOTE SHALE GAS IN THE UK?**

**11. Geology** - Obviously, geology cannot be changed by policy but policy can certainly affect the commerciality of the geology. The first option is to improve the fiscal terms under which companies operate. This was important in the US story of shale gas in the early days with the tax breaks for unconventional operations in the 1980 Energy Act in place until 2002. More recently, the UK government has offered what it views as attractive fiscal incentives to shale gas operations in the hope of kick-starting the industry. The new proposed system acknowledges there is a slower cost of recovery for shale gas projects compared to conventional offshore developments, and that costs are often spread over a much wider area than a traditional oil or gas field. Whether this will provide a sufficient carrot, remains to be seen. Another obvious policy contribution for government to improve the commerciality would be to fund basic scientific research relating to shale gas operations making the results available to the industry. The sort of research envisaged is fundamental science that would not and should not be undertaken by private companies. Fundamental scientific research is a “public good”. No private company would fund Isaac Newton to sit under his apple tree in order to “discover” gravity since it has no commercial value and once “discovered” cannot be patented to allow the funder to recover their financial outlay.

**12. Shale gas service industry** – The U.S. shale revolution benefitted from operators and service companies working together as an alliance, sharing infrastructure and vital technological enhancements. This decreased the cost of developments significantly. Pad drilling, improved fracking mechanisms and improved rig mobility are such technologies leading to increased efficiency and growth. Information sharing is key for new entrants to the market. For example, in the U.S., the Marcellus shale coalition with 300 partnering operators and service companies is such an alliance proven to increase the production exponentially within a shorter time span. It has also helped to push the industry up the technological learning curve at a faster rate. Currently only a handful of service companies are involved in the shale gas operations in the UK. This needs policies to get more service companies such as offering a more attractive tax regime by altering capital allowances and depreciation. It is worth pointing out that given the growing interest in shale gas in Europe more generally; the development of a UK shale gas service industry on any scale could be a major export earner.

**13. Environmental Concerns** - Community acceptance is vital to secure and maintain the shale gas operations. The shale operations have been widely criticized in environmental terms in the context of water pollution, greenhouse gas emissions, noise, dust and pollution. Therefore, it is important to ensure there is an effective credible regulatory framework to mitigate these concerns. While there are regulations covering oil and gas, they are not specific to shale operations. There needs to be a specific regulatory regime for shale gas operations. In particular attention needs to be paid to the quality of well completion and the treatment of waste fracking water. At the very, least such a regime, if strictly enforced, would do much to address the concerns of local communities proximate to the shale gas operations.

14. At the same time as developing a regulatory regime specifically for shale, there is a need for a credible public relations campaign. Most of the scientific evidence suggests that there does not need to be problems with fracking<sup>174</sup> but this is not sufficient to persuade many concerned locals. A policy of public disclosure of the chemicals used would help reduce public concerns. The implementation of such policies leading to increased transparency is key to engage with community concerns. It is also important to convey the message to communities about the economic prosperity that could flow from shale gas operations. Currently there are lots of negative messages about shale gas operations, which ignores the existing scientific evidence. The government could fund such advertising campaigns. However, messages funded by government may carry little credibility. Far more effective would be to mobilize the Universities and Research Institutes to promote such messages given the very large body of scientific evidence in existence that is not anti-fracking.

15. Policies leading to community development with increased local community participation in shale gas development process will help also to promote confidence in shale gas projects. Currently, unlike the U.S., landowners do not have the incentives of ownership of hydrocarbon resources to encourage them to facilitate surface access. Short of changing the underlying property rights along the lines used in the U.S. it would be possible to force companies to “compensate” local communities for the disruption from shale gas operations and also to make them feel as though they are sharing in the economic benefits of the project. A good example of such a mechanism is the Shetland Charitable Trust which covers crude oil landed at Sullom Voe in the Shetland Islands. The Government recently announced a compensation scheme specific to shale gas operations in an attempt to assuage local opposition. Under this scheme, local communities will receive £100,000 per well drilled (although some reports indicate this will be per well site) plus one percent of the revenues. How effective this may be remains to be seen.

26 September 2013

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<sup>174</sup> For example see the special report by the Royal Society and the Royal Academy of Engineering in the UK Shale gas extraction in the UK: A review of hydraulic fracturing— published in June 2012.

## **TUC—Written evidence**

The TUC is the voice of Britain at work. With 58 affiliated unions representing more than six million working people from all industries and occupations, we campaign for a fair deal at work, for social justice at home and abroad, and for a fair and just transition to a low carbon future. We negotiate in Europe, and at home build links with political parties, business, local communities and wider society.

The TUC's approach to shale gas fracking is based on a decision at its 2012 annual Congress, that "The principle of precaution should be applied when developing new energies and the health of people and the environment should be put before profit." Effectively, the motion calls for a moratorium on the fracking method of gas extraction "unless proven harmless for people and the environment."

**The TUC welcomes the opportunity to respond to the Select Committee inquiry, and wishes to focus on two issues of concern, in Questions 3 and 11: the need for reliable forecasts of economic and employment benefits; and setting the highest standards for occupational health and safety at work.**

**Q3: What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

### **Employment forecasts**

Currently in the UK there are no non-industry, peer reviewed estimates of the balance of local and national economic and jobs benefits of shale gas fracking. The government has argued that the process could support 74,000 jobs. However, its own commissioned research suggests a maximum of 32,000 jobs on the highest growth assumption. A commonsense view would recognise that shale gas fracking produces positive and negative economic and jobs impacts.

Both of the most widely reported job forecasts - 74,000 jobs according to the Institute of Directors<sup>175</sup>; between 2,660 and 32,000 according to Amec<sup>176</sup> - rely heavily on data provided by the oil and gas industry and fracking companies<sup>177</sup>, including mainly US research. The multipliers used to estimate gross employment gains appear to apply "multipliers" untested in the UK context of the ratio between direct and spin-off jobs in supply chains. None of the UK studies look at the locally sensitive negative impacts on tourism, recreation and farming, nor the evidence from the US of a displacement of jobs and investment from renewable energy companies.

In Amec's *Strategic Environmental Assessment for further onshore oil and gas licensing (2013)*, the consultants provide job estimates that could arise from a national shale gas exploration licensing programme based on two scenarios, representing a "low" and "much higher" level

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<sup>175</sup> <http://www.iod.com/influencing/policy-papers/infrastructure/infrastructure-for-business-getting-shale-gas-working>

<sup>176</sup> Strategic environmental assessment 2013:

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/266330/environmental\\_report.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266330/environmental_report.pdf)

<sup>177</sup> [http://www.cuadrillaresources.nl/wp-](http://www.cuadrillaresources.nl/wp-content/uploads/2012/02/Full_Report_Economic_Impact_of_Shale_Gas_14_Sept.pdf)

[content/uploads/2012/02/Full\\_Report\\_Economic\\_Impact\\_of\\_Shale\\_Gas\\_14\\_Sept.pdf](http://www.cuadrillaresources.nl/wp-content/uploads/2012/02/Full_Report_Economic_Impact_of_Shale_Gas_14_Sept.pdf)

of fracking activity. Amec’s employment forecasts are based on available literature, not on a fresh econometric study.

	<b>Low activity</b>		<b>High activity</b>	
Year	No. Wells drilled a year	Total full time jobs	No. Wells drilled a year	Total full time jobs
1	12-24	1,100-2,100	24-48	2,100-4,200
8	30-60	2,600-5,300	180-360	16,000-32,000

The low activity scenario appears to assume no further development in the fracking industry beyond year 8, peaking at between 2,600 and 5,300 jobs. Under the high activity scenario Amec estimates a peak at between 16,000 and 32,000 jobs.

Details of the peak estimate are provided below. Around 31,771 jobs are predicted in year 8, by which time 1,440 wells will have been drilled, at a rate of 360 per year.

Jobs numbers are broken down into 13,973 developers’ jobs (i.e. 38 jobs per well drilled that year) with a further 7,816 jobs in supply chains. The figures also include 3,644 jobs in infrastructure (including road and pipe laying) and a further 576 in maintenance. The total jobs forecasts of around 32,000 positions equates to a multiplier ratio of 1:2.3 direct to indirect jobs. By year eight, direct jobs equate to 38 jobs per well drilled.

<b>First round</b>					
Year	Number of wells	Cumulative wells	Developers’ jobs	Supply chain	Total
8	360	1,440	13,973	7,816	24,291
Jobs per well			38		67
<b>Infrastructure</b>					
Induced jobs	Direct Jobs	Induced jobs	Maintenance	Induced jobs	Direct Jobs
3,337	3,644	501	576	3,337	3,644

Source: Amec 2013.

According to Amec, “all figures in the table are based on figures used in modelling used within Regeneris Consulting (2010, The Economic Impact of shale gas exploration and production in Lancashire and the UK).” This study was funded by Cuadrilla. In turn, this Cuadrilla study cites employment studies undertaken by Timothy Considine from Penn State University (e.g. The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play, 2010), also an oil industry funded academic study.

A review of the American evidence by Food and Water Watch found “numerous inaccuracies and methodological flaws in the calculations, which led to gross exaggeration of the jobs that might be expected in New York State if the state chose to allow shale gas development.”

Commenting on work by the Public Policy Institute of New York State (PPINYS), Food and Water Watch found that, “Correcting these problems affects forecasting models by nearly a factor of 10. But even this corrected PPINYS jobs projection likely remains generous to the shale gas industry, at the expense of public health and the environment. This is because the corrected projection relies on industry-supplied spending data and on economic forecasting models, rather than on the ground employment data in Pennsylvania. On effect is that the negative impacts that shale gas development has had in other economic sectors in Pennsylvania are not taken into account,” such as tourism and agriculture.

Drilling 360 wells a year in the UK, as Amec suggests in its high ambition scenario, will clearly create direct employment, and more jobs can be expected from supply chain development and local expenditure of wages. It is perhaps surprising that it does not appear to provide an independent, peer reviewed assessment of local economic benefits based on the actual evidence on the ground in the US and UK. In particular, it does not look beyond the industry figures to the negative as well as positive multiplier effects, nor the transient nature of employment as the workforce moves from site to site.

At its peak, Amec’s forecasts suggest a maximum of 32,000 jobs generated in total. This is 40% of the 74,000 jobs forecast by the Institute of Directors, which the authors reported was “around twice as many as our previous estimate,” and which relied heavily on industry data.

Other evidence is available from the US that the spin off from investments in shale gas is having a negative impact on renewable energy jobs and investment. Citing low gas prices as a major factor, Siemens and Vestas have laid off workers: Siemens announced it was laying off 945 wind energy jobs in Florida, Iowa and Kansas in September 2012<sup>178</sup>. A study of the state of Ohio found that the development of shale gas has dealt a huge blow to the wind industry in the state, despite Ohio being a national leader in the development of wind energy. In 2010, the state possessed 106 wind power supply chain businesses and 63 solar power supply chain businesses, employing 9,000 workers. Since then, many of these companies have declared bankruptcy, and thousands of workers have lost their jobs. Were similar impacts to be seen in the UK, perhaps because of generous government support to the fracking industry limiting assistance for renewable energy sectors, net jobs benefits could be further overstated.

## **Q.11 What changes to public policies are necessary to maximise the potential of any shale gas development?**

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<sup>178</sup> Environmental Law and Policy Center. 1/11. “Supply Chain in Ohio.” Retrieved 1/15/14 from: [http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal\\_HQ.pdf](http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf). See also CBS News. 9/12. “Siemens to lay off 615 in Iowa, Kansas, Florida.” Retrieved 1/15/14 from: [http://www.cbsnews.com/8301-501363\\_162-57515254/siemens-to-lay-off-615-in-iowa-kansas-florida/?tag=mncol:lst:5](http://www.cbsnews.com/8301-501363_162-57515254/siemens-to-lay-off-615-in-iowa-kansas-florida/?tag=mncol:lst:5)

The company blamed market conditions due to lack of congressional action on a wind energy tax credit as well as increased use of natural gas-fired power plants. It said it has worked for the past 10 months to address the uncertainties but needed to adjust its work force until demand for turbines returns.

See also McKenna, John. Wind Power Monthly. 9/1/12. “Vestas Slashes Another 1400 Jobs – For Now.” Retrieved 1/15/14 from: <http://www.windpowermonthly.com/news/1147004/Vestas-slashes-1400-jobs-/>



### **Health and safety at work**

Gas extraction is a historically dangerous industry. Although worker safety hazards are known and understood, there are very limited data regarding occupational health hazards from exposure to the chemicals, proppants and processes used in high volume hydro-fracking. A proppant is a solid material, typically treated sand or a man-made ceramic material, designed to keep an induced hydraulic fracture open during or following a fracturing treatment. It is added to a fracking fluid which may vary in composition depending on the type of fracturing used, and can be gel, foam or slickwater-based. In addition, there may be unconventional fracking fluids.

The way forward involves good management of risks supported by tight regulation and full transparency. The TUC would want to ensure tight regulations across a range of health and safety at work issues, developed in consultation with trade unions. The onset of potentially high volume shale gas fracking across many parts of the country represents a new industrial, environmental, and land use development pattern with significant potential for impacts on public and employee health.

A study by the National Institute for Occupational Safety and Health (NIOSH) in the US, based on field research, shows that workers may be exposed to dust with high levels of respirable crystalline silica during hydraulic fracturing, a cancer-causing substance. For example, silica dust clouds may form during the delivery of sand from sand mover to transfer belt. Transporting, moving, and filling thousands of tonnes of sand onto and through sand movers, along transfer belts, and into blenders generate dust containing respirable crystalline silica. The National Institute for Occupational Safety and Health (NIOSH) recently collected air samples at 11 different fracking sites in 5 different states (Arkansas, Colorado, North Dakota, Pennsylvania, and Texas) to evaluate worker exposure to crystalline silica<sup>179</sup>. At each of the 11 sites, NIOSH consistently found levels that exceeded relevant occupational health criteria. The AFL-CIO, the United Steelworkers and the United Mine Workers have lobbied regulatory authorities with regard to the risks facing workers exposed to crystalline silica.

The implementation of new natural gas extraction technologies, continual changes in the gas development industry, rapid growth of drilling operations in new areas, the need for transparency and disclosure of the full range of chemicals used in fracking, and variations in operations between companies pose significant challenges for occupational health which have yet to be comprehensively addressed.

*January 2014*

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<sup>179</sup> <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1439>

## Tyndall Manchester Climate Change Research—Written evidence

### ***Submission to HoL Select Committee on Economic Affairs inquiry into: The Economic Impact on UK Energy Policy of Shale Gas and Oil***

Tyndall Manchester has been investigating the climate change implications of shale gas developments for the past three years. We have raised concerns around the cumulative quantities of emissions that may be released by the extraction and combustion of shale gas and the implications for climate change mitigation of a widespread expansion of the industry in two reports. The most recent report (Broderick et al., 2011, attached) contains research of relevance to two specific questions raised by the committee, namely:

- 2) How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?
  1. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?

And in light of the answers to these and a supplementary report (Broderick and Anderson, 2012, attached) we provide additional insights into questions:

10. How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?
  1. What lessons can be learnt from the US experience of shale gas and oil?

All views contained within this submission and the reports attached are attributable to the authors and do not necessarily reflect those of other researchers from the wider Tyndall Centre, the University of Manchester or the organisations themselves.

1. This submission is a précis of the arguments and evidence presented in Broderick et al (2011) with additional material from a supplementary report (Broderick and Anderson, 2012) examining the impact of shale gas on US energy system emissions. For background on the emissions budget analysis, considering also the incompatibility of the UK's present commitments under the Climate Change Act (short-term carbon budgets and the 80% reduction pathway) with our explicit international commitment on 2°C, please see our recent submission to the HoC Environmental Audit Committee Inquiry into Progress on Carbon Budgets (Anderson et al 2013).
2. Our work on shale gas has concluded that novel sources of gas production (or indeed any new fossil fuel source) are problematic for climate change mitigation generally and more specifically are incompatible with the UK's explicit contribution to international commitments to stay below a 2°C rise. The recent global emissions trajectory is at the high end of IPCC emissions scenarios, and correlates with a 50:50 chance of 4°C rise by 2100. Such a rise would exceed any warming level thought to have occurred in the past 5 million years. It is clear that the production of fossil fuels of all sorts needs to be curtailed in the absence of strict and coordinated international greenhouse gas emissions caps.
3. If carbon and capture storage technologies are proven to work at scale and with high levels of capture (90% or higher), gas fired powerstations would be compatible with the UK's carbon budgets, but remain incompatible with the UK's 2°C international commitments, under the Copenhagen Accord and Cancun Agreements. *Understanding the quantitative scale of inconsistency between the UK's domestic and international commitments on climate change is pivotal to developing any informed conclusion on*

*unconventional hydrocarbons*. In many respects the response of the UK Government to the prospect of large scale indigenous shale gas production is a bellwether of the veracity or otherwise of the UK's commitments and leadership on climate change.

**Regarding Q2) How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

4. The Energy and Climate Change Committee (2011) has previously noted that a substantial move to exploit new shale gas reserves could attract investment that might otherwise go to renewable energy. The 2011 report states that “...*shale gas has the potential to shift the balance in the energy markets that the Department has tried to create away from low carbon electricity generation*”.
5. In our updated report (Broderick et al. 2011) we estimated the potential scale of such a diversion by assessing the capital costs of gas powerstations burning the output of a mature shale gas industry, which for illustrative purposes we take to be ~9bcm/year sustained over a 20 year time period. We refer the committee to Section 3.4 of Broderick et al. (2011) for full details and summarise the conclusions below.
6. In total, potential resource substitution was found to be £19bn to £31bn, depending upon the discount rate applied to future investment. The higher figure relates to a Treasury Green Book discount rate of 3.5%, arguably the most appropriate rate for assessing public policy.
7. Table 3.11, reproduced below, illustrates the scale of potential wind generating capacity foregone if capital is diverted to shale gas infrastructure. Given the need for climate mitigation, the costs of gas generating plants (CCGT) with carbon capture and storage (CCS) was also considered. CCS substantially increases capital costs and has an energy penalty in operation, in the order of 10% to 20%, hence 7GW capacity, rather than 8GW conventional CCGT, is assumed to be sustained with 9bcm/year shale gas. In the absence of large scale demonstration plants there are considerable uncertainties in the technology's cost and efficiency parameters. Nevertheless, even with the CCS gas fired powerstations are likely to have lifecycle emissions in region of 50 to 80gCO<sub>2</sub>/kWh; approximately 5 to 10 times higher than either wind or nuclear.

<b>Table 3.11: Investment equivalents in gas and renewable capacity</b>				
	<b>10% Discount rate</b>		<b>3.5% Discount rate</b>	
	<b>8GW CCGT</b>	<b>7GW CCGT +CCS</b>	<b>8GW CCGT</b>	<b>7GW CCGT +CCS</b>
<b>Onshore wind (GW)</b>	12.5	16.5	16.8	20.8
<b>Onshore wind (3MW turbines)</b>	4,172	5,503	5,594	6,925
<b>Offshore wind (GW)</b>	7.0	9.2	9.4	11.6
<b>Offshore wind (5MW turbines)</b>	1,401	1,849	1,879	2,326

8. The potential scale of displacement is comparable to the 2020 ranges in UK Renewable Energy Road Map; 10-13 GW onshore wind and 11-18 GW offshore (potentially 40 GW).
9. If the cost of CCS is included and a 3.5% public discount rate used, then the equivalent 21 GW of onshore wind capacity could be constructed. This would be expected to generate up to 27% more electricity per annum considering representative capacity factors of 70% for gas and 30% for wind. Approximately 12GW of offshore turbine capacity, for the same investment, would be expected to generate 5% less electricity than the equivalent gas infrastructure. It is also worth noting that the larger generation of wind turbines (onshore and offshore) being installed and planned are likely to drive up the capacity factor of wind, potentially to around 40%.
10. So as not to renege on UK climate change commitments, it is imperative that investment is directed towards very low and zero carbon energy infrastructure. Construction without CCS would place much greater pressure on other parts of the economy to decarbonise and risk gas infrastructure worth £19 to £26bn becoming 'stranded assets'. However, as we describe below it cannot be assumed that CCS will provide sufficient levels of abatement for gas-fired electricity to continue to be a major energy source in the long term.
11. Our analysis considered only capital costs, not operating costs; a simplification that significantly favoured gas over wind as the latter has much lower operating costs as a percentage of total costs. The levelised cost estimates for gas CCGT (Parsons Brinkerhoff, 2011), with 10% discount rate, suggest that fuel costs account for 88% of the total cost per MWh of electricity. In contrast, the operating costs for wind generation make up only 6% of total costs (Arup 2011). Costs of transmission, distribution and balancing infrastructure for both gas and electricity were also excluded.

**Regarding Q8) What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

12. Much of the discussion on the climate change impact of shale gas centres on its relative emissions intensity compared with other fuel sources. This issue is of interest, and is described well in the DECC Chief Scientific Advisor's recent report on the matter

(MacKay & Stone, 2013), with an overview provided in paragraphs 13 and 14 below. However, it must not distract from the most climatically relevant issue of *absolute* quantities of emissions from the global energy system.

13. There are important concerns about the possibility of additional climate change impacts from gas produced by hydraulic fracturing; this remains a contentious topic in the academic literature. Life cycle analysis studies include inter alia emissions from energy required to produce and distribute the gas, for instance those embodied in water transported to the well pad, and releases of methane itself to the atmosphere both deliberately and inadvertently during the full fuel production, transmission and distribution cycle.
14. Methane itself is an important greenhouse gas, however, there is a shortage of independent primary research on the actual quantities of methane released during shale gas production and many studies use the same underlying empirical data that is recognised to be limited in scope and applicability. Our previous research provides a fuller discussion of this topic (Broderick et al. 2011, Section 3.2.4) as well as an estimate of the additional emissions due to hydraulic fracturing. A recent comparative statistical approach has concluded that it is difficult to distinguish between the life cycle emissions impact of different gas production and distribution methods and that greater attention should be paid to energy system impacts (Weber & Clavin 2012).
15. Regardless of the unavoidably contextual framing of life cycle GHG impact, either per unit of gas produced or per unit of electricity generated, the direct carbon content of shale gas means that its widespread use is incompatible with the UK's international climate change commitments.

***Therefore, considering Q1) How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK? Over what timeframe?***

16. The absolute necessity of decarbonisation means that technologies with orders of magnitude lower emissions are required to provide energy to UK households and industry in the short to medium term. The Committee on Climate Change (2008) has advised “that any path to an 80% reduction by 2050 requires that electricity generation is almost entirely decarbonised by 2030”, although it is important to recall that challenging though this 80% pathway may be, it still falls far short of what is the UK's obligation under its international commitments, including the 2012 Camp David Declaration. Decarbonisation of the electrical supply is an effective way of rapidly reducing emissions. Renewable supply technologies, with very low associated emissions, are available now and are compatible with existing infrastructure. The efficiency of transport and heating can be improved through the deployment of new electric vehicle and heat pump technologies respectively.
17. Understanding timescales is pivotal from a cumulative emission (carbon budget) perspective. The CCC argues that the transition to a very low carbon grid, with an intensity of the order of 50g CO<sub>2</sub>/kWh, should take place by 2030. Scenarios described by the MARKAL economic optimisation model identify this point as being on the way to a zero carbon grid soon after. It is worth noting that the CCC acknowledges a low probability of keeping below 2°C of warming on the basis of their budgets, this is despite their assumption of unrealistically early global peaking dates (~2016).

18. Accounting for an emissions floor for food production and making fair (but still very challenging) allowance for emissions from non-Annex I nations, Anderson and Bows (2011, C+6 scenario) find that complete decarbonisation of Annex I energy systems must be accomplished rapidly (i.e. within a decade) for even a 50% chance of avoiding 2°C of warming.
19. It is sometimes argued that shale gas could be burned safely in the short term, however this is not the case for any 2°C framing of climate change. Given that shale gas is yet to be exploited commercially outside the US, limitations on the availability of equipment mean that it is very unlikely it could provide other than a marginal contribution to UK supply before 2020. However, gas fired power stations produce emissions of approximately 440gCO<sub>2</sub>e/kWh of electricity and typically have a lifespan of over 25 years. Therefore, unless allied with carbon capture and storage (CCS) technologies, as yet unproven at a large scale, all new powerstations intended to burn shale gas would need to cease generating within five to fifteen years of construction, and at the latest be decommissioned by 2030. Green Alliance scenarios (2011) indicate that if there is a second “dash for gas”, emissions from the grid could still be 302gCO<sub>2</sub>e/kWh in 2030 necessitating 95% deployment of CCS to meet our fourth period emissions budgets (2023-2027). In this respect, the “golden age” may turn out to be a gilded cage, locking the UK into a high carbon future
20. Even CCS is problematic when such low carbon electricity is required. At commercial scale CCS will be significantly less than 100% effective at capturing carbon dioxide. Moreover, it will always add costs to electricity production by reducing the efficiency of the power station requiring additional energy input in transportation and injection of the captured carbon dioxide. Best case emissions performance for gas CCS is in the range 35-75gCO<sub>2</sub>/kWh (80-90% capture efficiency on 55% efficient CCGT with 10% energy penalty for capture).
21. CCS therefore also increases the net quantity of upstream emissions of gas or coal production and transport; reduced efficiency means that greater quantities of fuel must be used for equal electricity output, increasing life-cycle emissions over and above those from the fuel combustion. For unconventional gas production these have the potential to be significant if mitigation is not in place; Broderick et al (2011) estimate up to an additional 17gCO<sub>2</sub>e/MJ of gas produced, equivalent to an additional 120gCO<sub>2</sub>e per kWh of electricity generated depending upon mitigation during production.
22. With regards to using shale gas for heating purposes, the CCC (2008) note that as the grid decarbonises it is “more carbon efficient to provide hot water and space heating with electricity than with gas burned in a condensing boiler”. Non-energy uses accounted for less than 1% of total UK demand for natural gas in 2010 (DUKES 2010). It is therefore reasonable to assume that new gas production in the UK will be combusted in power generation and, in the absence of carbon capture and storage, released to the atmosphere.

***Finally, regarding Q13) What lessons can be learnt from the US experience of shale gas and oil?***

23. Shale gas has the potential to contribute substantial additional emissions to the atmosphere. Global estimates of reserves suggest this may be up to 30% of a global emissions budget with a 50% chance of avoiding dangerous climate change (Broderick et al. 2011, Section 3.3.2).

24. Substitution between fuel sources cannot necessarily be assumed to reduce emissions in absolute terms. We have examined the CO<sub>2</sub> emissions consequences of fuel switching in the US power sector using two simple methodologies (Broderick and Anderson, 2012). The analysis presented is conditional upon its internal assumptions, but provides an indication of the scale of potential impacts. It suggests that emissions avoided at a national scale due to fuel switching in the power sector may be up to half of the total reduction in US energy system CO<sub>2</sub> emissions of 8.6% since their peak in 2005. Since 2007, the production of shale gas in large volumes has substantially reduced the wholesale price of natural gas in the US. The suppression of gas prices through shale gas availability is a plausible causative mechanism for at least part of this reduction in emissions. Although we were not able to isolate the proportion of fuel switching due to this effect, other studies note that between 35% and 50% of the difference between peak and present power sector emissions may be due to shale gas price effects. Substantial increases in renewable generation and capacity appear to have had an effect of similar magnitude through policy and cost competitiveness. Air quality regulations, energy efficiency and demand management, and the impact of the recession are cited to have played a considerable part in driving this change.
25. It is essential to note that there has also been a substantial increase in coal exports from the US over this same time period. Much of this coal has been burned in the UK and Europe, increasing our annual emissions. Without a meaningful cap on global carbon emissions, the exploitation of shale gas reserves is likely to increase total emissions. For this not to be the case, consumption of displaced fuels must be reduced globally and remain suppressed indefinitely, in effect *displaced coal must stay in the ground*.
26. Our calculations suggest that more than half of the potential emissions avoided in the US power sector may actually have been exported as coal. Summing the quantity of implicit emissions exported over the period 2008 to 2011 suggests that approximately 340 MtCO<sub>2</sub> of the 650 MtCO<sub>2</sub> of potential emissions avoided may be added elsewhere. The continued oversupply of permits in the EU ETS means that this is likely even of exports to the UK and Europe.
27. Discussing the cumulative impact of emissions from shale gas, MacKay and Stone conclude in their report for DECC (2013) that “...without global climate policies (of the sort already advocated by the UK) new fossil fuel exploitation is likely to lead to an increase in cumulative GHG emissions and the risk of climate change.” Even in the International Energy Agency 450 Scenario, based on a 50% chance of exceeding 2°C, more than two thirds of already proven fossil fuel reserves are not commercially exploited (IEA 2013). It is clear that the production of fossil fuels of all sorts, not only shale gas, needs to be curtailed in the absence of robust and coordinated international GHG emissions caps.

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30 September 2013



## UK Energy Research Centre (UKERC)—Written evidence

### UK Energy Research Centre

The UK Energy Research Centre carries out world-class research into sustainable future energy systems.

It is the hub of UK energy research and the gateway between the UK and the international energy research communities. Our interdisciplinary, whole systems research informs UK policy development and research strategy.

[www.ukerc.ac.uk](http://www.ukerc.ac.uk)

### Introduction

This response is largely based on research carried out within the UKERC project: *The Geopolitical Economy of Global Gas Security and Governance: Implications for the UK*. It also draws on UKERC's energy system modeling research which has explored the changes that are necessary to meet the UK's climate change targets. Below we have provided a question-by-question response to the Call for Evidence made by the Select Committee on Economic Affairs.

### Responses to the Committee's questions

- **How much scope is there for shale gas and oil - from domestic and overseas sources - to be used in the UK and over what timeframe?**

The current unconventional oil and gas revolution originated in North America, but its effects have been felt in the UK. We can think of this first phase as one of 'indirect impact' and it relates to shale gas, rather than shale oil. Less than 10 years ago the US was expecting to become a major importer of natural gas and was building a large number of terminals to receive liquefied natural gas (LNG). However, the rapid ramp up of domestic shale gas production in the US reduced the need to import LNG and many of those terminals are now sitting idle. A number of LNG projects - particularly in Qatar - were built in anticipation of there being a growing LNG market in this US. This did not materialise, instead some European gas-importing countries (more precisely private companies invested in this capacity) seized the opportunity to expand their LNG import capacity and were able to attract this displaced LNG. This was certainly the case in the UK where new LNG terminals opened, first at the Isle of Grain in 2005 and then at Milford Haven in 2009 (Dragon LNG and South Hook).

In a short period of time, the UK has become one of the largest LNG importing countries in the world. This is, in part, an indirect consequence of the growth of shale gas production in the US. More recently our LNG deliveries have fallen, partly because of economic recession, but also because more LNG has been attracted to Asian markets since 2011. The increase in LNG demand in Asia is due to both the Fukushima accident (immediately after which gas traders brought up a lot of LNG, anticipating increased Japanese demand, but this did not happen straight away and a lot of LNG was dumped on European markets) and growing gas

demand in Asia. At the same time, as shale gas has displaced coal in the US power generation sector, cheap US coal has come to the UK and Europe and this has displaced higher-priced gas. UK coal imports increased by 37.7% between 2011 and 2012, and imports from the US increased by 65.4%. Consequently total UK gas demand fell by 6% in 2012.

The next phase could be that of direct impacts, first from the imports of shale-gas based LNG from the US and then, potentially, from domestic shale gas production. At present, the US gas market is over-supplied and prices are low. The gas industry wishes to export gas as LNG to increase revenues and sustain domestic production. Just as there was a long list of LNG reception terminals being built in the US in the past, now there is an equally long list of over 20 LNG export terminals seeking approval from the US Government.<sup>180</sup> At present, four terminals have been given federal approval. To date, Asian buyers have shown the greatest interest in importing US LNG, but some of it could come to the UK. For example, last March, Centrica signed an agreement with Cherniere Energy Partners PLC to import 1.75 mtpa of LNG for 20 years from 2018. However, there is no guarantee that Centrica would ship its LNG to the UK.

The second stage of direct impacts could involve domestic shale gas production in the UK. As will become clear below, at present we have no way of knowing whether or when that might happen and what the potential volume of production might be. All of the best estimates suggest that it won't be until the early 2020s at the very earliest. National Grid's latest *UK Future Energy Scenarios* include a modest contribution from onshore UK gas production from zero today to 2-4% of demand by 2020. This share rises to 15-20% by 2035<sup>181</sup>. While there is considerable uncertainty about what the future level of UK gas demand will be, we do know that production from the UK continental shelf (UKCS) is likely to continue to decline (from a peak of 108bcm in 2000 to a projected level of 19bcm by 2030); thus, our level of import dependency is likely to increase (DECC suggest 70% import dependency by 2025). In sum, the most immediate possibility for shale gas to be used in the UK is as imported US LNG.

- **How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?**

In a recent speech at the Royal Society, the Secretary of State Ed Davey emphasised the uncertainties associated with shale gas in the UK: "Nobody can say, for sure, how much onshore UK shale gas resource exists. Or how much of it can be commercially extracted."<sup>182</sup> It is impossible to know what the costs will be and how much of the 'gas in place' in the UK that was identified by the British Geological Survey<sup>183</sup> will turn into 'proven' reserves. Proven reserves are defined as "those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reserves under existing economic and operating costs"<sup>184</sup>. Those costs will include the cost of obtaining a 'social licence to operate' that is the environmental, social and economic costs associated with exploration and development. Until developers have carried out a

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<sup>180</sup> The US Department of Energy's Federal Energy Regulatory Commission (FERC) complete list of projects: [www.ferc.gov/industries/gas/indus-act/lng.asp](http://www.ferc.gov/industries/gas/indus-act/lng.asp)

<sup>181</sup> National Grid (2013) *UK Future Energy Scenarios: UK gas and electricity transmission*. National Grid: Warwick, p. 119.

<sup>182</sup> Davey, E. (2013) 'The Myths and Realities of Shale Gas Exploration'. Speech to the Royal Society, 9<sup>th</sup> September.

<sup>183</sup> Andrews, I.J. (2013) *The Carboniferous Bowland Shale gas study: geology and resource estimation*. British Geological Survey for Department of Energy and Climate Change, London, UK.

<sup>184</sup> BP (2013) *Statistical Review of World Energy 2013*. London: BP.

meaningful exploration programme and have a good idea of operating costs in the UK we cannot answer this question. According to the Energy Information Administration in the US, the economic recoverability of oil and gas resources depends on three factors<sup>185</sup>:

- The cost of drilling and competing wells (which we don't know in relation to UK shale gas and oil);
- The amount of oil or gas produced from an average well over its lifetime (which we don't know this for the UK. It is highly variable across a shale 'play');
- The prices received for oil and gas production (again, we don't know this).

Thus, any estimate of how much shale gas and oil can be produced at present is unknown. There is no basis to say that there is 'x' amount of gas in place and at a recovery rate of 20% that means 'y' amount of gas, because the recovery rate is unknown and will vary greatly across the shale deposits. It could be that the greater depth of UK shale deposits, compared to the US, results in higher possible flow rates, but it could also be the case that production costs are higher.

- **What is the potential impact of shale gas and oil on the local economies in area where development is possible?**

This is very difficult to know with any certainty owing to the limited level of development underway in the UK. Clearly, there is much that could be learnt from the US case, particularly the development of the Marcellus shale in Pennsylvania. It is no surprise that the advocates of shale gas development in the UK make much of the potential economic benefits and a strong case is made in the Institute of Director's report on *Getting Shale Gas Working*, which was sponsored by Cuadrilla Resources Ltd<sup>186</sup>. The shale gas industry in the US is evolving very quickly and there are many lessons that can be learnt in terms of maximising the economic benefits to local economies, while minimising the safety and environmental costs. The ability of UK industry to develop an onshore shale gas and oil supply chain will be a key factor shaping both the pace of development and the economic benefits and this is an issue that requires independent research.

- **What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?**

Once shale gas enters the national gas transmission system (NTS) it will be no different from other sources of gas - domestic production from the UKCS, imported gas from the Norwegian Continental Shelf, gas through the interconnector from Europe, imported LNG - it will be traded on UK and international gas markets. This is why domestic shale gas alone is unlikely to reduce the domestic price; it is an open trading system subject to gas-to-gas competition and is exposed to price risks in the domestic, European and LNG markets. Thus, shale gas will be the same price as other sources of gas.

The development of shale gas globally could, in principle, have an impact on the price of gas. But this will only be the case if shale gas production is very significant. It is important to

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<sup>185</sup> See [www.eia.gov/analysis/studies/worldshalegas/](http://www.eia.gov/analysis/studies/worldshalegas/)

<sup>186</sup> Institute of Directors (2013) *Getting Shale Gas Working*. London: IOD.

remember that the future trajectory of gas prices will depend primarily on other factors – i.e. trends in the production of more conventional sources of gas and in the demand for gas.

The extent to which gas-fired power generation will be cheaper than other forms of generation depends partly on the price of gas – both in absolute terms and relative to the price of other fossil fuels. It also depends on the details of the Electricity Market Reform package of policies, most of which are being implemented through the Energy Bill that is currently being considered. These include the level of strike prices agreed for new investments in low carbon power generation using renewables, nuclear power and carbon capture and storage (CCS), the future evolution of the carbon price floor and the incentives available from the new capacity market. As things stand, unabated gas-fired generation will be able to take advantage of incentives from the planned capacity market – but, once again, this is not dependent on the source of the fuel that will be used in gas-fired power stations.

All these factors are subject to uncertainty. A recent report by the Committee on Climate Change shows that unabated gas-fired generation (without CCS) is likely to be cheaper than most low carbon technologies in 2013<sup>187</sup>. This comparison includes the impact of the carbon price floor, which is projected to rise as set out by the Treasury. However, this cost advantage may not continue if the carbon price floor is increased as planned (a course of action that is not guaranteed) and the provisions of the Energy Bill are implemented.

All this uncertainty is leading the power generation sector to hold off on investments in new gas power generating capacity until the impacts of the Energy Bill are much clearer. This uncertainty is also likely effecting investment in LNG import capacity and gas storage.

- **Will the UK electricity market be easily able to incorporate shale gas in the future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?**

As explained above, shale gas is likely to be treated as just another source of gas coming into the NTS, and this gas will be traded alongside other supplies at the market price. It is highly unlikely that any generating company would tie itself to a particular source of supply and the ability of the industry to shift from gas to coal recently demonstrates how readily the generators respond to price signals.

One of the major benefits of the development of the UKCS is that the UK, for the most part, benefits from a well-developed NTS. The areas most likely to develop shale gas production are areas well served by the NTS, thus the cost of connecting new producers to the NTS will be minimal. However, the shale gas producers will have to ensure that their gas meets the standards required of the NTS (this will require processing), and that it enters the NTS at the appropriate pressure. Given the disparate nature of shale gas production, this could mean significant infrastructure investment will be required for shale gas producers to collect their production and make it compatible for entry into the NTS. An alternative might be to sell the gas directly to a local customer.

- **Which forms of electricity generation is shale gas likely to displace and by how much?**

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<sup>187</sup> Committee on Climate Change (2013) *Next Steps on Electricity Market Reform*. London: CCC.

Shale gas is a fuel and not a form of electricity generation. As noted above, any domestic shale gas that is produced will contribute to the gas resources available for the UK and for international markets – and for that reason, gas-fired power plants fuelled by shale gas will not be any different to gas-fired power plants fuelled by other sources of gas. The question should therefore be what forms of generation might be displaced by gas-fired generation should that become (or remain) cheaper than other sources. As noted in our answer to question 4, the answer to that question depends on a range of uncertain factors. However, it is important to note that the role of unabated gas fired generation will need to be limited during the 2020s due to the UK’s legally binding climate change targets (see answer to question 8 below). The successful commercialisation of CCS technologies would be required for gas to continue to play a major role in that decade and beyond.

- **What impact will shale gas and oil have on household energy bills?**

Obviously, in the US at present shale gas and oil have resulted in lower prices. But this is a very particular situation that is not likely to last and which cannot easily be replicated in other markets. For all the reasons explained above, UK shale gas and oil production is likely to have a minimal impact on our household energy bills. Longer-term, if shale gas production impacts on global gas markets it could be part of a wider set of processes that brings down the price of gas (the high price of oil and the dominance of oil-indexed gas pricing is more of a problem in Continental Europe at the moment). But this is a complex issue that is currently only in the realms of informed speculation. Similarly, if shale oil made a significant impact on global oil supplies (at the moment it is reducing US imports of light crude) it could help moderate the price, but there are a host of other factors likely to have greater influence on the future price of oil, which nobody can predict. In summary, there is no evidence that UK shale gas will have a particular impact (positive or negative) on household energy bills in the short to medium-term.

- **What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

This is a highly contentious issue that has two important dimensions. The first is the carbon footprint associated with the production of shale gas - both from the energy and materials consumed in the production process (so-called life cycle emissions) - and so called fugitive emissions from the production process. Emissions are not just made up of carbon dioxide. Methane – the main constituent of shale gas - is itself a potent greenhouse gas. Fugitive methane emissions can leak from wellheads during the extraction process and during transportation.

Emissions estimation is an emerging area of research, with contradictory results coming from studies in the US that require careful review. A recent report for DECC by their Chief Scientific Advisor David Mackay and Tim Stone concludes that: ‘If adequately regulated, local GHG emissions from shale gas operations should represent only a small proportion of the total carbon footprint of shale gas, which is likely to be dominated by CO<sub>2</sub> emission associated with its combustion’<sup>188</sup>.

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<sup>188</sup> MacKay, D. and Stone, T. (2013) *Potential Greenhouse Gas Emissions Associated with Shale Gas Production and Use Report* for the Department of Energy and Climate Change. London: DECC.

This is important because one of the benefits of natural gas is that it emits about half the amount of carbon dioxide compared to coal when used to generate electricity. Thus, if increased gas consumption in the power sector reduced coal consumption it would have a positive de-carbonising effect. However, that positive effect is reduced if shale gas is shown to have higher life cycle and fugitive emissions than other forms of natural gas. In fact the MacKay and Stone report concludes that UK shale gas would have a lower emissions profile than imported LNG.

The second dimension of this issue concerns the carbon emissions associated with burning natural gas. This is not about shale gas *per se*, but is a bigger question about the future role of gas in the UK energy system. In the US, shale gas has replaced a significant amount of coal in the power generation sector over the last few years, and this contributed to a substantial reduction in US emissions. The UK is different. We have already had a ‘first dash for gas’ in the 1990s and early 2000s that reduced emissions in a similar way. However, UKERC research shows that there are limited further decarbonisation benefits to be had from a ‘second dash for gas’ without the commercialization of CCS technologies. Significant amounts of unabated gas-fired generation in the UK power generation mix in the 2020s and beyond would make it very difficult to comply with the UK’s legally binding carbon targets.<sup>189</sup>

## **9. Will shale gas and oil increase UK energy security?**

It depends on what you mean by energy security. In their recent Energy Security statement, DECC distinguished by ‘physical security’ and ‘price security.’ Domestic production of shale gas and oil could contribute to physical security of gas supply, as it would reduce import dependency. However, this only holds true if shale gas is more reliable than other sources of gas (domestic or foreign). Whilst there is a tendency to believe that domestic sources of gas (and energy in general) are more secure than gas from abroad, there is very little empirical evidence to support this assumption. Threats to gas security over the past few years have largely occurred for technical reasons, not geopolitical reasons – and many of the technical problems have occurred within the UK. Furthermore, this assumption does not take into account one of the primary reasons for importing energy in the first place – that it allows UK consumers to access cheaper sources of energy than could be produced in the UK. Domestic production would bring some economic advantages by having a positive impact on the UK’s balance of payments.

One difficulty with these security arguments is that the anticipated levels of UK shale gas production are impossible to predict and they are unlikely to significantly reduce our growing import dependence any time soon. As explained above, domestic shale gas and shale oil production is unlikely to have a significant impact on the price paid by consumers and the level of volatility, this is because of the open nature of our energy markets that are exposed to global market conditions. In sum, increased domestic production of oil and gas could help improve physical security of supply (though only if you believe that it will be more reliable than gas from Norway, the UK continental shelf and other locations), but will do little to influence price security.

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<sup>189</sup> Ekins, P. et al. (2012) *The UK energy system in 2050: Comparing Low-Carbon, Resilient Scenarios*. UKERC, London.

**1. What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help ensure sufficient UK energy supplies? How will this investment be financed?**

The first part of this question, relating to infrastructure, is impossible to answer as we are not close to knowing that extent of proven reserves and the possible level of commercial development. Most of the infrastructure impacts are likely to be local in relation to the exploration, development and production activities. The UK already has a developed NTS and significant gas-fired power generating capacity (note that only a third of UK gas consumption is in the power sector, another third is in industry and the remaining third is consumed in household sector). As noted above, the shale gas industry is developing quickly and ‘pad drilling’ (multiple wells being drilled from a single site) will reduce the infrastructure demands, but this a question that requires further research based on an understanding of the US experience and the plans for exploration and production in the UK.

As to who should finance it, the UK Treasury has already indicated a willingness to provide production tax breaks (i.e. subsidies) for shale gas development. But this is not something that the industry requested and, for understandable reasons, it has not been well received by environmentalists. The general direction of travel in developed economies, and the UK is no exception, is to place a cost on carbon emissions and to subsidise low carbon sources of energy. In our view, there is no justification for the tax breaks that have been offered. Given the uncertain benefits that any domestic shale gas developments would bring, it would be better to focus government spending on low carbon energy sources and energy efficiency.

**2. What changes to public policies are necessary to maximise the potential of any shale gas development?**

At the moment public opinion seems to be divided on shale gas and there is a strong and vocal opposition movement. The recent debate that has polarised around events at Balcombe in Sussex is not helpful. Both sides of the argument have engaged in rhetoric and misinformation. It is unclear if it is possible to regain public trust around the issue of onshore shale gas and oil drilling in the UK.

There needs to be a more ‘rational’ debate about the issues and what it might take for shale gas developers to obtain a ‘social licence to operate.’ A simple appeal on the basis of unfounded promises of lower energy bills, employment opportunities and local pay-offs is not going to work, nor is resorting to exaggerated claims about the risks associated with exploratory drilling operations.

Research by UKERC into public attitudes towards energy system transformation suggests that there is public support for low carbon energy, but not for further fossil fuel development.<sup>190</sup> The study did not ask about shale gas. The Balcombe protests have clearly raised the visibility of the issue, but it is also clear that the public is confused by the current situation. We believe that the academic community has an important role to play in providing the public and the policy making community with independent and scientifically rigorous research on shale gas – including on public attitudes to shale gas drilling in the UK.

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<sup>190</sup> Parkhill, K.A. et al. (2013) *Transforming the UK Energy System: Public Values, Attitudes and Acceptability-Synthesis Report*. UKERC: London.

## **12. Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?**

A cursory examination of the data in DECC's Digest of UK Energy Statistics (DUKES) reveals that the UK is not currently overly dependent on these regions for its oil and gas imports. According to the official data, in 2012 the UK imported 54,357 thousand tonnes of crude oil and 98.6% of that came from non-Middle Eastern sources, with Russia providing 11.4% of total imports. Norway provided 50.2% of total crude oil imports. In the case of natural gas, in 2012 the UK imported 47% of the gas it required. Norway provided 40.5% of total imports as pipeline gas and Qatar 40% of imports as liquefied natural gas (LNG). Qatari imports equate to about 23% of total gas supply. However, the LNG industry is flexible and there are other sources of supply that could be attracted to the UK if the price was right.

The significant decline in UK gas production and coal's continued importance in power generation means that we have a high level of coal-import dependence, but this is never discussed in relation to energy security. In 2012 the UK imported 44,796 tonnes of coal, nearly 41% of which came from Russia, 26.6% from Columbia and 23.4% from the US. Thus, while Russia is always raised in relation to UK gas security, we do not directly import Russian gas. Some Russian gas is likely to come through the interconnector from continental Europe as a result of trading activities. By contrast, we do import a lot of Russian coal.

The UK has a well-developed infrastructure for importing gas, with more than sufficient capacity. However, as the level of import dependence continues to increase, there will be an increasing rationale for increasing the UK's gas storage capacity which is low when compared to our European neighbours. At present, the Government has concluded that there is no economic rationale for public subsidies for gas storage<sup>191</sup>.

### **1. What lessons can be learnt from the US experience of shale gas and oil?**

The short answer is a great deal. We would extend that to the whole of North America because Canada has extensive experience of shale gas drilling in a regulatory system that it is more akin to that in the UK. However, as we note several times in this submission, great care needs to be taken when seeking to draw lessons or conclusions for the UK from the development of shale gas and oil in other countries.

To our knowledge, there has been no substantial academic research undertaken in the UK on this issue and this is something that needs to be addressed in the proposed Research Council funded programme on Unconventional Oil and Gas. If we had to choose one lesson it would be the importance of baseline social, economic and environmental research before the onset of commercial shale gas drilling in the UK. Without this it is impossible to monitor, manage and mitigate the impact of shale gas and oil development.

27 September 2013

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<sup>191</sup> DECC (2013) 'Fallon: no new subsidy needed for gas storage - decision saves bill payers up to £750 million'. Press release, 4<sup>th</sup> September.



## **United Kingdom Onshore Operators Group (UKOOG)—Written evidence**

UKOOG is the representative body for the UK onshore oil and gas industry including exploration, production and storage. The organisation's objectives are to enhance the profile of the onshore industry, promote better and more open dialogue with key stakeholders, deliver industry wide initiatives and programmes and to ensure standards in safety, the environment and operations are maintained to the highest possible level. Membership is open to all companies active in the onshore industry including those involved in the supply chain.

### **About UKOOG**

The United Kingdom Onshore Operators Group is the representative body for the onshore oil and gas industry in the UK. Our objectives are to:

1. enhance the profile of the whole onshore industry (both conventional and unconventional);
2. promote better and more open dialogue with key stakeholders;
3. deliver industry wide initiatives and programmes;
4. ensure the highest possible standards in safety, environment management and operations.

### **Summary**

The UK Onshore oil and gas industry has been producing oil and gas onshore, safely, environmentally sensitively and in collaboration with communities for decades. The UK is the international gold standard in safe and highly regulated exploration and production.

Our detailed response highlights that at present the industry does not have sufficient data to answer conclusively a number of questions in this consultation regarding shale. The key to answering these questions and unlocking the economic benefits for the UK is the rapid and successful development of early shale gas sites.

Everyone; industry, politicians, regulators and officials have a role to play to build public acceptance for these early projects because unless we have the opportunity to explore or drill we are never going to compile the data necessary to know the UK potential for shale.

UKOOG recommends the following course of action:

- Industry and the Office for Unconventional Gas and Oil (OUGO) should spearhead work in the early shale sites to create better public understanding where acceptance will be more cautious. Regulators and experts need to go out into the relevant communities in order to build the scientific case, because scientific evidence holds the key to assuring the local community about the safety of shale exploration. This includes specific enquiries and focuses on key concerns for people, such as water.

- More work is required to map the supply chain opportunities and the jobs that could be created alongside a better understanding and strategy for the skills required. These too need to be communicated to local communities.
- Planning regulations need to be robust but must reflect that much of the activity takes place well below the surface and well away from aquifers and other areas of public interest. Recent guidance has helped but more could be done to facilitate the industry without removing any of the safeguards in place.
- The need for a supportive tax regime has already been highlighted by the recent Treasury consultation and the industry supports the approach and awaits further announcements.

## Introduction

The Lord's inquiry has come at an interesting time in the industry's development. Recent actions instigated by both government and industry have included a community benefit scheme designed to reward communities that host sites on behalf of the nation, guidance on planning and a proposed tax incentive scheme.

The impact of these initiatives will not be felt immediately but are designed to improve the overall chance of success that the industry can develop further sources of onshore energy in the UK.

The onshore oil and gas industry in the UK has been in existence for well over 100 hundred years, drilling some 2000 wells of which 10% have been hydraulically fractured to date.<sup>192</sup> Today there are c.120 sites with c.300 operational wells producing in excess of 20,000 of barrels of oil equivalent per day or about 1% of UK's consumption, safely and with adherence to the most stringent environmental regulation in the world.

The scale of the opportunity for UK shale-gas as recently outlined in the BGS report is potentially huge. The industry is beginning the exploration phase for new sources, which UKOOG currently estimates will include the drilling of 50 exploration wells within the next 2 to 3 years. These wells will differ in nature depending on the operator, some will be designed to core and log data and some will test gas flow rates and the impact of hydraulic fracturing. But all will give the industry vital information about the extent of the hydrocarbons and the potential in a commercial environment.

The questions in this inquiry are the obvious ones, however getting to the answers for the UK is what the next 2 to 3 years is really all about. The honest answer to many of the questions, is we simply don't know yet. However the track record of the industry in the UK suggests we will get the answers.

There are of course many forecasts based on predominantly the US experience and the range in those estimates is significant. However we should sound a word of caution which is that shale geology and extraction methods and regulation are different wherever you go and this has a major impact on many of the questions raised in this inquiry.

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<sup>192</sup> Shale gas extraction in the UK: a review of hydraulic fracturing, The Royal Society/Royal Academy of Engineering, June 2012.

Our document attempts to summarise the main arguments and some of the forecasts, however the real answers will only come from drilling and testing exploration wells.

### **I. How much scope is there for shale gas and oil to be used in the UK? Over what timeframe?**

The scope for shale gas and oil is significant. Recent numbers produced by the British Geological Survey (BGS) has indicated that there could be 1300 trillion cubic feet (tcf) of gas in the Bowland and Hodder shale. This compares to an average UK annual demand of 3tcf. Not all the gas in place will be economically or technically extractable. Recovery rate assessments depending on the US experience vary between 10% to 40%.

We expect further studies to be completed by the BGS in other areas of the country starting with the Weald Basin, to be published early next year which will also show the extent of shale oil in place.

Natural gas has played a significant role in heat and electricity production and providing feedstock into industry over the last 20 years and natural gas from shale will continue to do so as shown by the following factors:

#### ***Gas Imports to rise to 70%***

One of the major influencers on the UK energy market over the next 20 years will be the increasing dependency on gas imports as the production of domestic sources from the North Sea continues to decline. Many forecasts including the Government's central estimate project an import dependency of c.70% or greater by 2025<sup>193</sup> as compared with 14% in 2000.

Increasing reliance on imports generates both physical and political energy security issues. In addition as imports are increasingly filled by LNG, the UK will also become a price taker and subject to risk of price spikes caused by a physical disaster elsewhere in the world such as recently experienced during the problems at Fukushima. The disaster highlights what could happen, Japanese LNG imports went up by 25%<sup>194</sup> and the prices rocketed 50%<sup>195</sup>. Recent reports estimate that electricity costs have gone up by 30%.<sup>196</sup>

#### ***Coal supplies 39% of total electricity in 2012***

Electricity supplied from gas decreased from 40% to 28% between 2011 and 2012, as gas prices increased, particularly in relation to coal. Electricity supplied from coal rose from 30% to 39% primarily as a result of global prices falling due to US shale gas displacing US coal to other parts of the world.<sup>197</sup>

#### ***Continued role for Gas in the UK***

35% of all energy consumed in 2012 came from Gas<sup>198</sup>. We are likely to need significant investment in new gas generation plant. Modeling by DECC suggests that

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<sup>193</sup> Energy Security Strategy, DECC, November 2012

<sup>194</sup> Federation of Electric Power Companies of Japan

<sup>195</sup> US Energy Information Administration

<sup>196</sup> <http://www.reuters.com/article/2013/09/26/us-japan-survey-power-idUSBRE98P18P20130926>

<sup>197</sup> Digest of United Kingdom Energy Statistics, DECC, 2013

<sup>198</sup> <https://www.gov.uk/government/publications/energy-consumption-in-the-uk>

up to 26 GW<sup>199</sup> of new gas plant could be required by 2030 (in part to replace older coal, gas and nuclear plant as it retires from the system). It also indicates that, in 2030, we may need more overall gas capacity than we have today, although operating at lower load factors.

Gas is also important for balancing out the increasing levels of intermittent and inflexible low-carbon energy on the system. Unabated gas generation will continue to play a crucial role in our generation mix for many years to come, and the amount of gas capacity we will need to call on at times of peak demand will remain high.

Oil and natural gas provide the energy source or raw material to make a wide range of products. In fact, it is nearly impossible to get through a day without using multiple products that contain oil or gas. Natural gas is the raw material for plastics; a material found everywhere and is also a key component in the manufacture of fertilisers. The Haber-Bosch process uses natural gas to provide hydrogen, which is combined with nitrogen in air as part of the process to create ammonia. Ammonia is used as a feedstock for other nitrogen based fertilisers, and with up to 70%<sup>200</sup> of the costs of the fertiliser coming from natural gas, a cheap supply is essential for its production.

### ***Gas to continue to heat our homes and drive our industry***

Around 80%<sup>201</sup> of all the heat used in the UK – in homes, in commercial buildings and in industrial processes– comes from gas. According to DECC, natural gas will supply the majority of our heat demand for many years to come.

The Government has put in place a strategy of reducing reliance on natural gas in heating but this will take many years to develop as it involves not only new technologies but also modification in infrastructure and behavior. Gas and therefore shale gas has a major part to play in bridging the gap between now and then.

## **2. How will the costs, including those on the environment, of accessing the UK's shale gas and oil compare to those of other energy sources?**

Costs are dominated by the drilling of wells and are usually higher than for conventional gas because of the additional expense of multistage hydraulic fracturing.

The shale industry in the UK is still at a very early stage and therefore it is impossible to be accurate about the cost to extract onshore hydrocarbons. There are a number of factors which will determine the cost of extraction

2. Rate of recovery which is largely dependent on geology
3. Development of a UK supply chain to generate price competition
4. Climate change policies impacting on the cost of carbon
5. Public perception and the impact on planning decisions
6. Environmental and safety related costs
7. Well success factors

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<sup>199</sup> Gas Generation Strategy, DECC, December 2012

<sup>200</sup> Agricultural industries confederation

<sup>201</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48574/4805-future-heating-strategic-framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf)

8. Well learning curve – time taken to reduce well costs
9. Operator efficiency

In the US cost of extraction varies significantly based on a number of the factors above, in particular geology and the presence of hydrocarbon liquids.

Reports vary on how the UK shale extraction cost will compare to the US, with some commentators predicting the difference as high as three times more expensive in the UK.

Unlike the US however, the UK already has access to sophisticated gas distribution and transmission systems. Not only would it cost several billion pounds if these systems had to be built today, but it also means that the need for flaring will be far less than in the US.

Whilst it still needs to be fully tested, at this stage, it appears that in certain parts of the UK, the shale is significantly thicker than in the US. Consequently, this will allow more gas to be extracted per well site.

However the UK suffers from a number of potential cost pressures compared to the US in particular the current lack of shale supply chain. For example one recent rig count identified 1900 land rigs and 500 fracturing crews in the US compared with 77 rigs and 10 fracturing crews in the whole of Europe. This position will steadily improve as it did in the US. In addition to the immature supply chain there is also a bigger environmental and regulatory cost of doing business in the UK, longer lead times particularly around planning make scheduling difficult.

The industry is currently working closely with the Department of Business, Innovation & Skills with respect to identifying the potential for growing a UK supply chain; this will not only reduce the cost of doing business but also create UK jobs. This work is at an early stage but should be encouraged.

The increased cost burden in the UK particularly in the early stages of development result in shale projects being marginal for development and therefore the industry has welcomed the proposals for a specific tax regime along the lines given to marginal offshore fields.

In terms of planning, the recent guidance produced by the Department of Communities and Local Government has been welcomed by the industry. However more clarity is required with respect to the planning regime and underground workings; a fairer regime is required along the lines of similar industries so as not to increase the regulatory burden for underground workings which are already governed by a significant amount of environmental regulation. A clear demarcation within both the planning and legal regimes is required between surface and subsurface activities.

In terms of comparing other energy sources, most will attempt to compare shale oil and gas with renewable energies and nuclear power. This is not a real comparison as shale oil and gas firstly has multiple uses from heat and electricity through to feedstock supply. In addition the final use of the hydrocarbon whether it may be for heat or electricity will have a big determinant on the efficiency of conversion to other forms of energy.

The most obvious comparison therefore is with imported fuels. As explained in the answer to question 1, the cost of shale oil and gas in the UK is yet to be determined and will only be answered after a prolonged period of exploration and testing. However it should be

noted that the cost of transport either by pipeline or by tanker adds substantially (between 10% and 50%<sup>202</sup> of the total delivered wholesale gas price depending on distance and method) to the cost both in terms of economics as well as environment. For example liquefaction and regasification consumes up to 13%<sup>203</sup> of gas being transported as LNG and therefore adds to the cost significantly.

### **3. What is the potential impact of shale gas and oil on the local economies in areas where development is possible?**

The benefits of the shale industry will be felt across the UK in lower imports, higher revenues to the Exchequer, job creation, supply chain development and energy security.

The industry has made it clear from the outset that local communities that host our sites should be rewarded. As a result in June 2013 UKOOG announced its first industry-wide community benefits scheme. At the exploration phase for sites that involve hydraulic fracturing the local community will benefit to the sum of £100,000. During production communities will receive in total 1% of all gross revenues before costs are deducted. The industry estimates that this could amount to over £1.1bn in a 25 year period or £5m to £10m per site.

Alongside the direct and indirect benefits, developers will also be paying increased business rates as a result of their operations, 50% of which will go directly back to local councils, again benefiting local communities.

### **4. What forms of electricity generation is shale gas likely to displace and by how much?**

If we are serious about reducing the impacts of climate change we need to radically look at the way we use coal. Many coal fired generators are actually in the process of closing as a result of the EU's large combustion plant directive and many more are considering moving to biomass as a feedstock.

Natural gas prices have now risen above the equivalent cost of coal for the generation of power. This has resulted in power generators increasing power from coal stations and reducing generation on gas stations. With coal stations emitting more carbon dioxide per unit of power generated, this has resulted in a significant increase in emissions.

Shale has the ability to firstly displace coal and then imported gas. However this depends largely on whether shale can be cost competitive against the other forms mentioned and whether any credit is given for its environmental benefits.

### **5. What impact will shale gas and oil have on household energy bills?**

In the US, exploitation of shale gas has led to a dramatic reduction in gas prices, from highs of around \$12/MMBtu in 2008 to a low of \$1.80/MMBtu in March 2012, since when they have recovered to around \$3.40/MMBtu. This has been reflected in the price to the consumer.

Commentators are divided about the impact of shale on household bills in the UK.

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<sup>202</sup> Unconventional gas, the potential impact on UK Gas Prices, Navigant, 2013

<sup>203</sup> Unconventional gas, the potential impact on UK Gas Prices, Navigant, 2013

In November 2012, Poyry estimated that gas and electricity prices could go down by as much as 4% assuming shale provided 50% of the UK's underlying indigenous gas production. This would seem to be an inconsequential amount but could be significantly bigger if the amount of shale produced goes beyond this conservative estimate. Even at 4% the annual saving to the UK economy is £800m.

Navigant in June 2013, estimated in their optimistic scenario that prices could go down to 50p/therm compared to the current 70p/therm based on an international shift to shale.

However Bloomberg New Energy Finance is less optimistic as it believes the price of gas will be set by imports and the amount of shale will not offset the decline in the North Sea and will be significantly more expensive to produce.

UKOOG notes that many of the current forecasts show a significant increase in European gas prices without the introduction of shale and that shale gas production in the longer term should result in lower prices when compared to a future with no shale gas production.

## **6. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?**

The use of natural gas extracted from shale reservoirs has significant scope to reduce the UK's overall carbon emissions, as natural gas from shale will probably displace coal and imported gas in the energy mix.

The burning of natural gas to produce energy releases around half the carbon emissions of coal.

A study by AEA Technology in 2012 for the European Commission concluded that the lifecycle CO<sub>2</sub> emissions for shale gas could be 2-10% lower than emissions from electricity generated from conventional pipeline gas located outside of Europe and 7-10% lower than that of electricity generated from LNG imported into Europe.

The Committee on Climate Change concluded in April 2013 that shale gas “could have lower emissions than imported LNG if regulatory arrangements are in place to manage methane released during its production.”

Gas demand projections made by the Department of Energy and Climate Change (DECC) are consistent with forecasts made regarding the UK's net carbon account, which is expected to fall by 45% by 2025 (from a 1990 baseline)

However, plenty of scope still remains to reduce the UK's reliance on coal. DECC figures show that in 2012, coal power overtook gas to become the biggest single source of UK electricity generation.

## **7. Will shale gas and oil increase UK energy security?**

For many years the UK has had access to locally sourced supplies of natural gas which have provided consumers with competitively priced energy supplies. As conventional reserves have declined, however, UK import dependency has increased with ever-greater volumes of gas being sourced from Norway and through LNG.

In addition to electricity generation and industrial and domestic heating, the UK energy intensive and petrochemicals sectors require certainty that energy and feedstocks will be secure and competitive in the medium term. Without that certainty, it is likely that these sectors will decline, reducing manufacturing capacity.

Replacement of North Sea capability with another indigenous source of fuel has to provide better security than reliance on a physical pipeline to Norway or political reliance on places like Qatar and Russia.

## **8. What lessons can be learnt from the US experience of shale gas and oil?**

The UK has well established arrangements in a wide variety of industries for responsibly managing environmental and other risks. The US has demonstrated the technology which should be readily transferable.

Much Research and Development was undertaken in the US which has aided the US to be in a position to extract the maximum from its resources. Improvements in lateral drilling and the ability to locate areas of natural prospectively have improved recovery rates.

The UK will benefit from this experience. However not all shale is the same and we will need to ensure that we understand the shale in the UK with respect to the available technology.

Much has been made of some of the issues that the US has had with water contamination and air quality, with many studies contradicting each other. However we need to be clear that taking issues from one country and transposing them onto another country with a very different regulatory regime is not a correct comparison.

The UK regulatory regime is different and significantly more stringent and incorporates a quadruple layer of regulation from local mineral authorities, Department of Energy and Climate Change, the Health and Safety Executive and the Environment Regulators across the devolved regions (EA, SEPA and NSW).

Many of these issues are myths. There have been over 2 million hydraulic fracture operations carried out in the last 40 years with no incidence of hydraulic fracturing fluid having entered the water supply and limited examples of methane leakage.

Some of the issues around methane leakage are likely to be due to poor well design or control. The regulations in the UK are some of the most stringent in the world with respect to well integrity with an emphasis of reducing risk to as low as reasonably possible.

However the situation with respect to repudiating some of these myths has been more difficult by the lack of baseline monitoring in the US, making it difficult to prove that the industry has not been at fault. This situation will be rectified in the UK by baseline and continuous monitoring.

The promulgation of these myths has made local people cautious about the plans operators have in their areas and there is a real need to create better public understanding. Much can and will be done by the operators themselves in line with the UKOOG community



engagement charter which stipulates early engagement. However regulators and experts need to go out into the relevant communities in order to build the scientific case, because scientific evidence holds the key to assuring the local community about the safety of shale exploration. This includes specific enquiries and focuses on key concerns for people, such as water.

*September 2013*

United Kingdom Onshore Operators Group and Future Energy Strategies—Oral evidence (QQ 58-68)

**United Kingdom Onshore Operators Group and Future Energy Strategies—Oral evidence (QQ 58-68)**

Transcript to be found under [Future Energy Strategies and United Kingdom Onshore Operators Group—Oral evidence \(QQ 58-68\)](#)

United Kingdom Onshore Operators Group—Supplementary correspondence with Committee Clerk

## **United Kingdom Onshore Operators Group—Supplementary correspondence with Committee Clerk**

Dear Mr Cronin,

### **Economic Affairs Committee: Inquiry into *The Economic Impact on UK Energy Policy of Shale gas and Oil***

Since you gave evidence on 29 October the Committee has heard more witnesses and is nearing the end of oral evidence-taking in this inquiry.

One main theme common to most witnesses is that no-one can know what the UK's economically recoverable reserves of shale gas or oil might be until exploratory drilling takes place.

Industry witnesses indicated that they were keen to go ahead with exploratory drilling but that regulatory constraints impeded progress.

Witnesses from the regulators indicated on 3 December that regulatory requirements were clear and known to the industry and that responses to applications for the various permits were normally quite speedy. But, according to Tony Grayling of the Environment Agency, no application to drill by hydraulic fracturing had come in since the moratorium was lifted in December 2012.

Can you add anything to your evidence to help the Committee understand why an industry eager to get exploratory drilling under way is apparently not pursuing the necessary permits?

It would be helpful if you could reply by 16 January, in part to inform the Committee's questioning of forthcoming witnesses.

Bill Sinton

(W B Sinton)  
Clerk to the Economic Affairs Committee

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Dear Mr Sinton,

### **The Economic impact on UK Energy Policy of Shale Gas and Oil: Supplementary Letter**

Your recent letter asked why an industry eager to get exploratory drilling under way is apparently not pursuing the necessary permits.

United Kingdom Onshore Operators Group—Supplementary correspondence with  
Committee Clerk

In my opinion the industry and government have moved a long way in the 12 months since the moratorium has been lifted and I would expect to see operators pursuing environmental permits and planning consents for exploration sites in 2014.

However it must be noted that here was a major change in the approach by the Environment Agency to regulating onshore oil and gas exploration announced at the end of June last year. This had a major impact on the industry, delaying a number of projects and causing the industry to reassess its approach.

The change in approach has involved the requirement by industry to apply for as many as 8 environmental permits. The industry alongside the Environment Agency set up a working group to ensure that this new approach was well understood and that a smooth transition could take place. That process took the rest of the year and has still not been completed. I am therefore unsurprised no companies have yet applied for permits.

In addition to the change in Environment Agency approach the industry has also had to grapple with the introduction of a requirement to create an environmental risk assessment, this approach has not yet been finalised with DECC, but we expect completion soon.

We now have a stable and understood regulatory framework which should give confidence to operators to start formal application procedures.

As I said in our initial response to the committee the key now is to ensure that the local communities we will be working in are well informed by operators, regulators and government.

Yours sincerely

Ken Cronin  
Chief Executive  
United Kingdom Onshore Operators Group

*January 2014*

## The Weir Group PLC—Written evidence

### Introduction

The Weir Group PLC (Weir) is pleased to provide evidence to the Committee. Our observations address the lessons that can be learnt from the US experience of shale gas and oil, with a focus on how the critical oil services and engineering support industry has developed.

Weir is a global engineering business, operating in more than 70 countries and employing more than 14,000 people. Of particular relevance to the Committee are our leading market positions in equipment and services provided to the unconventional oil and gas markets of North America. Weir provides a broad range of surface equipment, from pump to wellhead, for use in drilling and well completion applications and has been active in North American unconventional oil and gas markets since 2007.

### Weir Group evidence

- Even in the US, shale gas development is a relatively young industry. Although hydraulic fracturing has been safely and widely used since the 1940s, it was its combination with horizontal drilling in the early 2000s that has driven the rapid growth of North American onshore unconventional exploration and production. An illustration of the growth of the industry can be seen in the case of SPM, a pressure pumping business acquired by Weir in 2007. In 2008, the business, based in Fort Worth, Texas, had around 700 employees and around \$275m turnover. By 2012, SPM employed around 1500 people with turnover of around \$800m. Should the UK develop domestic shale gas resources, it would stand to benefit from the experience of a US industry which has rapidly developed and continues to improve the efficiency, safety and environmental impact of shale operations.
- The scale of unconventional oil and gas activity in North America has had broad economic benefits. According to IHS Global Insight, this supported 1.7m jobs in 2012. Employment has been created in the industries most closely involved in the process, such as drilling, extraction, equipment and services, but also in supporting sectors such as manufacturing, construction, financial and insurance services.
- Unconventional development has been made possible by innovation and creativity, leading to the development of new partnerships between industry and academia and significant increases in patent filings. In Weir's case, the Group has worked with institutions in the US and the UK to develop new patent-protected technology for pressure pumping, the process by which fracturing fluid is delivered to the wellbore. As well as mechanical engineering developments, shale exploration and production has also stimulated investment in solutions for reservoir evaluation and enhanced mitigation of environmental impacts such as the treatment of wastewater. The US industry continues to develop new technologies and best practice, enhancing the safety and economics of unconventional resources.
- As the US industry has grown, the critical oilfield services activity that supports the exploration and production processes has developed a number of highly professional

large service companies. These companies are increasingly active in emergent international shale markets and it is likely that they would play an important role in supporting a nascent UK industry. This would complement the UK's very strong existing oil and gas industry and skills base which positions the UK to take a leadership position in shale production as opportunities develop across Europe.

- While outside expertise will facilitate smooth initial development, a UK shale gas industry provides the opportunity to develop skills and a local supply chain. Differences exist between onshore and offshore techniques, but the established oil and gas services industry in the UK has readily transferable skills and technologies and a strong international reputation, reinforced by global leadership in subsea operations which is exported from the North Sea to areas such as the Gulf of Mexico. The UK supply chain is well positioned to satisfy both upstream and midstream requirements. Onshore rig sites will also require significant numbers of engineers, technicians and semi-skilled labour. Thought will need to be given to balancing the skills needs of the offshore industry with a potential shale gas industry, given the high demand for candidates in areas such as engineering and geoscience. Depending on the scale of recoverable resource, thought should be given to training requirements and capacity building.
- Drilling and hydraulic fracturing is a process that requires high volumes of water. Figures vary, but it is estimated that in the US the drilling and fracturing of a horizontal well requires an average of three million gallons. Alongside concerns about water levels in areas of drought or shortage, water is often brought to rig sites by lorry which brings additional traffic and noise. The US industry is already taking a number of steps to mitigate this, with the now routine recycling of 'flowback' water, where up to 30% of the water used to fracture the well returns to the surface, alongside produced gas. While water usage should be an area considered in any regulatory or planning process, Weir does not consider this to be a significant issue for the UK. Notwithstanding the lessons already learned in the US and the continued efficiency in the use of water for shale operations, the UK has a more developed mains system and sewerage network, in contrast to the many more private water sources in the US.
- In the US, financial incentives are provided directly to minerals rights owners, which have arguably helped to ensure the rapid acceptance of drilling development. Indeed, large hydraulic fracturing operations often take place in suburban areas. Individuals in the US receive royalties based on the production beneath their land. This is not the same as the current proposal in the UK whereby the community in general is expected to receive the financial benefit.
- Debate about the environmental pros and cons of shale development is healthy and robust evidence to inform the debate is helpful. Establishing reliable baseline data in the UK will be important to determining the environmental impacts to air and water of any shale development. In the US, often for reasons of commercial confidentiality, the industry was slow to provide transparency on issues that vexed campaign groups and wider stakeholders. A good example would be the length of time taken to disclose the chemical content of fracturing fluid, used to help prop open the fissures in shale which allow hydrocarbons to escape following the fracturing process. For

thousands of wells across the US, this information is now available at [Fracfocus.org](http://Fracfocus.org), a publicly available portal where members of the public can establish the chemicals used. The industry has also recognised the need to involve stakeholders in decision making and many good examples of organisations committed to effective and meaningful engagement exist, such as the Marcellus Shale Coalition, the Barnett Shale Energy Education Council and the Centre for Sustainable Shale Development. UK regulators and planning authorities should ensure that consistent and reliable data can be drawn upon to enable a balanced debate on the environmental impact of shale operations, with science, rather than emotion, informing stakeholders.

27 September 2013

World Wildlife Fund (WWF-UK), Friends of the Earth England, Wales and Northern Ireland and Greenpeace UK—Written evidence

**World Wildlife Fund (WWF-UK), Friends of the Earth England, Wales and Northern Ireland and Greenpeace UK—Written evidence**

Submission to be found under [Friends of the Earth England, Wales and Northern Ireland, Greenpeace UK, and World Wildlife Fund \(WWF-UK\)—Written evidence](#)



WWF-UK, Friends of the Earth and Greenpeace UK—Oral evidence (QQ 33-46)

**WWF-UK, Friends of the Earth and Greenpeace UK—Oral evidence (QQ 33-46)**

Transcript to be found under [Friends of the Earth, Greenpeace UK and WWF-UK—Oral evidence \(QQ 33-46\)](#)

## Chris Wright—Written evidence

- My name is Chris Wright. I have been a technology and energy entrepreneur for over 20 years. I have been fascinated with energy my entire life. I went to MIT when I was 17 to study plasma physics in the interest of hastening the arrival of commercial fusion energy. Realizing that I did not possess the patience for basic research, I received my bachelor's degree in mechanical engineering and pursued graduate work in electrical engineering in the MIT Power Systems Lab. Since then I have worked in geothermal energy, energy conversion and conservation, solar power, and most significantly in the shale revolution from the very start. My original company, Pinnacle Technologies, developed the first technologies to directly and in real-time map the growth of hydraulic fractures. These direct measurements enabled some fracture design changes – refracturing, network fractures, and high-rate slickwater fracturing – which led to the first commercial shale gas production from Mitchell Energy's Barnett Shale in 1998. We worked with Mitchell, and later Devon Energy who acquired Mitchell Energy, to expand the application to multi-stage horizontal wells in the Barnett shale.
- I don't deserve much credit for what happened (blind squirrel finds nut), as the real credit is due to the entire team at Mitchell Energy who relentlessly pursued the shale gas concept for 16 years before it yielded economic gas production. But yield it did. Ten years after the breakthrough in 1998, the Barnett shale gas production was roughly 2 TCF per year making it by far the largest gas field in the United States and supplying an amount roughly equal to two-thirds of the entire UK gas consumption. Time would prove that the Barnett shale was a mid-grade shale at best as many other shale plays emerged by utilizing the same technology / approach that was developed in the Barnett.
- This year the production from the Marcellus shale in Pennsylvania (not including the rapidly growing Marcellus production in West Virginia) will exceed 3 TCF and continues to grow rapidly. Shale gas production now represents roughly 40% of US natural gas production. This surge in US natural gas production catapulted the US past Russia as the world's largest producer of natural gas. While the breakthrough came first in shale gas production, the price drop in US natural gas prices that resulted from the abundant supply drove production companies to apply the same innovations to oil production. The result has been a dramatic rise in US oil production after thirty years of declining US oil production. The US imported 60% of our oil in 2005 and this year will import less than 40%. The oil production in the state of North Dakota, a modest producer prior to the shale revolution's 2006 arrival in the Bakken shale, now exceeds that of two OPEC Nations (Ecuador and Qatar) and the United Kingdom.
- I should declare my strong interests in the shale revolution. Pinnacle Technologies, which I started in 1992, saw its business grow even faster with the launching of the shale revolution. I also recapitalized a tiny coalbed methane production company, Stroud Energy, in 2001 and turned it into a shale gas producer in the Barnett shale. I also co-founded and am currently the CEO of Liberty Resources, a shale oil producer most recently in the Bakken Shale of North Dakota. I am also the CEO and co-founder of a hydraulic fracturing services company, Liberty Oilfield Services,

that works in the Bakken Shale and the Niobrara shale in Colorado and Wyoming. I have no commercial interest in seeing shale gas development in the UK, but I do indeed have a great commercial interest in the US shale revolution.

- To give but one example of the local economic impacts of the shale revolution, North Dakota ranked 39<sup>th</sup> among the US states in per capita income in 2006. Six years after horizontal shale oil drilling began in western North Dakota's Bakken shale North Dakota rose to 7<sup>th</sup> in US per capita income in 2012.
- Much has been written about the surge in jobs, wages, and innovations in the US energy industry. It is there for all to see. But even more significant is the benefits to the greater US economy of abundant supplies of lower cost energy and the accompanying roughly \$200 billion per year improvement in the US trade balance due to reductions in oil and natural gas imports. Perhaps best of all is the American manufacturing industry renaissance. Energy pipeline and infrastructure firm Enterprise Products Partners reports \$40B dollar investment in 50 US gulf coast facilities under construction or in planning approval to exploit the US surplus of ethane, a by-product of shale gas which is dominantly methane. The economic impact of the vast new supply of methane is far larger than the investment in ethane-feedstock plants.
- Methane gas is the dominant component of natural gas. Methane is the leading source of heating for residential and commercial buildings in the US. It also is used to generate more than one quarter of the electricity produced in the United States and as the marginal supplier of electricity it is responsible for the drop in US electricity prices in contrast to rising prices in all other industrialized nations. The third major use of methane gas is its dominant role in powering manufacturing. For energy intensive manufacturing, natural gas prices play a major role in deciding the most efficient location to build or expand a plant. I myself am a founding board member and investor in a project that just completed a large (\$200M) ceramic proppant manufacturing facility in Wrens, Georgia. The last five or ten such plants were constructed in China, but now the energy cost advantage of the United States offsets the labor cost advantage of China.
- Much has been said about the enormous economic advantages that have accompanied the United States shale gas revolution and that would surely accompany UK shale gas development. So I will move my comments now to the technology itself and the environmental impacts of shale development.
- Shale gas originates from marine life buried in stagnant seas hundreds of millions of years ago. With additional deposition the sediments are buried deeper causing the temperature and pressure to rise, eventually converting the dead organisms into kerogen, the precursor of hydrocarbons. With time the kerogen "cooks" first into long-hydrocarbon chain "heavy" oil, followed by "light" oil, natural gas liquids and eventually methane. Cooking of kerogen into gas results in significant volumetric expansion that induces millions of hydraulic fractures that eventually link together the pore spaces in the shale and allow gradual migration of the gas out of the source-rock. The buoyant gas migrates upwards and will vent at the surface unless it is trapped by another "cap-rock" which creates a conventional natural gas reservoir.

Shale gas involves less exploration risk as wells are drilled directly in to the source rock and a series of man-made hydraulic fractures are performed to accelerate the gas migration out of the shale. However this controlled “migration” is directed into the wellbore that conducts gas flow to surface gathering lines, as opposed to gas naturally migrating upwards into other geologic strata. Shale gas production simply accelerates and controls gas migration out of source rocks.

- Shale gas production was enabled by two recent technological innovations. One is advanced packers (doughnuts that attach outside of steel wellbores) and drillable bridge plugs that are placed inside wellbores and allow individual zone isolation along horizontal wellbores. The other is innovations in hydraulic fracturing that have allowed the creation of “network” fractures that create far more surface contact area with the gas-saturated shale rocks than was possible with conventional hydraulic fracturing. Ironically given the recent concerns, these innovations in fracturing for shale reservoirs led to the use of far less chemicals in shale fracturing versus conventional hydraulic fracturing!
- Hydraulic fracturing began in the late 1940’s in Oklahoma to “stimulate” increased oil and gas production from low permeability rocks that would not otherwise yield enough oil and gas to pay for the cost of drilling a well. Over the last forty years the vast majority of all wells drilled in the United States were hydraulically fractured after being drilled and before being put on production. Hydraulic fracturing has been key to the vibrancy of the United States oil and gas production since the 1970’s. In the 1990’s hydraulic fracturing has been employed regularly as a technique to dispose of drilling waste in remote areas (North Sea, Alaska, Indonesia, etc.). The safety record of hydraulic fracturing is nothing short of superlative. There is not a single instance of a hydraulic fracture contaminating ground water in the more than two million hydraulic fractures that have been performed over the last 65 years. The reason for this is that hydraulic fractures are executed deep underground far below the near-surface fresh ground-waters.
- Great effort has been expended to convince the public that hydraulic fracturing is new, a threat to our water supplies and a significant seismic hazard. It is none of these.
- Hydraulic fracturing has been going on for over 60 years. Fracturing has also spread geographically to include Canada, Mexico, China, Russia, Germany, Italy, Japan, Australia, Great Britain, Austria, Poland, Norway, Indonesia, Argentina, Columbia, Pakistan, India – a partial list of only the countries that I personally have been involved with hydraulic fracturing in. Two significant fracturing projects that my original company, Pinnacle Technologies, was involved with immediately before the shale innovations involved fracturing over a dozen wells in Beverly Hills and nearby Los Angeles, and another large project in Nigata, Japan. Hence fracturing in densely populated urban areas and remote wilderness areas was not problematic.
- Two American movies, Gasland and Gasland 2, have received great publicity for showing purported cases of fracturing resulting in methane contamination so that tap water could be lit on fire. The example in the first Gasland was from a farm near my home in Denver, Colorado. There are some thin coal seams in the local aquifer for

Denver. This is not uncommon. Hence there are locations where water wells can be drilled into groundwater containing methane outgassed from the coal seams. This has been widely known in the Denver area since the first settlers arrived. The second Gasland film shows a hose in the Dallas, Texas, metro area being lit on fire. This latter case was ruled a fraud by the local courts as the perpetrators simply hooked a garden hose up to a residential gas line. State and Federal regulators in the U.S. have also cleared hydraulic fracturing these cases. At Pinnacle Technologies we have several times published composites of ALL the hydraulic fractures we have mapped in the principal shale gas fields: Marcellus, Barnett, Niobrara, Eagle Ford, and Fayetteville. The fracture mapping data shows compellingly that even the cases of exceptional upward fracture growth do not get within two thousand feet of the deepest possible fresh groundwater.

- Seismic risk has also recently been raised as a risk of shale gas development. This risk gets particular attention as there were two seismic events around magnitude 2 induced by hydraulic fractures in the Bowland Shale. These induced seismic events were indeed significantly larger than normal for hydraulic fracturing. However even these anomalous events, almost certainly caused by fracturing immediately adjacent to an active fault, were still far below the magnitude able to be felt at the surface. A thorough study was prepared on these events and a sensible monitoring system was recommended to assure that seismic risk is mitigated. Mining and hydroelectric power have far greater seismic risk than shale gas drilling.
- Is there an environmental impact from shale gas development? Of course. Development of ANY kind involves environmental tradeoffs. However the environmental impact of shale gas development is above ground, visible for all to see. And on this measure it compares quite favorably with alternative sources of energy production. As a lifelong climber, wilderness adventurer, and board member of an environmental group (Property and Environment Research Center) I am keenly interested in minimizing human impact on the environment. Liberty Resources, of which I am the CEO, uses roughly 10 acres to construct a “pad” which houses the drilling rig and after drilling is done is used to stage all the hydraulic fracturing equipment. After drilling and fracturing are done, the 10-acre pad contains the 16 total well-heads and surface production facilities. These 10 acres of land are used to produce the oil and gas from 2560 acres (four square miles). Meaning that we utilize a little under 0.5% of the land to produce the massive Bakken oil field. Which means that the other 99.5% of the land is still farmed, ranched, otherwise occupied (town or city), or remains native grassland or forest.
- To expand on the above point about land utilization, let’s take a shale gas example from the Marcellus shale in Pennsylvania and West Virginia. An average Marcellus shale well will ultimately recover about 10 Billion cubic feet of natural gas (BCF). The thermal energy from 10 BCF of gas is roughly 3 Terrawatt-hours (TWh). A 10-acre Marcellus well pad can easily host 10 wells meaning that the pad will ultimately produce about 100 BCF of gas, which equates to 30 TWh of energy. Factoring in the roughly 60% thermal efficiency of a combined-cycle gas turbine, yields about 18 TWh of electric power from this 10-acre well pad in Pennsylvania. This amount is roughly equivalent to the 19 TWh of electricity from the entire British wind industry in 2012. Shale gas and shale oil are amazingly land efficient sources of energy.

- What about all the chemicals in fracturing fluids? The same could be said about the chemicals employed in making a couch, a sculpture, a wind turbine, a solar panel, or a Starbucks. Except with shale gas you can increasingly access ALL of the chemicals used on each fracturing job from the Frac Focus website. The vast majority of these chemicals could also be found in household cleaning products, food additives, solvents, etc. Truth be told, the real hazard from oil & gas production has nothing to do with frac chemicals. Instead it comes from the foul nature of produced water that inevitably accompanies production of oil or natural gas liquids – dry gas sometimes is indeed produced without subsurface waters. Water from deep underground is far saltier than the oceans, often contains heavy metals and Naturally Occurring Radioactive Materials (NORM). This problem is as old as the oil industry. The United States produces far more water from its oil wells than it produces oil. This volume of foul produced water is typically piped to a nearby disposal well and re-injected deep underground where it came from. Unfortunately a Marcellus producer in Pennsylvania instead delivered its produced water to a nearby water treatment facility that was not equipped to handle the huge salt content and NORM from the produced water. This has made big news in the US and has rightly drawn condemnation as it needlessly contaminated streams nearby the water treatment plant. This was not a problem with fracturing per se, but instead a problem of produced water disposal.
- In addition to careful regulation of produced water disposal, the other major concern is wellbore construction. A shale gas wellbore typically goes down 2 miles and then turns horizontal in the targeted shale zone and might go another mile or two within the targeted zone. The steel casing cemented inside the drilled borehole provides the conduit for fracturing fluids to travel down into the rock and subsequently for produced gas, oil, and water to flow back to the surface. These steel wellbores must be appropriately designed and cemented in place to prevent the migration of fluids upwards outside of the steel casing – for example via the annulus outside of the steel casing but inside of the drilled hole. This migration can be reliably prevented if the casing and cementing programs are properly designed and executed. US State Regulations in this area are continually placing stricter protocols on wellbore construction. I fully support this evolution.
- Water consumption is another area of concern that is often raised. In short, the water consumption is quite modest for the energy produced. In Colorado, home to the booming Niobrara shale that now produces over 100,000 barrels of oil per day from my home state, water consumption for fracturing is 0.13 percent of Colorado total water consumption. Oil and gas production is roughly 7% of the Colorado economy, so one can conclude that shale gas / oil production is roughly 50 times more water efficient than our state's industry as a whole. Agriculture of course is by far the biggest consumer of water in the United States. Electricity production is also a major consumer of water. However, hydraulic fracturing for oil and gas production is far from a major consumer of water.
- I will conclude with a few thoughts about Great Britain from this American outsider. I drove with my wife and son from northeast England across to northwest England and then down central England to London. I was struck by two things: a

countryside that looked quite suitable to shale drilling and urban areas that looked in need of revitalization. England launched the industrial revolution due to leading engineering innovations and readily available low cost energy. Development of the Bowland shale gas could bring them both back to England again.

- I apologize for the rushed and informal nature of my written testimony. I am passionate about this subject and not just because I have been involved in it from the start. I would happily come back to England for oral testimony if desired.

*October 2013*

## Chris Wright—Oral evidence (QQ 223-237)

TUESDAY 14 JANUARY 2014

*Evidence Session No. 16*

*Heard in Public*

*Questions 223 - 237*

### Members present

Lord MacGregor of Pulham Market (Chairman)  
Baroness Blackstone  
Lord Griffiths of Fforestfach  
Lord Hollick  
Lord Lawson of Blaby  
Lord May of Oxford  
Lord McFall of Alcluith  
Baroness Noakes  
Lord Rowe-Beddoe  
Lord Shipley  
Lord Skidelsky  
Lord Smith of Clifton

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### Witness

**Chris Wright**, US energy and technology entrepreneur, CEO of Liberty Resources, and CEO of Liberty Oilfield Services

**Q223 The Chairman:** Let us begin. Welcome to the Economic Affairs Committee. This is the 12th public hearing of our inquiry into the economic impact on UK energy policy of shale gas and oil. Mr Wright, we are very grateful indeed to you for coming. Apologies for the slight delay, but we had one of two bits of business to conduct. We are also very grateful to you for your paper, which you sent us some time ago, which certainly excited our interest. You have very extensive experience of shale oil and gas exploration in the United States, and we will be asking you about your experience there to fill out what you say in your paper. Could I start with a question? It arises from an article in the Christmas edition of the *Economist* which concluded: “The fracking boom could be every bit as important as the gold rush” in the United States. How do you feel about that?

**Chris Wright:** That is a big statement. I lived in California for a long time, and the gold rush certainly was enormous. It created the city of San Francisco and brought 300,000 people to California, so it was quite a significant event in Californian history. On a broader scale, gold is a store of value. If you print more money or you discover more gold, it just results in inflation or a decrease in the value of that medium of exchange. The gold rush ultimately just transferred wealth from the previous holders of gold to the people who profited from the gold rush. The shale boom is quite different. We are not producing a store of value; we are producing a good that creates human well-being. It allows for production and growth. It is a much larger increase in real wealth. Of course, the scale of the shale boom,



as you well know, is quite tremendous. It is definitely measured in hundreds of billions of dollars.

**Q224 The Chairman:** Could you expand a little bit more about how you think shale gas and oil will develop in the US in the future? We have had a lot of evidence about what it is doing at the moment.

**Chris Wright:** I have prepared some remarks. Would it be inappropriate to read them? It will take maybe three or four minutes.

As a kid, my interest was astronomy and energy: what powered the stars? I have been a technology and energy entrepreneur for my entire life. By good fortune or luck, I was involved in the shale revolution at the very start with Mitchell Energy via a company I founded in 1992, Pinnacle Technologies, that started the fracture mapping industry measuring how fractures grow.

Stepping back, energy has always been intimately connected with human well-being. A thousand years ago, an energy innovation—using horses instead of oxen to pull ploughs—doubled the energy available to medieval farmers. This increase in human efficiency played a significant role in ending feudalism. In Britain, the proud tradition of human freedom, and especially economic freedom, via Magna Carta, the Glorious Revolution, and, ultimately, the 1842 registration Act enabled the launching of the Industrial Revolution. In addition to economic freedom, the Industrial Revolution required cheap and abundant power. In the Midlands of England, that came from coal. From the 1840s until today, inflation-adjusted per capita income increased twenty-fivefold. This unprecedented increase in human well-being doubled human life expectancy and created the modern world.

Today, access to cheap and reliable energy sources plays a major role in where investments are made and new jobs are created. For example, in North Dakota, where I work, modern hydraulic fracturing—what we are calling today “fracking”—came to the Bakken shale in earnest in 2006. Six years later, North Dakota’s per capita income had grown from 39th among the 50 US states to seventh. Today, North Dakota has 2.7% unemployment, and a massive state budget surplus. It also produces more oil than the United Kingdom.

The shale revolution brought about by modern fracking began about 15 years ago in the Barnett shale just north of Fort Worth, Texas. Mitchell Energy had a gas-processing plant and a contract with a Chicago utility to supply a certain amount of gas. Falling production from its conventional fields was threatening that contract. The start of the shale revolution or fracking in 1998 allowed Mitchell to reverse its declining production and start quite a significant rise in gas production. It took off rapidly, and by 2007 the Barnett shale was by far the largest natural gas field in the United States, producing about 10% of US supply, which is equal to about two-thirds of the entire United Kingdom consumption. All of this came from three counties—Tarrant, Denton and Wise—which had a population of just under 3 million people and an area of a little less than 3,000 square miles, giving a population density of about 1,000 people per square mile, which is roughly equal to that in the Netherlands, and certainly well above that in the United Kingdom.

This got noticed, although in 2008 the US was still frantically building natural gas import facilities. Of course, now they are being converted to export facilities. The shale revolution did not get recognised as a game changer until 2009, and since then until I sit here today the average price of natural gas in the United States has been about one-third of what it has been in the United Kingdom and the European Union. That difference in the cost of our

gas—a little less than \$4—and yours—\$10 to \$12—is a \$200-billion-a-year saving to the United States. This equates to about \$1,500 per US family.

It has led to a massive reshoring boom which you have read about as well. To take one example, natural gas is mostly methane, but it produces some natural gas liquids: ethane, propane and butane. Ethane is what we make plastics out of, and there are 50 facilities under construction on the Gulf Coast and \$40 billion of investment to use this ethane as a feedstock. Those are the benefits from shale gas.

Today, 80% of the drilling rigs in the United States are drilling for oil, not gas. The numbers are just as impressive there. In 2005, the US produced 5.5 million barrels of oil a day and we imported about 60% of our liquid fuels. Today, we recently passed 8 million barrels of oil per day, and we are well below 40% in imported oil.

We also realised huge savings from how much cheaper oil is in the United States. A surplus of production pushed down the local price to a little bit more than 10% below the world average. The shale industry, this new industry, which started 10 years ago, contributed \$75 billion in government revenue in 2012.

So what is not to like about this? Number one, a huge change in economic growth always creates disruption. As we sit here right now, imagine what it was like when this awe-inspiring building was built. Certainly there was a lot of dust and activity to construct it, but the world has been changed by it. Modern fracking with long-reach horizontal well bores—I can talk more about that in the questions—uses a little bit less than 1% of the surface land above an oil and gas field, so when you drive in western North Dakota the farm output and the ranch output has not changed whereas a traditional oil field might impact 10% to 20% of the land above. The development has been to shrink the human footprint on the surface.

Over its 65-year history, over 2 million fractures have been executed in the United States. We found not a single case of groundwater contamination from fracking. Fracking has also significantly reduced US CO<sub>2</sub> emissions. In fact, last year United States CO<sub>2</sub> emissions per capita were lower than they had been in any year since I was born.

So what are the biggest risks to shale fracking? They are the same as the biggest risks to conventional oil and gas drilling. One is ensuring that you have nice cement integrity outside the casing, inside the borehole. That is how you seal unwanted migration. For the first 40 years of the US oil and gas industry, no cement was used. In 1903, they started to use cement, and it has continued to get better. The risks are the cement seal and disposal of the produced water that comes from underground. Whether you are producing oil, gas or natural gas liquids, you always produce some water. That water is nasty, and you want to dispose of it. It should be injected deep underground. The regulations on cement and well construction have gotten more rigorous in the United States, and I support that, and we have moved to almost all produced water being reinjected, and I support that as well. Shale gas has been a big deal in our country, and I think it can be in the UK as well, and I am thrilled to be here.

**Q225 Lord Lawson of Blaby:** It is very good to have you here. You obviously have an intimate knowledge of the United States experience and I think you know a little bit about the United Kingdom because you come here from time to time. We have had a survey, which demonstrates that in the north of England alone, which is the only part that has been surveyed, we have a huge amount of potential shale resources. The important question is what percentage of those resources which the survey has found do you think are economically recoverable? That is a major question which affects our judgment on how

important it is in the United Kingdom. Based on your great experience in the United States and your knowledge of the United Kingdom which, although less, is far from negligible, what is your best guess about the percentage that is recoverable from the resources that we have?

**Chris Wright:** That is a hard question to answer because the devil is always in the details of gas recovery. It is different in different rocks. Most importantly, it has been different with time. When shale gas started, the hope was to get 2% to 5% out. Now in gas, there are places where shale gas recovery is 40%. No one thought that we would get to 10%. In areas with the best rock and the best fracture treatments, we have gotten 40%. With oil, you get lower amounts.

**Lord Lawson of Blaby:** I was thinking particularly of gas, which is obviously what the focus in the United Kingdom is on at present.

**Chris Wright:** To date, we do not have the production data that are key to reliably answering that, but the core data, the geological data, we have of the Bowland shale look very promising. It certainly looks to be a far superior shale with far more gas in place than the Barnett shale, which I discussed, under Fort Worth, Texas. My personal guess is that the recoverable gas will be immense, and as that production gets going, you will find other shales. The estimates of recoverable gas in the UK will continue to grow, if there is development.

**Lord Lawson of Blaby:** In this range which you have described between 2% and 5% on one hand and 40% or maybe more on the other, whereabouts within that range, because it is quite a big range, would you guess—I realise you do not know—is the position in the United Kingdom?

**Chris Wright:** My guess would be 10% to 20%, but it could be much higher.

**Lord Lawson of Blaby:** One other thing about the United Kingdom, before we move on, is that it has been represented to us that we cannot replicate the United States experience because the United States is geographically a very big country, whereas we are a small country with a very high population density, and that will make it impossible for us to replicate anything like the American experience. Do you see that as a problem?

**Chris Wright:** I do not. I have driven across northern England, where the Bowland shale is, and it is rolling countryside. It looks like North Dakota after it has rained. As I said, the Barnett shale, where the shale gas revolution began, was under the northern suburbs of the city of Fort Worth, so there was a high population density for the United States. My company has worked on hydraulic fracture treatments in Beverly Hills, Los Angeles. Is there going to be drilling in downtown London? It is highly unlikely, although there is in downtown LA, but most of the British countryside looks to me to be quite favourable for shale gas development.

**Q226 Lord Shipley:** Can I pursue the question of what is recoverable and what the advantages could be to us? Sir David King told the Committee last week that for shale to have an impact in the UK similar to that in the US, we would have to drill between 1,000 and 2,000 wells a year. Do you recognise those figures? Does that sound to you to be about right given your North Dakota experience?

**Chris Wright:** In the US, we talk mostly in terms of drilling rigs: how many rigs are running. They run continuously and drill wells. In shale gas, a round number is that a drilling rig might drill 20 wells in a year. In the United States right now, we have 350 rigs drilling for

natural gas, so 7,000 wells a year are drilled in the United States. Our natural gas production is growing. We matched Russia two years ago, so I can say that 7,000 wells has changed world gas markets. The British market is an eighth the size of the United States market, maybe a tenth with our growth in gas exports to Mexico. So 700 wells, or 35 drilling rigs, would probably supply UK gas if it was parallel to the United States.

**Lord Shipley:** Okay. Can you say something about rates of decline? One of the factors that we would have to consider is what rates of decline there would be. Are rates of decline high in the US?

**Chris Wright:** As you go to lower permeability rocks—which is what the shale revolution is, we are going to lower and lower permeability rocks—you create fractures with more contact area so that you can get an economic amount of gas out. Yes, the rate of production decline from the first month to the 13th month is quite steep. I do not view this as a negative at all because when you make a plan about drilling a well, one of the things you estimate early on in your plan is how much gas you are going to get out of that well. A shale well in Pennsylvania might produce 10 billion cubic feet of gas. Would you rather get it out quickly or slowly? I am actually in favour of getting as much of it out up front as possible.

**Lord Shipley:** Right. I just want to understand your numbers clearly. I think you said that in the UK we would probably have 35 rigs a year. Did that include an estimate of the rate of decline? In other words, that would be 35 a year each year, but that would include what we would lose through the rate of decline.

**Chris Wright:** Correct. I just drew that parallel from the United States. We have 350 natural gas rigs drilling in the United States. Almost half of our entire gas production is from shale, so all those wells have a high rate of decline, and with 350 rigs drilling in the United States right now our gas production is increasing—it is growing—not declining. Each well's production declines with time, as with any resource extraction. To have stable or growing production, you have to run drilling rigs continuously. That has been a fact in the industry from the start.

**Lord Shipley:** So finally, on the basis of driving across Lancashire, you think that there would be no noticeable impact on the countryside as a consequence of the number of rigs and wells that you think we would have to sink? You do not think there would be a noticeable problem.

**Chris Wright:** There definitely would be a noticeable impact. Drilling rigs are 200 feet tall, so they will be viewed. There will be a lot of cars and trucks with people going to work. Each drill pad is maybe five or 10 acres, so there will definitely be a visible impact, no doubt about it, but the bang for the buck in land usage is about as good as we have in the US right now. There is definitely an impact, of course.

**Lord Skidelsky:** You do not think the visual impact will be rather like that of an army advancing across open countryside? As each generation of wells is exhausted, you build more outwards.

**Chris Wright:** Probably everyone in the room has travelled in the United States, and has anyone seen a drilling rig in the United States?

**Lord Skidelsky:** I have not, but others have, probably.

**Chris Wright:** In the normal course of business in the US, you have to be lucky to see a drilling rig. They are there if you live in natural gas field. If you live in western North

Dakota, you have seen them for sure. In the areas where there is development, it is definitely visible, but does it wildly change the landscape? It is certainly nothing compared to when I drive around England and see windmills everywhere. I do not see drilling rigs everywhere when I drive across the United States.

**Lord Skidelsky:** I was just referring to the fact that there will be a widening area.

**Chris Wright:** The rig moves on. For about a month or 20 days it drills, then it leaves, some fracturing equipment comes on, then that leaves and then there is a well head. It is about 15 feet tall, and with a shrub, you will not see it. After the well is drilled, you will not see it any more, so the only things you see are wells being drilled. You do not see wells that are producing. As you drill more and more wells in the country, the only thing you see are wells that are actually being drilled, not the wells that are already drilled.

**Q227 Lord Rowe-Beddoe:** Can we talk about the costs? I would appreciate your views on whether you think that developing shale gas in the United Kingdom would be at a higher cost than it was in the United States.

**Chris Wright:** I think that undoubtedly it will be higher cost; there is no question about it. In the US, we have a large service industry, there are lots of trained people and the regulations and the ability to move quickly are there, so it is quite efficient. It is cheaper to drill a well in the US than in about any other country in the world. If you drill in other countries, costs are escalated by a number of different things. Well costs here would probably be about 2x what it would cost in the US, but with gas prices that are 3x, the prospects for it being economic are quite strong. If it grew, and you supplied all of British domestic gas from these 35 or so drilling rigs, your costs would come down. The efficiencies would be there, and the process would be in place. Initial wells will definitely be expensive.

**Lord Rowe-Beddoe:** Do you expect the costs in the industry in the United States to keep reducing?

**Chris Wright:** The cost per barrel produced or per increment of gas produced is dropping pretty rapidly right now. I expect it will continue to decline gradually, at least for the next 10 years or so. Ultimately, you will drill out the best spots and will go to the less attractive spots. All the different US shale plates have different costs of production, so a lot of them are going quiescent right now because the Marcellus in Pennsylvania and the Utica in Ohio have cheaper production costs than the others.

**Lord Rowe-Beddoe:** Thank you. What is your view on whether the advance in technology is contributing to lower costs?

**Chris Wright:** Hugely. For 25 years that is what I have done: I have worked on fracturing technology. I have also run two production companies: a natural gas production company and an oil production company. Our cost of production per barrel is far lower today than it was four or five years ago. It is the same for the shale gas players as well. There is plenty of room to run in the technology there. It will continue to get better.

**Lord Rowe-Beddoe:** You alluded a moment ago to the ability of the workforce—in other words, getting operatives trained—and then you led on to the supply chain. I realise it is very difficult to compare this with the United States, but how quickly do you think it could happen?

**Chris Wright:** I would say quickly. In my time in northern England there was definitely quite a workforce there with the skills required for oil and gas drilling. Really it is mechanical savvy. People who are auto mechanics, who have worked on the construction of a house

or who have those technical skills are quite prevalent in the UK. I think it would happen quite quickly. My personal view is that in the UK the efficiency of permitting and the ability to deploy capital will determine the speed at which it happens. People in service industries follow economic activity, and it happens quickly.

**Lord Rowe-Beddoe:** Other than people, what are the big components of the supply chain?

**Chris Wright:** Drilling rigs, which are abundant. There is a surplus of them in the United States. I am sure that our rig companies would love to ship some out of our country.

**Lord Rowe-Beddoe:** I hope they are modern enough.

**Chris Wright:** That is a great point that you raise. The old rigs are being retired in the US. Modern rigs are much more expensive, but they are so much faster that their efficiency is just displacing the old rigs. Seven to 10 years ago we had five times as many rigs drilling for US gas, and our gas production was declining and gas prices were going up. We have far fewer rigs today because they are so much more efficient. It will be better five years from now as well. The rigs, fracturing equipment and some kind of proppant or sand supply would happen quite quickly if the climate was there.

**Q228 Lord May of Oxford:** I have a slightly curiously different question about costs. I think it is worth raising at this point. I do not know whether you are aware of it, but in the UK we have the Climate Change Act. It is primary legislation, and we are committed to reducing the fossil fuel we burn by 80% by 2050. En route to that, our intermediate and agreed—so called legally binding—target for 2030 is based on decarbonising electricity. Now, I for one think that gas replacing coal in the interim is a really good thing, but if you are thinking about the longer term costs of this industry, if we remain serious about these tasks, that has implications for shale gas. A return on investment now is not going to be coming because we are not going to be using gas very much unless we can sequester CO<sub>2</sub>. I wonder whether anybody ever thinks about this.

**Chris Wright:** I think that is a great question. Normally when you drill in the US, if you drill an oil and gas well, you are looking for your return and you are going to get 70% of the gas out in the first five years.

**Lord May of Oxford:** You are certainly not hampered by any regulations about caring about carbon.

**Chris Wright:** We have dropped our CO<sub>2</sub> emissions more than any major nation.

**Lord May of Oxford:** That is in absolute, not relative, terms, but that is a distraction.

**Chris Wright:** They have has dropped 12% in the past five years in the United States. It depends on the timeframe. The bigger issue would be about the infrastructure. A pipeline gathering system and natural gas-burning power plants are longer lived assets. If the life of natural gas was five years, you probably would not draw the capital for pipelines and gathering plants. Drilling wells is a quicker payback business, but there is no question that you have to have a long-term time horizon where you are going. Unquestionably, you could drive a significant drop in CO<sub>2</sub> emissions by building a shale gas industry here, but there would have to be some “When’s everybody going home?” date. If it is 2030, you could probably build an industry here. If it is 2020, you probably could not.

**Lord May of Oxford:** Thank you. Good answer.

**Q229 Lord Griffiths of Fforestfach:** In your introductory remarks you talked a little about the transformation that has happened in the Bakken shale field in North Dakota. Can you expand on how it transformed the local communities?

**Chris Wright:** In rural states in the United States, and I am sure in the UK as well, the population has been declining. North Dakota's population peaked in 1930, and it has been on a slow decline since then. Declining populations are tough on communities. In 1900, the percentage of the US population that worked on farms was 40%, and it is about 1% today, so rural communities have had it tough. The oil and gas industry coming into an area such as North Dakota has been an enormous boon. Farmers think of it as additional income now, but it means that their grandchildren can farm. The funniest thing is that people whose land we drill wells on make a lot of money in royalties from our stuff, but they are still farming seven days a week. They have not changed what they do, but now there is certainty that their grandchildren can farm as well. The young generally leave these rural communities and go to the cities for jobs, but now they have jobs there. Now they are coming back.

In fact, there are a lot of temporary workers in North Dakota because there are not enough workers in North Dakota so a lot of people are living there temporarily on location. However, there is no question but that when you grow that rapidly, there are stresses on the roads and the infrastructure. It does have a little bit of a gold rush feel. It is better now than two years ago when it was very hard to get a place to stay. There were not many hotels. Now, many hotels have been built and there are restaurants. The boom is going on, but the stresses have come down a bit. I always say that I not only get Christmas cards but I get Thanksgiving cards from the farmers whose land we drill on in North Dakota. It has been a great partnership between the people there and the industry.

**Lord Griffiths of Fforestfach:** What proportions of the jobs that have been created are permanent and what proportion are temporary? How many are confined to the industry and how many are in the wider economic chain in the area?

**Chris Wright:** That is a great question. The jobs in the industry tend to follow drilling rigs. In the Bakken with the current plan, the number of drilling rigs will be similar to the number we have right now probably for the next 20 or 30 years. As a field gets more mature, there will still be drilling, there will still be fracking, but the number of jobs will probably decline a little. Certainly the vast majority of jobs created are not directly in the oil and gas industry. They are in all the support functions. I mentioned that North Dakota has the lowest unemployment in the United States. The state with the second lowest unemployment is South Dakota and Minnesota has one of the lowest unemployment rates in the United States. The economies of the states that border North Dakota have been lifted up quite a bit as well. Every year \$30 billion is invested in North Dakota. It is a massive economic stimulus. In the shale industry as a whole about \$150 billion is invested in the US.

**Lord Griffiths of Fforestfach:** So at least for the next few decades, you see this as economic prosperity for the Dakotas?

**Chris Wright:** Yes, absolutely. The technologies I developed to look at fractures were done in oil fields that began in the 1920s and 1930. Oil fields keep going. There is lots of oil still there. In fact, what probably comes next, and is being tested in North Dakota, is injecting CO<sub>2</sub> into the Bakken oil. If you inject CO<sub>2</sub> into oil, it gets absorbed by the oil and increases its mobility. The primary drilling might go for another 20 or 30 years, and then you will probably have CO<sub>2</sub> or organic gas flooding so the Bakken field will certainly go on for 50 to 100 years, I would say.

**The Chairman:** To what extent was the welcome by the local community and the increasing prosperity due to the fact, as I understand it, that landowners/farmers own the mineral rights under their land and therefore have a continuing revenue for some time to come?

**Chris Wright:** It was a significant part. There is no question that it immediately aligns a partnership between the farmers and the landowners and the companies. The vast majority of people who live in North Dakota now do not own mineral rights, so they benefit from jobs, their property is worth more and all that, but there is no question but that it helps enormously that landowners own those royalty rights, and their money obviously flows out into the community in other ways.

I have gone on record in the UK saying that—and I am not a developer and have no plans to develop in the UK—I would probably offer 2% of gross revenues to the surface owners of the land because they would immediately become my partners and would immediately want it to happen and to be better than it was going to be otherwise. If it is just a surface use fee, or the money goes directly to a government far away, it is a different feel. That can be fixed by businessmen.

**Q230 Baroness Noakes:** Shifting to the impact of the development of shale gas, as it has happened in the US, on other industries—in particular, energy-intensive industries such as petrochemical industry—can you describe the experience in the US?

**Chris Wright:** I mentioned the \$40 billion investment. That is just in ethane, which they make plastic out of. There is massive investment in the US going to that, but the far bigger impact is in methane, the low cost of energy. This has led to the fertiliser industry returning to the United States. This has led to steel manufacturing in the United States. I am a partner in building a plant. We spent \$200 million to build a manufacturing plant in Wrens, a small town in Georgia. The last five or 10 plants like it were built in China. Today, the energy-cost advantage of the US over China more than offsets the labour cost disadvantage in energy-intensive manufacturing. So the mid-Western states—Indiana and Illinois—that do not have oil and gas production are getting an enormous economic benefit from it. I rode on the plane with an executive in a very large South African petrochemical company. He said the future of its business was in the United States. It was diversified around the world, but it was hard to justify investing money anywhere but in the United States.

**Baroness Noakes:** That came about because of the extraordinary fall in the price of gas in the States, so for us to be confident we would get an equivalent impact in the UK, we would have to be able to postulate a similar sort of fall in the price of gas in the UK. Some of the evidence we have had is that because we are effectively taking a European gas price, the gas price will not fall in the same way, so the opportunities for the UK would not be commensurate with those that we have seen in the US. Have you a view on the likely impact in the UK?

**Chris Wright:** I have read that, and I have been quite puzzled to read it. Obviously the United States is connected by pipeline with Canada and Mexico and our gas market is much larger than the European gas market, so if it caused a big decline in the US, I have trouble imagining why it would not do so in Europe. If you increase the supply of a commodity, it will have an impact.

The other thing I should say is that when we compare US prices and European prices—I mentioned a factor of four—it is the nine-match or Henry Hub price, which is the price of gas at one location in Louisiana. The price of gas is quite different throughout the country.



In fact, there are places in the country where gas is less than \$2. You have to move gas and transport gas, so where gas is produced, it is cheap; where gas has to be transported a long way, it is expensive. Even in the US, there is quite a differential in gas prices and oil prices. Where factories and plants are being built in the US, they are choosing where in the US they have advantageous gas prices. Anywhere you produce a commodity in a significant amount, you will have a price impact. There is no doubt about it. If you develop gas in northern England, you will see manufacturing spring up local to that gas.

**Q231 Lord McFall of Alcluith:** It has been suggested that gas exploration in the US is increasingly determined by the price of oil and natural gas liquids. Do you agree?

**Chris Wright:** Yes. Originally, if I go back to when the shale revolution was hitting stream in 2008, when it scaled to magnitude, about 80% of US drilling rigs were drilling for gas. It is much easier to produce gas than oil. The energy equivalent price of gas was not that much below oil, so it was more profitable to drill for gas. Today, the shale revolution has been so successful that, as the technology has got better, we have a vast surplus of gas and we have pushed prices down. So now instead of 20% of the rigs drilling for oil, 80% of our rigs are drilling for oil. Natural gas liquids are part of the 20% that are drilling for gas and NGLs. When the price moved down, people drilled for other things, but it does not take us very many rigs to keep US gas production inclining.

**Lord McFall of Alcluith:** The information we have is that the current gas price in the US is under \$4 per million BTUs. Some experts have indicated to us that they believe the break-even price to cover the cost of a well's lifecycle is \$6 per million BTUs. Are those figures in the ballpark of your thinking?

**Chris Wright:** There is not really one price for break even. If you are drilling in southwestern Pennsylvania, at \$3 you have a greater than 50% rate of return. There are a lot of places where a \$3 gas price is fabulously profitable. There are other shale places where at \$4 you make no money and you need \$6 to drill. There are places that were drilled when gas prices were quite high that take \$7 or \$8 to make money. There is a palette of production price—the price you need to make a reasonable return at. The drilling just goes to the low-cost areas, and as the demand grows, it will eventually migrate to the slightly higher cost areas.

**Lord McFall of Alcluith:** Would you consider investing in UK shale gas production at present—not you personally as you said you were not going to engage in it? Would it make sense for a business person to do that just now?

**Chris Wright:** Not right now. I am in favour of strict regulation, and if you had rigorous but crisp and clear environmental regulations, and you had a way to align the community and move quickly, I would do it in a heartbeat, but that is not there today. Shale gas was discovered years ago, and none has come to the surface yet. If the business climate was here, it would happen.

The other thing I should say on that is that when you think of the oil and gas industry, people think of very big companies: ExxonMobil, Shell, BP. These companies are fabulous at a 15-year plan to spend billions of dollars to build a platform and doing all that and executing it. Shale gas is a totally different game. There were no big oil companies involved at all in the development of shale gas. Shell, for example, entered the US shale gas market, bought into a bunch of plates and is leaving. It is not a game for big companies. Every rock is different; every rock you have to innovate: “This did not work, we’ve got to target the well in a different place” or “We need a different frack recipe”. With unknown stress state, you

have to be able to move quickly to figure out the formula—the right way to make it work—and then you have to continue to innovate as you move away from that original place.

**Lord McFall of Alcluith:** It is very interesting that you mentioned the issue of environmental regulation. Perhaps we can get something more from you later on on that. You also mentioned squaring local communities, and we have had representations from a number of communities opposed to fracking. Indeed, today the all the MPs, from all parties, from the county of Lancashire and five council leaders have written a letter to the Prime Minister saying that a 10% share of profits from shale gas sites would be required if community support was to be forthcoming. Is that a realistic figure, or would that knock fracking exploration out of the ballpark?

**Chris Wright:** It is hard for me to speak too much on those details.

**Lord McFall of Alcluith:** I want you to focus on 10%.

**Chris Wright:** It depends what other taxes and levies are there. In the United States, for example, in a typical lease when I drill in North Dakota somewhere between 15% and 20% of the revenues that come from that well go to the mineral owners, and then the state takes about another 10% in sort of severance tax, and that works, but it works because we have aligned owners and things move quick. A large amount of the revenues from oil and gas drilling do go elsewhere. Obviously, there is a limit where it does not work, but it is hard to answer. If that 10% were the total royalty paid, and it got everybody on the side of the activity, that would probably work fine, but I do not know what the British tax system is. I should plead my ignorance of business law here. I will say something stupid or stupider than what I have already said.

**The Chairman:** I think we understand your reservations on that.

**Q232 Lord Skidelsky:** When do you expect the US to commence exports of LNG?

**Chris Wright:** Four plants have been permitted—ironically, the first one that will start exporting in about two years from now, at the very beginning in 2016, was permitted and built to import LNG into the United States. They say at the end of 2015; I think realistically early in 2016 we will export gas LNG. Right now we export it to Mexico, and there is a project under way to double the capacity of that pipeline, so Mexican exports are growing rapidly. LNG will go out in two years.

**Lord Skidelsky:** Do you think it will take a bit longer to become a net exporter or do you think that will be about the time?

**Chris Wright:** That is probably 2017. Canadian imports are declining quite a bit right now. We will probably become a net exporter in two to three years from now.

**Lord Skidelsky:** How do you think exports of LNG will affect gas prices in Europe, and in the United States as well when it becomes a net exporter?

**Chris Wright:** Great question. If there is more LNG exported, it will put some downward pressure on LNG. The problem of LNG is that if gas leaves the US at \$4—the price today is about \$4—it is about \$5 to \$6 to compress it, ship it, regassify it and bring it back on, so I do not think you can have a marginal price of gas anywhere below \$10 with LNG as your marginal supply. I do not think you would get cheap gas prices in Britain no matter how much LNG you import. In the US, if we export gas, as we will, it is a marginal increase in demand and it will create a marginal bumping up in the price, but with the plans for exporting LNG and the reshoring of manufacturing, on the futures curve, you could today

buy gas for 2020 delivery in the US at \$5. Oil in the US is the opposite. If you buy oil five years from now, it is 15% to 20% cheaper than it is to buy it today. There will be a small upward pressure in gas prices from it, but it is very hard to imagine a scenario of gas prices getting to \$6 again.

**Lord Skidelsky:** Can you imagine production of UK shale gas having an impact on the price of gas in the United Kingdom, or will it be on too small a scale to affect our domestic gas prices?

**Chris Wright:** As I say, the devil is in the details. If you had a clear regime of what it took and how you developed drilling, and if you were equivalent to the US and ran 35 drilling rigs in England and you produced the entire UK production from British gas wells, there is no question about it: you would have significant drop in British gas prices, probably a dramatic drop.

**Lord Lawson of Blaby:** Following on from that, it seems to me that the issue in the cost of producing shale gas in the United Kingdom is not so much proper regulation—because I am sure we would have that in place, and it is not difficult—but delays. Time is money. Time is a cost. Is it not most important? If you are giving advice based on your own great experience, would your advice be not to cut corners on the regulation but to cut out unnecessary delays?

**Chris Wright:** I agree wholeheartedly. Of course, time is a huge amount of money and risk of money, but it is more than that. To make it work with British rocks, you have a different stress regime and different microfracturing in the rocks. We do not understand these yet. To make it work will require innovation. The first well will produce some gas and will have some shortcomings and some problems and “We should have done this”. Then there will be the second well, and there will be a learning curve. If it takes a year to permit each one of those wells, no one will be around for the learning curve, and it will not happen. I could not agree more, Lord Lawson. That is the key thing. If you have some certainty and can move quickly, it will happen in the UK. If it is slow and cumbersome, I do not know whether it will happen.

**Q233 Lord May of Oxford:** What other countries do you think are likely to become significant producers of shale gas and when do you think significant production from such countries is likely show up?

**Chris Wright:** Your first question is easier than your second one. I have some notes on that; if I cannot find them, I shall just wing it. Right now, Canada is a major player in shale gas. It is the second player. Its resources and reserves are vastly greater than its current production, and its problem is just market. Canada already has enough gas and exports some to the US, so there will be projects in Canada to build pipelines to export LNG. Huge investments are being made in that. When that happens, Canada will become a massive shale gas producer, together with the US. China is certainly going at it hard. There is not great success yet. It has not been very successful in getting more entrepreneurial smaller companies to go at it yet. That might change. Argentina and Russia have tremendous quality shale rocks. They could both be world-class producers quickly, and they will grow pretty quickly in spite of the political situation there. The rocks are tremendous. Then there are a number of other places with potential. Certainly Tunisia, Algeria, Turkey, Columbia, the United Kingdom and several others have what look to be very promising rocks, but efforts have not launched yet. Where those efforts take hold, I think they will be dominantly driven on the efficiency of the regulatory regime, and how efficiently you can drill.

**Lord May of Oxford:** Taking the liberty of indulging my curiosity, what about Australia, my country?

**Chris Wright:** It was on my list, and I forgot to mention it.

**Lord May of Oxford:** It has the advantage of being a really empty place.

**Chris Wright:** I am not sure that is as critical as some say, but Australia has what look like quite promising rocks. It has a favourable business climate. I think a lot will happen there in the next few years. I get called about Australia all the time.

**Lord May of Oxford:** Coming quickly back to the UK, international companies such as Shell have been involved in shale exploration in the US and other parts of the world. Why do you think it is that so few of the bigger companies have been involved in UK?

**Chris Wright:** In the UK? Well, for the same reason that they are not really involved in the US. It is not a big company game. It is not a thing you can plan 10 years in advance. It is a thing where you look at the geology, you pick what you think is the best place, you drill a few wells, you find out that you were wrong, then you find out which way you think you were wrong, and then you try something different. They did not play any part at the start of it. They have come in, but Shell is exiting unconventional drilling in the US right now. Exxon came into it by buying another company but, at least in North Dakota, it is one of the lowest quality producers we have. It has been driven by private, faster moving or public but smaller entrepreneurial, fast-moving companies.

**Lord May of Oxford:** Your website says that you are searching for additional investment opportunities worldwide. I think you touched on this earlier, but could you recapitulate what are the factors you would consider before investing outside the US in general and in the UK in particular?

**Chris Wright:** The certainty to move quickly, to be able to innovate and do things different, to learn from our mistakes and to act on them in a timely fashion. I do not think I have ever been to our website, so you are one up on me.

**Lord May of Oxford:** To be truthful, I have not either, but it is in the briefing.

**Chris Wright:** In North Dakota, for example, little Liberty, my company, is the number one average-well-quality producer in the state. It is because we do things different than the other people and we are constantly trying to innovate and find a better formula. A month ago, I was in Turkey. I met the Turkish Energy Minister on an outreach from Turkey, not of my own. There is a desire there. There was a pitch about what their oil and gas laws are like and the simplicity of doing business there.

My son's middle name is Winston. My actual heroes, almost to a man, are British - from Adam Smith to Isaac Newton to James Clerk Maxwell. I have a tremendous cultural and emotional passion and attachment to the UK, so I have been coming here for a little bit, but right now, in the little bit of outside data I am seeing of not much happening, it is not a climate that someone with my personality who wants to make things happen would survive in. I am here because I care about that.

**The Chairman:** I am terribly sorry. We have a vote. I hope you can stay for a little longer, because we all have to go away for about 10 minutes to vote. We will be back as quickly as possible. Is that all right for you?

**Chris Wright:** Fantastic. Absolutely. If it is shale gas, vote yes.

**The Chairman:** It is nothing to do with it, I am afraid.

*Sitting suspended for a Division in the House.*

**Q234 The Chairman:** I think we will just begin. We have two Members still to come, but in the interests of time—you have been very generous, Mr Wright, with your time, but we are under a bit of time pressure now—we could try to deal with the end of your evidence in the next 10 minutes of so.

**Lord Rowe-Beattie:** I have been reflecting on what you have been saying. Do you think that it might help in the general perception of matters if the word “unconventional” as an adjective was changed?

**Chris Wright:** That is a great question. I have not viewed it as a negative, but I am not PR savvy.

**Lord Rowe-Beattie:** Obviously, it has a certain ring as an adjective.

**Chris Wright:** As you probably know, instead of producing the oil and gas that has already leaked out of a shale, we are going to the source rock itself. Maybe you can help us with a sexier name.

**Q235 Lord Hollick:** I wonder whether you can address one of the principal uncertainties in the UK at the moment, which is the local communities’ concern and anxiety about fracking. That stands in the way of the process of getting licences and planning consents and obviously leads to significant delays. That is what is happening at the moment. You mentioned the Forth Worth area where the population density was very significant. Clearly, not all those people benefited from the mineral rights; most of them did not. How were you and companies like yours able to convince local people right at the start of this, before it became clear that it can have a beneficial impact on the local economy? How did you change people’s minds?

**Chris Wright:** I would say that the industry as a whole has failed in a significant amount in that. Certainly, in the main areas, I would say the majority of people are quite in support of it. There are areas that are different where it is more challenging, and I constantly chastise myself and our industry that we have not done a very good job of reaching out, explaining what we are doing and answering everyone’s questions. We bring frack trucks out to towns and let people come in and ask questions. I think a lot more of that needs to happen. The oil industry is coming into new areas in our country. That is where the problems are. In areas where the oil and gas industry was there before, that kind of trust or understanding of what was going on has long been there.

As this technology has developed, using less chemicals, more water and deeper monitoring technologies so that safety of fracturing has gotten so much better, the industry was definitely not prepared for organised groups really against hydrocarbon development, not really against hydraulic fracturing. But they have been effective in the UK, and in certain parts of the United States as well, in making people believe it is scary, explosive, dangerous, hurts water and a bunch of things that are simply not true, but shame on us for not communicating more convincingly and openly to people what we do and what the real risks are and are not.

**Lord Hollick:** Have local politicians taken a lead in explaining to people and advocating why fracking would be of great benefit to the community?

**Chris Wright:** In many cases, yes, absolutely.

**Lord Hollick:** Has the reverse been true?

**Chris Wright:** Absolutely.

**Lord Smith of Clifton:** I think I know your answer to this but do you believe that shale gas development in the UK requires a special tax regime to incentivise operators? Recently, as you know, the Government have indicated that there will be greater rewards for communities if they go along with it.

**Chris Wright:** I am not knowledgeable enough to answer that question. The key thing is obviously that you have to have a reasonable fiscal regime, but I do not know enough about the British tax system to even comment on it. Major to me, and very key to this development, is getting communities on your side. That needs to happen here as well, and I have ideas about it, but I am not in the trenches here.

**Q236 Baroness Blackstone:** Do you think that the environmental risks associated with shale gas and oil have been well managed in the US?

**Chris Wright:** On balance, yes. Were there mistakes? Could things have been better? Absolutely, and some of those stick in my craw because if somebody cuts a corner and does something wrong, it reflects poorly on our whole industry and the community. On balance, for the level of activity, the massive economic uplift and all that, I would say the environmental record is pretty impressive.

I like that in the US it is regulated by the states, so different states try different regimes, and different states adopt other states' regimes. There is a little bit of a feedback mechanism on what is the right way to do that.

**Baroness Blackstone:** Could you point to those states that have been particularly effective? You talked about "on balance" it has been well done. Could you give us one or two instances where it has not been well done where there are lessons for us to learn?

**Chris Wright:** I live in Colorado, although I am not an operator in Colorado, but there has been a lot of concern, very understandably, from people saying, "What's in those chemicals? We don't even know what's in 'em". The industry has foolishly not wanted to say because it is their competition against the other guys. I think it is foolish, and Colorado passed a law that all chemicals that are pumped underground have to be disclosed. They are on a website called FracFocus. I am very much in favour of that. The public has every right to know what we are doing, why it works and how it works. I think Colorado has done well on the regulating environment.

Pennsylvania is really where the frack opposition started. The US industry started in Pennsylvania 150 years ago, but it left 100 years ago, so it is basically a new area. It had huge challenges. On balance, I think it has done a nice job, but there were some mistakes early on. One in particular you read about. When you produce gas, or oil, you always flow some water as well. This water comes from deep underground. It has got very brackish, it can have heavy metals, and it can have NORM. It has things in it that you do not want in your drinking water. Some of this flowback water went to a local sewage treatment plant which was just not equipped to handle it. There were discharges downstream with things that never should have been in the stream. It should never have happened, but it happened. It would never happen in Pennsylvania today. The best thing to do with this water is just to inject it back down where it came from.

**Baroness Blackstone:** Does greater transparency about the whole process help to convince communities or does it sometimes hinder it?

**Chris Wright:** I am not aware of it ever hindering it. People in general are afraid of the unknown—I am too—so transparency in saying what we are doing and how we are doing it has, in my experience, been very helpful. There is always a little bit of NIMBYism in it as well: “I really want your oil and gas, but can’t you drill next to my neighbour and not me?”. That gets harder to address without some kind of aligned economic incentives or some kind of compensation.

**Q237 The Chairman:** Mr Wright, thank you again for your paper and for all your evidence to us today. As I said before, you have been very generous with your time. Your answers have been direct and very much to the point from our point of view and, of course, were based on your practical experience and your wisdom from all the developments that you have helped to bring about in the United States. It has been enormously helpful to us. Thank you very much.

**Chris Wright:** Thank you so much. The questions were fantastic. The fact that you have a committee on this is fantastic, and I am honoured to be here.

**The Chairman:** If you would like to stay and listen from the public seats behind you to our next witness from the European Commission, you are very welcome to do so. Thank you again.

**Chris Wright:** I will do just that.