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THE ECONOMIC IMPACT ON UK ENERGY POLICY OF SHALE GAS AND OIL

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Witnesses: Professor Richard Davies and Mr Howard Rogers

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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

Examination of 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, 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 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 has some area 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 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 LMG 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 energy 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 LMG into the market. What will be interesting for Europe is that the excess LMG 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 LMG exports to impact not just the European market but the Asian energy 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 energy 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 arbitraged away on the European traded hubs, and it would impact LMG 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 is 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_2 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.