



# postnote

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## THE FUTURE OF UK GAS SUPPLIES

**The UK's gas reserves are declining. Government and industry analysts estimate that by around 2006 the UK will no longer be self-sufficient in gas production and will revert to being a net gas importer. Gas is the largest proportion of the UK's primary energy supply, and gas-fired power plants are the main method of power generation. The UK will increasingly depend on gas imported from Europe and further afield. This POSTnote examines the UK's options for dealing with a diminishing domestic gas supply and for ensuring future gas security.**

### Background

The UK relies on gas to provide energy for heating and electricity more than any other primary energy source.<sup>1</sup> 39% of the UK's primary energy comes from gas, compared with 35% from oil, 15% from coal, 9% from nuclear and 2% from other sources. Gas-fired power plants are also the main method of power generation, generating 38% of the UK's electricity requirement.<sup>2</sup>

Although the UK is self-sufficient in gas supply and a net gas exporter, this situation is set to change soon, as UK gas production declines with the UK expected to become a net gas importer on an annual basis by 2006.<sup>3</sup> Gas is already imported from Europe to meet high winter demand. By 2010, it is estimated that the UK will be 50% dependent on imported gas, rising to 80% by 2020<sup>4</sup> (see figure). The shift from domestic gas surplus to import dependency may leave the UK more vulnerable to supply interruptions and gas price fluctuations (box 2).

### Government policy

The Government recognises that the decline of the UK's indigenous gas supplies is a major challenge. Concern has been expressed in Parliament about any impact from the decline of indigenous gas reserves and the shift

from self-sufficiency to import dependency on the security of UK energy supplies.<sup>5</sup> This is because gas is also integral to the UK's electricity generation industry, so that security of gas supply cannot be decoupled from security of electricity supply. Gas is expected to continue to play a large role in future electricity generation especially as nuclear facilities reach the end of their operational lives and carbon emission reductions force the modernisation or closure of older coal-fired power plants. The 2003 Energy White Paper does not set specific targets for the share of gas in the total energy mix. Instead the Government prefers to create a market framework which encourages investment in a diversity of energy sources. However, estimates suggest that the minimum share of gas in electricity generation will rise to 46% by 2012 and some analysts suggest this figure could be as high as over 60%.

Both government and industry argue that to ensure security of gas supply, a diversity of supply sources and entry points into the UK is essential. Some projects are planned to increase the UK's gas import and storage capacity, and long-term import agreements have been established with companies based or operating in several key gas producing countries including the Netherlands, Norway, Malaysia and Qatar.

### Current status of UK gas supplies

The UK's total 'proven' (see Box 1) gas reserves currently amount to between 590<sup>6</sup> and 630<sup>7</sup> billion cubic metres (bcm), ranking it 32nd in terms of global gas reserves. The range reflects the uncertainty in estimating the precise amount of oil or gas which can be extracted from an underground reservoir. The UK is currently the world's fourth largest producer of natural gas, producing around 100bcm a year. However this high level of production cannot be sustained and a decline in the rate

of production from the UK Continental Shelf (UKCS) is already occurring. UK gas production peaked in 2000 at 108bcm and has since declined by ~1% every year. Current production rates can be maintained for approximately 4 more years, but from about 2008 a rapid decline in production is forecast (see figure).<sup>8</sup> UK gas consumption is 95bcm a year, but this demand is generally expected to rise by around 1% a year.

### Gas import and storage infrastructure

#### Pipelines

There are currently two gas import pipelines into the UK:

- UK-Belgium interconnector between Bacton in Norfolk and Zeebrugge in Belgium which connects the UK to the mainland Europe gas network. This pipeline has an import capacity of 8.5bcm a year.
- UK-Norway 'Vesterled' pipeline link which connects St Fergus in Scotland to both the Frigg gasfield, a jointly operated offshore gasfield straddling UK and Norwegian waters, and to facilities on Norway's Heimdal field. This has a capacity of 11bcm a year.

#### Storage

The UK currently has a total gas storage capacity of 3.3bcm, equivalent to 14 days' supply at average winter gas demand rates. Gas is mainly stored underground since larger volumes (several bcm) can be stored in natural reservoirs or cavities than in above ground tanks. The UK's largest gas storage reservoir is the Rough field, a partially depleted gas field in the southern North Sea, operated by Centrica.<sup>9</sup> It provides over 80% of total UK gas storage capacity at 2.8bcm. Additional gas storage facilities are located in nine man-made underground salt cavities at Hornsea in Yorkshire.

#### Box 1. How gas reserves are defined<sup>10</sup>

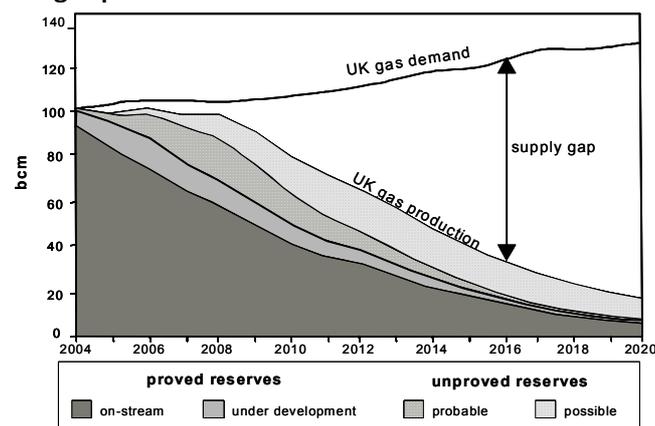
Estimating the amount of gas (and oil) underground is inherently uncertain because it is not possible to measure the exact volume of hydrocarbons in a reservoir situated thousands of metres below the surface. The amount of oil or gas can be approximated by the volume of the reservoir, but only a proportion of the total amount can be recovered. This proportion is determined by the properties of the reservoir including its size; rock porosity (how many pore spaces are between rock grains); rock permeability (how well the pores are connected); reservoir pressure; the type of hydrocarbon (oil or gas); and the development plan (how many wells will be drilled). If these factors are favourable, gas will flow into the well and up to the surface. Variability in these properties makes estimating the total amount of recoverable hydrocarbon in a reservoir difficult. On average, around 85% of gas in the North Sea gasfields can be recovered.

#### Uncertainties in calculating reserve volumes

The uncertainty in calculating reserve volumes is conveyed by classifying hydrocarbons as either 'proved' or 'unproved', depending on the likelihood of recovery.

- Proved reserves are the oil or gas in place (in the reservoir) that is recoverable under today's economic and technological conditions i.e. having a >90% chance of being produced.
- Unproved reserves are less certain to be recovered than proved reserves and may be sub-classified as probable (a >50% chance of being producible) and possible (<50% chance) reserves to denote increasing uncertainty in their recoverability.

### UK gas production and demand to 2020



Source: Modified from WoodMackenzie 2004, 'From surplus to shortage'

### Prolonging UK gas self-sufficiency

Although the UK will become increasingly dependent on imported gas supply, UKCS gas production will continue to contribute to domestic demand. It is estimated that just over half of the UK's gas reserves have so far been produced, so significant volumes of indigenous gas still remain to be fully exploited. However, demand for gas is now far higher than when the first half of North Sea gas reserves were produced, so depletion will be more rapid. Even additional gas discoveries will not be sufficient to stem UKCS production decline. Even in the most optimistic scenario, where all 'proved' and the less certain 'unproved' reserves are produced (see box 1), indigenous gas reserves will be unable to meet projected UK gas demand (see figure).

### Initiatives to invest in the UKCS

The UKCS is a mature oil and gas province; i.e. the area has been extensively explored and many of the major hydrocarbon accumulations have already been discovered. But there are still many unexploited gas accumulations on the UKCS. To ensure that these gas (and also oil) reserves will be produced economically in the future, a joint industry and Government partnership called 'PILOT' was established in 1998. Under this partnership incentive schemes such as 'Promote UKCS' (2000) and the 'Fallow Field Initiative' (2002) have been launched to stimulate exploration and development on the UKCS.<sup>11</sup> These schemes have attracted many new companies into the UKCS with the expertise to commercialise undeveloped oil and gas accumulations.

### Concerns about reliance on imported gas

Reliance on imported gas is not a new situation for the UK. During the 1960s and 70s Algerian liquefied natural gas (LNG) was imported into the UK at Canvey Island on the Thames, and in the 1980s gas from Norway, imported via the Frigg pipeline, met up to 25% of UK gas demand. Since 1998, the UK has also imported gas from Europe during high winter demand periods via the Bacton-Zeebrugge interconnector.<sup>12</sup> Imports obviously increase diversity in supply sources compared with self-sufficiency alone. However, the extent of previous import dependence was not on the scale now anticipated, estimated to be up to 80% by

2020. In the past, increased domestic demand for gas has been met by increased production from UKCS gas fields. Now, with UKCS production in decline, the ability to meet seasonal demand swing from indigenous production is decreasing.

### Meeting peak winter gas demand

National Grid Transco is statutorily required to have sufficient gas transport capacity to meet peak winter gas demand. This is defined in terms of a '1 in 20 winter day'; that is, the exceptional demand on a winter day which statistically occurs once in 20 years. However, a recent report by the House of Lords EU Select Committee on security of gas supply casts doubts on the UK's ability to meet short term demand peaks over the next two years before increased import and storage capacity becomes available.<sup>13</sup> Although new gas import projects are scheduled to commence from 2006/2007, there is a critical period before these new import schemes come on stream, where the gas supply/demand balance required to meet peak UK winter demand will be tight.

### EU gas market liberalisation

The UK Government believes that security of gas supply is achieved by having a fully liberalised market for gas. This view is also supported by the European Commission and in June 2003 a new EU Gas Directive was adopted by the member states. The objective is to establish an integrated, liberalised European gas market by 2007 with common rules on storage, transmission, supply and distribution of natural gas, to guarantee security of gas supplies. There is debate about whether a liberalised market will enhance or diminish security of supply. Demand for gas from Europe is expected to double during the next 15 years, and prices may rise as competition for gas intensifies (see box 2). As a safeguard, the Directive proposes minimum measures to guarantee gas supplies and to ensure co-operation between member states in the event of supply problems.

#### Box 2. Gas prices

Since liberalisation of the UK gas market in the 1990s the UK has enjoyed some of the cheapest gas prices in Europe. In August & September 2004, three of the UK's largest energy suppliers, British Gas, EDF and Npower, announced electricity and gas price rises of up to 12%. The reason cited for this is a 40% increase in the wholesale price of gas, caused by the decline in UK gas supplies and increasing reliance on imported gas.

### Ensuring security of future gas supplies

Security of supply encompasses both the availability and the reliability of gas supplies and is a measure of the degree to which an uninterrupted supply of gas can be maintained. Several projects are currently under way to expand and diversify the UK's gas supplies (see table). By winter 2007/08, these new facilities could potentially increase the UK's annual gas import capacity to between 52 and 119bcm, and will be sufficient to meet the supply gap resulting from the decline in UK gas production.

### Increasing pipeline import routes

In addition to the two existing import routes into the UK, two new pipelines are planned. The largest is the 1,200km Langeled pipeline linking the Ormen Lange gasfield in the Norwegian Sea to a UK import terminal at Easington in Yorkshire. This is designed to deliver up to 25bcm a year, representing 20% of annual UK gas demand, with first gas expected to flow from 2007/08. There is also a proposal to construct a pipeline from the Netherlands (Balgzand) to Bacton, importing upwards of 10bcm a year from 2006/2007. New compression facilities are also being installed on the existing UK-Belgium interconnector at Zeebrugge which will increase its import capacity from 8.5 to 16.5bcm a year as from 2006. Future proposals also include Danish and Russian gas pipeline routes, although the construction of these is less certain. Increasing the number of pipeline entry points will reduce the UK's vulnerability to reliance on just two import routes.

### Increasing gas storage capacity

Gas storage facilities can act as a buffer against surges in demand or disruption of supply. The UK's gas market is based on a 'just-in-time' delivery system relying on flexible supplies, or 'swing capacity', from indigenous gas fields to meet demand peaks. In essence, the UKCS gas fields are the strategic storage for the UK. This ready availability of indigenous gas supplies has meant that it was not necessary to develop large underground strategic storage capacity to maintain a secure gas supply. The UK's existing gas storage facilities are thus not designed to provide long-term strategic storage in the event of prolonged gas disruption. Instead, they are intended as 'peak-shaving' (top-up) facilities which supplement the normal amount of gas delivered to customers during peak-use periods. This contrasts with many European countries whose gas markets developed with import dependency and which have large strategic storage capacities, of up to 80 days' on average compared to 13 days for the UK. New UK 'peak-shaving' gas storage has recently been approved at Humbly Grove in Hampshire and Aldbrough in Yorkshire which will increase total UK gas storage capacity from 3.3bcm to ~4bcm.

### New Liquefied Natural Gas (LNG) facilities

LNG is natural gas which is liquefied by refrigeration to a temperature of -160°C. In its liquid state natural gas occupies around 1/600th of its gaseous volume, making it easier and more economic to transport over large distances by sea and store in larger quantities than in its gaseous state. LNG also improves security of supply as it is not necessary to be connected to an import pipeline. As noted earlier, the UK imported LNG from Algeria during the 60s and 70s but this contract expired as North Sea gas production increased and there are currently no operational UK LNG import facilities.

However, three new LNG terminals are now under development. National Grid Transco is building one at the Isle of Grain on the Thames estuary, with the first gas expected in 2005. This terminal will initially handle 5bcm a year, rising to a total capacity of 15bcm annually. Planning permission has been granted to two

consortia to build two LNG terminals at Milford Haven in Wales; Petroplus/BG (Dragon terminal), and ExxonMobil/Qatar Petroleum (South Hook terminal). Their combined capacity will be 25bcm a year, with first gas expected in 2007. All three will be regasification plants which convert LNG from its liquid state back into a gas and then distribute it directly into the national gas transmission network.

**Existing & planned UK gas import & storage**

Mode	Project	Capacity bcm/year	Available
Pipeline	Interconnector (Belgium -UK)	8-24	2007/08
Pipeline	Vesterled (Norway - UK)	4-10	Now
Pipeline	Langeled (Norway - UK)	15-25	2007/08
Pipeline	Balgzand (Netherlands - UK)	10-17	2006/07
Storage	Rough field	2.80	Now
Storage	Humbly Grove	0.28	2005/06
Storage	Aldbrough	0.42	2007/08
LNG	Isle of Grain	5-15	2005
LNG	Milford Haven (2 terminals)	10-25	2007
<b>Total</b>		<b>52-119</b>	<b>By ~2007</b>

Source: DTI and Ofgem Joint Energy Security of Supply (JESS) report May 2004

**Establishing agreements with gas producing countries**

The problem facing the gas industry in the short term is not accessibility to gas but getting the gas to markets. It is estimated that 70% of the world's gas reserves lie within transportable distance (5,000km) of Europe. Some commentators worry that some gas is likely to come from countries which may be less politically and economically stable than the UK. However, countries supplying energy are dependent on the buying countries so it is in their interest to establish trade agreements with importing countries to ensure ready export markets. For example, over a 40 year period Algeria showed that it was a reliable gas supplier to the UK. The UK has also recently signed a long-term gas import agreement with Norway, and several UK companies have long-term gas and LNG contracts with suppliers in major gas producing countries such as the Netherlands, Malaysia and Qatar. In future, Russia, Algeria and Egypt are expected to become significant gas exporters to Europe and the UK.

**Box 3. Global Gas 'Peak'**

The UK is not alone in facing diminishing gas reserves and production. According to industry analysts, many gas-producing nations are already past their peak gas production and are now in decline, including the US, Canada and the Netherlands, one of the countries upon which the UK is relying for future gas imports. Analysts predict the global gas production 'peak' will occur by 2020 - 2030.<sup>14</sup> Production will continue after this time, but at lower rates. As global gas supplies decline it may become economically viable to switch to other forms of energy.

**Threats to security of gas supply**

Failure to provide sufficient insurance against disruption of gas supply could result in serious economic and social consequences. If gas supply fails and pressure is lost in a gas pipeline there is a risk that air can mix with the gas in a potentially explosive combination. In the event of

supply disruption, 1996 UK Gas Safety (Management) Regulations require that every gas appliance be checked prior to reconnection, which is personpower intensive and time consuming. Potential threats to security of gas supplies include:

- *Deliberate or inadvertent destruction of a pipeline or processing terminal* - the International Energy Agency suggests that the greatest risk of prolonged interruption to gas supply comes from the destruction of a production or processing facility or of a deep-water pipeline. The UK has six terminals that receive gas, but 60% of all gas landed in the UK comes through just two terminals: Bacton in Norfolk and St Fergus in Scotland. The UK is currently dependent on just two import pipelines, but plans to increase the number of entry points will reduce dependence on this limited number of import routes.
- *Market competition* - international demand for gas to fuel electricity generation is increasing, so the UK may face competition for gas and LNG supplies, for example from the USA as its indigenous gas supplies deplete (see box 3), and from China as its economy grows and demand for gas increases.

**Overview**

- The UK's indigenous gas supply is diminishing. By 2006 the UK is expected to be a net gas importer; by 2020 up to 80% of the UK's gas will be imported.
- The Government believes that increasing the diversity of gas suppliers and supply routes is key to achieving security of supply. New pipelines, LNG terminals and gas storage facilities are currently under construction.
- By 2007, UK's gas import capacity will be sufficient to meet the supply gap resulting from the decline in UK gas production. There are, however, some concerns about the UK's ability to meet winter demand before new import facilities are operational.
- Threats to gas supply exist, but increasing the diversity of import routes will reduce vulnerability to disruption.

**Endnotes**

- 1 'primary energy' refers to resources that produce energy such as oil, gas, coal, nuclear, renewables. Electricity is secondary energy because it is generated from primary energy
- 2 DTI White Paper, "Our Energy Future", Feb 2003
- 3 Joint Energy Security of Supply (JESS) working group, May 2004
- 4 Transco Ten Year Statement, 2003
- 5 Early Day Motion 784, Security of Energy Supplies, 04-03-04
- 6 www.og.dti.gov.uk
- 7 BP Statistical Review of World Energy, June 2004. www.bp.com
- 8 WoodMackenzie study, June 2004, 'From surplus to shortage'
- 9 Centrica www.centrica.co.uk
- 10 Society of Petroleum Engineers
- 11 Pilot website www.pilottaskforce.co.uk
- 12 Interconnector website www.interconnector.com
- 13 House of Lords EU Select Committee, HL Paper 105, June 2004
- 14 Association for the Study of Peak Oil and Gas, www.peakoil.net

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