

Gas supplies to the UK – a review of the future



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Key Points

- Natural gas is expected to provide over two-thirds of the UK's fuel consumption by 2020.
- From 2006 the UK will become a net importer of gas, which has implications for security of supply, in terms of:
 - potential threats to supply arising from political instability in gas-producing nations;
 - price disruptions arising from risks associated with the supply and demand of gas; and
 - concerns relating to the transit of gas and the facilities through which it is delivered.
- Greater demand across the EU for natural gas is forecast, with increased competition for the same gas resources as nations attempt to meet their own carbon and pollutant-reducing targets.
- Even though carbon dioxide emissions from gas-fired generating plants are significantly less than from previously dominant coal-fired plants, gas-fired electricity generation alone will struggle to help meet the UK's future climate change targets. In addition, there are concerns over gas leakage during transit along long pipelines.
- Gas-fired generating plants currently offer the cheapest method of generating base-load electricity. However, nuclear power and renewable options become more competitive when fuel price fluctuations and future carbon dioxide emission allowances are taken into account.
- Market liberalisation will bring greater transparency, efficiency and wider access to the market. However, full and effective market liberalisation in Europe is a way off, and will always struggle to create a framework for long-term strategic investment decisions about security of supply and emissions that lie at the heart of energy policy.

Introduction

The Energy White Paper, *Our energy future – creating a low carbon economy*¹, published in February 2003, launched a thorough debate of future UK energy policy. The White Paper outlined the Government's response to the threat of climate change and set a target of reducing carbon dioxide emissions by 60% by 2050. The White Paper also addressed wider energy issues, including the declining capacity of the UK's nuclear power and fossil

fuel resources and the need to update the energy infrastructure. The White Paper sets out the long-term strategies against which policy initiatives will be formulated, including goals to ensure reliable and secure energy supplies, an energy framework to promote competitive business and a target that no household will be living in fuel poverty by 2018.

In the White Paper, the need for a diverse mix of electricity generation to provide reliable and secure energy supplies was recognised. In reality, a single fuel dependency on natural gas from non-indigenous sources is in prospect, bringing an increased risk of disruption to the UK's energy supplies, and a dependence on an electricity generation technology that alone will struggle to meet the UK's climate change targets.

With a few notable exceptions over the years, domestic fossil fuel resources, nuclear power and a variety of other sources have provided the UK with a long period of stability and self-sufficiency in its energy supply. A transformation within the energy industry presents a challenge to the continued stability of the country's energy supply. In the UK, natural gas has already become the major component in meeting its energy requirement, fulfilling almost 40% of both the primary energy demand and the fuel source for electricity generation in 2002². This contribution is set to increase over the next few decades whilst UK fossil fuel resources and generating capacity from other sources diminish (see figure 1). It is probable therefore, that the UK will have an unprecedented dependence upon natural gas, from a broader global base.

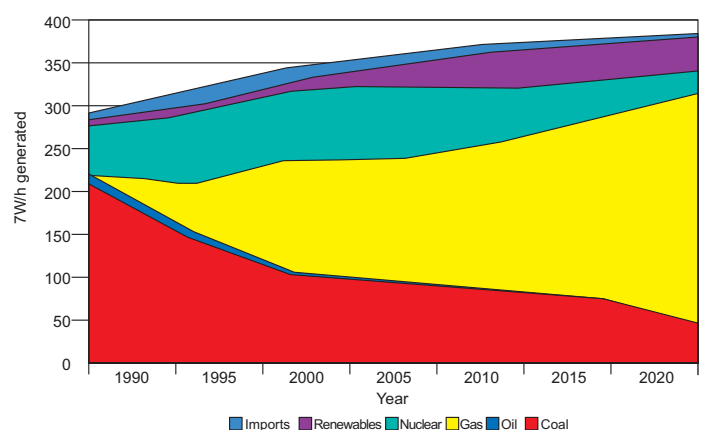


Figure 1
UK power sector fuel mix 1990 - 2020
(DTI projections)²
(Source: The Energy Review – A Performance and Innovation Unit Report – February 2002. Crown copyright 2002)

Recent power disruption in California, Italy and elsewhere highlights the risks of an insecure energy supply. The security of the UK's energy supply is set to become less of a domestic issue and more of an international one, a feature that will impact upon the Government's policy in many areas.

Security of Supply

The UK and Canada are currently the only leading industrial nations that are net energy exporters. The balance of net importers to net exporters is even more marked within Europe; of 33 nations, only five are self-sufficient or net exporters, whilst nine import more than 95% of their energy requirement³. However, the UK is expected to become a net energy importer within the current decade. The Government points out that the UK has been a net energy importer before and this in itself should not be a major cause for concern.

Government analysis of the gas market acknowledges that encouraging diversity in key areas is a feature of a strategy to safeguard supply. It is argued that this diversity should be applied to two strands, first in the sources of supply and secondly in the facilities and infrastructure on which the gas supplies rely. Together with this diversity there should be an in-built ability to adapt quickly to changes. It has been suggested that this should be achieved using a variety of measures, including storage of fuels and commissioning dual-firing capacity in fossil fuel power plants. However, such diversification of supply will also mean that significant investment will be required in new infrastructure.

UK's Own Usage of Gas

Fuel diversification in the UK has principally been confined to the production of electricity: following a change in European legislation, the power generation industry has over the last few years turned increasingly to gas to generate the UK's electricity, a trend that initially increased diversity. Although this trend was followed largely for economic reasons, there was an additional benefit in the drive to a low-carbon economy, in that the carbon dioxide emissions from gas-fired generating stations are significantly less than from the previously dominant coal-fired plants. This movement to gas will continue in the short-term at least, leading to a radical reduction in fuel-type diversity. According to the *Energy Review*², the UK power sector will become 80% dependent on gas by 2025 if current energy policies are followed, as the trend towards lower

emission electricity generation continues and as the existing nuclear plant is decommissioned.

Gas as a direct supply of energy is also familiar to most of us. It is the principal source of domestic heating, with deliveries to over 20 million UK customers achieved via a quarter of a million miles of piping. It is expected that gas will become an even more dominant source of energy providing two-thirds of the UK's total energy requirement by 2020. Natural gas, both as the combusted fuel and in the short term as a source for hydrogen fuels, is also one of the key elements in diversifying and securing the supply of fuel for the transport sector, with particular application in reducing emissions, including noise, from heavy vehicles¹.

Remaining Gas Resources

Although the UK's resources of gas are becoming depleted to the point where the UK will shortly become a net importer of gas and will remain so for the foreseeable future, it is widely agreed that there are substantial gas resources remaining elsewhere worldwide (see figure 2). The supplies in Norway and the Netherlands (short-term), Russia and Algeria are seen as being of primary importance to the UK. European and foreign policy will be influenced by the location of the principal resources and the routes of the pipelines required to deliver supplies.

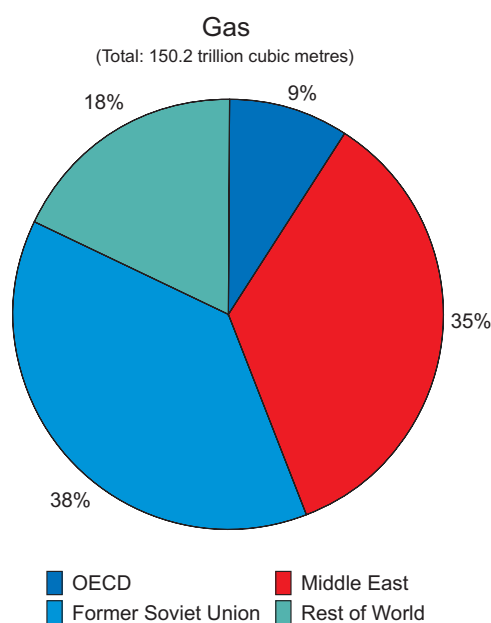


Figure 2
Location of world reserves of gas, 2000
(Source: The Energy Review – A Performance and Innovation Unit Report – February 2002. Crown copyright 2002)

It is estimated that the reserves in the fields within economic distance of the European gas market are in the region of 100 years of current European consumption level. However, with gas consumption in the UK, across Europe and worldwide set to increase dramatically over the next 20 years, the long-term picture is not as comfortable as these estimates might at first suggest.

United Kingdom Continental Shelf

The United Kingdom Continental Shelf (UKCS) contains approximately 0.5% of the world's oil and gas reserves. The estimates of reserves remaining on the UKCS (see figure 3) have displayed a remarkable resilience to the forecasts, often repeated over the last three decades that they will run out "in the next 20 years." The UKCS is a difficult environment from which to extract fossil fuels and this has been a factor in the UK's research councils and industry funding the development of world-leading expertise and technology for the extraction and exploitation of oil and gas. These technologies often find application in areas of the world other than the UK, providing a positive export contribution for the UK in its own right, as well as improving the competitiveness of global oil and gas companies⁵.

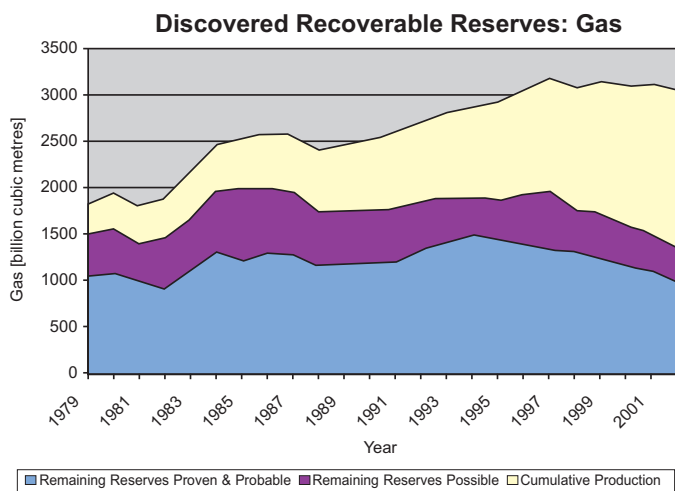


Figure 3

UKCS remaining gas reserves

(Source: DTI Oil and Gas website. Crown copyright 2001)

Low-Carbon Energy Options

The main forum for co-operation between the Government and the oil and gas industry, PILOT⁶, seeks to improve the competitiveness of the UK industry through continued exploration and development activity on the UKCS. This support for the oil and gas industry is part of the approach to prolong the UK's self-

sufficiency in oil and gas, to secure a strong UK industrial sector and a diversified supply of these fuels. However, as the emphasis in energy policy shifts to move the UK towards a lower carbon economy, it is essential that greater levels of funding should be directed towards research into renewable energy and clean coal technologies and into other means to overcome the economic barriers hampering the uptake of such technologies.

And what role is there for nuclear power generators? By 2025, there is scheduled to be one remaining operating nuclear power plant in the UK. There are no current plans to build new nuclear generating capacity. However, there is a recognition that nuclear power may yet have a significant role to play in generating energy for a low-carbon economy, particularly if other technology options are unable to meet the requirements for generating capacity, carbon emissions, unit cost of electricity and reliability of supply. The political, social and economic arguments must be placed firmly on the agenda. Putting forward a strong case for the role of nuclear power and preventing a skills shortage are critical issues for the Government, industry and academia to tackle.

Economics and the Transit of Gas

Security of supply relates not only to the prevention of physical interruption, but also to the resilience to fluctuations in energy and fuel prices. The UK is not alone in the changing composition of its energy supply. Other EU member states are subject to similar legislative drivers as the UK, with the result that there will be more competition for the same gas resources as member states attempt to meet their own carbon and pollutant-reducing targets – a substantial growth in demand for gas is forecast. Expansion of the EU will exacerbate the situation.

Furthermore, substantial costs associated with the supply, transport and delivery of gas from sources thousands of kilometres away will add to the cost of the commodity in the market. The rich gas fields in the Yamal Peninsula, northern Siberia, are being connected to consumers in Western Europe via a 4,000 kilometres long dual pipeline, along a route via Poland. The pipeline capacity, by completion in 2010, will be 65.7 billion cubic metres per year. Other pipelines, for example, from Turkmenistan via Iran and Turkey, Qatar via Egypt and Nigeria via the Sahara, are being considered.

Currently, only two interconnectors move gas between the UK and continental Europe, an obvious

vulnerability in terms of physical interruption of supply. An agreement in October 2003 with Norway will pave the way for an interconnector that will provide 20% of the UK's current annual demand for gas⁷. Further investment in UK infrastructure is planned: other new gas interconnectors under the North Sea are due to be commissioned in 2006/2007 and new storage facilities in the UK will also help to smooth out disruptions to supply⁸. However, it is investment in infrastructure at other points of the long supply chain, over which the Government has little influence, that cause most concern.

Another concern is that the process of transporting gas is inefficient. Transporting the gas requires compressor stations (see figure 4) roughly every 100 kilometres along the pipeline. The compressors typically utilise a small proportion of the transported gas to power the turbines used to pressurise and move the gas. It has been estimated that up to 25% of the natural gas may be lost to the consumer in transporting the gas over thousands of kilometres⁹. Of further concern regarding greenhouse gas emissions is that as much as 4% of the gas may also be lost to the atmosphere.



Figure 4
A gas compressor station on the Polish section of the Yamal-Europe transit gas pipeline
(Source: EuRoPoL GAZ s.a., Poland)

In a global analysis, it is unclear how the greenhouse gas emissions incurred in transporting natural gas over such long distances should be allocated. To put the issue into context, sequestration of carbon dioxide from coal-derived electricity generation would be environmentally more acceptable than transporting Russian gas to the UK. According to the EU's forecast for natural gas prices, it will be more economical too⁹.

Indeed, questions have been raised about whether the real cost of supplying gas to the UK, positioned at the

western extremity of a very long supply chain, has been underestimated. This is key to the energy strategy pursued by the Government and links directly to the economic barriers faced by renewable and clean coal energy (new technology, scale of operation) and some of the arguments against nuclear generated power. A recent in-depth study carried out by PB Power for the Royal Academy of Engineering¹⁰ concludes that gas-fired Combined Cycle Gas Turbine (CCGT) plants currently offer the cheapest method of generating base-load electricity. However, when fuel price fluctuations are taken into account (see figure 5) and with the possibility of future carbon dioxide emission allowances potentially adding a further 50% or more to the generating costs from new gas and conventional coal plants, nuclear power and renewables options become much more competitive.

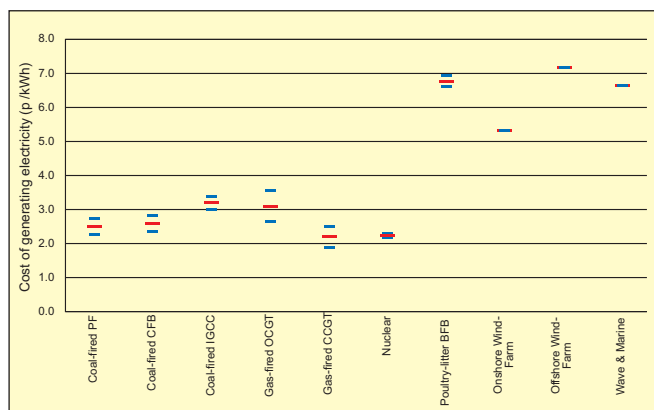


Figure 5
Effect of a $\pm 20\%$ change in fuel price on the cost of generating electricity
(Source: The Cost of Generating Electricity, The Royal Academy of Engineering¹⁰)

The compact transport and storage and excellent safety record offered by Liquefied Natural Gas (LNG) make it an attractive fuel option. Although currently making-up a small percentage of Europe's gas supply, LNG already introduces a significant element of supply diversity in those regions, such as southern Europe, where the specialist infrastructure required has been installed and continues to be expanded. In the UK, a new LNG terminal is scheduled to start operation in 2005/06⁸. Whilst a move to LNG will improve source diversity for the UK, there remain substantial infrastructure cost issues to resolve before implementation on a large scale will proceed. Demand for LNG is also increasing worldwide, notably as the US increases its capacity for importing the fuel.

Regarding the competitive energy markets within the UK as a success, the Government is seeking a similar approach to the energy market within the EU: a

commitment to a full liberalisation of the energy market within the EU has been secured, to be in place by 2007. Liberalisation of Russian and Algerian gas exports is also likely within the next few years. Whilst it is hoped that such liberalisation will provide one of the elements of a diversified source of gas supplies, the economic outcome is unclear. A liberalised, competitive energy market has led to lower prices for the UK consumer in the recent past. However, in the face of greater demand for the commodity from across the EU, as well as from China and the gas-producing nations' own internal requirements, the overall effect on prices is less predictable, but is generally forecast to be upwards.

Other Threats to Supply

Although the last couple of decades have witnessed significant political upheaval in major gas-producing nations such as the former Soviet Union and Algeria, there was surprisingly little impact on the exports of gas during those times. Whilst this might indicate that gas exports have some resilience to political uncertainty, it would be risky to assume that this will always be the case. Indeed, in the current climate of increased threat from deliberate acts of disruption, including sabotage, terrorism and protest, the insurance market views supplies of Russian gas as being particularly exposed to risks caused by political or terrorist action against the transportation infrastructure, to the extent that up to half the capacity to the UK could be at risk of disruption every eight years¹¹.

Serious concerns exist about the levels of investment required to commission and maintain the required infrastructure in some of the major gas-exporting nations. Geological risks along long lengths of pipeline can be predicted and designed for, but not eliminated entirely. Building dual pipelines and encompassing shut-off valves that allow flow to be diverted to the parallel pipe, albeit with a loss in capacity, will mitigate risks to the supply, but add cost and do not provide guarantees.

There is some unease amongst European governments and gas companies in trading with potentially unreliable partners²: indeed, Russian gas supplies to Turkey have recently suffered serious interruption. Furthermore, a new element of concern has emerged with the creation of the Gas Exporting Countries Forum (GECF) in 2001, which includes Russia and Algeria. Although the Forum has expressed no intention to form a cartel to exert control over European gas supplies and prices, there is the potential for conflict with those, such as the UK, who wish to liberalise European gas markets³.

Conclusion

There appears to be little chance of a crisis of energy supply in the short-term. However, many are of the view that the UK is following a path that may make it more vulnerable to disruptions to energy supply, caused by events over which it has little or no influence. The trend towards natural gas as the major primary fuel, coupled with declining UK fossil fuel resources and a reduction in electricity generating capacity from other domestic sources, brings to the fore the need for diversity and a balanced mix in order to provide security of supply.

It is the role of policy-makers to provide the right framework to allow the development of an infrastructure and range of energy supply that combines acceptability in terms of cost, risk of disruption to supplies and environmental emissions. The full economic and environmental costs of supplying gas to the UK from reserves thousands of kilometres away should be properly assessed. In this light, the arguments for developing nuclear power, renewables and clean coal technologies must be made to the policy-makers in the most convincing terms.

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