

UK ENERGY SHALE GAS

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Increasing demand for energy worldwide means that there is a constant search for new energy sources, in terms of both geographical locations and exploitation methods. One such source is shale gas, which has transformed the energy sector in the USA recently. Although there is considerable uncertainty regarding the global shale gas resource and estimates suggest that the bulk is located in the USA and China, potential sources exist in Europe which could provide the UK with energy opportunities both at home and abroad.

To date, the adoption of shale gas as an energy source across Europe has been slow, due to different perspectives on a number of environmental factors and uncertainty regarding the role that it should play in energy policy. This policy statement considers the inclusion of shale gas in the UK's future energy mix.

The Institution of Mechanical Engineers urges Government to adopt the following recommendations:

- 1. Accelerate the enhancement of the environmental regulatory framework to ensure safe exploitation of shale gas in the UK as soon as possible.** Recent studies have shown that the UK's regulatory framework is fundamentally fit-for-purpose for shale gas exploration, but Government should urgently extend the framework for production to build public confidence in the management of the environmental risks associated with the emergence of a shale gas industry.
- 2. Develop UK industrial strategy to include a regional strategy for exploitation of shale gas.** The Government is committed to rebalancing the UK economy and has strong cross-party support. The Department for Business, Innovation and Skills is developing a UK industrial strategy and the opportunity should be taken to include shale gas as a regional dimension. This would support the creation of highly skilled jobs with future export potential, while contributing to the nation's energy security.
- 3. Prioritise the development of Carbon Capture and Storage (CCS) with gas-fired power plant.** The UK is committed to a decarbonised energy system by 2050 to meet legally binding mitigation targets. With gas-fired plants projected to make up a substantial part of the generation mix in the coming decades, Government must urgently prioritise the demonstration and deployment of commercial-scale CCS technology in gas power stations and ensure low-carbon gas generation is included in policy development, especially the Electricity Market Reform.

UK SHALE GAS

THE DEMAND FOR ENERGY

In the 21st century, the demand for energy is anticipated to increase substantially as human population growth and large-scale shifts to more energy-hungry demographics in developing countries both lead to increased consumption^[1]. International Energy Agency (IEA) projections suggest that a 40% increase in global primary energy demand will take place between 2010 and 2035 ('New Policies Scenario'), with 90% of that growth being located in non-OECD economies^[2]. Such projections, coupled with shifting market economics, drive a continual search for new sources of energy. This search can take place through technological innovation in exploitation methods, (eg concentrated solar, thorium reactors, fusion, biofuels and most recently shale gas) or exploration in new geographical locations that become available through socio-political changes, technical advances or, increasingly, climate change^[3].

In the UK it is anticipated that for the next two decades the overall energy requirement will, as for the past few decades, remain relatively stable at about 2,000TWh per annum^[4]. However, within individual components of the UK's energy mix, a substantial transition is projected to take place as a result of legally binding commitments to reduce greenhouse gas (GHG) emissions^[5]. This is expected to lead to a large-scale electrification of ground transportation and space heating in both domestic and commercial buildings. Indeed, projections by the Committee on Climate Change (CCC) suggest that UK electricity supplied to customers will increase from about 310TWh in 2010 to about 450TWh in 2030 (medium scenario) and possibly to as much as 500TWh by 2050^[6]. A doubling of the need for electricity by mid-century is anticipated by the Department of Energy and Climate Change (DECC)^[7].

POTENTIAL ROLE OF SHALE GAS IN UK ENERGY SUPPLY

Despite efforts to introduce renewables and other low carbon technologies, a significant portion of the electricity generation capacity that will be needed to meet this forecast increase in UK power demand is likely to be gas-fuelled. Indeed National Grid recently predicted that 27% of the UK generation fleet will still run on gas by 2030 ('Gone Green' scenario)^[4]. However this may increase substantially, as allowed investment in the UK's new nuclear build programme, uncertainty over support for renewables, and the Government's announcement in the draft Energy Bill^[8] that the Emissions Performance Standard (EPS) will be set at 450gCO₂/kWh until 2045, potentially encourages a new era of gas plant construction. Additionally, it is considered sensible to incentivise renewal of the UK generation mix before strongly encouraging decarbonisation of domestic heating based on electricity, so most buildings will likely still be heated by gas in 2030^[6,7]. If current demand expectations for power supply and space heating are met, then, assuming slow progress on decarbonisation, overall gas demand in the UK might conservatively be expected to be about 800TWh in 2030, compared with 900TWh today^[4].

How the UK will meet this demand for gas in the context of dwindling North Sea reserves is an important question for the nation's energy future. Since 2004 the UK has been a net importer of gas^[9], largely through supply agreements with Norway, LNG imports and supplies from Continental Europe. This trend is set to increase with over 80% of UK gas anticipated to come from overseas sources by 2030^[4] (compared with 40% in 2011)^[9]. Globally for the foreseeable future there is an abundance of conventional natural gas resource accessible to the UK through infrastructure that connects the nation with large reserves in Norway, Russia and the Middle East. However, a new easily accessible domestic reserve would clearly be of significant benefit in a world where energy demand is increasing substantially.

Shale gas bearing geology in the UK is widely distributed across the nation. GB onshore licensed areas with potential sources are shown in **Figure 1** and include extensive fields in the North-East and resources in Lancashire, Somerset and Avon, South Wales, the Moray Firth, the South-East and the Poole area. In addition the UK has potential sources in Northern Ireland^[11]. There are various estimates regarding the size of the available resource represented by these regions. A number of companies that are involved in UK exploration activities have made estimates that suggest about 6,000 billion m³ of gas resources are available within the areas covered by their concessions^[12]. Currently the UK's annual gas consumption^[4] is of the order of 100 billion m³.

Analysts currently suggest UK resources are unlikely to lead to national gas price reductions similar to those experienced in the USA^[13]. In the UK, and Europe more widely, the market structure and dynamics are different and the costs of exploitation are very uncertain as there has been no production outside the USA to benchmark against^[14]. European geology appears to be less amenable, and the environmental requirements across the EU are potentially tighter. Consequently, future exploitation of the UK resource is anticipated to have only a small impact on gas prices, but it could make a positive strategic contribution to energy security by providing less dependency on major overseas sources^[15].

ENVIRONMENTAL ISSUES

There has been substantial debate recently regarding potential environmental issues related to the exploitation of shale gas resources in Europe and the UK, much of which has been stimulated by concern arising from a number of examples of bad practice in the USA. Poland has declared that hydraulic fracking* is safe^[16], as long as correct environmental procedures are followed, and a comprehensive joint report issued by the UK's Royal Society and Royal Academy of Engineering in June 2012 drew similar conclusions^[17]. The latter considered in detail the principal environmental

*The technical method by which the gas is extracted from the shale rock.

concerns related to perceived risks of groundwater contamination, the use of large volumes of process water, both in terms of abstraction and wastewater handling, the stimulation of seismic activity and potential for greenhouse gas emissions from drilling and fracking activities ('fugitive' emissions). Another recent investigation by the Institution of Gas Engineers & Managers additionally considered the concern of visual and audio impact^[15]. Both reports concluded that the regulatory application of operational best practices, through implementation and enforcement, could effectively manage the risks associated with shale gas exploitation in the UK. It is worth noting here that the Environment Agency's position is that current regulation in England and Wales (its area of jurisdiction) is adequate to cover small-scale exploration, but that if there is a scale-up of activity to production then it will be necessary to strengthen the regulation^[12].

DECARBONISATION OF THE UK ENERGY SYSTEM

The UK has committed to reduce GHG emissions by 80% by 2050, relative to 1990 levels^[6]. In order to help achieve this goal, the CCC proposes that the power sector should reduce the average CO₂ emissions intensity of its generation fleet from about 500gCO₂/kWh in 2010 to 50gCO₂/kWh in 2030 and almost zero in 2050^[6]. The recent announcement in the draft Energy Bill^[8] setting the Emission Performance Standard (EPS) at 450gCO₂/kWh until 2045 is not easily reconciled with delivery of a decarbonised UK power sector in line with the CCC's recommendations^[18]. Combined cycle gas turbine power plants (CCGTs) fired on natural gas have an emissions intensity of about 350gCO₂/kWh and the proportion of these is set to rise in coming decades. With or without the exploitation of shale gas it is therefore important for the longer term to ensure that Carbon Capture and Storage (CCS) is developed and deployed in a timely manner for gas plants^[19].

INDUSTRIAL STRATEGY

Since 2005, gas from shale resources in the USA has grown from about 2% of overall natural gas production to about 24%^[14]. Furthermore, anticipation of self-sufficiency in this energy source is underpinning the nation's vision of a resurgence in manufacturing and industrial production. Indeed the focus on domestic use to rebalance the US economy leads many analysts to conclude that despite the large volume of shale gas exploitable on the North American continent, little will be exported^[14]. Similarly, despite a range of challenges that will make exploitation more challenging than in the USA, including more-difficult geology and a lack of enabling infrastructure in proximity to the shale, the Chinese authorities appear likely to follow a strategy driven by a political desire for both security of supply and a fuel for industrial growth^[14].

Within Europe there are a number of factors conducive to the growth of shale gas exploitation, including close proximity of infrastructure and end-user markets; however in an EU Energy Policy context the matter of exploration and production

from national resources is an issue for individual states. In this regard there are very different positions developing across the continent. For example, Poland, with an estimated resource^[15] of 5,300 billion m³, is keen to move forward with production and has been highly active in clearing policy, legislative and incentive barriers to progress. Germany on the other hand is undecided and the approach varies from state to state (there are currently moratoria in some states). France has the second largest estimated resource in Continental Europe behind Poland but banned hydraulic fracking in July 2011; however a recent government report^[20] appeared favourable to exploration with a particular focus on the Paris Basin. In the Netherlands, which is an existing gas producer from conventional wells, the government is positive and work is under way, however there is growing public opposition and calls for increased legislation.

The UK is currently one of the best-informed countries in Europe on shale gas and has both a robust regulatory framework from which to build an effective system to manage its exploitation^[12] and a suitably placed infrastructure for product distribution^[15]. With the nation's indigenous conventional gas reserves in decline and a strong desire across all political parties to rebalance the economy, shale gas provides the Government with an opportunity to help attain security of supply as well as deliver on a wide range of other policy objectives, including the encouragement of localism and the development of a UK Industrial Strategy^[21].

Estimates^[22] have shown that over the life of a shale gas project in the UK, about 95 full-time equivalent (FTE) jobs could be created per well, 30 of those being at the county level (see **Table 1**). This is particularly important in those regions such as the North-West, where job opportunities are needed in the face of a shrinking public sector employer that underpins the local economy. Similarly, Tamboran's proposed Northern Ireland project is expected to run through to 2050 and produce 600 local jobs from direct employment, 2,400 associated jobs across the UK, and yield some £6.9 billion in tax revenues^[11].

Table 1: Estimate of potential UK jobs created by exploitation of Shale Gas in North-West England (based on 400 wells drilled over ten years)^[22]

| | Lancashire | UK |
|--|--------------|-------|
| Peak FTE Jobs per annum via drill programme | 1,700 | 5,600 |
| Average FTE Jobs per annum via drill programme | 1,300 | 4,200 |
| Long-term Maintenance | 160 FTE jobs | |

A key characteristic of the employment opportunities is that they would be highly skilled and of the type needed to meet cross-party political aspirations to rebalance the UK's economy. Although individual exploration and production programmes would last about a decade, the skills, knowledge, equipment and supplier base developed would position the UK for ongoing participation in emerging EU and worldwide shale gas activity. There is precedence for this, in that substantial oil and gas technical resources in Aberdeen are now focused on utilising their North Sea experience for the benefit of the UK in international markets.

Estimates of future production of gas from shale across Europe vary between 5–50 billion m³ per year and 60–200 billion m³ per year^[23]. However, if Europe were to achieve a moderate level of production at a rate of about 30 billion m³ per year by 2025, it would require approximately 1,000 to 4,000 wells to be drilled per year, which would in turn need between 200–800 rigs; currently there are about 20 suitable rigs in Europe^[23]. Given the current slow pace of shale gas policy development across much of the EU (with the exception of Poland), strategic early exploration and production activity by the UK could give the nation an advantage in exploiting an emerging Continental shale gas services market. This would not only be good for the country's security of energy supply, but also provide a contribution to rebalancing of the UK economy.

At a local level, in addition to jobs and a welcome injection of economic activity, other benefits to be gained through shale gas exploitation include the creation of apprenticeship programmes (as this is a new industry requiring specific technical skills that will need to be cultivated), enhanced Further Education and Higher Education opportunities through extended and enhanced curricula developed to meet the needs of this emerging industry, and local supply-chain development based on engineering and services businesses^[22].

However, like most energy exploitation projects, shale gas needs significant capital investment. It is estimated that about £6 billion is needed to realise Tamboran's proposed Northern Ireland project^[11]. It is therefore vitally important that Government supports the development of a UK shale gas industry through creating a policy framework that removes unnecessary barriers and encourages growth. By integrating shale gas into the Government's emerging Industrial Strategy^[21] with a regional dimension, communities such as those in the North West that are keen to see industrial development to mitigate the effects on local economies of public sector job cuts, can embrace the opportunity and underpin future UK export potential.

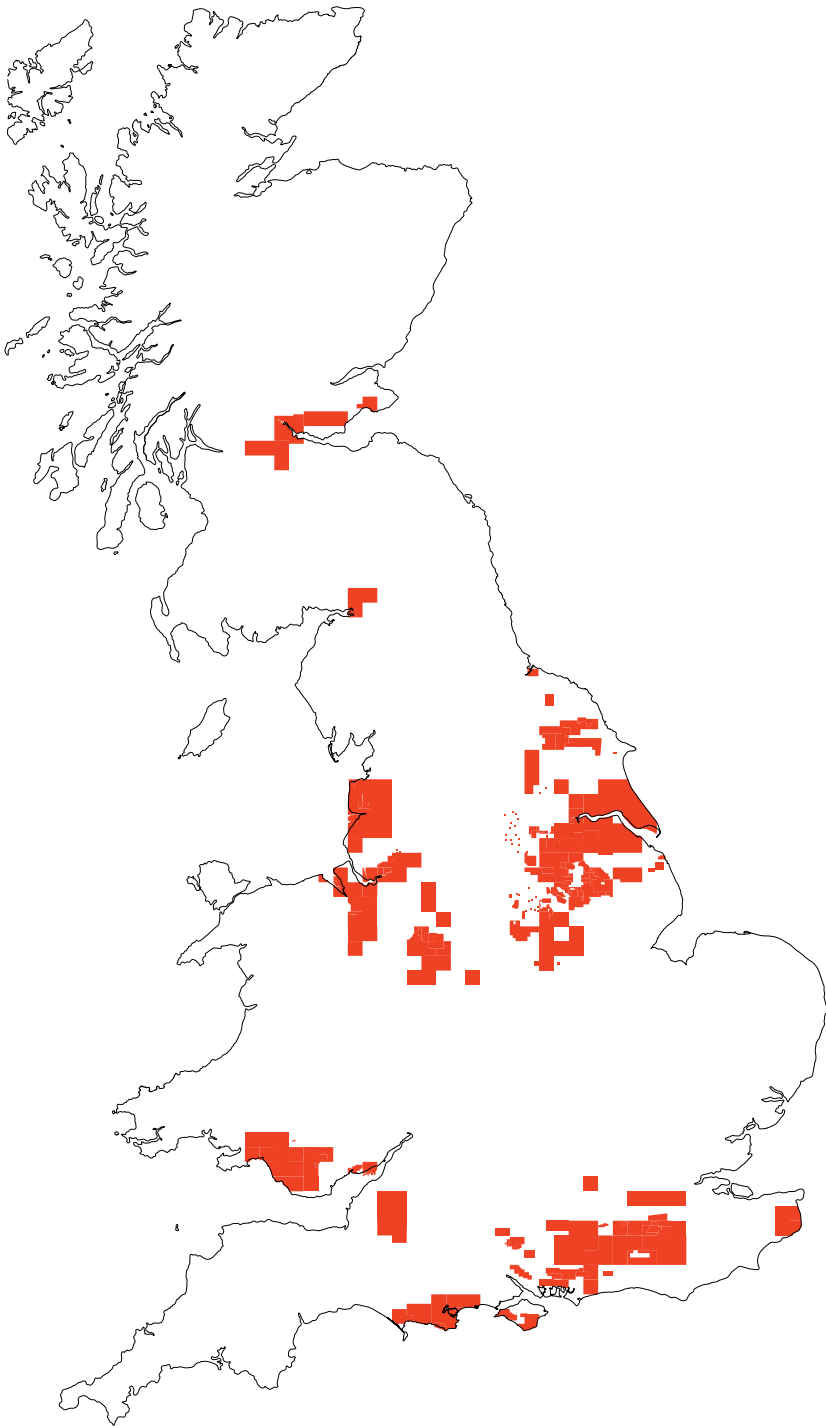


Figure 1: GB Onshore Licensed Areas
Department of Energy and Climate Change
Petroleum Act 1998 Onshore Licensing
July 2012^[10]. (Permission given for use.)

RECOMMENDATIONS

The Institution of Mechanical Engineers urges Government to adopt the following recommendations:

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