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Shale Gas in the United Kingdom

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INTRODUCTION

There is a growing debate over shale gas in the United Kingdom. The government appears to be very much in favour of a 'shale gas revolution', seen as a mechanism to reduce dependence upon imported gas and leading, it is hoped, to lower gas prices that would improve the export competitiveness of UK industry.[1] However, there is strong opposition from many to shale gas operations. This is based around environmental concerns over hydraulic fracturing to produce the shale gas and also concerns over the subsequent greenhouse gas emissions arising from fugitive methane emissions during shale production and CO_2 emissions when the gas is burnt.

There have been several parliamentary inquiries into shale gas operations in the United Kingdom. The House of Commons Select Committee most recently reported in April 2013.[2] In June 2013, the House of Lords Economic Affairs Committee announced that it was launching its own inquiry into UK shale gas operations, inviting answers to a series of questions.[3] Implicit in these was the nature of policy decisions needed to get the best outcome for the country in the context of shale gas. Put simply, assuming the United Kingdom wants a shale gas revolution similar to that experienced in the United States, what policy measures may facilitate this? This paper is based upon the evidence submitted by the author to the committee.[4]

THE SCOPE FOR SHALE GAS TO BE USED IN THE UNITED KINGDOM

As Figure 1 shows, the consumption of natural gas in the United Kingdom 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 five per cent came from net pipeline imports from Europe and 95 per cent 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.

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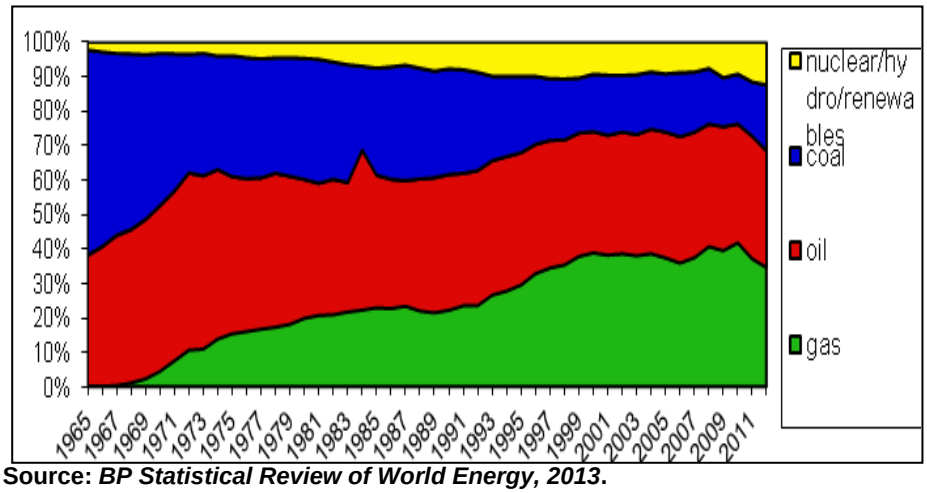
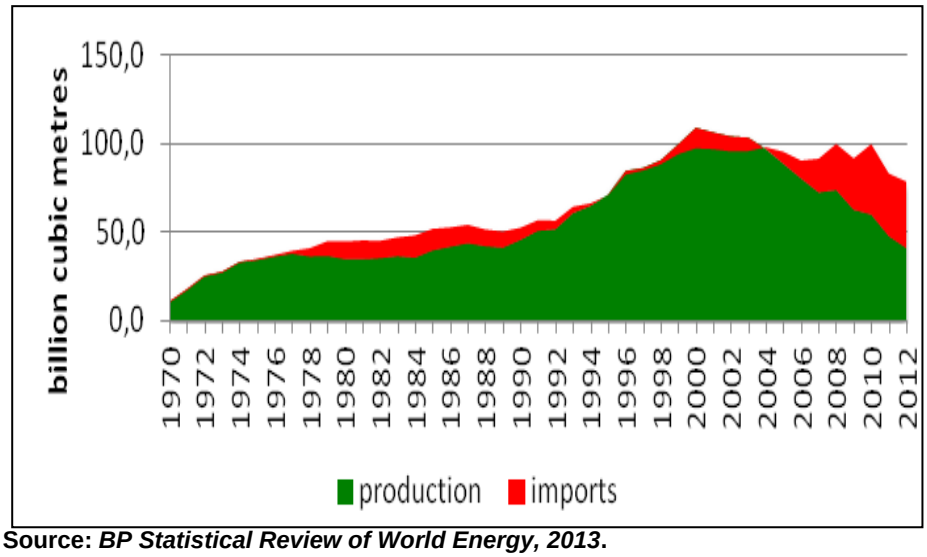
1 There are, however, widely reported differences of opinion between the Treasury, which is strongly in favour, and the Department of Energy and Climate Change, which has reservations based upon a fear that a greater use of shale gas could undermine the country's greenhouse gas targets.
2 This report and a previous one were generally supportive of shale gas operations.
3 The questions can be found at http://www.parliament.uk/business/committees/committees-a-z/lords-select/economic-affairs-committee/inquiries/parliament-2010/energy-policy/.
4 UK House of Lords Select Committee on Economic Affairs, 26 September 2013. For further details, see Paul Stevens, *The 'Shale Gas Revolution' Hype and Reality* (Chatham House, 2010) and *The 'Shale Gas Revolution': Developments and Changes* (Chatham House, 2012).

Figure 1: UK primary energy consumption by fuel, 1965–2012



Source: ***BP Statistical Review of World Energy, 2013*****.**

Figure 2: UK natural gas consumption, 1970–2012



Source: ***BP Statistical Review of World Energy, 2013*****.**

COSTS COMPARED WITH OTHER ENERGY SOURCES

There are considerable uncertainties over the cost of producing shale gas in the United Kingdom. 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 United Kingdom is in its infancy. Furthermore, not only are shale plays notoriously different, so too are wells on the same play. Costs also change as the shale gas operations move along the learning curve. This uncertainty is compounded by the uncertainty over the externalities of environmental

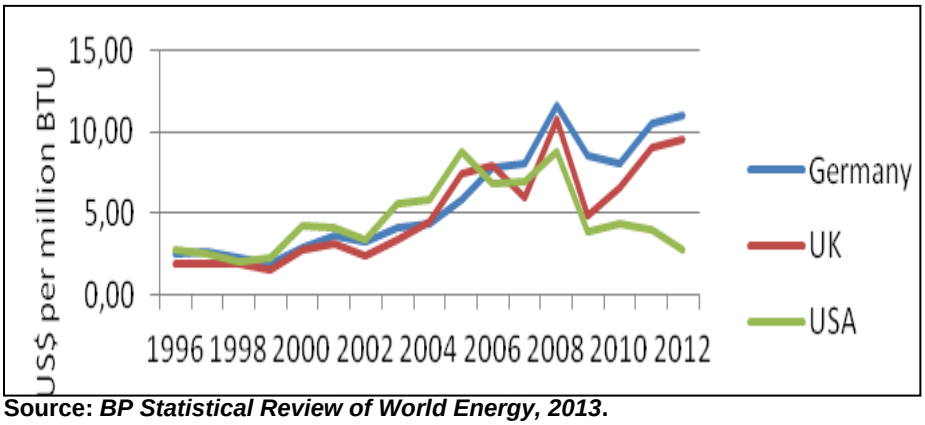
damage that may be associated with shale gas operations. This should be accounted for in the 'cost'. While all the evidence suggests that hydraulic fracturing is environmentally safe if well regulated and done properly, little is yet known about the level of fugitive methane emissions. This represents a potentially significant addition to greenhouse gas emissions. However, in the absence of data, it is impossible at the moment to value this in order to internalize the costs.

The capacity of the UK service industry to undertake onshore shale operations is very weak, with few drilling rigs and even fewer units that can hydraulically fracture. In the Barnett shale play in the United States 199 rigs were drilling at the height of operations in 2008, while there were only 34 rigs in all of Western Europe in 2010. Estimates in Poland, where the service industry is in a similar state to that in the United Kingdom, suggest a shale well costs three times more than in the United States. The relative costs of energy alternatives are equally uncertain. The future of the UK nuclear industry is uncertain, while the future of LNG markets is very controversial because of the fall-out from the shale gas revolution in the United States and its potential replication elsewhere.

IMPACT ON THE UK GAS PRICE

Views on the impact on gas prices have been strongly influenced by the US experience, as seen in Figure 3. The dramatic fall in US domestic prices since 2008 has given a major boost to the country's manufacturing industry, especially in petro-chemicals. It is clearly the prospect of replicating this experience in the United Kingdom that has made the Treasury such a fan of shale gas.

Figure 3: Natural gas prices, 1996–2012



Source: ***BP Statistical Review of World Energy, 2013*****.**

However, such optimism is very much misplaced. The United Kingdom is physically linked into the European gas market via the Bacton Interconnector. Therefore, 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. The effect of this type of arbitrage can be observed in Figure 3. For example, as European prices rose after 2010, gas flowed from the United Kingdom to Europe, thus pushing up UK prices. In the US case there is no market for lower-priced gas so the price stays low, though this could change if the United States begins to export substantial quantities of LNG. Equally, the large gas suppliers in the United Kingdom are very unlikely to leave any money on the table for consumers. The idea that a UK shale gas revolution would lead to significantly lower gas prices is a myth.

IMPACT ON CARBON EMISSIONS

Methane is a far more potent greenhouse gas than CO_2 – something like 70 times more potent over a 20-year period. If fugitive emissions from shale operations are high, therefore, this could affect climate change policies. Producing shale gas, because it is more energy-intensive, will produce more CO_2 than conventional gas, but studies by the Tyndall Centre at the University of Manchester suggest the extra is insignificant, at only four per cent more. The key issue is what energy source might be replaced by shale gas. If coal or oil is replaced, given methane emits less CO_2 than either – roughly half the emissions of coal for the same energy content – obviously this would reduce the United Kingdom's carbon footprint. A similar situation has already been seen in the United States where shale gas is pushing out coal from power, although 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 had an impact on 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 CO_2.

IMPACT ON ENERGY SECURITY

Clearly the impact of shale gas on the United Kingdom's energy security depends upon the amount produced and over what period. There are two ways in which energy security – defined as physical access to energy sources – can be enhanced by shale gas, at least in theory. First, it represents a diversification of gas supplies away from offshore UK production and imports by pipeline or LNG. Furthermore, the potential of significant shale gas supplies can enhance the bargaining power of the United Kingdom when negotiating 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. A credible threat of significant supplies from shale 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, but this may not be the case as successive miners' strikes in the United Kingdom and threats of industrial action by French nuclear engineers have illustrated.

LESSONS FROM THE US EXPERIENCE

The shale gas revolution of the United States happened because of a coincidence of characteristics. The main ones are listed in Table 1. A key point is that the American 'revolution' in reality happened over a very long period of time – over 20 years – although it was 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 mix of conditions that will be difficult to replicate in the United Kingdom.

Table 1: Factors creating the 'shale gas revolution' in the United States	
UNITED STATES	**UNITED KINGDOM**
Geology	
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
After many years of oil and gas drilling, there were plenty of drill core data publicly available to allow explorers to find the 'sweet spots' on the plays.	No
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
Research	
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
Regulation	
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 assessment.	Strong environmental legislation
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 government is claiming to introduce some tax breaks
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
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
The nature of the gas market	
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 US also has a very large and extensive gas pipeline grid.	No Access is by Third Party Access.
The US 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
The US domestic gas market experienced strong rising prices in the period after 2002, culminating in a price over $10 per thousand cubic feet in May 2008.	See Figure 3
Industry	
The industry was dominated by small, entrepreneurial companies, the so-called 'momma and poppa' companies.	No
The majority of the work was done by a dynamic, highly competitive service industry. At the height of the Barnet Play in 2008, 199 rigs were operating.	No
The capital markets are more willing to provide risk finance for oil and gas activities	No

CHANGES TO PUBLIC POLICY TO PROMOTE SHALE GAS IN THE UNITED KINGDOM?

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 tax breaks for unconventional operations in the Energy Act of 1980 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 with 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 and make the results available to the industry. The sort of research envisaged is fundamental science, a 'public good' that would not and should not be undertaken by private companies.

Shale gas service industry

The US shale revolution benefited 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. Sharing information is key for new entrants to the market. For example, in the United States, the Marcellus shale coalition, with 300 partnering operators and service companies, is an alliance that has proved to increase production exponentially within a shorter time span. It has also helped to push the industry along the technological learning curve at a faster rate. Currently only a handful of service companies are involved in shale gas operations in the United Kingdom. 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.

Environmental concerns

Community acceptance is vital to secure and maintain any shale gas operation. Shale operations have been widely criticized in environmental terms in the context of water pollution, greenhouse gas emissions, noise and dust. 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 in the proximity of the operations.

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 need not be problems with fracking,[5] but this is not sufficient to persuade many concerned local communities. 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 engaging with community concerns. It is also important to convey the message about the local economic prosperity that could flow from shale gas operations. Currently there are many negative messages about operations that ignore 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 universities and research institutes to promote such messages, given the very large body of scientific evidence in existence that is not anti-fracking.

Policies leading to community development with increased local participation in the process will help also to promote confidence in shale gas projects. Currently, unlike in the United States, 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 US lines, it would be possible to force companies to ‘compensate’ local communities for the disruption from shale gas operations and also to encourage them to 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 per cent of the revenues. How effective this may be remains to be seen.

CONCLUSION

There is growing evidence from outside the United States that simply leaving shale gas developments to the market is not enough.[6] If governments want a shale gas revolution, they will have to intervene with policy measures. In particular, they must deploy policy to help overcome the very real barriers that have been identified above. What those measures might be needs considerable thought. Any policy is subject to the law of unintended consequences. Because of the complexity of shale gas operation, whether in terms of engineering, technology, economics or environmental concerns, this is especially relevant for shale gas.

ABOUT THE AUTHOR

Paul Stevens is Distinguished Fellow with the Energy, Environment and Resources research department at Chatham House as well as Emeritus Professor at the University of Dundee and Visiting Professor at University College London (Australia).

5 For example, see the special report by the Royal Society and the Royal Academy of Engineering, *Shale Gas Extraction in the UK: A Review of Hydraulic Fracturing* (2012).
6 For example, see the situation in Australia outlined by 'The Green Paper: Shale Gas in Australia: The Policy Options', October 2013, http://www.ucl.ac.uk/australia/ucl-australia-news/shale-gas-in-australia-green-paper.