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House of Lords Economic Affairs Committee

Inquiry on 'The Economic Impact on Energy Policy of Shale Gas and Oil'

Response on behalf of the UK Energy Research Centre

Prepared by

Professor Michael Bradshaw
Department of Geography, University of Leicester

Professor Jim Watson
Research Director, UK Energy Research Centre

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UK Energy Research Centre

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Introduction

This response is largely based on research carried out within the UKERC project: *The Geopolitical Economy of Global Gas Security and Governance: Implications for the UK.* It also draws on UKERC's energy system modeling research which has explored the changes that are necessary to meet the UK's climate change targets. Below we have provided a question-by-question response to the Call for Evidence made by the Select Committee on Economic Affairs. As requested, we have provided concise responses and we are happy to respond to particular issues in more detail if required (contact: Professor Michael Bradshaw; Email mjb41@le.ac.uk; Telephone 0116 252 3842).

Responses to the Committee's questions

1. **How much scope is there for shale gas and oil – from domestic and overseas sources – to be used in the UK and over what timeframe?**

The current unconventional oil and gas revolution originated in North America, but its effects have been felt in the UK. We can think of this first phase as one of 'indirect impact' and it relates to shale gas, rather than shale oil. Less than 10 years ago the US was expecting to become a major importer of natural gas and was building a large number of terminals to received liquefied natural gas (LNG). However, the rapid ramp up of domestic shale gas production in the US reduced the need to import LNG and many of those terminals are now sitting idle. A number of LNG projects – particularly in Qatar – were built in anticipation of there being a growing LNG market in this US. This did not materialise, instead some European gas-importing countries (more precisely private companies invested in this capacity) seized the opportunity to expand their LNG import capacity and were able to attract this displaced LNG. This was certainly the case in the UK where new LNG terminals opened, first at the Isle of Grain in 2005 and then at Milford Haven in 2009 (Dragon LNG and South Hook).

In a short period of time, the UK has become one of the largest LNG importing countries in the world. This is, in part, an indirect consequence of the growth of shale gas production in the US. More recently our LNG deliveries have fallen, partly because of economic recession, but also because more LNG has been attracted to Asian markets since 2011. The increase in LNG demand in Asia is due to both the Fukushima accident (immediately after which gas traders brought up a lot of LNG, anticipating increased Japanese demand, but this did not happen straight away and a lot of LNG was dumped on European markets) and growing gas demand in Asia. At the same time, as shale gas has displaced coal in the US power generation sector, cheap US coal has come to the UK and Europe and this has displaced higher-priced gas. UK coal imports increased by 37.7% between 2011 and 2012, and imports from the US increased by 65.4%. Consequently total UK gas demand fell by 6% in 2012.

The next phase could be that of direct impacts, first from the imports of shale-gas based LNG from the US and then, potentially, from domestic shale gas production. At present, the US gas market is over-supplied and prices are low. The gas industry wishes to export gas as LNG to increase revenues and sustain domestic production. Just as there was a long list of LNG reception terminals being built in the US in the past, now there is an equally long list of over 20 LNG export terminals seeking approval from the US Government.[1] At present, four terminals have been given federal approval. To date, Asian buyers have

[1] The US Department of Energy's Federal Energy Regulatory Commission (FERC) complete list of projects: www.ferc.gov/industries/gas/indus-act/lng.asp

shown the greatest interest in importing US LNG, but some of it could come to the UK. For example, last March, Centrica signed an agreement with Cherniere Energy Partners PLC to import 1.75 mtpa of LNG for 20 years from 2018. However, there is no guarantee that Centrica would ship its LNG to the UK.

The second stage of direct impacts could involve domestic shale gas production in the UK. As will become clear below, at present we have no way of knowing whether or when that might happen and what the potential volume of production might be. All of the best estimates suggest that it won't be until the early 2020s at the very earliest. National Grid's latest *UK Future Energy Scenarios* include a modest contribution from onshore UK gas production from zero today to 2-4% of demand by 2020. This share rises to 15-20% by 2035[2]. While there is considerable uncertainty about what the future level of UK gas demand will be, we do know that production from the UK continental shelf (UKCS) is likely to continue to decline (from a peak of 108bcm in 2000 to a projected level of 19bcm by 2030); thus, our level of import dependency is likely to increase (DECC suggest 70% import dependency by 2025). In sum, the most immediate possibility for shale gas to be used in the UK is as imported US LNG.

2. How will the costs, including those on the environment, of accessing the UK's shale gas and oil deposits compare to those of other sources of energy?

In a recent speech at the Royal Society, the Secretary of State Ed Davey emphasised the uncertainties associated with shale gas in the UK: "Nobody can say, for sure, how much onshore UK shale gas resource exists. Or how much of it can be commercially extracted."[3] It is impossible to know what the costs will be and how much of the 'gas in place' in the UK that was identified by the British Geological Survey[4] will turn into 'proven' reserves. Proven reserves are defined as "those quantities that geological and engineering information indicates with reasonable certainty can be recovered in the future from known reserves under existing economic and operating costs"[5]. Those costs will include the cost of obtaining a 'social licence to operate' that is the environmental, social and economic costs associated with exploration and development. Until developers have carried out a meaningful exploration programme and have a good idea of operating costs in the UK we cannot answer this question. According to the Energy Information Administration in the US, the economic recoverability of oil and gas resources depends on three factors[6]:

1. The cost of drilling and competing wells (which we don't know in relation to UK shale gas and oil);
2. The amount of oil or gas produced from an average well over its lifetime (which we don't know this for the UK. It is highly variable across a shale 'play');
3. The prices received for oil and gas production (again, we don't know this).

Thus, any estimate of how much shale gas and oil can be produced at present is unknown. There is no basis to say that there is 'x' amount of gas in place and at a recovery rate of 20% that means 'y' amount of gas, because the recovery rate is unknown and will vary greatly across the shale deposits. It could be that the greater depth of UK shale deposits, compared to the US, results in higher possible flow rates, but it could also be the case that production costs are higher.

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[2] National Grid (2013) *UK Future Energy Scenarios: UK gas and electricity transmission*. National Grid: Warwick, p. 119.

[3] Davey, E. (2013) 'The Myths and Realities of Shale Gas Exploration'. Speech to the Royal Society, 9th September.

[4] Andrews, I.J. (2013) *The Carboniferous Bowland Shale gas study: geology and resource estimation.* British Geological Survey for Department of Energy and Climate Change, London, UK.

[5] BP (2013) *Statistical Review of World Energy 2013*. London: BP.

[6] See www.eia.gov/analysis/studies/worldshalegas/

3. What is the potential impact of shale gas and oil on the local economies in area where development is possible?

This is very difficult to know with any certainty owing to the limited level of development underway in the UK. Clearly, there is much that could be learnt from the US case, particularly the development of the Marcellus shale in Pennsylvania. It is no surprise that the advocates of shale gas development in the UK make much of the potential economic benefits and a strong case is made in the Institute of Director's report on *Getting Shale Gas Working*, which was sponsored by Cuadrilla Resources Ltd[7]. The shale gas industry in the US is evolving very quickly and there are many lessons that can be learnt in terms of maximising the economic benefits to local economies, while minimising the safety and environmental costs. The ability of UK industry to develop an onshore shale gas and oil supply chain will be a key factor shaping both the pace of development and the economic benefits and this is an issue that requires independent research.

4. What will be the impact of shale gas on the cost of electricity generated at gas-fired power plants and how will it compare to other forms of generation including coal, nuclear and renewable?

Once shale gas enters the national gas transmission system (NTS) it will be no different from other sources of gas – domestic production from the UKCS, imported gas from the Norwegian Continental Shelf, gas through the interconnector from Europe, imported LNG – it will be traded on UK and international gas markets. This is why domestic shale gas alone is unlikely to reduce the domestic price; it is an open trading system subject to gas-to-gas competition and is exposed to price risks in the domestic, European and LNG markets. Thus, shale gas will be the same price as other sources of gas.

The development of shale gas globally could, in principle, have an impact on the price of gas. But this will only be the case if shale gas production is very significant. It is important to remember that the future trajectory of gas prices will depend primarily on other factors – i.e. trends in the production of more conventional sources of gas and in the demand for gas.

The extent to which gas-fired power generation will be cheaper than other forms of generation depends partly on the price of gas – both in absolute terms and relative to the price of other fossil fuels. It also depends on the details of the Electricity Market Reform package of policies, most of which are being implemented through the Energy Bill that is currently being considered. These include the level of strike prices agreed for new investments in low carbon power generation using renewables, nuclear power and carbon capture and storage (CCS), the future evolution of the carbon price floor and the incentives available from the new capacity market. As things stand, unabated gas-fired generation will be able to take advantage of incentives from the planned capacity market – but, once again, this is not dependent on the source of the fuel that will be used in gas-fired power stations.

All these factors are subject to uncertainty. A recent report by the Committee on Climate Change shows that unabated gas-fired generation (without CCS) is likely to be cheaper than most low carbon technologies in 2013[8]. This comparison includes the impact of the carbon price floor, which is projected to rise as set out by the Treasury. However, this cost advantage may not continue if the carbon price floor is increased as planned (a course of action that is not guaranteed) and the provisions of the Energy Bill are implemented.

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[7] Institute of Directors (2013) *Getting Shale Gas Working*. London: IOD.

[8] Committee on Climate Change (2013) *Next Steps on Electricity Market Reform*. London: CCC.

All this uncertainty is leading the power generation sector to hold off on investments in new gas power generating capacity until the impacts of the Energy Bill are much clearer. This uncertainty is also likely effecting investment in LNG import capacity and gas storage.

5. Will the UK electricity market be easily able to incorporate shale gas in the future or will generators be locked into long-term contracts with other energy sources? Are there any other potential barriers to the use of shale gas in electricity generation?

As explained above, shale gas is likely to be treated as just another source of gas coming into the NTS, and this gas will be traded alongside other supplies at the market price. It is highly unlikely that any generating company would tie itself to a particular source of supply and the ability of the industry to shift from gas to coal recently demonstrates how readily the generators respond to price signals.

One of the major benefits of the development of the UKCS is that the UK, for the most part, benefits from a well-developed NTS. The areas most likely to develop shale gas production are areas well served by the NTS, thus the cost of connecting new producers to the NTS will be minimal. However, the shale gas producers will have to ensure that their gas meets the standards required of the NTS (this will require processing), and that it enters the NTS at the appropriate pressure. Given the disparate nature of shale gas production, this could mean significant infrastructure investment will be required for shale gas producers to collect their production and make it compatible for entry into the NTS. An alternative might be to sell the gas directly to a local customer.

6. Which forms of electricity generation is shale gas likely to displace and by how much?

Shale gas is a fuel and not a form of electricity generation. As noted above, any domestic shale gas that is produced will contribute to the gas resources available for the UK and for international markets – and for that reason, gas-fired power plants fuelled by shale gas will not be any different to gas-fired power plants fuelled by other sources of gas. The question should therefore be what forms of generation might be displaced by gas-fired generation should that become (or remain) cheaper than other sources. As noted in our answer to question 4, the answer to that question depends on a range of uncertain factors. However, it is important to note that the role of unabated gas fired generation will need to be limited during the 2020s due to the UK's legally binding climate change targets (see answer to question 8 below). The successful commercialisation of CCS technologies would be required for gas to continue to play a major role in that decade and beyond.

7. What impact will shale gas and oil have on household energy bills?

Obviously, in the US at present shale gas and oil have resulted in lower prices. But this is a very particular situation that is not likely to last and which cannot easily be replicated in other markets. For all the reasons explained above, UK shale gas and oil production is likely to have a minimal impact on our household energy bills. Longer-term, if shale gas production impacts on global gas markets it could be part of a wider set of processes that brings down the price of gas (the high price of oil and the dominance of oil-indexed gas pricing is more of a problem in Continental Europe at the moment). But this is a complex issue that is currently only in the realms of informed speculation. Similarly, if shale oil made a significant impact on global oil supplies (at the moment it is reducing US imports of light crude) it could help moderate the price, but there are a host of other factors likely to have greater influence on the future price of oil, which nobody can predict. In summary, there is no evidence that UK shale gas will have a particular impact (positive or negative) on household energy bills in the short to medium-term.

8. What effect will the use of shale gas and oil have on carbon emissions compared to other combinations of energy sources?

This is a highly contentious issue that has two important dimensions. The first is the carbon footprint associated with the production of shale gas – both from the energy and materials consumed in the production process (so-called life cycle emissions) – and so called fugitive emissions from the production process. Emissions are not just made up of carbon dioxide. Methane – the main constituent of shale gas – is itself a potent greenhouse gas. Fugitive methane emissions can leak from wellheads during the extraction process and during transportation.

Emissions estimation is an emerging area of research, with contradictory results coming from studies in the US that require careful review. A recent report for DECC by their Chief Scientific Advisor David Mackay and Tim Stone concludes that: 'If adequately regulated, local GHG emissions from shale gas operations should represent only a small proportion of the total carbon footprint of shale gas, which is likely to be dominated by CO_2 emission associated with its combustion'[9].

This is important because one of the benefits of natural gas is that it emits about half the amount of carbon dioxide compared to coal when used to generate electricity. Thus, if increased gas consumption in the power sector reduced coal consumption it would have a positive de-carbonising effect. However, that positive effect is reduced if shale gas is shown to have higher life cycle and fugitive emissions than other forms of natural gas. In fact the MacKay and Stone report concludes that UK shale gas would have a lower emissions profile then imported LNG.

The second dimension of this issue concerns the carbon emissions associated with burning natural gas. This is not about shale gas *per se*, but is a bigger question about the future role of gas in the UK energy system. In the US, shale gas has replaced a significant amount of coal in the power generation sector over the last few years, and this contributed to a substantial reduction in US emissions. The UK is different. We have already had a 'first dash for gas' in the 1990s and early 2000s that reduced emissions in a similar way. However, UKERC research shows that there are limited further decarbonisation benefits to be had from a 'second dash for gas' without the commercialization of CCS technologies. Significant amounts of unabated gas-fired generation in the UK power generation mix in the 2020s and beyond would make it very difficult to comply with the UK's legally binding carbon targets.[10]

9. Will shale gas and oil increase UK energy security?

It depends on what you mean by energy security. In their recent Energy Security statement, DECC distinguished by 'physical security' and 'price security.' Domestic production of shale gas and oil could contribute to physical security of gas supply, as it would reduce import dependency. However, this only holds true if shale gas is more reliable that other sources of gas (domestic or foreign). Whilst there is a tendency to believe that domestic sources of gas (and energy in general) are more secure than gas from abroad, there is very little empirical evidence to support this assumption. Threats to gas security over the past few years have largely occurred for technical reasons, not geopolitical reasons – and many of the technical problems have occurred within the UK. Furthermore, this assumption does not take into account one of the primary reasons for importing energy in the first place – that it allows UK consumers to access

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[9] MacKay, D. and Stone, T. (2013) *Potential Greenhouse Gas Emissions Associated with Shale Gas Production and Use* Report for the Department of Energy and Climate Change. London: DECC.

[10] Ekins, P. *et al.* (2012) *The UK energy system in 2050: Comparing Low-Carbon, Resilient Scenarios*. UKERC, London.

cheaper sources of energy than could be produced in the UK. Domestic production would bring some economic advantages by having a positive impact on the UK's balance of payments.

One difficulty with these security arguments is that the anticipated levels of UK shale gas production are impossible to predict and they are unlikely to significantly reduce our growing import dependence any time soon. As explained above, domestic shale gas and shale oil production is unlikely to have a significant impact on the price paid by consumers and the level of volatility, this is because of the open nature of our energy markets that are exposed to global market conditions. In sum, increased domestic production of oil and gas could help improve physical security of supply (though only if you believe that it will be more reliable than gas from Norway, the UK continental shelf and other locations), but will do little to influence price security.

10. What infrastructure investment will be necessary to cope with the development of shale gas and oil? How far will it help ensure sufficient UK energy supplies? How will this investment be financed?

The first part of this question, relating to infrastructure, is impossible to answer as we are not close to knowing that extent of proven reserves and the possible level of commercial development. Most of the infrastructure impacts are likely to be local in relation to the exploration, development and production activities. The UK already has a developed NTS and significant gas-fired power generating capacity (note that only a third of UK gas consumption is in the power sector, another third is in industry and the remaining third is consumed in household sector). As noted above, the shale gas industry is developing quickly and 'pad drilling' (multiple wells being drilled from a single site) will reduce the infrastructure demands, but this a question that requires further research based on an understanding of the US experience and the plans for exploration and production in the UK.

As to who should finance it, the UK Treasury has already indicated a willingness to provide production tax breaks (i.e. subsidies) for shale gas development. But this is not something that the industry requested and, for understandable reasons, it has not been well received by environmentalists. The general direction of travel in developed economies, and the UK is no exception, is to place a cost on carbon emissions and to subsidise low carbon sources of energy. In our view, there is no justification for the tax breaks that have been offered. Given the uncertain benefits that any domestic shale gas developments would bring, it would be better to focus government spending on low carbon energy sources and energy efficiency.

11. What changes to public policies are necessary to maximise the potential of any shale gas development?

At the moment public opinion seems to be divided on shale gas and there is a strong and vocal opposition movement. The recent debate that has polarised around events at Balcombe in Sussex is not helpful. Both sides of the argument have engaged in rhetoric and misinformation. It is unclear if it is possible to regain public trust around the issue of onshore shale gas and oil drilling in the UK.

There needs to be a more 'rational' debate about the issues and what it might take for shale gas developers to obtain a 'social licence to operate.' A simple appeal on the basis of a unfounded promises of lower energy bills, employment opportunities and local pay-offs is not going to work, nor is resorting to exaggerated claims about the risks associated with exploratory drilling operations.

Research by UKERC into public attitudes towards energy system transformation suggests that there is

public support for low carbon energy, but not for further fossil fuel development.[11] The study did not ask about shale gas. The Balcombe protests have clearly raised the visibility of the issue, but it is also clear that the public is confused by the current situation. We believe that the academic community has an important role to play in providing the public and the policy making community with independent and scientifically rigorous research on shale gas – including on public attitudes to shale gas drilling in the UK.

12. Will shale gas and oil lead the UK to be less dependent on energy from less reliable regions of the world such as the Middle East and Russia?

A cursory examination of the data in DECC's Digest of UK Energy Statistics (DUKES) reveals that the UK is not currently overly dependent on these regions for its oil and gas imports. According to the official data, in 2012 the UK imported 54,357 thousand tonnes of crude oil and 98.6% of that came from non-Middle Eastern sources, with Russia providing 11.4% of total imports. Norway provided 50.2% of total crude oil imports. In the case of natural gas, in 2012 the UK imported 47% of the gas it required. Norway provided 40.5% of total imports as pipeline gas and Qatar 40% of imports as liquefied natural gas (LNG). Qatari imports equate to about 23% of total gas supply. However, the LNG industry is flexible and there are other sources of supply that could be attracted to the UK if the price was right.

The significant decline in UK gas production and coal's continued importance in power generation means that we have a high level of coal-import dependence, but this is never discussed in relation to energy security. In 2012 the UK imported 44,796 tonnes of coal, nearly 41% of which came from Russia, 26.6% from Columbia and 23.4% from the US. Thus, while Russia is always raised in relation to UK gas security, we do not directly import Russian gas. Some Russian gas is likely to come through the interconnector from continental Europe as a result of trading activities. By contrast, we do import a lot of Russian coal.

The UK has a well-developed infrastructure for importing gas, with more than sufficient capacity. However, as the level of import dependence continues to increase, there will be an increasing rationale for increasing the UK's gas storage capacity which is low when compared to our European neighbours. At present, the Government has concluded that there is no economic rationale for public subsidies for gas storage[12].

13. What lessons can be learnt from the US experience of shale gas and oil?

The short answer is a great deal. We would extend that to the whole of North America because Canada has extensive experience of shale gas drilling in a regulatory system that it is more akin to that in the UK. However, as we note several times in this submission, great care needs to be taken when seeking to draw lessons or conclusions for the UK from the development of shale gas and oil in other countries.

To our knowledge, there has been no substantial academic research undertaken in the UK on this issue and this is something that needs to be addressed in the proposed Research Council funded programme on Unconventional Oil and Gas. If we had to choose one lesson it would be the importance of baseline social, economic and environmental research before the onset of commercial shale gas drilling in the UK. Without this it is impossible to monitor, manage and mitigate the impact of shale gas and oil development.

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[11] Parkhill, K.A. *et al.* (2013) *Transforming the UK Energy System: Public Values, Attitudes and Acceptability-Synthesis Report*. UKERC: London.

[12] DECC (2013) 'Fallon: no new subsidy needed for gas storage – decision saves bill payers up to £750 million'. Press release, 4th September.