



UNIVERSITY OF
GLOUCESTERSHIRE

This is a peer-reviewed, post-print (final draft post-refereeing) version of the following published document and is licensed under All Rights Reserved license:

Jones, Peter ORCID: 0000-0002-9566-9393, Comfort, Daphne and Hillier, David (2017) Fracking for shale in the UK: risks, reputation and regulation. In: Handbook on Geographies of Technology. Research Handbooks in Geography series . Edward Elgar Publishing, Cheltenham, pp. 302-317. ISBN 9781785361159

This is a draft chapter / article. The final version is available in Handbook on Geographies of Technology edited by Walf, Barney, published in 2017 by Edward Elgar Publishing Ltd. The material cannot be used for any other purpose without further permission of the publisher, and is for private use only.

Official URL: <https://www.elgaronline.com/view/9781785361159.00030.xml>

EPrint URI: <https://eprints.glos.ac.uk/id/eprint/4360>

Disclaimer

The University of Gloucestershire has obtained warranties from all depositors as to their title in the material deposited and as to their right to deposit such material.

The University of Gloucestershire makes no representation or warranties of commercial utility, title, or fitness for a particular purpose or any other warranty, express or implied in respect of any material deposited.

The University of Gloucestershire makes no representation that the use of the materials will not infringe any patent, copyright, trademark or other property or proprietary rights.

The University of Gloucestershire accepts no liability for any infringement of intellectual property rights in any material deposited but will remove such material from public view pending investigation in the event of an allegation of any such infringement.

PLEASE SCROLL DOWN FOR TEXT.

FRACKING FOR SHALE GAS IN THE UK:

RISKS, REPUTATION AND REGULATION

Peter Jones, David Hillier and Daphne Comfort

Peter Jones, The Business School, University of Gloucestershire, Cheltenham, UK
pjones@glos.ac.uk

Daphne Comfort, The Business School, University of Gloucestershire, Cheltenham, UK
dcomfort1@glos.ac.uk

David Hillier, Centre for Police Sciences, University of South Wales, Pontypridd, UK
illier@2006@outlook.com

FRACKING FOR SHALE GAS IN THE UK: RISKS, REPUTATION AND REGULATION

Introduction

The identification of potentially exploitable large shale gas reserves, and plans for their subsequent commercial development by hydraulic fracturing, popularly known as fracking, within many countries of the world have generated mixed responses. In the United States, for example, the introduction of new drilling and fracturing technologies in the late 1990's saw the rapid commercial development of shale gas resources across many areas of the country which in turn prompted the exploitation of shale gas reserves in Canada. By way of contrast the identification and possible development of shale gas in parts of Europe has met with considerable public and political opposition. In France, which has the greatest potential shale gas resources, a moratorium on fracking has been in place since 2011, and was upheld in 2013 and Germany has not allowed any fracking since 2011. In June 2015 a majority of Members of the European Parliament voted for a moratorium on fracking which was described as *'a clear indication that public acceptance for this industry is crumbling across the EU'* (Food and Water Europe 2015, webpage).

Within the UK there has recently been increasing interest in Government circles and amongst energy companies about the identification of potentially large scale shale gas reserves and the Government *'believes that shale gas has the potential to provide the UK with greater energy security, growth and jobs'* (Gov. UK 2014a , webpage). Despite this interest exploration for shale gas is still at an early stage in the UK and there are currently no definitive or meaningful estimates of the likely shale gas reserves or of what proportion of the potential reserves MAY be practically and commercially recoverable. However the possible future commercial development of the shale gas reserves, by fracking, has also generated concerns about a wide range of environmental risks. Two linked factors seem to be important in addressing these concerns and arguably in facilitating the future development of shale gas resources within the UK. On the one hand the Government has emphasised its commitment to a regulatory regime designed to protect the environment and ensure public safety. On the other hand there is a commercial consensus that *'the industry needs to control reputation and risk'* and that *'negative public opinion about environmental safety of the hydraulic fracturing process could undermine the development of this industry'* KPMG (2011, p.19). With this in mind this chapter offers a case study of the current debate surrounding the potential for fracking for shale gas in the UK. It begins with some introductory contextual thoughts on the changing and contested geographies of energy resources, describes the characteristics of shale gas and the process of fracking and outlines the scale and geography of potential shale gas reserves within the UK. The main body of the chapter provides a commentary on the environmental risks and issues associated with exploration and development of these reserves, reviews the contrasting and contested positions on the benefits and costs of shale gas development and examines the evolution of the regulatory framework with specific emphasis on planning policy and practice.

The Changing and Contested Geographies of Energy Supply

In introducing the *'New Geographies of Global Energy'*, Zimmerer (2013) suggested that geography is *'crucial to addressing the multiple, interconnected dimensions of the current potpourri of global energy dilemmas and opportunities'* and Bridge (2012) argued that *'the manner in which energy is captured and transformed lies at the heart of society's relationship with the natural world.'* The geography of energy supply changes as new resources are discovered and old ones become depleted and/or economically unviable and as technological development makes reserves more accessible and economically recoverable. Bradshaw (2009), for example, charted the geographical dimensions of energy supply and demand and the recent global shift in the location of energy production and demand growth and argued that *'this shift is the result of increasing demand in emerging markets such as China and India'* and that *'the centres of production are now focused on the Middle East, Africa and the former Soviet Union.'* Changes in the geography of energy production are also occurring within countries looking to make the transition to a more sustainable energy supply based on renewable sources and in some cases to develop recently discovered fossil fuels.

In addressing the *'geographies of energy transition'* Bridge et. al. (2013) suggest that *'the energy challenge in the twenty-first century is to bring about a new transition towards a more sustainable energy system characterised by universal access to energy services and security and reliability of supply from efficient low-carbon sources.'* Bradshaw (2010) has argued that *'we now face a global energy dilemma created by concerns about future availability of fossil fuels and the impact of their exploitation on the planetary ecosystem.'* Bradshaw (2010) further suggested that within the *'developed market economies'* the solution to this energy dilemma *'is being sought through increased energy efficiency, carbon trading, the development of technologies to de-carbonise fossil fuel use and electricity generation and the promotion of renewable energy and nuclear power.'* That said Bridge et.al. (2013) argued that *'the geographical implications of this new energy paradigm are not well defined and a range of quite different geographical futures are currently possible.'* However within developed market economies renewable forms of energy generation cannot fully match current levels of demand and as such fossil fuels will remain a crucial element in the global energy mix into the foreseeable future. Where possible, many countries may look to exploit newly discovered indigenous fossil fuel resources while also pursuing a transition to more sustainable sources of energy supply.

At the same time in a seemingly increasingly volatile and unstable international environment concerns about the security of energy supplies loom large. Bridge (2010), for example, argued that *'the Issues of energy availability and the vulnerability of fuel supplies have assumed new political prominence , so that hoary questions about depletion and security now share space on the environment and development agendas with greenhouse gas emissions and atmospheric pollution.'* Energy security is a wide ranging and complex issue and in identifying *'the key energy policy issues for energy security in the UK'*, Hoggett et.al. (2011), for example, suggested that energy policy is *'a reflection of the sort of society*

that is wanted, including whether it is acceptable that the UK has large numbers of fuel poor; whether the UK should act as a responsible global nation/friend; if there is a concern about the environment; and that the balance is between environment and security'. The issue of energy security also has important geographical dimensions. Bridge et. al. (2013) argued that 'the different elements of a policy to promote energy security..... rest on assumptions about the geographical scale at which energy systems should be governed.' Further Bridge et. al. (2013) suggested that 'ensuring the availability and accessibility of energy services in a carbon constrained world will require developing new ways- and new geographies- of producing , living and working with energy.'

It is important to recognise that emerging energy landscapes have become a focal point of debate within many countries and concerns are increasingly being raised about these energy landscapes and more specifically about the benefits and costs new energy developments bring to a range of stakeholders and particularly to those local communities where developments are taking place. Calvert and Mabee (2013 webpage), for example, argued that *'the unique physical properties or materialities (i.e. quality, quantity, location') of emerging energy resources are at the root of disruptive change to physical and social landscapes, and therefore of social resistance to policy efforts aimed at a sustainable energy future.'* Selman (2010,), for example, has argued that *'energy is likely to be a major driver of new landscapes as society seeks ways of weaning itself off fossil carbon fuels'* and that *'society's increasingly earnest pursuit of sustainable development will involve landscape changes that attract protest and opposition.'* More generally Jiusto (2009, p.534) has called for research into how society is *'contesting the next energy revolution'* and Bridge (2012, p.7). has emphasised the need to explore *'contemporary energy dilemmas—such as determining whether, how and for whom particular landscapes should be valued for their energy generating potential, or deciding on the geographical scale at which trade-offs between energy security and environmental impact should be made.'*

Shale Gas and Fracking

Shale gas is natural gas, mainly composed of methane, trapped in organic rich shale beds often located between **3,250 and 13, 000 feet** below the ground. Traditionally within the UK shale has not been seen as a reservoir rock rather as a source rock in which gas, and oil, are stored before migrating into sandstone or limestone where they have been commercially exploited in a conventional manner. Indeed gas and oil produced from shale are often technically referred to as 'unconventional hydrocarbons.' Shale gas is accessed by fracking. The process involves drilling vertically perhaps 5,000 feet or more below the surface and then drilling a number of horizontal boreholes in several directions. The horizontal drilling means large areas of shale gas can be reached while minimising the number of surface boreholes and this facilitates drilling to less accessible locations. The fracking process involves pumping a mixture of fluids at high pressure into the shale, which creates a path for the gas to flow into the borehole and thence to the surface. Water makes up some 90% of the fluids used in fracking and a large field with 1500 horizontal wells can use up to 20 million gallons of water per day. The water is mixed with gelling agents, which help to prise open the fractures, sandy materials, which hold open the fractures, chemicals, which reduce surface friction during the fracking process, and biocides, which kill bacteria

The development of shale gas reserves includes three distinct stages namely exploration; production; and decommissioning. During the first stage two or three wells are normally drilled using a 25 metre high structure known as a 'well over rig', and flow tested, to determine the incidence of shale gas reserves and this process normally takes up to two weeks. Production involves the commercial development of these reserves which may, depending on the size of the reserve, continue for up to 20 years. When the shale gas reserve reaches the end of its lifespan decommissioning involves filling the well with cement, to prevent further gas flowing into watercourses or to the surface, and capping and landscaping the well head.

The principle of fracking is not new. Explosive charges containing nitro-glycerine were first dropped down wells in the US in the 1880's to shatter hard rock to release gas or oil. Hydraulic fracturing dates from the late 1940's, initially on an experimental basis on a gas field in Kansas in the US, and then on a commercial basis in Oklahoma and Texas. The fracking of shale gas first took place on a demonstration basis in the 1970's but it was early in the 21st century before the technique began to be employed on a large scale commercial basis. Since then developments in drilling and exploitation technology have seen dramatic growth in the fracking of shale gas within the US. By 2013 shale gas was estimated to account for the largest share of total US natural gas production (US Energy Information Administration 2013) and to have transformed the energy landscape within the US. Shale gas resources are now being exploited in West Virginia, Pennsylvania and New York State in the east across to Colorado and New Mexico and from Michigan in the north and as far south as Texas. In summarizing trends within the US KPMG (2013, p.2) suggested that the commercial development of shale gas reserves will continue *'for the foreseeable future.'* At the same time KPMG (2013, p.8) reports that *'inconsistent environmental regulations'* have *'led investors to shun certain states, such as New York, in favour of those which are more supportive of development, such as Texas, North Dakota, Pennsylvania and West Virginia.'*

Globally the Institute for Energy Research (2015) estimated that the total technically recoverable shale gas reserves are some **255, 465 trillion cubic feet** with China, Argentina, Algeria, the US and Canada accounting for 45% of this total. While the term technically recoverable reserves is used to describe the volume of shale gas that could be produced with current technology, three factors, namely the cost of drilling and establishing wells, the volume of gas produced from a well during its lifetime and the price received for the gas, shape the economics of recovery. China has the largest shale gas resources in the world but many of these are located deep below the surface in mountainous rocky desert areas. The installation of production equipment and the construction of pipeline connections to the existing gas network seem likely to impede the commercial exploitation of these resources. In Australia there are sizeable shale gas reserves in both South and West Australia and in the Northern Territories. In Southern Australia, for example, production drilling began in 2012 in the Cooper Basin and here optimistic estimates suggest that up to 25,000 wells may be in production by the late 2020's (UCL International Energy Policy Institute 2013). That said here and elsewhere in Australia the need for the development of new pipelines to transport gas to existing networks and thence to centers of market demand and regulatory problems in allowing access to existing pipelines by new contractors may well slow the pace of development. Within Western Europe shale gas reserves have been identified in the Netherlands, Ireland, France, Germany, Poland, Romania, Bulgaria,

Denmark Sweden and Norway, as well as in the UK, but KPMG (2011, p. 12) suggested that as reserves in a number of these countries *'tend to be close to populated areas and as European environmental laws tend to be quite strict, the potential for significant shale gas production there in the near future seems unlikely.'*

Potential Shale Gas Reserves in the UK

Within the UK there are several areas where Carboniferous and Jurassic shale beds have the potential to produce shale gas including sizeable areas of north-west, central and eastern England, smaller parts of south and north east England, central Scotland and Northern Ireland. Although the commercial development of shale gas has been underway in the US for over twenty years exploration for shale gas reserves within the UK is still very much in its infancy. There are currently no national estimates of how much shale gas will be technically and economically recoverable. The geological conditions are complex in that many of the shale basins are not large continuous structures, such as those found in many North American shale regions, but more typically comprise small fault-bounded sub-basins (Advanced Resources International 2013). At the same time the exploratory process is costly with some estimates suggesting that the average cost of drilling an exploratory well in the UK is some £6 million compared to £2.4 million in the US (Ratcliffe 2014).

The British Geological Survey, in association with the UK Government's Department for Energy and Climate Change, has undertaken a number of shale resource estimates for some areas of the UK. In 2013, for example, the British Geological Survey published their estimate of shale gas resources in the Bowland-Hodder Shale Gas Resources underlying an area stretching from north Wales and Blackpool in the east to Scarborough and Nottingham in the west (British Geological Survey 2015a, webpage). Given geological uncertainty this estimate ranged from 822 trillion cubic feet (tcf) to 2281 tcf with the central estimate being 1329 tcf. That said the British Geological Survey stressed that *'not enough is yet known to estimate a recovery factor'* nor to estimate *'how much gas may be ultimately produced'* (British Geological Survey/Department of Energy and Climate Change 2013, p, 3). Estimates of the Carboniferous shales in the Midland Valley of Scotland ranged from 49 tcf to 135 tcf with the central estimate being 80 tcf but the British Geological Survey suggested that *'the relatively complex geology and limited amount of good quality constraining data result in a higher degree of uncertainty to the Midland Valley of Scotland shale gas estimate than the Bowland-Hodder'* study. (British Geological Survey 2015b, webpage).

A number of small energy companies, including Cuadrilla, IGas, Third Energy and Celtique Energie, have undertaken test drilling wells principally in West Lancashire, Cheshire, Manchester, Somerset, East Yorkshire, South Wales and Northern Ireland.. Cuadrilla, for example, began drilling in 2010 at Preese Hall in Lancashire but following some seismic activity associated with the hydraulic fracturing, the company suspended exploration activity and plugged the well. In response the UK Government announced a moratorium on fracking in July 2011 but following further investigations and consultations permission was given to resume exploratory drilling in December 2012. More recently Cuadrilla recommenced exploratory drilling, and obtained planning permission for such drilling, elsewhere in Lancashire. and Dart Energy, have acquired planning permission for exploratory fracking in Dumfries and Galloway and submitted planning applications for

exploration in the Falkirk and Stirling area of central Scotland. The Scottish Government announced a moratorium on all consents for fracking for shale gas in January 2015 and the Welsh Government imposed a similar moratorium the following month and in the light of these developments the main body of this chapter focuses on fracking for shale gas in England. (REFERENCE)?

Environmental Issues and Risks

The momentum behind shale gas development within the UK has been accompanied by growing and increasingly vocal concerns about the environmental impact of fracking. A wide range of environmental issues and risks have been identified. These include climate change; fugitive carbon dioxide and methane emissions; water use, waste water treatment and water pollution; seismic activity; air pollution; noise; visual intrusion; damage to valued and heritage landscapes; and the fragmentation and loss of habitats, damage to species and reductions in bio-diversity. The potential environmental risks are manifest at a variety of, often partly interlinked, spatial and temporal scales. Concerns about carbon dioxide emissions and climate change might, for example, be seen to be global though they have implications for the UK Government's national targets on the reduction of greenhouse gas emissions.

Shale gas, like other natural gases, is not a low carbon source of fuel and the large scale development of shale gas would certainly not be consistent with a transition towards a more sustainable energy supply system. Methane can be emitted at a number of stages within the fracking process and such fugitive emissions are a particular concern in that methane has high global warming potential. Research on potential climate change impacts of shale gas (Tyndall Centre for Climate Change Research 2011, p.110) concluded that *'without a meaningful cap on global carbon emissions, any emissions associated with shale gas are likely to be additional, exacerbating the problem of climate change.'* Arguably more pointedly Friends of the Earth (2013a, webpage) claimed that *'burning shale gas could set the world on course for catastrophic climate change'* and *'have a major impact on investment in renewable energy needed to decarbonise the energy sector.'*

The initial drilling process and the fracking of shale gas require large volumes of water. Meeting these demands in areas where other users are already finding it difficult to meet their water needs and that are vulnerable to water shortages, may generate increasing stress on resources across wide geographical areas. Following the drilling of a well perhaps as much as 80% of the fracturing fluid, which may be saline and contain naturally occurring radioactive materials, returns to the surface and requires treatment before being returned to natural watercourses. That said although the fracking fluid may be pumped into boreholes at discrete locations, once deep underground it is often difficult to predict its migration and concerns may arise about the contamination of drinking water over a wide area. Groundwater can also be contaminated by fugitive methane.

During the shale gas exploration and production stages a range of gaseous emissions can pass into the air not only from the wells themselves but also from the diesel powered machinery at the drilling site. These emissions can lead to the formation of ozone, photochemical oxidants and particulate matter which can be damaging to human health. While earthquakes can be induced by fracking, shale rock is inherently weak and any

resultant seismic activity is normally too small to be noticed at ground level. During the initial drilling phase the delivery of equipment, materials and water and the increase in vehicle movements can cause environmental disruption and there is also noise pollution from the drilling process. Fracking also has a significant footprint on the landscape. Land clearance is required, with up to two hectares required for each well head plus any land required for improved road access, and this can damage or destroy amenity, landscapes and habitats, reduce biodiversity, and lead to soil erosion.

There are also social concerns about the disruption fracking could bring to small communities, and to their traditional ways of living and working and of the possible impact on property prices and land values. There are concerns, for example, about the capacity of local infrastructure to cope with the attendant increase in traffic, employees and drilling equipment and worries that the chemicals used in the fracking process could pose health risks. In some rural areas there are fears that fracking operations may lead to a reduction in the number of tourists and of the income tourism has traditionally generated. While proposed fracking operations may have an effect on house prices, on potential purchaser's perceptions, on the availability of mortgages and on property insurance in the immediate vicinity of such operations. The employment of horizontal drilling could also have adverse property impacts across a much wider geographical area.

More general concerns have been expressed about the cumulative impact of a number of the environmental (and social) risks outlined above in areas such as South West Lancashire in the north of England, for example, where much of the initial fracking activity in the UK has been concentrated. In a wide ranging report on the potential environmental risks arising from fracking operations in Europe for the European Commission, AEA, for example, suggested that the development of shale gas reserves may span a wide geographical area and argued that *'cumulative risks need to be taken into account in risk assessment'* (AEA 2012, p. 24). The AEA report classed the cumulative impacts associated with water resources; ground and surface water contamination; gas emissions; land take; risks to biodiversity; noise impacts; and traffic as all being *'high'* (AEA 2012, P. vi). More specifically research on the large Marcellus shale gas reserves in the US (Evans and Kiesecker 2014) concluded *'our analysis reveals it will be the cumulative impacts that pose the greatest challenge for landscape level conservation.'*

Reputation

Public concern about many of the potential environmental risks associated with the fracking of shale gas reserves is generally seen to pose a significant threat to the successful commercial development of these reserves. In taking *'a global perspective'* on the *'risks that could dim the future of shale gas'*, KPMG (2011, p.18), for example, suggested that *'the industry needs to control reputation risk and turn public opinion round'* and that *'negative public opinion about environmental safety of the hydraulic fracturing process could undermine the development of this industry, particularly where the process is used in –or directly under- populated areas'* (KPMG 2011, p.19). More specifically within the UK in identifying *'reputation'* as one of the main barriers to enabling commercial production to go ahead the Institute of Directors (2013a,p.137) suggested that *'without a social licence to operate the industry will find it more difficult and more time consuming to obtain the*

necessary approvals to undertake exploration, and subsequent production activities. In a similar vein KPMG (2013, p.25) argued that *'If the UK is to meet the government's goals and extract shale gas on a commercially viable basis, the sector needs to overcome regulatory and market barriers and manage negative public views on exploration'* (KPMG 2013). A battle has certainly been underway within the UK to win the public's hearts, minds and confidence particularly, though certainly not entirely, within local communities where exploratory fracking for shale is underway or planned. While it would be an oversimplification to suggest that either those who wish to pursue, encourage and support the commercial development of shale gas and those who oppose its development sing from the same, if very contrasting, hymn sheets two simple illustrative examples provide some basic insights into the case for and against shale gas development and how the battle for reputation is currently being played out.

Firstly a number of national organisations and local groups have been mobilizing against shale gas exploration and production. These groups are generally well organized at the grassroots level, their case draws on a wide range of research evidence and they also tap into powerful community emotions. They have been harnessing information and communication technologies and social media to good effect and some have taken direct action to blockade sites in an attempt to stop exploratory drilling activity. At the local level a large number of opposition groups have emerged and are linked under the umbrella of 'Frack Off: Extreme Energy Action Network.' In July 2013 some 21 local groups were listed on the pressure group's website (Frack Off: Extreme Energy Action Network 2013, webpage) but by November 2015 the number of local groups had risen to 202 spread throughout much of the UK. (Frack Off: Extreme Energy Action Network 2015a, webpage). Local group Trowbridge Area Frack Free, for example, *'is for anyone in the Trowbridge area who is concerned about the impact fracking will have'* and claims *'we want to share information with the public and raise awareness of what fracking means for the environment, wildlife, house prices and the increase in heavy traffic on our roads'* (Frack Off Extreme Energy Action Network 2015a, webpage). In a similar vein Frack Free York is *'a grassroots group set up to raise awareness about and to prevent new forms of gas extraction in our local community. We provide a channel for action and work together with local and national groups'* (Frack off Extreme Energy Action Network 2015a, webpage).

Nationally Frack Off outlined *'The Fracking Threat to the UK'* in graphic terms namely *'Fracking is a nightmare! Toxic and radioactive water contamination. Severe air pollution. Tens of thousands of wells, pipelines and compressor stations devastating our countryside and blighting communities. All while accelerating climate change. And to produce expensive gas that will soon run out'* (Frack Off: Extreme Energy Action Network 2015b, webpage). More widely, but equally graphically, Frack Off argued *'fracking is just a symptom of a much wider problem. As easier to extract energy resources are exhausted by the unsustainable energy consumption of the present system, we are resorting to ever more extreme methods of energy extraction'* (Frack Off: Extreme Energy Action Network 2015b, webpage). Frack Off also argued *'at present we are on a course which leads towards a world dominated by energy extraction and where most of the energy produced is used to run the extraction process while people live and die in its toxic shadow'* and that *'the present system's addiction to massive amounts of energy is driving this headlong rush towards oblivion and unless something is done to stop it we will all be dragged down into hell with it*

(Frack Off: Extreme Energy Action Network 2015b, webpage). Extreme Energy Action Network provides a range of *'Campaign Resources'* on its website including impact image resources, films, flyers and fact sheets and workshops.

Secondly energy companies, the business community and the UK Government have stressed the benefits that shale gas development will bring and have looked to assuage environmental and social concerns. The energy company, Cuadrilla, for example, argues that such development *'has been shown to have significant benefits for the communities in which operations take place, the regions that host them and for the rest of the country as well'* (Cuadrilla 2015a, webpage). These benefits are described as *'jobs and investment', 'energy security', 'community benefit'* and *'tax revenue'* (Cuadrilla 2015 a webpage). Cuadrilla claims to be *'part of the community it operates within'* and to be *'keen to make a contribution to community life'* (Cuadrilla 2015b, webpage). Cuadrilla also claims that throughout its operations *'robust safety measures are in place to protect the environment'* Cuadrilla 2015c, webpage). Cuadrilla has also undertaken a number of other public engagement activities designed *'to provide residents and representatives with factual information about what is involved in the exploration for natural gas in shale rock'* (Cuadrilla 2015d, webpage). These activities included the distribution of newsletters to residents living near to current and proposed drilling sites, site visits, presentations to community groups and a free phone community helpline.

More widely some sections of the UK business community have been keen to emphasise the economic benefits that the development of shale gas could generate. The UK's Institute of Directors argued that *'shale gas could represent a multi-billion pound investment, create tens of thousands of jobs, reduce imports, generate significant tax revenue and support British manufacturing'* (Institute of Directors' 2013b, p. 2). More specifically the UK's Institute of Directors claimed that *'cement and steel manufacturers, equipment manufacturers, drilling service companies and water treatment specialists would form important parts of the supply chain'* and that *'spending by employees of the industry and its supply chain would benefit local businesses including restaurants, shops, pubs, theatres and hotels'*(Institute of Directors 2013b, p.2). The UK Government has clearly sought to make a strong economic case for the development of shale gas reserves. In 2014 David Cameron, the UK Prime Minister, for example, claimed that *'we're going all out for shale. It will mean more jobs and opportunities for people and economic security for our country'* (Gov. UK 2014b, webpage). Edward Davey, the then Secretary of State for Energy and Climate Change has argued that shale gas is *'a national opportunity'* and more specifically *'an opportunity for investment, jobs and tax revenues'* (Gov. UK 2013b, webpage). At the same time the Government has also looked to answer many of the environmental concerns outlined earlier. A study of the potential greenhouse gas emissions from the production of shale gas in the UK, for example, commissioned in 2012 by the UK Government's Department of Energy and Climate Change (Mackay and Stone 2013, p.37), concluded that *'with the right safeguards in place, the net effect on UK greenhouse gas emissions from shale gas production in the UK will be relatively small.'* The Government has also looked to present shale gas as the *'cleanest fossil fuel'* (Department of Energy and Climate Change 2013, p.10) which would help, as part of a diverse energy mix, to act as a bridge in the transition to a low carbon future.

The Government has also stressed that shale gas development *'must be done in partnership with local people'* and that it wants *'to encourage a shale industry that is safe and doesn't damage the environment,'* (GOV. UK 2013a, webpage). In March 2013 the Government announced the creation of the new Office of Unconventional Gas and Oil within the Department of Energy and Climate Change. This Office plans, inter alia, to *'bring forward proposals to ensure people benefit from shale gas production if there are future developments in their area'* (Gov. UK 2013c, webpage). In 2014 the Government introduced a package of benefits, including financial support, for communities located close to exploratory wells and local councils in such areas will be able to retain 100%, as opposed to the existing 50%, of business rates from any shale gas developments (Gov. UK 2014b, webpage).

Regulation and the Planning Framework

Shale gas within the UK is owned by the state, under the Petroleum Act of 1988, and a Petroleum and Exploration and Development Licence (PEDL) is required for the development of shale gas reserves. At the time of writing (November 2015) the UK government had issued licences to a range of energy companies for 203 blocks, each about 4 miles square, and these licences confer exclusive rights to undertake exploratory drilling and production of shale gas (White, Felt, Smith and Keep 2015). Licences in themselves do not give consent for fracking and a number of other permissions are required before a company can begin exploratory or production drilling for shale gas. More specifically companies must gain access rights from the landowners, obtain both the relevant environmental permits to drill from the UK's Department for Energy and Climate Change, meet the UK's Health and Safety Executive's health and safety regulations and obtain local authority planning permission. Where fluids used in the fracking process contain pollutants, for example, then an environmental permit must be obtained from the UK's Environment Agency. The Environment Agency will also take account of the potential impacts of fracking on groundwater levels and the appropriate consents may be required before drilling can commence. The Health and Safety Executive is responsible for monitoring safe working practices and the integrity of borehole operations.

Within the UK it is the local minerals planning authority that is responsible for determining if shale gas exploration and production by fracking is acceptable at specific sites. Given the scale of recent estimates of shale gas reserves local minerals planning authorities in many parts of the UK seem likely to face a growing number of applications for shale gas exploration and production. Some national planning guidelines have recently been published which might be seen to help local minerals planning authorities in determining such applications. The National Planning Policy Framework (NPPF) for England and Wales published in 2012, for example, did not explicitly mention fracking and thus it offered nothing by way of specific guidance for local planning authorities. That said potentially contradictorily the NPPF stressed the need *'to help increase the use and supply of renewable and low carbon energy, local authorities should recognise the responsibility on all communities to contribute to energy generation from renewable and low carbon sources'* (Department for Communities and Local Government 2012, p. 22.) That said the NPPF also emphasised the need *'to respond to the changes that new technologies offer us', to 'accommodate the new ways by which we will earn our living in a competitive world'*

(Department for Communities and Local Government 2012, p. 1) and to *'give great weight to the benefits of mineral extraction, including to the economy'* (Department for Communities and Local Government 2012, p34).

However in 2013 the Government published planning practice guidance for onshore oil and gas exploration and production for England. This guidance provides advice on *'how shale gas development should proceed through England's planning system'* (Department for Communities and Local Government 2013) and included advice on development management procedures, environmental impact assessment, determining planning applications and decommissioning and land restoration. This guidance on the need to conduct an environmental impact assessment, for example, suggested that such an assessment would only be required *'if the project is likely to have significant environmental effects'* and that *'it is unlikely that an Environmental Impact assessment will be required for exploratory drilling operations'* (Department for Communities and Local government 2013, p.13). Planning authorities are also advised to take account of the possible cumulative effects of one or more applications for shale gas development within an area but here again the advice is that such cumulative effects are unlikely at the exploration phase. The guidance lists some 16 environmental issues including noise, landscape character, land contamination and flood risk, which should be addressed by planning authorities. More generally local planning authorities are advised that they must ensure that shale gas development is appropriate to its location and that it does not have an unacceptable adverse impact on the natural or historic environment or human health (Department for Communities and Local Government 2013). In determining planning applications for shale gas exploration and production, local authorities were advised that while they should not consider the demand for, or the alternatives to shale gas but that they should *'give great weight to the benefits of mineral extraction'* (Department for Communities and Local government 2013, p. 15).

While the guidance sought to provide greater clarity about the planning process for shale gas exploration and extraction it was not universally well received. Within the planning profession some critics have argued that this guidance was weighted in favour of granting permission. A principal planner at Savills, the UK's leading estate agency, for example, was reported as arguing that the guidance was akin to a presumption in favour of the development of shale gas resources and more specifically that *'rather than just introducing controls over how decisions would be made, the guidance implies that government wants to see them go through'* (Planning Resource 2013, webpage).

Pinsent Masons (2013, p.2), a UK based law firm with specific expertise in energy and natural resources and real estate, for example, suggested that the guidance was not comprehensive. More specifically Pinsent Masons argued *'there are areas where some in the industry may find that guidance is lacking: for example, in its failure to tackle key questions such as how planning boundaries should be drawn for directional and horizontal drilling once the appropriate rock formation is reached, how to deal with issues where the surface and subsurface are in different ownership and the way in which the guidance deals with the consideration of alternatives in the context of need and demand.'* More critically Friends of the Earth (2013b, webpage) has criticized this guidance, arguing that it *'will ride*

roughshod over local concerns about shale gas exploration and development with little regard for the impact on the wellbeing of local people or the environment’ and that it is ‘little more than a carte blanche to dispatch dirty energy companies into the British countryside to start sinking thousands of new fracking wells.’

In June 2015 the first, and currently the only, planning applications to permit shale gas production by fracking in the UK, on two sites, at Roseacre Wood in Preston and at Little Plumpton, between Blackpool and Preston in Fylde, West Lancashire, submitted by the energy company Cuadrilla, were rejected by Lancashire County Council planning authority. The application at the Plumpton site, for example, was rejected for two reasons. Firstly *‘The development would cause an unacceptable adverse impact on the landscape, arising from the drilling equipment, noise mitigation equipment, storage plant, flare stacks and other associated development. The combined effect would result in an adverse urbanising effect on the open and rural character of the landscape and visual amenity of the residents contrary to policy DM2 Lancashire Minerals and Waste local Plan and Policy EP11 of the Fylde Local Plan.’* Secondly *‘The development would cause unacceptable noise impact resulting in a detrimental impact on the amenity of local residents which could not be adequately controlled by condition contrary to Policy DM2 of the Lancashire Minerals and Waste Local Plan and Policy EP27 of the Fylde Local Plan’* (Lancashire County Council 2015). In July 2015 Cuadrilla announced their intention to formally appeal against Lancashire County Council’s refusal of planning permission for fracking at the two sites and the appeals were subsequently submitted in September 2015.

Seemingly, though not explicitly, in response to Lancashire County Council’s rejection of these two applications and perhaps because of the signal it might be seen to send to other local planning authorities, in August 2015, the UK Government announced that *‘shale gas planning applications will be fast tracked through a new dedicated planning process’* (Gov..UK 2015). The objective was *‘to ensure shale applications can’t be frustrated by slow and confused decision making amongst councils (local planning authorities), which benefits no one’* and a number of specific measures were included in the announcement. The Secretary of State for the Department for Communities and Local Government can call in shale gas planning applications on a case by case basis, thus removing the decision making process from the local planning authority and can also call in shale gas applications that have not been determined by local planning authorities within the 16 week statutory timeframe. More pointedly where local authorities repeatedly fail to determine shale gas applications within the statutory time frame could lose their right to determine any such future applications. At the same time the emphasis will ensure that any applications called in and all appeals are prioritised by the Government’s Planning Inspectorate.

While it remains to be seen how these new measures will play out in reality they attracted widespread criticism when announced. Local authority politicians in Lancashire, for example, expressed concerns about proposals which may effectively take decisions about the fracking of shale gas away from the locally elected representatives. At the same time there are also concerns that in submitting planning applications for fracking shale energy companies may include large amounts of detailed technical data and documentation in support of their application and the local planning authority may find this very difficult to

assimilate and evaluate within the statutory 16 week time frame. Where local community groups and environmental organisations also look to make detailed and wide ranging representations to the local planning authority this may further exacerbate delays and effectively play into the hands of the applicants. Friends of the Earth (2015) argued *'bulldozing fracking applications through the planning system, against the wishes of local people and councils, will simply fan the flames of mistrust and opposition. Local authorities have been following the rules. These changes are being made because the Government doesn't agree with the democratic decisions councils have been making.'* More generally a report on the potential environmental impacts of fracking for shale gas undertaken for a range of UK nature conservation organisations concluded *'the current regulatory regime is not fit for purpose and therefore unable to adequately manage serious environmental risks that may arise from individual projects and cumulative development'* (Moore et.al. 2014, p. 26).

Conclusion

The commercial exploitation of shale gas reserves is very much at the exploratory stage in the UK but the pressures for the commercial development of these reserves by fracking have gained momentum in a number of areas. Opinion is sharply divided about the potential economic benefits and environmental risks of such development. While the UK Government and the business community have generally been keen to stress the economic benefits the development of shale gas could bring nationally and locally, a range of environmental pressure groups are energetically and vociferously opposed to such development. Within the shale gas industry there certainly is a broad consensus that promoting positive messages about shale gas development and managing and countering many of the negative public views about such developments are essential if shale gas resources are to be successfully exploited commercially. To this end a number of the energy companies have engaged public relations companies to develop comprehensive, coherent and co-ordinated media relations campaigns in an attempt to win hearts and minds at both the local and national levels. However the scale of the challenges should not be underestimated. The independent global risks consultancy, Control Risks (2013, p1), for example has argued that *'the oil and gas industry has largely failed to appreciate social and political risks and has repeatedly been caught off guard by the sophistication, speed and influence of anti-fracking activists.'*

Given current Government thinking local minerals planning authorities in many parts of the UK may receive a growing number of planning applications for shale gas exploration and development and they seem likely to have the primary regulatory responsibility for determining whether initial exploration for, and subsequent production of, shale gas reserves goes ahead. As such in looking to reconcile competing interests at the local level planning authorities may have to balance the potential inward investment and job creation benefits claimed for such exploration and development and their commitments to sustainability and to the transition to a low carbon future and deeply held local environmental and community concerns. That notwithstanding there is a body of opinion that suggests that the direction of thinking adopted by the UK Government is, at best,

flawed and at worst, weighted in favour of the development of shale gas reserves. More generally the potential economic benefits and environmental risks associated with fracking for shale gas can be seen in terms of a local and national framework. Thus while major national economic and energy benefits are claimed for the development of shale gas the environmental risks are concentrated at the local level many.

REFERENCES

- Advanced Resources International (2013) 'World Shale Gas and Shale Oil Resource Assessment', http://www.adv-res.com/pdf/A_EIA_ARI_2013%20World%20Shale%20Gas%20and%20Shale%20Oil%20Resource%20Assessment.pdf last accessed 25/03/2104
- AEA (2012) 'Support to the identification of potential risks for the environment and human health arising from hydrocarbons operations involving hydraulic fracturing in Europe', <http://ec.europa.eu/environment/integration/energy/pdf/fracking%20study.pdf> last accessed 25/03/2014
- Bradshaw, M.J. (2009) 'The Geopolitics of Global Energy Security', *Geography Compass*, Vol. 3, No. 5, pp.1920-1937
- Bradshaw, M. J. (2010) 'Geographical energy dilemmas: a geographical perspective', *The Geographical Journal*, Vol. 176, No. 4, pp. 275-290
- Bridge, G. (2010) 'Geographies of Peak Oil: the other carbon problem', *Geoforum*, Vol. 41, No. 4, pp. 523-530
- Bridge G. (2012) 'Teaching Energy Issues in Geography', http://www.heacademy.ac.uk/assets/documents/STEM/Teaching-Energy-Issues-in-Geography-GEES_2012.pdf last accessed 25/03/2014
- Bridge, G., Bouzarovski, S., Bradshaw, M. and Eyre, N. (2013) 'Geographies of Energy Transition: space, place and the low carbon economy', *Energy Policy*, vol. 53, pp. 331-340
- British Geological Survey (2015a) 'Bowland Shale Gas' <http://www.bgs.ac.uk/research/energy/shaleGas/bowlandShaleGas.html> last accessed 09/11/2015
- British Geological Survey (2015b) 'The Carboniferous Shales of the Midland Valley of Scotland: Geology and Resource Estimation', <http://www.bgs.ac.uk/research/energy/shaleGas/midlandValley.html> last accessed 09/11/2015
- British Geological Survey/Department of Energy and Climate Change (2013) 'The Carboniferous Bowland Shale Gas Study; Geology and Resource Estimates', https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226874/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf last accessed 24/02/2104

Calvert, K. and Mabee, W. (2013) 'Energy transition management as a spatial strategy: Geographical implications of the transition towards renewable energy',

http://www.geog.psu.edu/sites/default/files/Calvert_Geogs%20of%20RE_working%20paper.pdf last accessed 09/11/2015

Control Risks (2013) 'The Global Anti-Fracking Movement',

http://www.controlrisks.com/Oversized%20assets/shale_gas_whitepaper.pdf last accessed 25/03/2014

Cuadrilla (2015a) 'Benefits' <http://www.cuadrillaresources.com/benefits/> last accessed 09/11/2015

Cuadrilla (2015b) 'Community Benefits',

<http://www.cuadrillaresources.com/benefits/community-benefit/> last accessed 09/11/2015

Cuadrilla (2015c) 'Protecting Our Environment',

<http://www.cuadrillaresources.com/protecting-our-environment/> last accessed 09/11/2015

Cuadrilla (2015d) 'Part of the Community', <http://www.cuadrillaresources.com/about-us/part-of-the-community/> last accessed 09/11/2015

Department for Communities and Local Government (2012) 'National Planning Policy Framework',

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf last accessed 25/03/2014

Department for Communities and Local Government (2013) 'Planning practice guidance for onshore oil and gas',

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224238/Planning_practice_guidance_for_onshore_oil_and_gas.pdf last accessed 24/03/2014

Department for Energy and Climate Change (2013) 'Developing Onshore Shale Gas and Oil-Facts About Fracking',

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265972/Developing_Onshore_Shale_Gas_and_Oil_Facts_about_Fracking_131213.pdf last accessed 24/03/2014

Evans, J.S. and Kiesecker, J. M. (2014) 'Shale Gas, Wind and Water: Assessing the Potential cumulative Impacts of Energy Development on Ecosystem Services within the Marcellus Play', PLoS ONE, 9 (2) ,

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0089210> last accessed 20/03/2014

Food and Water Europe (2015) 'For First Time, A Majority of MEPs Vote for An Immediate Moratorium On Fracking', <http://www.foodandwatereurope.org/pressreleases/majority-meps-vote-for-immediate-fracking-moratorium/>

last accessed 09/11/2015

Frack Off: Extreme Energy Action Network (2013) 'Local Groups', <http://frack-off.org.uk/local-group-specific-pages/>

last accessed 30/07/2013

Frack OFF: Extreme Action Energy Network (2015a) 'Local Groups', <http://frack-off.org.uk/local-group-specific-pages/> last accessed 03/11/2015

Frack Off: Extreme Energy Action Network (2015b) 'Fracking Threat to the UK', <http://frack-off.org.uk/fracking-hell/> last accessed 03/11/2015

Friends of the Earth (2013a) 'Briefing: Unconventional, unnecessary and unwanted', http://www.foe.co.uk/resource/briefings/shale_gas.pdf last accessed 25/03/2014

Friends of the Earth (2013b) 'Govt. planning guidance on fracking slammed', https://www.foe.co.uk/resource/press_releases/govt_planning_guidance_on_fracking_slammed_19072013 last accessed 25/03/2014

Friends of the Earth (2015) 'UK GOVERNMENT announces new fast-track fracking policy' 'https://www.foe.co.uk/resource/press_releases/govt-fast-track-fracking-through-planning-system_13082015 last accessed 03/11/2015

Gov. UK (2013a) 'Estimates of shale gas resource in North of England published, alongside a package of community benefits', <https://www.gov.uk/government/news/estimates-of-shale-gas-resource-in-north-of-england-published-alongside-a-package-of-community-benefits> last accessed 24/03/2014

Gov. UK (2013b) 'The Myths and Realities of Shale Gas Exploration', <https://www.gov.uk/government/speeches/the-myths-and-realities-of-shale-gas-exploration> last accessed 24/03/2014

Gov. UK (2013c) 'New office to look at community benefits for shale gas projects', <https://www.gov.uk/government/news/new-office-to-look-at-community-benefits-for-shale-gas-projects> last accessed 25/03/2014

Gov. UK (2014a) 'Providing regulation and licencing of energy industries and infrastructure', <https://www.gov.uk/government/policies/providing-regulation-and-licensing-of-energy-industries-and-infrastructure/supporting-pages/developing-shale-gas-and-oil-in-the-uk> last accessed 24/03/2014

Gov. UK (2014b) 'Local councils to receive millions in business rates from shale gas development', <https://www.gov.uk/government/news/local-councils-to-receive-millions-in-business-rates-from-shale-gas-developments> last accessed 25/03/2014

Gov. UK (2015) 'Faster decision making on shale gas for economic growth and energy security', <https://www.gov.uk/government/news/faster-decision-making-on-shale-gas-for-economic-growth-and-energy-security> last accessed 05/11/2015

Hoggett, R., Mitchell, C., Woodman, B. and Baker, P. (2011) 'The Key Energy Policy Issues for Energy Security in the UK', http://geography.exeter.ac.uk/catherinemitchell/The_Key_Energy_Policy_Issues_for_Energy_Security_in_the_UK_-_Summary_Report.pdf last accessed 25/03/2015

Institute of Directors (2013a) 'Getting Shale Gas Working',
<http://www.iod.com/influencing/policy-papers/infrastructure/infrastructure-for-business-getting-shale-gas-working> last accessed 17/11/2015

Institute of Directors (2013b) 'Getting Shale Gas Working: Summary Report',
<http://www.iod.com/influencing/policy-papers/infrastructure/infrastructure-for-business-getting-shale-gas-working> last accessed 17/11/2015

Institute for Energy Research (2015) 'US Miles Ahead in Global Shale Race',
<http://instituteforenergyresearch.org/analysis/only-four-countries-produce-shale-oilgas/>
last accessed 20/07/2015

Jiusto, S. (2009) 'Energy Transformations and Geographic Research ' in 'A Companion to Environmental Geography', Eds. Castree, N., Demeritt, D. , Rhoads, D. and Liverman, B., pp. 533-551, Blackwell, London.

KPMG (2011) 'Shale Gas-A Global Perspective',
[http://www.google.co.uk/#bav=on.2,or.r_qf.&fp=881ed480936369b9&q=KPMG+\(2011\)+%E2%80%98Shale+Gas-A+Global+Perspective%E2%80%99%2c](http://www.google.co.uk/#bav=on.2,or.r_qf.&fp=881ed480936369b9&q=KPMG+(2011)+%E2%80%98Shale+Gas-A+Global+Perspective%E2%80%99%2c) last accessed 25/03/2014

KPMG (2013) 'Shale Development: Global Update',
<http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/shale-gas/Documents/shale-development-global-update.pdf> last accessed 25/03/2104
last accessed 15/07/2014

Lancashire County Council (2015) Development Control Committee
Minutes of the Meeting held on 23, 24, 25 and 29 June 2015 at 10.00 am in
Council Chamber, County Hall, Preston
<http://council.lancashire.gov.uk/documents/s67167/FinalDCminsJunewithannexs.pdf> last
accessed 29/10/2015

McKay, D. and Stone, T. (2013) 'Potential Greenhouse Gas Emissions Associated with Shale Gas
Extraction and Use',
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf last accessed 24/02/2104

Moore, V., Beresford, A. and Gove, B. (2014) 'Hydraulic fracturing for shale gas in the UK', RSPB,
Sandy, Bedfordshire,
[https://www.google.co.uk/#q=Moore%2C+V.%2C+Beresford%2C+A.+and+Gove%2C+B.+\(2014\)+%E2%80%98Hydraulic+fracturing+for+shale+gas+in+the+UK%E2%80%99](https://www.google.co.uk/#q=Moore%2C+V.%2C+Beresford%2C+A.+and+Gove%2C+B.+(2014)+%E2%80%98Hydraulic+fracturing+for+shale+gas+in+the+UK%E2%80%99) last accessed 25/03/2014

Pinsent Masons (2013) 'Shale Gas & Fracking Toolkit: Part 3',
<http://www.pinsentmasons.com/PDF/ShaleGasFrackingPart3.pdf> last accessed 25/03/2014

Planning Resource (2013) 'Warning of Fracking Guidance Bias',
<http://www.planningresource.co.uk/article/1192695/warning-fracking-guidance-bias> last
accessed 14/02/2014

Ratcliffe, V. (2014) 'Brakes put on UK shale gas revolution',
<http://www.ft.com/cms/s/0/99d6a16e-a3ba-11e3-88b0-00144feab7de.html#axzz2wxUlB2rr> last accessed 25/03/2014

Selman, P. (2010) 'Learning to Love the Landscapes of Carbon-Neutrality', Landscape Research, Vol. 35, No. 2, pp.157-171

Tyndall Centre for Climate change Research (2011) 'Shale gas: an updated assessment of environmental and climate change impacts',
<http://www.mylocalfuneraldirector.co.uk/Corporate/Fracking/1/Shale%20gas%20update%20-%20full%20report.pdf> last accessed 25/03/2014

UCL International Energy Policy Institute (2013) 'shale gas in Australia: The Policy Options',
<https://www.ucl.ac.uk/australia/files/shale-gas-in-australia-green-paper-final> last accessed 09/11/2015

US Energy Information Administration (2013) 'Technically Recoverable Shale Oil and Shale Gas Resources',
<http://www.eia.gov/analysis/studies/worldshalegas/pdf/overview.pdf?zscb=599773466> last accessed 20/02/2014

White, E., Fell, M., Smith, L. and Keep, M. (2015) 'Shale gas and fracking', House of commons Library; Briefing Paper Number SN06073,
<http://researchbriefings.files.parliament.uk/documents/SN06073/SN06073.pdf> last accessed 09/11/2015

Zimmerer, K. (2013) 'Approaching the New Geographies of Global Energy: Analytics and Assessment of Current Energy Landscapes and Alternatives' in 'The New Geographies of Energy', Ed. Zimmerer, K. pp. 1-10, Routledge, London.