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Asiantaeth yr Amgylchedd Cymru
Environment Agency Wales

Ms. Nicola Gandy,
Bridgend County Borough Council
Development Plan Section,
Innovation Centre,
Laurel Room,
Bridgend Science Park,
Bridgend,
CF31 3NA

Our ref: SH/2012/113690/01-L02
LPA ref: Examination
Date: 14 December 2012

Annwyl Ms Gandy/Dear Ms. Gandy,

EXAMINATION - Bridgend Local Development Plan.
Sessions 9 (Social; Community facilities & Infrastructure) & 12 (Energy).

We refer to the current Examination of the Bridgend Local Development Plan, with particular reference to our written representations and sessions 9 & 12.

We offer the following additional advice and guidance for the Inspector's attention in response to his original questions and enclose copies of 2 publications which may be of interest.

Session 9. Social; Community Facilities & Infrastructure.
Question 1c.
We note the content of the Inspectors agenda with matters and Issues paper for this session and our comments in relation to Policy SP 14.
We note that Bridgend County Borough Council "*offer no evidence to counter this representation*" and consequently we offer no further comments.

Question 1e.
We note that our comments have been noted by Bridgend County Borough Council and that a *SPG 14; Infrastructure, incorporating existing SPGs on Community Facilities and Educational Facilities will be published after the adoption of the LDP".*
We have no further comments.

Session 12. Energy.
Section 3 (Coal Bed Methane extraction) and section 4 (Shale Gas).
Questions 3a; 3b & 3c.
In the interests of clarity we would like to draw to the Inspectors attention the respective methods of extracting unconventional gas and the advice contained in the following documents;

- National Assembly for Wales Shale Gas and Coal Based Methane (unconventional gas) September 2012. Research Service.

BUDDSODDWR MEWN POBL
INVESTOR IN PEOPLE

- Environment Agency. Guidance Note: Regulation of exploratory shale gas operations

We hope the above information and enclosures are of assistance for the Inspector in his Examination of the Bridgend Local Development Plan.

We confirm that we do not wish to present any oral representations at either of the above Examination sessions but expressly draw the Inspector's attention to both this letter and our previous written representations.

Yn ddiffuant / Yours sincerely

[redacted]

David Watkins
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End

National Assembly for Wales

Shale Gas and Coal-bed Methane (unconventional gas)

September 2012

This research paper briefly examines the potential for shale gas and coal-bed methane exploitation, the regulatory regimes covering such activity, and the environmental impacts associated with the extraction and use of the gas.

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Enquiry no: 11/2832

National Assembly for Wales

Shale Gas and Coal-bed Methane (unconventional gas)

September 2012

Lisa Llewellyn

Paper number: 12 / 041

Research Service

Contents

1. Introduction

Shale gas and coal-bed methane (CBM), in conjunction with underground coal gasification, are often referred to as unconventional gases[1]. The term *unconventional* refers to the source rather than the nature of the gas itself. Shale gas is the gas trapped in shale and CBM is methane produced between coal seams. The composition of unconventional gases depends on their source, with shale gas and CBM predominately being methane like conventional natural gas.

[1] DECC, *Meeting Energy Demand, International Energy, **International Gas Markets** (Website)* [accessed 8 September 2011]

2. Shale Gas and Coal-bed Methane

Fossil fuels (such as gas, oil and coal), are produced by the slow decomposition of organic matter buried underground as a result of increased temperature and pressure. Shale gas and CBM differ from conventional gas reservoirs as the gas is directly extracted from the rock that was the source of the gas (shale and coal respectively).[2]

2.1. Shale Gas

Shale gas refers to natural gas that is trapped within fractures and pore spaces within fine-grained sedimentary shale rocks. The Tyndall Centre (2011) identified two major drilling techniques that are used in combination with one another to extract shale gas – horizontal drilling and hydraulic fracturing:

- Horizontal drilling is used to provide greater access to the gas trapped deep in the producing formation. At the desired depth, the drill bit is turned to bore a well that stretches through the reservoir horizontally, exposing the well to more of the producing shale;
- Hydraulic fracturing is where fluid (water, sand and other substances) are pumped into the well at pressure to create and increase fractures in the rock. These fractures start at the injection well and can extend a few hundred metres into the reservoir rock. A material such as sand holds the fractures open, allowing hydrocarbons to flow into the reservoir rock. Between 15 and 80 per cent of the injected fluids are recovered to the surface[3]. Fluid that returns to the surface is captured, treated and disposed of and gas that flows to the surface is captured and used for electricity generation or is put into the mains supply. It is also possible to 'frack' a well several times in its lifetime to increase yield.

2.2. Coal-bed Methane

CBM is different to other traditional gas reservoirs as methane is held within the coal by adsorption[4]. CBM is defined as gas extracted from intact coal seams, in contrast to gas extracted from active or abandoned mines. Extraction of CBM involves drilling down into coal seams, pumping out the groundwater, and the resultant drop in pressure is sufficient for methane held within the coal to be released. Boreholes can also be extended laterally along coal seams to increase extraction volumes. The methane is pumped up to the surface and either burnt for electricity or pumped to the national grid. Occasionally, CBM extraction may need to be enhanced by hydraulic fracturing due to insufficient natural permeability within the coal[5].

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[2] POSTNOTE 374 April 2011 **Unconventional Gas**
[3] Tyndall Centre for Climate Change Research, ***Shale gas: a provisional assessment of climate change and environmental impacts***, January 2011 (page 11)
[4] The accumulation of gases, liquids, or solutes on the surface of a solid or liquid.
[5] National Assembly for Wales, Environment and Sustainability Committee,29 March 2012, **Inquiry into Energy Policy and Planning in Wales, Environment Agency Wales written evidence, (E&S(4)4-13-12)**

3. Potential for Shale Gas and Coal-bed Methane

3.1. Shale Gas

World shale gas reserves are estimated at 450,000 billion cubic metres (BCM)[6] with large amounts of gas reserves available in North America and Western Europe[7]. The potentially recoverable resources of shale gas in the UK are uncertain. In 2010, a British Geological Survey (BGS) study commissioned by the Department of Energy and Climate Change, estimated that there could potentially be 150 billion cubic metres of shale gas recoverable resource within the UK which would equate to approximately 1.5 years of UK gas consumption.[8] However, the BGS also highlighted that:

> …the UK shale gas industry is in its infancy, and ahead of drilling, fracture stimulation and testing there are no reliable indicators of potential productivity.[9]

In June 2010, the then Minister for Environment, Sustainability and Housing (Jane Davidson) also stated that:

> It is not yet clear to what extent shale gas development will be feasible in Wales or the rest of Europe…Any shale gas exploration and assessment, which would be required before full exploitation could be considered, in Wales and the UK as a whole, is likely to be in the future when the sustainable development aspects are far better understood[10].

However, the UK Parliament's Energy and Climate Change Committee's 2011 shale gas report highlights that shale gas resources in the UK could be considerable, with substantial evidence that UK offshore unconventional gas reserves could dwarf the potential onshore supplies.[11] The report also states that these reserves:

> …are unlikely to be a 'game changer' to the same extent as they have been in the US…UK domestic shale gas reserves could be used to increase our self-reliance, but they are unlikely to have as large an impact on our security of supply due to the limited extent of the resource.
> [..]
> We will continue to encourage industry to invest in exploration and development, but recognise that the full potential for commercial shale gas production in the UK remains to be proven[12].

UK shale gas could also be harder to exploit than the major United States basins as:

- UK basins are smaller and more fragmented;
- UK source rock tends to contain less gas at lower pressure; and
- Fracturing may be more challenging due to higher clay contents in the rock[13].

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[6] New Scientist, **Frack responsibly and risks – and quakes – are small**, January 2012
[7] House of Commons Library, **Key issues for the new parliament 2010**
[8] DECC, **Shale Gas: Frequently Asked Questions** [accessed 17 June 2012]
[9] British Geology Survey, **Introduction to Shale Gas** [accessed 17 June 2012]
[10] Davidson, J., Answers to the Written Assembly Questions for answer on 2 June 2010
[11] UK Energy and Climate Change Committee, **Shale Gas**, May 2011
[12] *ibid*
[13] POSTNOTE 374 April 2011 **Unconventional Gas**

3.2. Coal-bed Methane

For CBM, exploration is aided by the significant volume of information available on the location of coal seams in the UK and their gas contents.[14] In 2010 the BGS mapped the locations of CBM wells in the UK and areas that may be of interest for future development (principally in central Scotland, north Staffordshire, Cheshire, Humberside and south Wales)[15]. It was estimated that the UK has total onshore CBM resources of 2,900 billion cubic metres[16]. Even with a yield of 10 per cent[17], the potentially recoverable resources of CBM (at 290 billion cubic metres) would be larger than those of shale gas, although, this volume is also small when compared with conventional resources[18].

For CBM, several companies are at the pilot production stage, for example Tower Colliery in South Wales, but large-scale production in the UK is unlikely before 2016.[19]

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[14] *ibid*
[15] DECC, 2010, ***The Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Coalbed Methane*** *(CBM)*
[16] *ibid*
[17] *ibid*
[18] POSTNOTE 374 April 2011 **Unconventional Gas**
[19] POSTNOTE 374 April 2011 **Unconventional Gas**

4. Regulatory Regime and Guidance

4.1. European

In 2011, the European Union Heads of State concluded that Europe's potential to extract and use unconventional fossil fuel resources should be assessed and the law firm Phillippe & Partners were commissioned to undertake this study.[20] The study was carried out in four countries – Poland, France, Germany and Sweden and concluded that small-scale activities relating to the exploration of shale gas are already subject to EU and national laws and regulations[21], such as REACH[22] and directives on habitats, mining waste, water and hydrocarbons and as such there are no major gaps in EU environmental law when it comes to regulating the current level of activity. Therefore they concluded that there is currently no need for an unconventional gas directive[23]. However, the report also notes that there are areas where EU law could be improved, such as thresholds for environmental impact assessments needing closer scrutiny, especially in cases where small-scale exploration projects with a relatively low impact turn into activities on a larger scale[24]. Following this report, the European Commission judged that its existing legal framework was adequate to address current shale gas extraction.[25]

However, organisations including WWF consider 'it is still too early for energy officials to conclude that existing EU laws do not need adjustment'[26].

4.2. UK Licensing

Within the UK a variety of legislation covers the individual activities associated with unconventional gas developments but does not address their use specifically for such a purpose[27].

There are three stages to unconventional gas exploitation within the UK:

- Exploration / test drilling;
- Pilot production wells; and
- Full-scale production.

The licencing for unconventional gas exploration is not devolved and as such is administered by the Department for Energy and Climate Change (DECC).

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[20] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[21] EurActiv, **No need for further regulation on shale gas: EU study**, 30 January 2012
[22] REACH is the European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances. The law entered into force on 1 June 2007.
[23] Phillippe & Partners, **Final report on Unconventional Gas in Europe** a study carried out for the Directorate General for Energy in the European Commission, November 2011
[24] ENDS Europe, **No need for shale gas directive, commission told**, 27 January 2012
[25] Vopel (2012), EU environmental framework applicable to shale gas practices, European Commission: Brussels.
[26] EurActiv, **No need for further regulation on shale gas: EU study**, January 2012 [accessed 21 March 2012]
[27] POSTNOTE 374 April 2011 **Unconventional Gas**

DECC issue Petroleum Exploration and Development Licences (PEDLs) to operators giving them exclusive rights to prospect for all petroleum types in a licensed area. Licences to exploit gas are provided by the Crown as mineral rights are owned by the Crown rather than the landowner. However PEDLs do not give immediate consent for drilling an exploration well or any other operation.

An operator must negotiate access with landowners; seek permission from the Coal Authority if operations will penetrate coal seams; and also seek local planning permission from the relevant Minerals Planning Authority (MPA), which in Wales is the relevant Unitary Authority or National Park Authority. Proposals will also be screened by MPAs to identify whether an Environmental Impact Assessment (EIA) (under Schedule 2 of the *Town & Country Planning EIA (England and Wales)* Regulations (1999)) is required. If an EIA is not required, environmental and health impacts can still be addressed through the conditions of planning permission, which can address aesthetic impacts, as well as contributions to local noise, traffic and air pollution.[28]

Approval from the Environment Agency may also be required for unconventional gas exploration for the treatment and discharge of water from the site or if the activity is likely to affect groundwater. Additionally the Health and Safety Executive (HSE) regulate the safety aspects of drilling work and in particular are responsible for ensuring appropriate design and construction of a well casing for any unconventional gas borehole. MPAs are responsible for ensuring operators comply with these conditions.

Welsh Ministers have the power to 'call-in' any of these planning applications in order to determine them. The First Minister has also stated[29] that in relation to planning applications for unconventional gas exploration, the Welsh Government would encourage a precautionary approach, as outlined in Mineral Planning Policy Wales:

> …where doubt exists, [local planning authorities] should adopt the precautionary principle in taking planning decisions on mineral development[30].

However, in October 2011, Vale of Glamorgan council leader Gordon Kemp called for more guidance from the Welsh Government specifically on shale gas issues when considering planning applications, noting that:

> There was a lot of public opposition to it [the shale gas test drilling proposal]…I have been calling the [Welsh Government] to determine matters such as this and also come up with some guidance[31].

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[28] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***

[29] National Assembly for Wales, Environment and Sustainability Committee, Energy Policy and Planning in Wales, **RoP**, 15 March 2012

[30] Welsh Government, **Minerals Planning Policy Wales** (page 14) [accessed 21 March 2012]

[31] Planning Portal, **Welsh council urges guidance over shale gas**, 27 October 2011 [accessed 21 March 2012]

In response to this call a Welsh Government spokesperson stated:

> The Welsh Government believes there is a need to look at both the potential of gas exploration, but also concerns about the potential impacts of this form of gas extraction. We would welcome the UK Government working with devolved administrations across the UK to put in place a robust and evidence-based policy framework for Shale Gas in the UK[32].

The Tyndall Centre (2012) also identified that there would be merit in having some technical guidance from the Welsh Government[33].

This is reinforced by the Environment and Sustainability Committee's 2012 Energy Policy and Planning in Wales report's recommendation that the Welsh Government should work with the UK Government and the other devolved administrations to produce technical guidance in the form of a new Technical Advice Note to help local planning authorities in Wales in dealing with planning applications for the exploration and extraction of unconventional gas, including applications where the use of hydraulic fracturing is proposed[34]. Additionally, the Committee identified that it would welcome the UK Government working with devolved administrations across the UK to put in place a robust and evidence-based policy framework for Shale Gas in the UK[35].

The Royal Society and the Royal Academy of Engineering identify within their 2012 report that the UK has experience of hydraulic fracturing and directional drilling for conventional gas applications and over the last 30 years, more than 2,000 wells have been drilled onshore in the UK, of which approximately 200 have been hydraulically fractured to enhance recovery.[36]

Written evidence submitted by Environment Agency Wales to the National Assembly for Wales' Environment and Sustainability Committee during their Energy Policy and Planning in Wales inquiry (2012) stated:

> Our view at present is that we have the necessary regulatory powers to manage the potential environmental risks of unconventional gas through the Environmental Permitting Regulations 2010 and the Water Resources Act 1991. As our experience of these activities increase we will further develop our technical guidance.
>
> We propose to undertake an Environmental Risk Assessment for shale gas similar to that produced for carbon capture and storage…This will be completed in April 2013[37].

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[32] ibid
[33] National Assembly or Wales, Environment and Sustainability Committee's Inquiry into Energy Policy and Planning in Wales, **RoP**, 29 March 2012 Transcript
[34] National Assembly for Wales, Environment and Sustainability Committee, **Inquiry into Energy Policy and Planning in Wales Report** (2012)
[35] *ibid*
[36] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[37] National Assembly for Wales, Environment and Sustainability Committee,29 March 2012, **Inquiry into Energy Policy and Planning in Wales, Environment Agency Wales written evidence, (E&S(4)4-13-12)**

The Royal Society and The Royal Academy of Engineering also stated in their 2012 report that:

> The UK's health and safety regulators and environmental regulators should work together to develop guidelines specific to shale gas extraction to help operators carry out goal based risk assessments…An Environment Risk Assessment (ERA) should be mandatory for all shale gas operations. Risks should be assessed across the entire lifecycle of shale gas extraction, including risks associated with the disposal of wastes and abandonment of wells. Seismic risks should also feature as part of the ERA[38].

4.3. Onshore Oil and Gas Licensing Round

As part of the 13th Onshore Oil and Gas Licencing Round, within Wales 14 PEDLs were issued to four companies in 2008:

- Centrica Energy;
- Composite Energy;
- UK Methane Ltd;
- Coastal Oil and Gas/Eden Energy Ltd (joint venture).

Centrica had PEDLs to look for Coal-bed Methane but divested its interests in each of these in September 2011.

Centrica has PEDLs to look for Coal-bed Methane, and has three proposed sites in Wales; Bryn-Caws, Llangeinor and Ogmore Vale. The planning applications for development of CBM in South Wales are currently for the exploration phase only[39].

Three sites have been identified by Coastal Oil and Gas Ltd for shale gas extraction in Wales, although none so far include the use of hydraulic fracturing. DECC has given permission for drilling at two of these sites. Planning permission has been granted for the sites in Maesteg and Neath. Planning permission was originally refused at Llandow, Vale of Glamorgan. However, this decision was appealed and following a public inquiry the Planning Inspectorate Wales has allowed test drilling to proceed.[40]

Coastal Oil and Gas Limited has already carried out test drillings for CBM in Aberavon, Llangeinor and Pencoed using a licence awarded in a previous licencing round.

DECC has published a **Strategic Environmental Assessment (SEA)** for the 14th onshore oil and gas licensing round, which has now completed its consultation period. DECC is currently considering the responses and intends to issue a response soon and will then be in a position, subject to publication in the Official Journal of the European Union of an appropriate notice, to invite applications in the UK's 14th Round.[41]

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[38] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[39] Planning Inspectorate: **Planning Casework Service**
[40] Planning, **Inspector overturns test drilling for shale gas refusal** [accessed 9 July 2012]
[41] Department of Energy and Climate Change, **Licensing and Regulation**, [accessed 15 July 2012]

5. Environmental Impacts of Unconventional Gas Extraction

Both conventional and unconventional gas wells use the same design and construction methodology, with variation between wells arising as a result of local geology rather than the source of the gas, although shale gas wells are generally deeper than CBM wells.[42] Whilst hydraulic fracturing has been described as an established technology[43,44], concerns have been expressed that the extraction of unconventional gas through this process may be detrimental to both the environment and local communities.[45] The most commonly used fluids for hydraulic fracturing are water-based, with various chemicals added, in addition to the sand proppant to keep fractures open.[46]

In 2012 the International Energy Agency (IEA) executive director stated that:

> If the social and environmental impacts are not addressed properly, there is a very real possibility that public opposition to drilling…will halt the unconventional gas revolution in its tracks[47].

Key areas of concern include the volume of water used for hydraulic fracturing, the risk of water contamination from this process, the emissions associated with unconventional gas, and the risk of seismic activity.

5.1. Water Volumes

In their 2011 report, the Tyndall Centre highlighted that excessive water use for 'fracking' is a particular problem 'given that water resources in many parts of the UK are already under pressure'[48]. Whilst the IEA notes that access to water may be a barrier to unconventional gas developments, it also highlights that technology is starting to reduce the amount of water required.[49] However, according to The Royal Society and the Royal Academy of Engineering's 2012 report, estimates indicate that the amount of water needed to operate a hydraulically fractured shale gas well for a decade may be equivalent to the amount needed to water a golf course for a month or the amount needed to run a 1,000MW coal-fired power plant for 12 hours.[50]

Environment Agency Wales has also identified that it ensures that any work to explore or extract gas does not pose a threat to local rivers, groundwater or public water supplies and that it regulates water abstraction linked to any extraction process if the

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[42] POSTNOTE 374 April 2011 **Unconventional Gas**
[43] Environment Agency, **Unconventional gas - shale gas and coal bed methane, Extracting unconventional gas**
[44] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[45] Tyndall Centre, **Shale gas: a provisional assessment of climate change and environmental impacts**, January 2011
[46] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[47] ENDS Europe, **IEA calls for 'practicable' regulation of shale gas**, 29 May 2012 [accessed 30 May 2012]
[48] Tyndall Centre for Climate Change Research at Manchester University, ***Shale gas: a provisional assessment of climate change and environmental impacts***, January 2011, p6-7
[49] IEA World Energy Report 2009H Chapter 11, p.415
[50] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***

operator wanted to take water directly from a river or from groundwater and will not licence any water abstractions that are unsustainable.[51]

During a House of Commons debate on 23 April 2012, UK Energy Minister Charles Hendry stated that:

> For fracking the actual volumes required are not at all exceptional compared to other industrial activities which routinely take place across the UK. Operators would typically use in total between 10,000 cubic metres and 20,000 cubic metres of water to drill and carry out hydraulic fractures on a well…Fracking is carried out for a few days to get the gas flowing, so the technique is only used for the initial production phase and perhaps again later when production levels begin to drop off. Any operator who wishes to abstract water will need a licence from the Environment Agency, who will only authorise additional water abstraction when there is water available and there are no risks posed to the rights of existing abstraction licence holders[52].

5.2. Water Contamination

Drilling and fracturing also produce large amounts of wastewater, which may contain dissolved chemicals and other contaminants that require treatment before disposal or reuse. The online Geology and Earth Science news site, Geology.com, identifies that due to the quantities of water used and the complexities inherent in treating some of the chemicals, wastewater treatment and disposal is considered an important and challenging issue.[53] It also highlights that if mismanaged, the hydraulic fracturing fluid could be released by spills, leaks, or various other exposure pathways, and due to the use of potentially hazardous chemicals in the fracturing fluid, any release of this fluid could potentially result in the contamination of surrounding areas, including sources of drinking water, negatively impacting natural habitats[54].

Concerns have arisen in the United States about the disposal of excess fracturing fluid and residual fluids produced by the well. In particular, complaints have been made about the temporary storage of these fluids in open pits, which could lead to local environmental damage should the pits overflow, for example following heavy rain.[55] Wastewater ponds however are not permitted in the UK and instead wastewater is stored in closed metal tanks before being treated[56].

Following reported instances within the United States of tap water catching alight when a flame is held next to it, many campaign groups have raised concerns that hydraulic fracturing may cause harmful substances and toxins to enter the water supply. However, in a November 2011 Westminster Hall debate, the Energy Minister Charles Hendry noted that most of the United States incidents could be explained:

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[51] National Assembly for Wales, Environment and Sustainability Committee,29 March 2012, **Inquiry into Energy Policy and Planning in Wales, Environment Agency Wales written evidence, (E&S(4)4-13-12)**
[52] HC Deb 23 April 2012 c614W
[53] Geology.com, **What is Shale Gas?** [accessed 3 January 2012]
[54] *ibid*
[55] POSTNOTE 374 April 2011 **Unconventional Gas**
[56] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***

> Where those reports have been investigated by the relevant US regulators, the evidence so far is that no incident of water contamination by methane has been attributed to fracking operations…Also, some incidents of methane contamination of water were not attributable to oil or gas operations at all; they were caused by methane of recent biological origin[57].

In the 2010 budget report for that fiscal year, the U.S. House of Representatives Appropriation Conference Committee recognised the need for a study into the potential effects and impacts of hydraulic fracturing on drinking water and groundwater and commissioned the Environmental Protection Agency (EPA) to undertake this study. The preliminary results of this study are expected by the end of 2012, with the final report scheduled for 2014.

President Obama's January 2012 State of the Union Address said that any companies drilling on government land would have to disclose chemicals used for fracking so "America will develop this resource without putting the health and safety of our citizens at risk".[58] This disclosure is already required in the UK where the environmental regulator has the power under the *Water Resources Act (1991)* to demand the disclosure of the composition of fracturing fluid[59].

The Tyndall Centre's 2011 report on shale gas states:

> Evidence from the US suggests shale gas extraction brings a significant risk of ground and surface water contamination and until the evidence base is developed a precautionary approach to development in the UK and Europe is the only responsible action. The depth of shale gas extraction gives rise to major challenges in identifying categorically pathways of contamination of groundwater by chemicals used in the extraction process[60].

However, the UK Energy and Climate Change Committee's 2011 Shale Gas report states that:

> There is no evidence that the hydraulic fracturing process poses any risk to underground water aquifers provided that the well-casing is intact before the process commences. Rather, the risks of water contamination are due to issues of well integrity, and are no different to concerns encountered during the extraction of oil and gas from conventional reservoirs. However, the large volumes of water required for shale gas could challenge resources in regions already experiencing water stress
> […]
> The Environment Agency needs to ensure that companies declare the type, concentration, and volume of all chemicals added to the hydraulic fracturing fluid. The Agency must ensure that they have the resources necessary to detect these chemicals in water supplies should an incident lead to potential contamination of water resources.[61]

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[57] HC Deb 3 November 2011 c363WH
[58] Financial Time, **US set to require disclosure from 'frackers**, 25 January 2012 [accessed 5 March 2012]
[59] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[60] Tyndall Centre for Climate Change Research, **Shale gas: a provisional assessment of climate change and environmental impacts**, January 2011 (page 5)
[61] UK Energy and Climate Change Committee, **Shale Gas** (May 2011)

In its response to this report, the UK Government stated that:

> Adverse effects on water resources as a result of possible expansion of the shale gas industry in the UK are not expected[62].

The Environment Agency Wales has also highlighted that:

> An environmental permit is needed if fluids containing pollutants are injected in to rock formations that contain groundwater. The operators must disclose all chemicals that will be used. We can also require the disclosure of substances even if an environmental permit is not required. This information is available to the public.
>
> We will only issue a permit if we believe that the activity does not pose an unacceptable risk to the environment. Where a permit is granted, officers will inspect the site to check that permit conditions are being met[63].

In a November 2011 Westminster Hall debate, the Energy Minister Charles Hendry stated:

> …there is no evidence that the fracking process itself poses a direct risk to underground water resources, and that the risks are related to the integrity of the well and are not different from those encountered in conventional oil and gas extraction. The Government and their regulatory agencies will continue to study the experience already gained in north America and its relevance to shale gas activities in the UK. It is, of course, necessary to make the point that UK conditions, including its geology and its regulatory framework, are different, and there will not necessarily be any straightforward read-across. However, it is clearly important that we learn from the US experience, as the Committee recommended[64].

5.3. Methane Emissions

Methane is released as a 'fugitive' emission[65] during the drilling and production of both unconventional and conventional wells, and as part of the processing, transportation and storage of the gas.[66] Such emissions were previously considered small relative to the overall emissions of natural gas, which include those from its combustion for electricity or heat generation. However, the Environment Protection Agency recently increased its estimates of fugitive emissions from United States unconventional gas wells[67]. Howarth *et al* (2011)[68] recently used this data to estimate that fugitive emissions from United States unconventional gas are 'at least 30 per cent more than and perhaps more than twice as great as those from conventional gas'.

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[62] Energy and Climate Change - ***Seventh Special Report Shale Gas: Government Response to the Committee's Fifth Report of Session 2010-12***, 19 July 2011
[63] National Assembly for Wales, Environment and Sustainability Committee,29 March 2012, **Inquiry into Energy Policy and Planning in Wales, Environment Agency Wales written evidence, (E&S(4)4-13-12)**
[64] HC Deb 3 November 2011 c363WH
[65] Fugitive emissions are unintended emissions released into the air, for example, from leaks in equipment
[66] US Environmental Protection Agency, **Greenhouse Gas Emissions Reporting from the Petroleum and Natural Gas Industry: Background and Technical Support document**
[67] *ibid*
[68] Howarth RW *et al.*, 2011, *Climatic Change.* DOI: 10.1007/s10584-011-0061-5

5.4. Carbon Emissions

In oral evidence to the Environment and Sustainability Committee of the National Assembly for Wales, the Tyndall Centre stated that the use of shale gas cannot be reconciled with the UK and Welsh Government's commitments to reducing carbon emissions even if carbon capture and storage technology was to become available.[69] Some groups are also concerned that additional gas production may supplement rather than displace the use of coal, especially in countries with increasing energy demand. There is also concern that increasing gas-based electricity generation, fuelled by abundant unconventional gas, could discourage investment in low-carbon technologies.[70]

The National Assembly for Wales' Environment and Sustainability Committee's 2012 Energy Policy and Planning in Wales report highlights that despite the Welsh and UK Government's view that the potential of unconventional gas needs to be explored whilst taking account of the potential risks, the Committee considers that the development of another carbon intensive energy industry at this time is not appropriate and cannot be reconciled with EU and UK commitments to reduce emissions[71].

5.5. Seismic Activity

On 1 April and 27 May 2011 two earthquakes with magnitudes 2.3 and 1.5 were felt in the Blackpool area. These earthquakes were suspected to be linked to hydraulic fracture treatments at the Preese Hall well operated by Cuadrilla Resources Ltd[72]. The hydraulic fracture treatments were carried out during exploration of a shale gas reservoir in the Bowland basin. On 31 May 2011 Cuadrilla issued a statement saying it was postponing 'fracking' operations while it interpreted seismic information and undertook a full technical study into the relationship between the earthquakes and their operations.

Cuadrilla funded a geomechanical study along with further work by the BGS and Keele University, which was produced on 2 November 2011 and given to DECC to consider. The study concluded the following:

- It is highly probable that the hydraulic fracturing of Cuadrilla's Preese Hall-1 well did trigger a number of minor seismic events.
- None of the events recorded, including one in April of 2.3 and one in May of 1.5 on the Richter scale, had any structural impact on the surface above.

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[69] National Assembly for Wales, Environment and Sustainability Committee, Inquiry into Energy Policy and Planning in Wales, **RoP**, 29 March 2012
[70] POSTNOTE 374 April 2011 **Unconventional Gas**
[71] National Assembly for Wales, Environment and Sustainability Committee, **Inquiry into Energy Policy and Planning in Wales Report**, 2012
[72] Department of Energy and Climate Change, **Invitation for comments on the report: 'Preese Hall shale gas fracturing: Review & recommendations for induced seismic mitigation'** [accessed 17 June 2012]

- The seismic events were due to an unusual combination of geology at the well site coupled with the pressure exerted by water injection as part of operations.
- This combination of geological factors was extremely rare and would be unlikely to occur together again at future well sites.
- If these factors were to combine again in the future local geology limits seismic events to around magnitude 3 on the Richter scale as a "worst-case scenario".
- Cuadrilla's water injection operations take place very far below the earth's surface which significantly reduces the likelihood of a seismic event of less than 3 on the Richter scale having any impact at all on the surface.[73]

The BGS said in January 2012 that the minor earthquakes caused by fracking are:

> 'comparable in size to the frequent minor quakes caused by coal mining. What's more, they originate much deeper in the crust so have all but dissipated by the time they reach the surface'[74].

The Royal Society and The Royal Academy of Engineering (2012) have stated in their report that:

> Concerns have also been raised about seismicity induced by hydraulic fracturing…the UK has lived with seismicity induced by coal mining for a long time. British Geological Survey records indicate that coal mining-related seismicity is generally of smaller magnitude than natural seismicity and no larger than 4 M_L. Seismicity induced by hydraulic fracturing is likely to be of even smaller magnitude. There is an emerging consensus that the magnitude of seismicity induced by hydraulic fracturing would be no greater than 3 M_L[75].

[73] Cuadrilla Resources, Press Release: **Geomechanical Study**, 2 November 2011
[74] New Scientist, **Fracking risk is exaggerated**, 11 January 2012
[75] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***

6. Moratorium

In May 2010, the Pennsylvania state legislature passed the Marcellus Shale Bill that enforced a three-year moratorium on further leasing of exploration acreage until a comprehensive environmental impact assessment had been carried out. On 3 August 2010 New York State issued a temporary moratorium on new shale gas activity. This moratorium suspended the issuing of 'new permits for horizontal drilling which utilizes the practice of hydraulic fracturing in the state' until after the United States Environmental Protection Agency (EPA) has reported on its study of shale gas.[76]

Moratoria have also been imposed elsewhere, including in the province of Quebec, Canada (March 2011), France (July 2011), South Africa (August 2011) and Bulgaria (January 2012)[77].

When asked whether it would consider delaying shale gas extraction in the UK in view of the concerns raised by the Tyndall Centre[78] and while the United States EPA investigated, the UK Government said that with a robust regulatory regime in place, they saw no need for a moratorium. They also considered that since UK's geology and regulations differ to that of the United States, the United States experience would not necessarily be relevant to UK conditions or to the UK regulatory framework.[79] As such in January 2012 the UK Government stated that it remains supportive of the industry[80] and it has 'no plans to introduce a moratorium on shale gas activities in the UK'[81].

This reiterated the conclusions from UK Energy and Climate Change Committee's 2011 shale gas report which states:

> On balance, we feel that there should not be a moratorium on the use of hydraulic fracturing in the exploitation of the UK's hydrocarbon resources, including unconventional resources such as shale gas.
> [...] There is no evidence that the hydraulic fracturing process poses any risk to underground water aquifers provided that the well-casing is intact before the process commences. Rather, the risks of water contamination are due to issues of well integrity, and are no different to concerns encountered during the extraction of oil and gas from conventional reservoirs...UK legislation needs to take account of the challenges unique to shale gas exploration and production; specifically the use of large volumes of hydraulic fracturing at multiple wells, which requires large volumes of fresh water and chemicals, as well as generating large volumes of waste water requiring treatment.[82]

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[76] Bill A10490!-200, State of New York, April 2010
[77] The Royal Society and the Royal Academy of Engineering (2012), ***Shale gas extraction in the UK: a review of hydraulic fracturing***
[78] Tyndall Centre for Climate Change Research at Manchester University, **Shale gas: a provisional assessment of climate change and environmental impacts**, January 2011, p6-7
[79] HC Deb 1 February 2011 Hc769W
[80] HC Deb 17 January 2012 c678W
[81] HL Deb 10 January 2012 c23WA
[82] UK Energy and Climate Change Committee, **Shale Gas Report Fifth Report of Session 2010–12 Volume 1** (2012)

7. Further Information

For further information on the topics below, double click on the links.

- National Assembly for Wales, Environment and Sustainability Committee, **Energy Policy and Planning in Wales** (2012)
- Department of Energy and Climate Change Website on **Unconventional Gas**
- UK Energy and Climate Change Committee: **Energy and Climate Change Committee - Fifth Report, Shale Gas**, May 2011
- United States Environmental Protection Agency Website on **Hydraulic Fracturing**
- The Royal Society and the Royal Academy of Engineering (2012), **Shale gas extraction in the UK: a review of hydraulic fracturing**
- Tyndall Centre for Climate Change Research, **Shale gas: a provisional assessment of climate change and environmental impacts**, January 2011

Guidance Note: Regulation of exploratory shale gas operations

We are the environmental regulator for shale gas operations in England and Wales[1]. Through effective regulation we will help ensure that shale gas operations are managed in a way that protects public health and the environment.

Any operator who wishes to explore for shale gas using deep drilling and high volume hydraulic fracturing will be regulated under the Environmental Permitting (England and Wales) Regulations 2010 and must have permits for their operational sites.

1. Background

Scope

This note covers our regulation of the exploration for shale gas using deep drilling and high volume hydraulic fracturing (fracking), including the exploratory production of gas to assess the quantity and quality available. It does not cover our regulation of commercial production of shale gas or exploration and production of other types of gas (conventional or unconventional) such as coal bed methane. Neither does it cover our regulation of boreholes for geological sampling.

The process of exploring for shale gas

The process of exploring and hydraulically fracturing for shale gas broadly involves:

- Developing a well pad and sinking a borehole to the target rock formations
- Hydraulically fracturing the rock through the pressurised injection of a mixture of water, sand and chemicals to allow gas to come to the surface. Some used fracturing fluid will flow back which now also potentially contains natural gas (predominantly methane), salts, metals and naturally occurring radioactive materials (NORM).
- The treatment and / or disposal of waste flow-back liquids that may be temporarily held on-site in secure storage. At the exploratory stage any gases produced may be flared or vented to atmosphere, subject to safety and environmental controls.
- Decommissioning or suspending the borehole.

These activities help the operator to understand the physical and chemical properties of the gas and the commercial potential of the shale rock.

The regulatory framework for shale gas operations

Shale gas operations, as with other industrial activities, are regulated under a number of different regimes. The Department of Energy and Climate Change (DECC) issues operators with a 'Petroleum Exploration and Development Licence' (PEDL), which gives operators exclusive rights to explore for, and develop, the resource. Before operators can begin, they need land use planning permission from the local Minerals

1 On 1 April 2013 a new single body for Wales will bring together the functions of the Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales. This single body will take on accountability for services currently delivered by us, both in or to Wales.

Planning Authority (MPA), as well as environmental permits from us. This may involve consulting with statutory consultees, such as Natural England, Countryside Council for Wales and the Health Protection Agency. Operators must also notify and engage with DECC on the plans for the borehole and with the Health and Safety Executive (HSE) to ensure health and safety at the workplace. DECC provide operators with the final consent for hydraulic fracturing, once all other permits and permissions are in place.

2. Our role in the planning system

Shale gas operators must have planning permission for their surface operations (that is the construction and operation of individual well pads) from the MPA. This is often, but not exclusively, the county or unitary council.

We are a statutory consultee in the planning process and will discuss proposals and provide advice to the MPA. We will do this for pre-application enquiries, for scoping of any Environmental Impact Assessment and for the planning application itself. Where risks to the environment are significant, for example where development is proposed contrary to our groundwater protection policy and practice, we will object to the planning application.

When a planning development also needs an environmental permit, we will provide advice to the MPA on permitting issues. Where a bespoke permit is needed, we will provide a more detailed response. We recommend applying for planning permission and environmental permits in parallel to avoid unnecessary delays.

3. Environmental regulation requirements

We take a risk based approach to regulating shale gas activities based on the available evidence. When we process applications we take into account the applicant's technical competence, the local characteristics of the site and any risks to the environment. We do not apply a one size fits all approach. We work closely with the other regulators of the shale gas industry, including DECC and the HSE, to ensure that regulation is joined-up, effective and efficiently delivered.

We expect that shale gas developments that include hydraulic fracturing will need environmental permits under the Environmental Permitting (England and Wales) Regulations 2010 (EPR). Operators will need to notify us of their plans under the Water Resources Act 1991 (WRA 1991). Operators can avoid delay by discussing their proposals with us at the earliest opportunity.

Water abstraction licensing

If operators want to abstract water directly from surface water or groundwater for operational purposes, and this exceeds 20 cubic metres a day, they will need a water abstraction licence. Applications for a licence will be assessed like any other. Groundwater investigation and pumping tests that are performed as part of the application for a water abstraction licence will also need our prior consent. A licence will be granted if the quantities proposed for abstraction can be taken in a way that doesn't harm the environment or other users. There is no guarantee that directly abstracted surface water or groundwater will be available.

Notice to drill

All shale gas operators must notify us of their intention to drill a borehole under WRA (1991). Operators must provide details of how they intend to protect water resources, including groundwater, in the construction and use of the borehole. If we are not satisfied, we may serve a notice on the operator to take appropriate measures to conserve water quantity and quality.

Groundwater activity

If hydraulic fracturing takes place in a borehole that passes through groundwater we would regard the fracturing as a groundwater activity. A permit under EPR will not be required as long as we are satisfied that groundwater is protected by the controls applied by the MPA, the HSE and through the notice to drill under the WRA 1991. Should we believe groundwater to be at risk we may use a notice either to require that a permit be obtained, which would include the appropriate measures designed to minimise any impact or risk, or if necessary to prohibit the activity altogether.

Only substances that have been assessed as being non-hazardous pollutants under the Groundwater Daughter Directive may be used in hydraulic fracturing fluids. Information on the chemicals used by an operator in hydraulic fracturing fluid will normally be made available to the public. We may not disclose the relative quantities in the mixture, as this is commercially confidential.

The borehole must be decommissioned through sealing and/or backfilling to protect groundwater and surface waters.

Mining waste operations

It is likely that an operator will need a permit under EPR for managing the flow-back fluid and waste gases from hydraulic fracturing, depending on the site specific activities. The flow-back fluid and waste gases are considered mining wastes and their management is a mining waste operation, whether or not it involves a mining waste facility. As such, the operator must provide a waste management plan with their permit application.

An area designated for the accumulation or deposit of flow-back fluid or waste gases may be a mining waste facility and may need to be included under the permit.

The requirement for permits for the management and disposal of wastes from drilling the borehole will be treated in the same way as those from any similar minerals exploration.

Radioactive substances

Naturally occurring radioactive materials (NORM) are present in many geological formations including oil and gas bearing strata such as shale formations. The flow-back fluid that returns to the surface following hydraulic fracturing, as well as sediments and scales in gas or water process vessels, are likely to contain sufficient NORM that they will be classed as radioactive waste[2]. As such the operator must have an environmental permit for their temporary storage and subsequent treatment and disposal.

Treatment and disposal may take place on-site leading to re-injection during subsequent hydraulic fracturing, or carried out at remote sites such as sewage treatment works or effluent treatment facilities. After treatment, the water may still retain some radioactivity. Its disposal to rivers, estuaries, sea or groundwater will have to be assessed for its impact on people and the environment.

We consider that hydraulic fracturing during the exploration, development or exploitation of shale gas involves the production of natural gas. This is listed as a NORM industrial activity in EPR due to the likely presence of radioactive substances. Therefore a permit is needed for the disposal of the flow-back fluid if radioactive substances are present. However, simply drilling a well does not involve the production of natural gas and therefore no permit is needed for disposal of these drill cuttings under radioactive substances controls.

4. Monitoring and compliance

We will work with the operator to set out how we will monitor their compliance on each site to ensure that environmental risks are properly managed. We use a variety of methods such as audits, site inspections,

2 There are concentrations of NORM that are so low that they are not subject to Schedule EPR 2010 controls. These concentrations can be found in Table 1 of Schedule 23 to EPR 2010. Concentrations below these levels are out of scope of Schedule 23 and no permit is required. However, experience suggests that, for fracking operations, this is very unlikely.

check monitoring and / or sampling, and reviewing operator records and procedures. We work closely with the HSE and DECC to ensure that our monitoring regimes are co-ordinated and effective.

Operators must demonstrate to us that their proposed activities are not harmful to people or the environment. We may ask them to monitor the effects their activities have on the environment and report these to us, for inclusion on our public registers if appropriate.

We will thoroughly inspect and monitor shale gas operations due to the relative novelty of the techniques deployed. This will help to reassure the public and local communities and help us to better understand the controls at each stage of the operation.

5. Openness and transparency - the permit application process

We expect that operations to explore for shale gas involving hydraulic fracturing will need bespoke environmental permits. We advise operators to discuss their proposals with us and apply for a permit as early as possible, and before any operations commence on site. We will process permit applications as quickly as possible. Operators can help speed this up through early discussions and by working closely with our staff to provide the information we need.

To make this easier we have established a shale gas unit as well as local single points of contact for shale gas operators, which can be accessed through our National Customer Contact Centre (03708 506 506).

Operators must submit two separate bespoke applications under EPR, one covering radioactive substances and the other covering the remaining environmental risk areas. We encourage operators to submit these together so that they can be managed, processed and consulted on at the same time. We are working to simplify and streamline the permitting process so that in future a single application should cover all activities regulated under EPR.

On receipt permit applications will be assessed to ensure they are complete (duly made). We then determine the applications, including putting applications on the public register and publicising them on our website for comment. Comments directly relevant to the permit applications will be taken into account when determining the application. However, comments outside of this scope cannot be considered. A standard permit can take up to 13 weeks to process.

If there is significant public interest in an application we will provide more opportunity for public scrutiny. The current level of public interest in shale gas increases the likelihood of us treating sites in this way. However, we are only able to consult on the issuing of environmental permits, and not wider issues related to the industry. In these cases, the augmented consultation is tailored to local circumstances and may include:

- extending the length of the public consultation on the permit application
- wider advertising, such as in local newspapers or drop-in sessions
- a second public consultation on any draft decision to issue a permit

For a bespoke permit application, where there is a lot of public interest, determining a permit may take four to six months from when the application is duly made. The process can be shorter or longer. The main factors affecting the timeframe are the quality of the application, the level of local interest and how locally contentious the site is. Good quality applications and local support through effective engagement generally result in faster determinations and more effective public consultations.

Final decisions are then published on the public register.

November 2012 (review December 2013 or earlier as appropriate)

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