



## Shale gas and fracking

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The recent rapid development of unconventional gas resources (notably shale gas) in North America has transformed the world gas-market outlook. The company Cuadrilla has been conducting test drilling in Lancashire, and in June 2013 Centrica acquired a 25% stake in their exploration licence there. Also in June 2013, DECC and the British Geological Survey published estimates of the shale gas resource in Northern England.

In December 2012 the Secretary of State for Energy and Climate Change announced that exploratory hydraulic fracturing (fracking) for shale gas could resume in the UK, after a temporary moratorium following small seismic tremors. There are several other extant UK onshore petroleum exploration and development licences which could be looked at for shale gas potential. However, before the most recent BGS estimates, the Energy and Climate Change Select Committee concluded that shale is unlikely to be a 'game-changer' in the UK.

Various concerns have been raised regarding fracking, but a Royal Society/Royal Academy of Engineering report has concluded that contamination of aquifers is unlikely, with any pollution most likely to occur through faulty well casings. The RS/RAE called however for the UK's offshore well regime to be adapted for onshore activities, and for further work on the net effects on climate change.

The current Energy Bill seeks to introduce "clean, secure and affordable" energy supplies. For the UK, energy security means diversity of generation and supply. Gas is cleaner than unabated oil or coal, and cheaper up-front than renewables or nuclear. Both the Energy Bill provisions and other Government policy announcements indicate a strong continuing role for gas and shale gas. Recent announcements include those in the Gas Generation Strategy, in the 2013 [Budget](#), and new planning guidance and promised benefits to communities.

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## 1 UK and World energy outlook

UK production of natural gas in 2012 was the lowest since 1985.<sup>1</sup> The UK has been a net importer of gas since 2004, with historically high imports in 2011. In that year, for the first time since large scale gas extraction began, UK imports exceeded production.<sup>2</sup> The North Sea is mature, and last year UK oil output fell below 1 million barrels a day for the first time.<sup>3</sup>

The rapid development of shale gas in North America has transformed the gas-market outlook. As early as 2009, announcing the 2009 World Energy Report, the International Energy Agency (IEA) [stated](#) that the share of unconventional gas in total US gas output was expected to reach 60% in 2030;

Unconventional gas is unquestionably a game-changer in North America with potentially significant implications for the rest of the world.

In the US, “unprecedented levels of domestic natural gas production” reduced net imports of natural gas into the US by a quarter in 2011, with several applications being made to the US

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<sup>1</sup> DECC, [Digest of UK Energy Statistics 2013](#) Chapter 4 Gas

<sup>2</sup> DECC, [Digest of UK Energy Statistics 2012](#) Chapter 4 Gas

<sup>3</sup> *Petroleum Economist* April 2013 Analysis North Sea work surges on high prices pp.4-7

Department of Energy for authorisation to export domestic LNG.<sup>4</sup> The US is now expected by the IEA to be nearly self-sufficient in energy by 2035.<sup>5</sup>

The IEA [World Energy Outlook special report on gas](#) in 2011<sup>6</sup> described a “golden age of gas” scenario in which natural gas overtakes coal by 2030, increasing to 25% of the global energy mix by 2035. Mean estimates from the current literature suggest that the global technically recoverable resource of shale gas is over 97 trillion cubic meters, equivalent to around 23% of the estimated remaining recoverable resources of conventional gas – but there is large variation between studies.<sup>7</sup>

### A note on definitions

In short, ‘unconventional gas’ is natural gas from unconventional sources. ‘Shale gas’, as the name suggests, is found within shale beds (rather than in a conventional ‘reservoir’ capped by shale or other beds).

Shale has not previously been considered a hydrocarbon reservoir rock in the UK, because the hydrocarbons are ‘trapped’ within low-permeability rocks. Traditionally, oil and gas were considered to mature within organic-rich shales before migrating into conventional reservoirs.

With advances in drilling and wellsite technology, and increases in the wholesale prices of hydrocarbons, production of gas directly from these less permeable formations is now commercially viable.

DECC has produced a note on [Resources vs Reserves: What do estimates of shale gas mean?](#)<sup>8</sup> The Parliamentary Office of Science and Technology (POST) has also published a POSTbox on [UK Shale Gas Potential](#). The following terms are used most commonly:

- **Total Resources:** the estimated total volume of oil and gas physically contained in the rock. One measure of total resources used commonly, including by the BGS, is the **Gas in Place (GIP)** which is an estimate of the total amount of gas that is trapped within the shale rock.
- **Reserves:** the amount of resources that are deemed to be technically and commercially recoverable.
- **Technically Recoverable Resource (TRR):** the estimated volume of gas that it is possible to extract from the total resource if not constrained by economics (and therefore larger than the reserves estimates).<sup>9</sup>

POSTnote 374, [Unconventional Gas](#) (April 2011), also gives some background.

## 2 Hydraulic fracturing, or fracking

Gas held within shale beds is accessed through a technique called “hydraulic fracturing” or “fracking”. According to the [British Geological Survey](#) (BGS):

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<sup>4</sup> US Energy Information Administration, [U.S. Natural Gas Imports & Exports 2011](#) July 2012

<sup>5</sup> *Financial Times*, Budget 2013: Support for shale gas sector 20 March 2013

<sup>6</sup> International Energy Agency “[Are we entering a golden age of gas?](#)” Special Report *World Energy Outlook 2011*

<sup>7</sup> McGlade, C. et al., “[A review of regional and global estimates of unconventional gas resources: A report to the Energy Security Unit of the Joint Research Centre of the European commission](#)”, UKERC, September 2012, p25

<sup>8</sup> DECC, 27 June 2013 (erroneously dated as 27 July 2013 on its cover)

<sup>9</sup> DECC, [Resources vs Reserves: What do estimates of shale gas mean?](#) 27 June 2013 and [UK Shale Gas Potential](#), POSTbox July 2013

After initial exploration of the shale deposits, a borehole is drilled into the shale horizon at a carefully selected site. It may be drilled horizontally to increase the volume of rock that can be accessed by the borehole. A process called hydraulic fracturing ('fracking') is undertaken. This involves pumping water into isolated sections of the borehole at pressures high enough to fracture the surrounding rock. Sand entrained in the water helps to 'prop' open the fractures, create permeability in the rock and allow the gas to flow into the borehole. Chemicals are also added to improve the efficiency of the fracking operation.<sup>10</sup>

Fracking can be used in combination with horizontal drilling which permits access to harder-to-reach resources and allows drilling (and fracking) in several directions from a single well bore.

### 3 Shale gas resource in the UK

#### Where are the shale gas formations?

A 2010 report by the BGS on the [Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Shale Gas](#) for the Department of Energy and Climate Change (DECC) shows the UK outcrops of formations with most shale gas potential.<sup>11</sup> The diagrams in the report reflect geological maps of the UK, where the same geological outcrops or formations run roughly on a South-East/North-West axis and can be seen, for example, running from the North East of England down to the South/South West coast.

In the UK these include the Upper Bowland Shale (the source rock for the Irish Sea conventional fields, and where Cuadrilla are exploring), and both the Kimmeridge Clay and Lias of the Weald Basin (source rocks for the North Sea and English Channel fields).

The maps showing shale gas potential alongside those showing extant [onshore areas under licence](#) and petroleum exploration and development [licenses offered in the 13<sup>th</sup> onshore round](#), may give some indication of the possibility of exploration drilling in an area.

#### What is the size of the resource?

A September 2012 [report](#) from the UK Energy Research Centre (UKERC) formed part of a larger study of unconventional gas resources by the Joint Research Centre of the European Commission.<sup>12</sup> This noted many significant uncertainties in assessing the recoverable volumes of shale gas, at regional and global level. It notes also that recovery rates are much lower than for conventional gas, around 15-30% of original gas in place (OGIP) compared to perhaps 80% in conventional reservoirs.

On 27 June 2013 the BGS/DECC published a [Bowland Shale Gas Study](#), including a gas-in-place resource assessment for the Bowland shale formation in Northern England.<sup>13</sup> This is therefore not an assessment for the entire UK or even England, nor of the total reserve, nor of the commercially recoverable gas.

Their central estimate of GIP is 37.6 trillion cubic meters (tcm). To put this in context, the POSTbox on [UK Shale Gas Potential](#) (updated July 2013) provides an accessible overview of the estimates. It extrapolates this to potentially recoverable resources of 1,800-13,000 billion cubic meters (bcm), assuming similar recovery factors to the US of 8-20%. This

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<sup>10</sup> BGS website, [New shale gas resource figure for central Britain](#) accessed 11 July 2013

<sup>11</sup> DECC/BGS, [Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Shale Gas](#), 2012

<sup>12</sup> European Commission, Energy Security Unit of the Joint Research Centre [Unconventional Gas: Potential Energy Market Impacts in the European Union](#), 2012

<sup>13</sup> Andrews, I.J. 2013. The Carboniferous Bowland Shale gas study: geology and resource estimation. British Geological Survey for Department of Energy and Climate Change, London, UK.

compared to DECC's published figures of a current annual UK gas consumption of 77 bcm and potentially recoverable conventional gas resources of 1,466 bcm.<sup>14</sup>

These are much higher than earlier BGS estimates, although a 2013 report from the [US Energy Information Agency](#) had suggested the technically recoverable resource could be as high as 736 bcm.<sup>15</sup>

A company called [Cuadrilla](#) started drilling shale gas exploration wells near Blackpool in August 2010.<sup>16</sup> In September 2011 Cuadrilla [estimated](#) that 5.7 tcm of gas was in the Bowland shale under Lancashire.<sup>17</sup> The BGS expressed scepticism about the accuracy of this estimate, and pointed out that recovery rates would be much lower.<sup>18</sup> In June 2013 [Centrica acquired](#) a 25% interest in the Bowland exploration license from Cuadrilla.<sup>19</sup>

In June 2013 [IGas](#), another company which has been conducting exploratory studies in the UK, [published estimates](#) of "gas initially in place" (or total resource) in shales in the North West (including the Bowland shale) with a "most likely" value of 102 trillion cubic feet (2.9 tcm). Drilling to be conducted in Q4 of 2013 was expected to further refine these estimates.<sup>20</sup>

### 3.1 Economic implications

The Energy and Climate Change (ECC) Select Committee, following its 2013 inquiry into [the impact of shale gas on energy markets](#), recommended that further exploratory operations be encouraged to help establish reliable resource estimates.<sup>21</sup>

An earlier ECC Committee [inquiry](#) in 2011 had concluded that shale gas was unlikely to be a "game-changer" as in the US, or perhaps countries like Poland.<sup>22</sup> A major factor is that there is less land available to drill on.<sup>23</sup>

The 2013 ECC Committee enquiry found that it was "too early to say whether domestic production of shale gas could result in cheaper gas prices in the UK", and that it would be wrong to assume that prices would come down as a result of domestic or foreign shale gas.<sup>24</sup>

In October 2011 Cuadrilla published Regeneris Consulting's [full economic assessment of the impact of shale gas exploration and production in Lancashire and the UK](#). This estimated that for test wells alone:

- A single test well operation, in 2011 prices, costs in the region of £10.5 million, made up of Cuadrilla's own costs, that of its two internal service companies and expenditure on a range of first tier suppliers.

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<sup>14</sup> [UK Shale Gas Potential](#), POSTbox July 2013

<sup>15</sup> EIA/ARI, [World Shale Gas and Shale Oil Resource Assessment](#), June 2013, XI-2, converted from original figure of 26 trillion cubic feet

<sup>16</sup> <http://www.cuadrillaresources.com/what-we-do/locations/>

<sup>17</sup> Cuadrilla Resources, [About natural gas](#), accessed 25 June 2013

<sup>18</sup> "What the frack?" *Economist*, 1 October 2011

<sup>19</sup> Centrica, [Centrica acquires a 25% interest in UK shale exploration licence](#), 13 June 2013

<sup>20</sup> IGas, [Shale Gas in place in IGas' North West licences of up to ca.170Tcf](#), 3 June 2013

<sup>21</sup> House of Commons Energy and Climate Change Committee, [The Impact of Shale Gas on Energy Markets](#), April 2013

<sup>22</sup> House of Commons Energy and Climate Change Committee, [Shale Gas](#), May 2011

<sup>23</sup> British Geological Society [Shale Gas Prospectivity web pages](#)

<sup>24</sup> House of Commons Energy and Climate Change Committee, [The Impact of Shale Gas on Energy Markets](#), April 2013

- Some 18% of expenditure is shown to be deployed on Lancashire workers/suppliers, with a third going overseas. Of all UK expenditure (circa £7 million per test well), a third is deployed on labour costs, with 7% being utilised for subsistence expenditure of workers most of which flows to Lancashire businesses.
- We estimate the test well activity will support some 250 FTE jobs across the UK over a 12 month period. Half of the jobs will occur within Cuadrilla and its extensive range of 1st tier suppliers.
- Some 15% of the jobs (circa 40) are estimated to be taken by Lancashire residents. ... At this stage very few of the specialist supply chain contractors make extensive use of local labour although this would change under a full commercial extraction scenario.<sup>25</sup>

Cuadrilla's report estimated that test well activity might support 250 FTE jobs across the UK over a twelve month period. Also at the UK Level, the estimated FTE employment impact peaks at some 5,600 FTE jobs in the period 2016 through to 2019, with a build up in the years from 2013 onwards, if there is a move to a commercial extraction phase.<sup>26</sup>

A May 2013 [report](#) from the Institute of Directors presented a scenario where UK shale gas production attracts investment of £3.7 billion per year and supports up to 74,000 jobs, often focused in regions with currently high unemployment and in important sectors such as manufacturing. It also potentially contributes significant tax revenue.<sup>27</sup>

[Budget 2013](#) said that the Government would introduce a new field allowance for shale gas and consult on the detail, including whether this should be extended to other forms of unconventional onshore gas.

## 4 Regulatory regime

### 4.1 Onshore petroleum licensing rounds

Shale gas drilling is currently only in the exploratory phase in the UK. It is covered by the normal UK regime for all oil and gas exploration and development activities. A UK Petroleum Exploration and Development licence (PEDL) allows a company to pursue a range of oil and gas exploration activities (including exploration and development of unconventional onshore gas), subject to necessary drilling/development consents and planning permission.<sup>28</sup> DECC outlines the onshore licensing system on its [oil and gas website](#) and says for instance:

The Secretary of State issues landward production licences (Petroleum Exploration and Development Licences) under powers granted by the [Petroleum Act 1998](#)[\[External link\]](#). They confer the right to search for, bore for and get hydrocarbons, but do not confer any exemption from other legal/regulatory requirements such as:

- any need to gain access rights from landowners
- health and safety regulations
- planning permission from relevant local authorities.

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<sup>25</sup> Regeneris Consulting for Cuadrilla, *Economic Impact of Shale Gas Exploration & Production in Lancashire and the UK* September 2010 published 5 October 2011

<sup>26</sup> Ibid, p.44

<sup>27</sup> IoD, *Infrastructure for Business: Getting shale gas working*, 22 May 2013

<sup>28</sup> See [http://www.decc.gov.uk/en/content/cms/meeting\\_energy/oil\\_gas/shale\\_gas/shale\\_gas.aspx#7](http://www.decc.gov.uk/en/content/cms/meeting_energy/oil_gas/shale_gas/shale_gas.aspx#7) for more links to information on the regulatory regime

The last (13th) Onshore Licensing Round was run in 2008 and following the grant of planning permission, consent was given to drill for shale gas in five locations. Of these, consent for fracking of the shale has been given to Cuadrilla at two sites at Poulton-le-Flyde. In addition, a number of companies awarded licences in earlier offshore rounds are re-assessing the shale potential of older licences.<sup>29</sup> A DECC [map](#) shows the onshore licences offered under the 13<sup>th</sup> round.<sup>30</sup>

A Strategic [environmental assessment](#) was published in 2010 for the 14th Onshore Round, and following the December 2012 announcement on the resumption of fracking, the SEA process has now restarted. Following this DECC will invite applications for the 14th Round.<sup>31</sup>

These extant and future licenses, now that unconventional hydrocarbons are more attractive, may be increasingly controversial with local residents. For example, in January 2012 the *Guardian* carried a series of reports about local residents in West Sussex opposing plans from Cuadrilla to drill a test well under licence.<sup>32</sup>

## 4.2 Other planning and licensing requirements

As well as holding the necessary PEDL, all drilling operations are subject to notification to the Health and Safety Executive and each site is assessed by the Environment Agency (SEPA in Scotland) who regulate discharges to the environment, issue water abstraction licences, and are statutory consultees in the planning process.<sup>33</sup>

For constituents, the main route for opposing exploratory oil drilling will probably be that the operations need local planning permission. The former Energy Minister Charles Hendry has confirmed (talking about projects in Wales):

As with all other proposals for oil and gas developments, proposals for shale gas exploration or extraction are subject to the requirements of the Town and Country Planning Act administered by the planning authority for the area in which the development is located. Planning is a devolved function in Wales and therefore it would be for the relevant planning authority to consider any application in the first instance. However Welsh Ministers have the power to call in an application if they consider it necessary.

The consent of the Department is also required for all drilling or production operations for oil and gas. This is given only once planning permission has been obtained.<sup>34</sup>

The Planning Portal has a [page on how to object to planning permission](#).<sup>35</sup>

## 5 Environmental considerations

The May 2012 World Energy Outlook special report on unconventional gas, [Golden rules for a golden age of gas](#), summarises the concerns around fracking. This says that while

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<sup>29</sup> HL Deb 6 October 2011 c213WA

<sup>30</sup> DECC, *Oil and gas: onshore maps and GIS shapefiles*, accessed 17.12.12

<sup>31</sup> [http://og.decc.gov.uk/en/olgs/cms/licences/lic\\_rounds/timing\\_of\\_the\\_/timing\\_of\\_the\\_.aspx](http://og.decc.gov.uk/en/olgs/cms/licences/lic_rounds/timing_of_the_/timing_of_the_.aspx) as of 17.12.12

<sup>32</sup> *Guardian* 12 January 2012 “No fracking in home counties, village residents tell oil company”

<sup>33</sup> HC Deb 1 February 2011 c669w and <http://www.environment-agency.gov.uk/business/topics/126689.aspx>

<sup>34</sup> HC Deb 11 June 2012 c200W

<sup>35</sup> <http://www.planningportal.gov.uk/general/faq/faqapplyprocess#Howdolojecttoapanningapplicationandcanldosoonline>

unconventional resources could boost energy diversity and security, this has to be done in an environmentally acceptable manner:<sup>36</sup>

Producing unconventional gas is an intensive industrial process, generally imposing a larger environmental footprint than conventional gas development. More wells are often needed and techniques such as hydraulic fracturing are usually required to boost the flow of gas from the well. The scale of development can have major implications for local communities, land use and water resources. Serious hazards, including the potential for air pollution and for contamination of surface and groundwater, must be successfully addressed. Greenhouse-gas emissions must be minimised both at the point of production and throughout the entire natural gas supply chain. Improperly addressed, these concerns threaten to curb, if not halt, the development of unconventional resources.

The IEA has developed a set of 'golden rules' in response, which it estimates would add on 7% to the cost of developing a typical shale gas wellsite, but which it says would give the industry public and environmental acceptance and a 'social licence' to operate.<sup>37</sup>

## 5.1 Climate change

Some commentators argue that generating electricity from natural gas is relatively clean in comparison to coal fired generation.<sup>38</sup> It has been suggested that more gas could help bridge the gap to cleaner renewables or more nuclear generation.<sup>39</sup> From the UK perspective, the Institute of Directors report highlights the emissions benefits of domestic production over importing liquid natural gas (LNG), the potential of shale gas as a transport fuel in place of diesel and avoided emissions through supporting manufacturing in the UK where production is more energy efficient than in most countries.<sup>40</sup>

However, cheap gas may divert investment from more expensive (up-front) alternatives such as renewables and nuclear, weakening the case for reducing reliance on fossil fuels.<sup>41</sup> The former Director of the Tyndall Centre for Climate Change Research, Professor Kevin Anderson, has said that "From a climate-change perspective this stuff simply has to stay in the ground."<sup>42</sup> A Tyndall Centre [report](#) published in November 2011 concluded in its summary:

... emissions from a fully developed UK shale gas industry would likely be very substantial in their own right. If the UK Government is to respect its obligations under both the Copenhagen Accord and Low Carbon Transition Plan, shale gas offers no meaningful potential as even a transition fuel.<sup>43</sup>

A [letter to the Guardian](#) (27 September 2011) said that the lower CO<sub>2</sub> emissions of gas compared to coal or oil are countered by methane releases of up to 10% of production. However, in a [letter in response](#) (6 October 2011), a petroleum engineer said that methane

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<sup>36</sup> International Energy Agency, [Golden rules for a golden age of gas](#) WEO special report 29 May 2012

<sup>37</sup> Ibid, in text box on pages 13 and 14

<sup>38</sup> e.g. "The case for shale and tight gas", Speech given by Malcolm Brinded, Executive Director, Upstream International, at the Foundation for Science and Technology, London, England, November 9, 2011

<sup>39</sup> Pearce, F., "Fracking: the monster we greens must embrace", *Guardian*, 15 March 2013, accessed 14 June 2013

<sup>40</sup> IoD, [Infrastructure for Business: Getting shale gas working](#), 22 May 2013

<sup>41</sup> Schrag, D.P., "Is shale gas good for climate change?" *Daedalus*, 141(2), 72-80, 2012

<sup>42</sup> "What the Frack?" *The Economist*, 1 October 2011 p.34 and "Natural Gas: Should fracking stop?" *Nature* Volume 477, pp 271–275 15 September 2011

<sup>43</sup> Tyndall Centre for Climate Change Research, [Shale gas: an updated assessment of environmental and climate change impacts](#), Executive summary, November 2011, p7

leakage with frac fluids can be either captured or flared and leakage of 10% would not be tolerated by any commercial company. Nevertheless, such 'fugitive' emissions mean that shale gas has higher greenhouse gas emissions than conventional gas.<sup>44</sup>

In a [June 2012 report](#), the Royal Society/Royal Academy of Engineering (RS/RAE) considered that more work is needed to monitor this, and to explore the carbon footprint and climate risks associated with both the extraction and use of shale gas.<sup>45</sup> The 2013 ECC Committee [final report](#) recommended that policies on flaring and venting of methane should be reviewed to keep fugitive emissions as close to zero as possible, and that these emissions should be monitored by DECC.<sup>46</sup> In June 2013, Energy Minister Michael Fallon said in a written answer:

In December 2012, the Secretary of State for Energy and Climate Change, the right hon. Member for Kingston and Surbiton (Mr Davey) requested a study to gather available evidence on potential greenhouse gas emissions from shale gas extraction in the UK and the compatibility of potential UK shale gas production and use with climate change targets. A report is being prepared with the outcome of this study and recommendations to mitigate the impacts of shale gas exploration, production and use. I expect this report to be published in the summer.<sup>47</sup>

## 5.2 Ground and surface water contamination in the US and implications for the UK

The Environment Agency describes fracking as an established technology.<sup>48</sup> The November 2011 Tyndall Centre report set out concerns about ground and surface water contamination, possibly even affecting quality of drinking water and wetland habitats, depending on factors such as the connection between ground and surface waters.

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. An analysis of these substances suggests that many have toxic, carcinogenic or other hazardous properties. There is considerable anecdotal evidence from the US that contamination of both ground and surface water has occurred in a range of cases.<sup>49</sup>

Evidence in the US remains anecdotal, but some states (e.g. [New York](#)) have put in place moratoriums on fracking, as have some countries including Northern Ireland and France.<sup>50</sup>

In December 2011 the US Environmental Protection Agency (EPA) issued a [press release](#)<sup>51</sup> about the initial results of two deep monitoring wells it drilled into an aquifer at one Denver location, where "fracturing is taking place in and below the drinking water aquifer and in close proximity to drinking water wells – production conditions different from those in many other areas of the country". It found that "ground water in the aquifer contains compounds likely associated with gas production practices, including hydraulic fracturing". However, private and public drinking water wells in the community were found to be safe.

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<sup>44</sup> Policy Exchange 24 February 2012 [Gas Works? Shale gas and its policy implications](#) p.42

<sup>45</sup> RS/RAE [Shale gas extraction in the UK: a review of hydraulic fracturing](#) June 2012

<sup>46</sup> House of Commons Energy and Climate Change Committee, [The Impact of Shale Gas on Energy Markets](#), April 2013

<sup>47</sup> [HC Deb 3 June 2013 cc942-3W](#)

<sup>48</sup> <http://www.environment-agency.gov.uk/business/topics/126689.aspx>

<sup>49</sup> Tyndall Centre for Climate Change Research, [Shale gas: an updated assessment of environmental and climate change impacts](#), November 2011, pp9-10

<sup>50</sup> See list on p.53 of Policy Exchange 24 February 2012 [Gas Works? Shale gas and its policy implications](#)

<sup>51</sup> EPA, [EPA Releases Draft Findings of Pavillion, Wyoming Ground Water Investigation for Public Comment and Independent Scientific Review](#) 8 December 2011

The EPA issued guidance last year that no company could frack with diesel in the mixture without a permit. The EPA has also sued one company for alleged water contamination in Texas although the industry counters that most wells are well below aquifers and problems are caused by faulty drilling or surface operations.<sup>52</sup> Given public concern and the proliferation of fracking, the EPA has embarked on further studies, publishing a [progress report](#) in December 2012 and with a final draft report due in 2014.<sup>53</sup>

According to a parliamentary answer, the fluids used to date by Cuadrilla comprise: fresh water and sand—99.96% and polyacrylamide friction reducers—0.04%. Other potential additives include hydrochloric acid, typically at a concentration of 0.125%, or biocide at a concentration of 0.005% if required to purify the local water supply.<sup>54</sup>

The ECC Committee's 2011 inquiry found no evidence that fracking poses a direct risk to underground water aquifers provided the drilling well is constructed properly.<sup>55</sup> In its response to the Committee, the Government noted:

The technologies used in shale gas operations are not generically novel or unfamiliar. Hydraulic fracturing, water injection and lateral drilling, individually or in combination, are all familiar techniques that DECC and the other regulators have had to deal with robustly for a long time.<sup>56</sup>

The former Energy Minister Charles Hendry has noted that the investigated US incidents of water pollution were explained by accidents on the surface rather than underground leaks of any kind, and said that the UK would learn from this. Regarding US methane leaks,

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.

However, there were cases in which gas leaks had occurred. That was attributed to unsatisfactory well construction or cementing. That confirms, if any confirmation were needed, that drilling for shale gas—like drilling for any other kind of oil or gas—is a hazardous operation that requires careful and consistent regulation. However, that also supports the Committee's conclusions that 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.<sup>57</sup>

The RS/RAE considered that because fracking takes place many hundreds of metres or even several kilometres below aquifers, it is very unlikely that fracking will affect those aquifers. However, more likely causes of possible contamination include faulty wells, and the report sounded a note of caution about ensuring that the same stringent controls for offshore wells were applied onshore:

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<sup>52</sup> "Fracking" *Financial Times*, 29 September 2011 p.2

<sup>53</sup> <http://www.epa.gov/hfstudy/index.html> accessed 17 December 2012

<sup>54</sup> [HC Deb 29 June 2011 c853w](#)

<sup>55</sup> Committee Press Release, *Shale gas gets support from MPs in new report*, 23 May 2011

<http://www.parliament.uk/business/Committees/Committees-a-z/commons-select/energy-and-climate-change-Committee/news/new-report-shale-gas/>

<sup>56</sup> Energy and Climate Change - *Seventh Special Report Shale Gas: Government Response to the Committee's Fifth Report of Session 2010-12* 19 July 2011

<sup>57</sup> [HC Deb 3 November 2011 c363WH](#)

The UK's unique well examination scheme was set up so that independent, specialist experts could review the design of every offshore well. This scheme must be made fit for purpose for onshore activities.<sup>58</sup>

### 5.3 Resource use

The Tyndall Centre highlighted excessive water use for fracking as a particular problem “given that water resources in many parts of the UK are already under pressure”.<sup>59</sup> For the current exploration sites Cuadrilla anticipated using approximately 1,600 m<sup>3</sup> of water for each hydraulic fracture operation.<sup>60</sup> The RS/RAE report recommends recycling and re-use of wastewaters and that water disposal options should be planned from the outset.

Because shale gas reserves are more diffuse than conventional reservoirs, productivity at each well falls relatively quickly. The IEA considers that, apart from local community buy-in, the most important above-ground considerations for unconventional gas developments are the availability of sufficient land and water. Shale gas drilling leaves “a large and comparatively invasive footprint on the landscape” because of the large number of wells needed. The IEA also notes that access to water may be a barrier to unconventional gas developments, although technology is starting to reduce the amount required.<sup>61</sup>

In its [response](#) to the 2011 ECC Committee inquiry, the Government said that “Adverse effects on water resources as a result of possible expansion of the shale gas industry in the UK are not expected.”<sup>62</sup> Any operator will also need a licence to abstract water from the Environment Agency who will assess existing abstraction levels and licences.<sup>63</sup> Because abstraction is controlled in the UK, the RS/RAE consider that water use can be managed sustainably.<sup>64</sup>

## 6 Temporary moratorium on drilling

At around 2.30 am on 1 April 2011 there was a 2.3 local magnitude (ML) earth tremor near Blackpool and a further, small 1.5 ML event at 0.48 am on 27 May 2011.<sup>65</sup> Cuadrilla issued a [statement](#) on 31 May 2011 saying it was postponing fracking operations while it interpreted seismic information. In its July 2011 response to the ECC report,<sup>66</sup> the Government agreed that a pause in hydraulic fracturing operations was appropriate.

‘Induced seismicity’ can occur in previously aseismic areas following oil and gas activities. Thousands of induced earthquakes are registered annually, and operators can take steps to

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<sup>58</sup> RS/RAE *Shale gas extraction in the UK: a review of hydraulic fracturing* June 2012 [http://royalsociety.org/uploadedFiles/Royal\\_Society\\_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf](http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf)

<sup>59</sup> Tyndall Centre for Climate Change Research at Manchester University, *Shale gas: a provisional assessment of climate change and environmental impacts*, January 2011, p6-7

<sup>60</sup> [HC Deb 29 June 2011 c853w](#)

<sup>61</sup> IEA *World Energy Report 2009* Chapter 11, p.415

<sup>62</sup> Energy and Climate Change - *Seventh Special Report Shale Gas: Government Response to the Committee's Fifth Report of Session 2010-12*, 19 July 2011

<sup>63</sup> [HC Deb 23 April 2012 c614W](#)

<sup>64</sup> RS/RAE *Shale gas extraction in the UK: a review of hydraulic fracturing* June 2012 [http://royalsociety.org/uploadedFiles/Royal\\_Society\\_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf](http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/projects/shale-gas/2012-06-28-Shale-gas.pdf)

<sup>65</sup> “Gas drilling on hold after earth tremor”, *Daily Post (Liverpool)* 1 June 2011 p.14

<sup>66</sup> Op cit.

reduce or control seismicity.<sup>67</sup> Natural or mining-induced earthquakes in the UK are not uncommon with around 150 earthquakes recorded on average each year.<sup>68</sup>

The BGS said in January 2012 that the risks to groundwater and of earthquakes had been exaggerated, with the minor earthquakes caused by fracking “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”.<sup>69</sup>

Cuadrilla funded a geomechanical study by the BGS and Keele University which was given to DECC to consider. In April 2012 DECC [published the report](#), which said:

The report concludes that minor earth tremors detected in the area of Cuadrilla’s Preese Hall operations near Blackpool in April and May last year were caused by fracking and, among other measures, recommends a real time seismic monitoring system and a “traffic light” control regime based on this monitoring.<sup>70</sup>

A consultation period was announced, and in the meantime the Environment Agency continued studies to ensure it had all the information it needed to regulate the industry.

On 13 December 2012 the Secretary of State [announced](#) that exploratory hydraulic fracturing for shale gas could resume in the UK.<sup>71</sup> New regulatory requirements for operators seeking consent under licences for fracking are related to seismicity only and are to:

- Conduct a prior review of information on seismic risks and the existence of faults in the area;
- Submit to DECC a frac plan showing how any seismic risks are to be addressed;
- Carry out seismic monitoring before, during and after the frac;
- Implement a “traffic light” system which will be used to identify unusual seismic activity requiring reassessment, or halting, of operations.<sup>72</sup>

## 7 Current policy on fracking and gas

During a [Westminster Hall debate](#) on the Government’s response to the ECC Committee’s 2011 report on shale gas, the overall consensus was that the Committee, which was broadly supportive of the industry, had taken a balanced and cautious approach. The Committee Chair, Tim Yeo MP, said that maintaining public confidence was absolutely essential, and that shale gas could make a contribution towards energy security and keeping prices down.<sup>73</sup>

On 5 December 2012 the Secretary of State laid the Government’s [Gas Generation Strategy](#) before Parliament.<sup>74</sup> Chapter 5 of this deals with shale gas and says, in summary:

- There are very large quantities of gas in the shales beneath the UK, but not enough is known to estimate what fraction of this could be produced.

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<sup>67</sup> *Petroleum Review* April 2012 p.16 “Shakin’ all over”

<sup>68</sup> [http://www.earthquakes.bgs.ac.uk/publications/annual\\_reports/2011\\_22nd\\_annual\\_report.pdf](http://www.earthquakes.bgs.ac.uk/publications/annual_reports/2011_22nd_annual_report.pdf)

<sup>69</sup> *New Scientist* “Fracking risk is exaggerated” 11 January 2012

<sup>70</sup> HC Deb 23 April 2012 c617W

<sup>71</sup> HC Deb 13 December 2012 c44WS

<sup>72</sup> DECC press release [New controls announced for shale gas exploration](#) 13 December 2012.

<sup>73</sup> HC Deb 3 November 2011 c399WH

<sup>74</sup> DECC [Gas Generation Strategy](#), December 2012, Cm 8407 and [HC Deb 5 December 2012 c62WS](#)

- If economic and safe, shale gas could, however, offer new economic opportunities for the UK. DECC will set up an Office for Unconventional Gas and Oil, which, working with Defra and other Government Departments, will join up responsibilities across Government, provide a single point of contact for investors and ensure a simplified and streamlined regulatory process.
- HM Treasury has opened discussions with industry on the appropriate structure of a fair tax regime for future shale gas production, and DECC will consult on how its licensing regime could be modified to support the particular characteristics of shale gas developments. DECC will also consult on an updated Strategic Environmental Assessment with a view to further onshore oil and gas licensing.
- If testing proves positive, shale gas production might commence in the second part of this decade, but production is likely to grow more slowly than has been seen in the United States.<sup>75</sup>

On the same day, in his Autumn Statement, the Chancellor said:

Today, we publish our gas strategy to ensure that we make the best use of lower-cost gas power, including new sources of gas under the land. We are consulting on new tax incentives for shale gas and announcing the creation of a single office so that regulation is safe but simple. We do not want British families and businesses to be left behind as gas prices tumble on the other side of the Atlantic.<sup>76</sup>

In March 2013 alongside Budget 2013, DECC announced the creation of the Office for Unconventional Gas and Oil (OUGO), the aim of which is “to promote the safe, responsible and environmentally sound recovery of the UK’s unconventional reserves of gas and oil”.<sup>77</sup>

Part of its role is to engage with communities and industry with the aim of ensuring that people see benefits from shale gas production in their local area. Energy Minister Michael Fallon said in June 2013 that the Government would soon be consulting on these community benefits, which could be “through grants or expenditure, or, better still, through discounts on their bills, which could be significant”.<sup>78</sup> The Government also announced in March 2013 that it would:<sup>79</sup>

- Produce technical planning guidance on shale gas by July 2013 to provide clarity around planning for shale gas during the important exploration phase for the industry;
- As the shale gas industry develops we will ensure an effective planning system is in place and by the end of the year will produce guidance for the industry to ensure that the planning system is properly aligned with the licensing regime and regulatory regimes, principally; health and safety; and environmental protection;
- Keep under review whether the largest shale gas projects should have the option to apply to the major infrastructure regime.

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<sup>75</sup> DECC Gas Generation Strategy 5 December 2012 Cm 8407 p.52

<sup>76</sup> [HC Deb 5 December 2012 c881](#)

<sup>77</sup> DECC, [New Office to look at community benefits for shale gas projects](#), 20 March 2013, accessed 24 June 2013

<sup>78</sup> [HC Deb 6 June 2013 c1655](#)

<sup>79</sup> DECC, [New Office to look at community benefits for shale gas projects](#), 20 March 2013, accessed 24 June 2013

These all seem to be sending clear signals of the Government's support for the industry. The [Energy Bill 2012-13 to 2013-14](#), currently in the Lords, includes an Emissions Performance Standard (EPS) set at a level to allow new gas generating plant to be built.

The Committee on Climate Change (CCC) has expressed its concerns about this without a decarbonisation target on the face of the Bill, saying it risks a dash for gas-fired generation instead of low carbon investment.<sup>80</sup> The ECC Committee has also concluded that the EPS proposals could lead to a dash for gas and a 'lock-in' to a high carbon system.<sup>81</sup> More details can be found in the Library Research Paper on the [Energy Bill](#) (committee stage).<sup>82</sup>

In the Secretary of State's [Written Statement](#) announcing the resumption of fracking, he addressed several of the environmental concerns and outlined the regulatory regime in place. As well as the new Office for Unconventional Gas and Oil, the Government would act on the [RS/RAE] recommendations that the regulation of a significant future production phase should be assessed. DECC would also conduct a full public consultation on the extended strategic environmental assessment, before any decisions were taken on further [onshore] licensing. In addition, he addressed local residents' concerns, which should be addressed through the planning permissions required in addition to DECC licences, but would be extended through enhanced risk assessment requirements.<sup>83</sup>

Planning procedures of course already provide for full consultation with communities who may be affected, and the planning authorities may require an environmental impact assessment to be carried out. However, the academies have in addition recommended that an environmental risk assessment should be mandatory for all shale gas operations, involving the participation of local communities at the earliest possible opportunity, and that this assessment should address risks across the entire lifecycle of shale gas extraction.

DECC will therefore take steps to enhance the existing frameworks for consultation and consenting to these activities, in line with these recommendations. Licensees will be required to carry out a comprehensive high-level assessment of environmental risks, including risks to human health, and covering the full cycle of the proposed operations, including well abandonment; and to consult with stakeholders including local communities, as early as practicable in the development of their proposals. The scope of these assessments would naturally be framed by the operations proposed, so that prospective future production operations would not be in scope for an assessment drawn up for exploration activities. Cuadrilla has been asked to conduct such an assessment in relation to their proposals for further exploration work in Lancashire.

This high-level assessment might inform the work entailed by risk assessments already required, for example by the Environment Agency under the environmental permitting regulations, or as required by the local planning authority.

Even as exploratory drilling resumes in Lancashire, or starts elsewhere, this is some way away from full production drilling, as Charles Hendry noted in July 2012, if not least because in the UK landowners do not own the mineral rights beneath their homes.<sup>84</sup>

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<sup>80</sup> CCC, [Comments on Emissions Performance Standard \(EPS\) for gas-fired power generation](#), 27 March 2012

<sup>81</sup> HC 275-I Energy and Climate Change - First Report of Session 2012-13 Volume I [Draft Energy Bill: Pre-legislative Scrutiny](#) 23 July 2012 paras 199-204 and 221 on

<sup>82</sup> [Energy Bill: Committee Stage Report - Commons Library Research Paper](#), 9 April 2013

<sup>83</sup> HC Deb 13 December 2012 c51WS

<sup>84</sup> HC Deb 12 July 2012 c441