





Fracking: the debate

Fracking is the term used to describe the process by which gas and oil are recovered from shale rock¹. During the process a vertical well is initially drilled into the rock; the drill is then turned sideways and the well extended horizontally, often for miles¹. This process allows companies to extract pockets of gas or oil that were previously unreachable by traditional drilling techniques².

Neither of the techniques used - hydraulic fracturing or horizontal drilling - is new. The first documented horizontal drill site was completed in the 1920s and hydraulic fracturing has been in use since the 1940s³. It is important to note that the economic case for and environmental concerns about fracking differ from country to country and from site to site. This document focuses on the UK environmental concerns with respect to fracking.

The quotes here refer to a fracking industry that would produce nine billion cubic metres (bcm) of gas per year (equivalent to 10 per cent of the UK's 2008 gas use), generally over a 20 year term, and they intend to capture the range of the debate. Readers should note that this is an area where new evidence is emerging all the time, so the positions may change in the future.

				
The issue	What the Government says	What the fracking companies say	What the campaigners say	What the scientists say
Water shortage	Adverse effects on water resources as a result of possible expansion of the shale gas industry in the UK are not expected ⁴ .	Natural gas from shale uses much less water to produce the same energy than other sources ⁵ .	The water industry has warned that fracking uses so much water it could cause localised shortages ⁶ .	Estimates for water usage during fracking equate to 1.25-1.65 million cubic metres - a relatively small addition to the 905 million cubic metres already abstracted by industry. However, this addition is averaged across the UK whereas the actual impacts are likely to be localised and may put unacceptable burden on local reservoirs ²³ .
Water Contamination (extraction)	Adverse effects on water resources as a result of possible expansion of the shale gas industry in the UK are not expected ⁴ .	In the industry such incidents have been extremely rare ⁷ . Wells are designed with at least three layers of steel casing. The intermediate casing ensures that there can be no ▶	Information from campaigning organisations predominantly focuses on the toxic chemicals that are used as part of the drilling fluid and the dangers of contamination ▶	When visually compared with substances in fracturing fluids the data on flowback fluid suggest mobilisation and presence of elevated concentrations of: ▶

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		<p>leakage from the shale path to the reservoir. These are inspected by an independent well examiner before being sent to the HSE for review⁷.</p>	<p>from flowback fluid.</p> <p>There is concern that fracking could cause pockets of gas previously trapped in rock under reservoirs to escape thus contaminating the reservoir⁶. There have been over 1,000 documented cases of water contamination next to areas of gas drilling as well as cases of sensory, respiratory, and neurological damage due to ingested contaminated water⁸.</p>	<ul style="list-style-type: none"> • Heavy metals • Radioactivity • Total dissolved solids²³. <p>Given the issues outlined [in the Tyndall Report], it would be problematic to conclude that there is no reasonably foreseeable risk to freshwater aquifers²³.</p> <p>HOWEVER</p> <p>A USGS survey of 137 drill sites concluded that groundwater contamination was not present at any level suggesting that drilling is safer than the Tyndall statistics indicate⁹.</p> <p>AND</p> <p>The RS/RAE report states that so far the only shale gas fracking in the UK has been at depths of 1.7km and 3.1km, equivalent to the height of many London Shards placed end to end. It is highly unlikely for contamination to occur through fractures extending up from the deep shales and intercepting an aquifer, since the two are separated by a vast cover of rock. Even if it were possible, pressure conditions mean that the fracking water would not flow that far upwards. This report concluded that if there were to be water contamination, it is much more likely to be due to poorly constructed and regulated wells¹⁰.</p>
<p>Water Contamination (use/transport/storage/disposal)</p>		<p>All water stored on [Cuadrilla] sites is stored in steel tanks and tested regularly by the EA. When ready for ▶</p>		<p>For shale gas to deliver 9 bcm per year, 3.6-26 million cubic metres of potentially hazardous wastewater ▶</p>

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		disposal, an EA-approved company removes the water for testing and treatment at a licensed plant ¹¹ .		would be recovered over a 20 year period requiring storage, transport and treatment. Importantly, the water use and percentage recovery rates imply that between 20-85 per cent of fluid is not recovered and would remain underground ²³ . The likelihood of pollution incidents that contaminate surface water or soil increases as the number of drilling sites increases ²³ .
Climate (carbon) use	Shale gas's overall carbon footprint is comparable to gas extracted from conventional sources, lower than that of Liquid Natural Gas (LNG), and, when used for generating electricity, significantly lower than that of coal ¹² .	Shale gas has significantly lower carbon content per unit of energy generated when compared with coal or oil. Research on the UK Electricity market suggests that shale gas production will displace coal in electricity generation and reduce reliance on imported gas. Both outcomes would reduce CO ₂ . Gas is likely to continue to play an important part in the UK's energy mix. Cuadrilla believes that producing indigenous Shale gas will prove to be a less CO ₂ intensive way of filling that UK demand than import ¹³ .	Campaigning organisations warn that allowing a 'dash for gas' would significantly impede the UK's chances of meeting its legally-binding Carbon reduction targets ¹⁴ . A primary concern with respect to climate change is the level of methane emissions that are associated with drilling. Studies show that the carbon benefit compared to coal is only realised if the methane leakage are kept to around 2 per cent ¹⁵ . Current leakage rates have been variously estimated at 4 per cent ¹⁶ and 9 per cent ¹⁷ .	If carbon emissions are to reduce in line with the Copenhagen Accord's commitment to 2°C, decarbonisation of electricity supply is urgently required. This need questions any role that shale gas could play as a transition fuel. In addition, it is important to stress that shale gas would only be a low-carbon fuel source if allied with, as yet unproven, carbon capture and storage technologies ¹⁸ . Research suggests that without a meaningful cap on emissions of global GHGs, the exploitation of shale gas is likely to increase net carbon emissions ¹⁸ . Rapid carbon reductions require a large amount of investment in zero-carbon technologies and exploitation of shale gas could delay this ¹⁸ .
	Fracking can and has caused seismic activity. For example: an investigation into the earthquake in Lancashire in 2011 concluded that the most likely cause of the tremors is the movement of the frac fluid into and along a ►	Shale is a weak rock and therefore does not allow enough tension to build to generate big tremors or tremors large enough to cause any damage.	Fracking can cause unexpected seismic activity; For example, seismic activity is rare in Oklahoma. Between 1972 and 2008, the USGS recorded just a few earthquakes a year. In 2008, there were more than a dozen; nearly 50 ►	Fracking can cause seismic events and, while these are unlikely to be of a sufficient magnitude to cause structural damage on the surface, structural damage to the wellbore itself (and in all likelihood other wellbores in the ►

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	<p>fault which was already under stress.</p> <p>The additional pressure of the fluid resulted in the perceived tremors at the surface.</p> <p>Government experts advise that there are many other similar faults in the Lancashire area, which could in a similar scenario likewise result in tremors. The amount of energy likely to be stored in these faults is not large, and the largest earthquake likely in this area from such a cause is assessed at magnitude³.</p> <p>While this is not large enough to cause significant material damage, it would be perceptible and disturbing¹⁹.</p>		<p>occurred in 2009. In 2010, the number jumped to more than 1,000. These so-called “earthquake swarms” are occurring in other places where seismic activity is uncommon. There have been abrupt upticks in both the size and frequency of quakes in Arkansas, Colorado, Ohio, and Texas. Scientists investigating these anomalies are coming to the conclusion that the quakes are linked to injection wells²⁰.</p>	<p>vicinity) is possible and has been documented²³.</p>
Space/visual/nimby/infrastructure		<p>Anti-fracking groups suggest that the production landscape would be characterised by dense, single-well developments. Even if this was allowed it would not be commercially viable²¹. Cuadrilla believe therefore that a lot of development can thus take place from a single pad - hence our view that the UK offers a low-density development opportunity¹³.</p>	<p>Analysis shows that to match what the UK obtains from North Sea deposits with shale gas fracking we would need 10-20,000 wells across the UK²².</p>	<p>300 well pads would be needed to deliver 9bcm/year of shale gas. Assuming 10 wells per pad the visual impacts are likely to be contentious²³.</p> <p>Research suggests that local traffic impacts for the construction of multiple pads in a locality are likely to be significant²³.</p>
Regulation		<p>Cuadrilla’s official statement says: The UK has a strict regulatory framework governing onshore oil and gas exploration and production, and this also covers onshore gas operations. Any associated risks regulated and closely scrutinised by the relevant independent bodies. With proper management risks should be minimal¹³.</p>		<p>The lack of sufficient regulatory control has been a concern in the US²³ as environmental concerns are likely to prove a considerable hindrance to the development of unconventional gas resources in Europe. If the governments of Europe do not emulate the US in initially allowing low environmental standards, and back them up with ►</p>

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				well-resourced and stringent regulation, it is possible European development could proceed without hindrance ²⁴ .
Conclusions	The consensus seems to be that shale gas will not be a 'game changer' in the UK as in the US. There is, for example, less land available to drill on and landowners do not own the rights to hydrocarbons beneath their land ²⁵ .			To sustain nine bcm/year the UK would require 2,500-3,000 wells and 25-33 million cubic metres of water. A proportionately large quantity of wastewater, some requiring treatment and transport to licensed treatment works must also be considered ²³ .

¹ BBC (2013) What is fracking and why is it controversial? [online]. Available from: www.bbc.co.uk/news/uk.14432401. [Accessed: September 2013].

² WIF (2013) What is fracking? [online]. Available from: www.what-is-fracking.com. [Accessed: September 2013].

³ Schumacher, J., Morrissey, J. (2013) The Legal Landscape of "Fracking": The Oil and Gas Industry's Game-Changing Technique is its Biggest Hurdle. *Texas Review of Law & Politics*. 17 (2), pp.239 - 303.

⁴ ECC Select Committee (2011) Energy and Climate Change - Seventh Special Report Shale Gas: Government Response to the Committee's Fifth Report of Session 2010-12.

⁵ Cuadrilla (2013) Water sourcing [online]. Available from: www.cuadrillaresources.com/protecting-our-environment/water/water-sourcing/. [Accessed: September 2013].

⁶ Water UK (2013) Water industry lays down challenge to UK shale gas fracking industry [online]. Available from: www.water.org.uk/home/news/press-releases/challenge-on-gas-fracking. [Accessed: September 2013].

⁷ Cuadrilla (2013) Water [online]. Available from: www.cuadrillaresources.com/protecting-our-environment/water. [Accessed: September 2013].

⁸ DOF (ND) What goes in and out of hydraulic fracturing [online]. Available from: www.dangersoffracking.com/. [Accessed: September 2013].

⁹ USGS (2013) No Contamination from Fayetteville Shale Exploration Found in Sampled Wells [online]. Available from: <http://pubs.usgs.gov/sir/2012/5273/sir2012-5273.pdf>. [Accessed: September 2013].

¹⁰ RS/RAE Report (2012) Shale gas extraction in the UK: a review of hydraulic fracturing. RS/RAE: London.

¹¹ Cuadrilla (2013) Water disposal [online]. Available from: www.cuadrillaresources.com/protecting-our-environment/water/water-disposal/. [Accessed: September 2013].

¹² DECC (2013) Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use. DECC: London.

¹³ Cuadrilla (2012) Energy and Climate Change Committee: Written evidence submitted by Cuadrilla Resources (ISG15) [online]. Available from: www.publications.parliament.uk/pa/cm201213/cmselect/cmenergy/785/785we03.htm. [Accessed: September 2013].

¹⁴ Carbon Brief (2012) Gas strategy: Government could loosen carbon targets to allow dash for gas [online]. Available from: www.carbonbrief.org/blog/2012/12/gas-strategy-would-ramp-up-construction-by-loosening-carbon-budgets. [Accessed: September 2013].

¹⁵ Campaign Against Climate Change (ND). Fracking and climate change [online]. Available from: www.campaignccc.org/fracking. [Accessed: September 2013].

¹⁶ Romm, J. (2012) Bombshell Study: High Methane Emissions Measured Over Gas Field "May Offset Climate Benefits of Natural Gas" [online]. Available from: <http://thinkprogress.org/climate/2012/02/08/421588/high-methane-emissions-measured-over-gas-field-offset-climate-benefits-of-natural-gasquot>. [Accessed: September 2013].

¹⁷ Romm, J. (2013) Bridge To Nowhere? NOAA Confirms High Methane Leakage Rate Up To 9% From Gas Fields, Gutting Climate Benefit [online]. Available from: <http://thinkprogress.org/climate/2013/01/02/1388021/bridge-to-nowhere-noaa-confirms-high-methane-leakage-rate-up-to-9-from-gas-fields-gutting-climate-benefit/>. [Accessed: September 2013].

¹⁸ Tyndall Centre (2011a) Shale gas: a provisional assessment of climate change and environmental impacts. Tyndall Centre: Manchester.

¹⁹ DECC (2012) Written Ministerial Statement by Edward Davey: Exploration for shale gas [online]. Available from: www.gov.uk/government/news/written-ministerial-statement-by-edward-davey-exploration-for-shale-gas. [Accessed: September 2013].

²⁰ Behar, M. (2013) Fracking's Latest Scandal? Earthquake swarms [online]. Available from: www.motherjones.com/environment/2013/03/does-fracking-cause-earthquakes-wastewater-dewatering. [Accessed: September 2013].

²¹ Cuadrilla (2013) Legacy [online]. Available from: www.cuadrillaresources.com/what-we-do/legacy. [Accessed: September 2013].

²² Greenpeace (2013) 4 reasons why we could all be fracked by fracking [online]. Available from: www.greenpeace.org.uk/blog/climate/3-reasons-why-we-could-all-be-fracked-fracking-20130812. [Accessed: September 2013].

²³ Tyndall Centre (2011b) Shale gas: an updated assessment of environmental and climate change impacts. Tyndall Centre: Manchester.

²⁴ Williams, J., Field, L., Lee, E. (2011) The impact of Unconventional Gas on Europe: A report to Ofgem [online]. Available from: www.poyry.co.uk/sites/www.poyry.uk/files/The_Impact_of_Unconventional_Gas_on_Europe.pdf. [Accessed: September 2013].

²⁵ House of Commons Library (2013) Shale gas and fracking - Commons Library Standard Note (SN06073).