# Friends of the Earth Scotland

## briefing on
# unconventional gas and fracking

April 2012

## Introduction

You've probably come across the fracking in the news recently and wondered if the reality is as ugly as the word. Maybe you've heard about the new natural gas boom and wondered what shale gas and coalbed methane mean for our energy needs.

We are in the middle of a big push to exploit what's known as unconventional gas, as more convenient, conventional sources run out. However, even though natural gas burns with lower emissions than dirtier fossil fuels like coal, the means of getting at these new sources of gas are far from clean.

There is a growing body of evidence from the USA, where the unconventional gas industry is far more developed, that there are inherent and unacceptably high environmental and health risks associated with coalbed methane and shale gas extraction, whether or not fracking is used.

This briefing explains some of the risks associated with unconventional gas extraction and why Friends of the Earth Scotland believes no further unconventional gas activity should go ahead until these problems have been fully addressed.


*(FoE EWNI 2011)*

## Contents

## What is unconventional gas

Unconventional gas is a term used to describe sources of gas that were historically too deep or difficult to extract, but are now becoming increasingly accessible and cost effective to exploit due to technological advances and high fossil fuel prices.

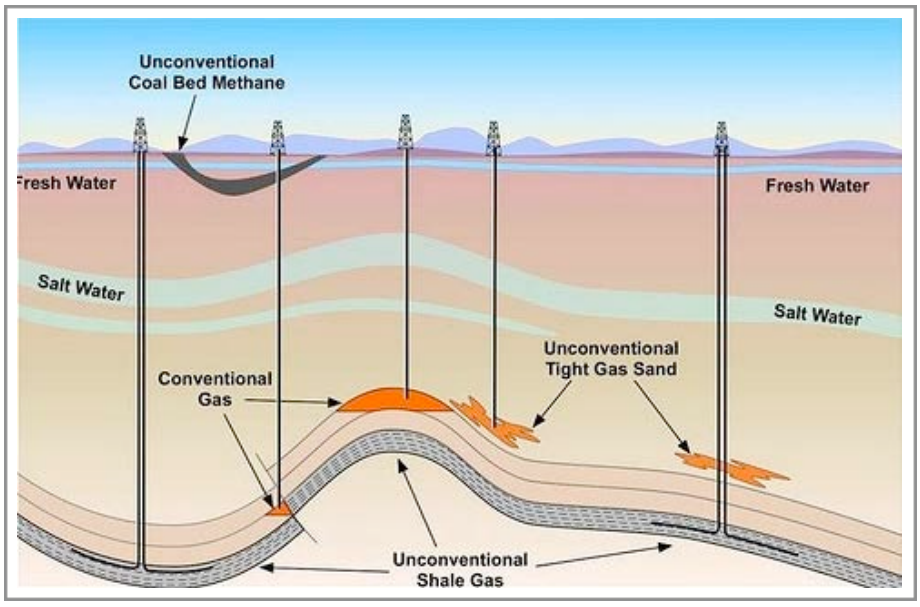
Natural gas is a fossil fuel produced over many hundreds of thousands of years through the decomposition and heating of organic matter. Conventional gas extraction involves drilling vertically through rock formations into gas pockets, from which the gas rises through the borehole and is captured at the wellhead.

However, as these convenient and relatively easily accessed pockets dry up, the industry has been developing ways of extracting gas that is trapped inside the rock formations – known as unconventional gas. Shale gas, coalbed methane (CBM) and tight gas are all unconventional gases.

The International Energy Agency estimates that technological advances in unconventional gas extraction have increased the total recoverable global gas resource from 120 years of current world consumption to 250 years worth.[1] The Agency's 2011 'Golden Age of Gas?' report predicts that from 2010 gas use will rise by more than 50 percent and in 2035 account for over 25 percent of world energy demand. Unconventional gas is being touted in the USA, Poland and here in the UK as the key to national energy security.

While Europe is still in the early stages of testing shale and CBM, unconventional gas already accounts for about 60 percent of marketed production in the USA,[2] and the Obama administration is strongly supportive of the industry. However, in January 2012 the United States Department for Energy almost halved its estimates for recoverable unconventional gas across the states from 827 trillion cubic metres (Tcm) to 482 Tcm.[3]

Estimates as to the UK's unconventional gas reserves vary wildly. The British Geological Survey (BGS) estimate the UK's recoverable shale gas reserve at 150 billion cubic metres (Bcm) or 1.5 years current consumption, while the US Department of Energy's statistical services estimates 560 Bcm in recoverable UK reserves, or 5.6 years worth.[4] Cuadrilla, a key player in the emerging UK shale industry claims to have discovered 5.6 Tcm of gas (approx 60 years worth) in Lancashire alone.[5] However, the UK Tyndall Centre has criticised even the lowest of these estimates as overblown.[6]




*Unconventional gas extraction (Frack Off 2012)*

However, although shale is the gas hitting all the headlines, CBM reserves are potentially much bigger: the British Geographical Survey estimates that the total UK CBM *resource* is 2,900bcm, although there is considerable uncertainty as to how much of this is recoverable.[7]

[1] International Energy Agency, The Golden Age of Gas? 2011 www.iea.org/weo/docs/.../WEO2011_GoldenAgeofGasReport.pdf
[2] IEA 2011
[3] http://www.bloomberg.com/news/2012-01-23/u-s-reduces-marcellus-shale-gas-reserve-estimate-by-66-on-revised-data.html
[4] http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79506.htm
[5] http://www.guardian.co.uk/business/2011/sep/21/gas-field-blackpool-dallas-sea
[6] http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79506.htm
[7] DECC 2010 Promote UK The Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Coalbed Methane (British Geological Survey)

A 2004 BGS study estimated that only one percent of this resource was recoverable due to low seam permeability (which would increase the need for fracking) and low gas content of seams, as well as planning issues. However developments in the USA indicate that up to 10 percent of the resource may be recoverable: 290bcm or over three years of UK gas consumption.[8]

## Shale gas

Shale is a hard rock formation deep underground from which natural gas (largely composed of methane) can be extracted. As shale rock is brittle and non-permeable, hydraulic fracturing is used to extract the gas. Developments in horizontal drilling combined with fracking have made shale gas extraction much more economically viable in recent years.

*Methane from old mines*
It's important to note the distinction between Coal Bed Methane extraction and the utilisation of methane gas from current or abandoned coalmines. DECC refers to the 'concept of utilising gas from working or closed mines' as Coal Mine Methane (CMM) or Abandoned Mine Methane (AMM).[9]

Methane building up in coal mine seams is a safety risk both in terms of workers' health and explosions and also an environmental risk in terms of GHG emissions, and capturing and using this gas makes sense. However, drilling (vertically and horizontally, and fracking) deep down into unworked coal beds to extract methane that is still locked up – CBM – is a different matter altogether, and introduces new health, safety and environmental risks where they did not previously exist. The relative lack of bad publicity regarding CBM may be due to the fact that it has been happening for longer in the UK and appears to be more of a gradual progression from CMM/ AMM.

## Coalbed methane

Coalbed methane (CBM) is a gas that can be extracted from coal seams using a variety of techniques including deep vertical and horizontal drilling and fracking. In most CBM developments the seam needs to be 'dewatered' before gas extraction can happen, whether or not fracking is used. This involves pumping a significant quantity of water (which has been stewing in coal for centuries) out of the coal seam and disposing of it. Sometimes pumping out water from seams is enough to stimulate gas flow, sometimes the seam needs to be fracked to extract the gas. CBM is sometimes referred to as Coal Seam Gas (CSG) (e.g in Australia).

## Key differences in extraction

Three key differences between CBM and shale extraction are:

- Shale gas extraction almost always involves fracking, while CBM doesn't necessarily
- CBM has the additional environmental impact of the need to dewater seams, and dispose of that water
- Coal seams are much closer to the surface – and therefore groundwater and aquifers – than shale deposits therefore arguably CBM developments have an increased risk of water contamination

*Underground coal gasification*
This briefing focuses on shale and CBM exploitation, but its worth noting that underground coal gasification (UCG), is also making its way to the UK with a number of offshore test sites including one in the Firth of Forth. UCG is a way of utilising the energy in coal that is too thin or too deep or difficult to extract, by drilling into the seam and injecting oxygen to trigger partial combustion in situ underground and capturing the hydrogen through a parallel borehole to utilise as natural gas above ground. By-products include carbon dioxide, carbon monoxide and methane.[10]

UCG carries with it a number of similar risks to CBM and shale extraction (e.g. fracking can be used in the process, and water contamination is a serious problem); an increased risk of subsidence; and the added risk of uncontrolled coal seam fires. It's notable that all current UK test sites are offshore, likely in an effort to mitigate these risks.

[8] DECC 2010 Promote UK
[9] http://coal.decc.gov.uk/en/coal/cms/publications/mining/seams/seams.aspx
[10] http://groundtruthtrekking.org/Issues/AlaskaCoal/UndergroundCoalGasification.html

## What is hydraulic fracturing

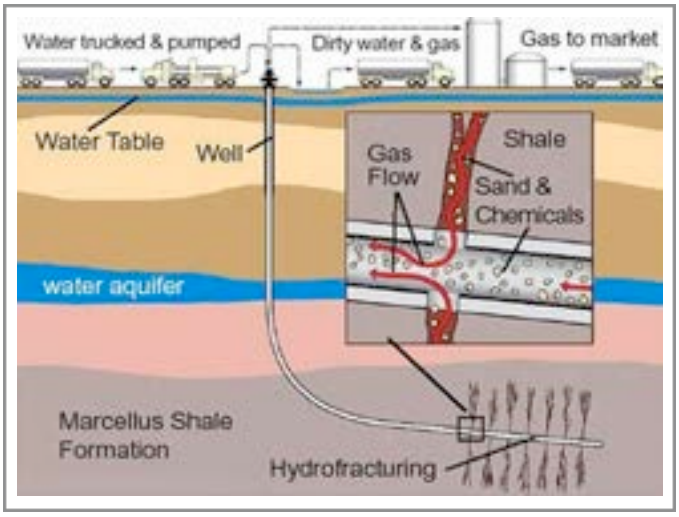
Hydraulic fracturing, or 'fracking', is a controversial technique sometimes used to exploit unconventional gas sources, including shale gas and coal bed methane (CBM).

Fracking involves drilling deep in the earth, vertically and horizontally, (up to 20,000 ft) and high-pressure pumping a mix of water, proppants (such as sand) and chemicals (including highly carcinogenic benzene and formaldehyde) into the borehole to ease the flow of gas for extraction. The amount of water and chemicals required varies depending on the permeability of the rock. It is an expensive process that is only economically viable when the price of fossil fuels is high.

Some companies are advancing fracking techniques using gel and foam, which reduces pressure on water usage and disposal. However, it is unlikely to reduce the risk of chemicals leaching into groundwater from seams, nor the risk of spills of pure frack fluid/foam. Halliburton have advocated a number of 'clean' fracking methods,[12] but it is not clear to what extent they are being used and remains to be seen how successful they are.

> *A company in Texas describes fracking*
> "The pumped fluid, under pressures up to 8,000 psi, is enough to crack shale as much as 3,000 ft in each direction from the wellbore. In the deeper high-pressure shales, operators pump slickwater (a low-viscosity water-based fluid) and proppant. Nitrogen-foamed fracturing fluids are commonly pumped on shallower shales and shales with low reservoir pressures".[11]

The industry are keen to point out that fracking is a long established technique. What's new though is its extensive use on horizontal wellbores for extracting unconventional gas, and the sheer scale of modern operations. Fracking is also used in geothermal technology amongst other things.




*Hydrualic fracturing (Frack Off 2012)*

### What's in fracking fluid

Fracking fluid is generally water based (it can be oil or acid based) with a small chemical and proppant component. A huge number of different chemicals can be used in fracking fluid, including many that are highly carcinogenic and cause birth defects. While the chemical component of fracking fluid is a tiny proportion (up to 2 percent), because of the sheer quantities of liquid used, a single fracking project can involve a significant volume of toxic chemicals. Clearly it is very problematic if these chemicals get into water for human or animal consumption and local ecosystems.

A questionable study by the US Environmental Protection Agency in 2004 (see box on page 7)[13] led to the exemption of fracking from Safe Drinking Water legislation through the 2005 Energy Policy Act (known as the 'Halliburton loophole' due to Vice President Dick Cheney's involvement – he is a former Halliburton CEO). This means companies are not obliged to tell the EPA or the public exactly which or how much chemicals were being used in fracking projects in the USA.

However, the US Committee on Energy and Commerce launched an investigation into fracking and asked key industry players to release information about chemicals used in fracking between 2005-2009 (and had to subpoena Halliburton to get them to disclose this information!). Their 2011 report listed a vast range of substances including some surprising elements (instant coffee and walnut hulls) but most of all, dozens of toxic and hazardous chemicals (including benzene and lead).[14]

[11] Andrews, Anthony et. al. 2009 'Unconventional Gas Shales: Development, Technology, and Policy Issues' Congressional Research Service. p 22 http://www.fas.org/sgp/crs/misc/R40894.pdf
[12] http://www.halliburton.com/public/projects/pubsdata/Hydraulic_Fracturing/CleanSuite_Technologies.html
[13] Subsequently concerns have been raised about the objectivity of the 2004 (reporthttp://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_coalbedmethanestudy.cfm); according to an EPA whistleblower, an early draft was said to include information on possible evidence of aquifer contamination, while 5 out of 7 of the peer review panel were current or former oil and gas industry employees, see http://www.nytimes.com/2011/03/04/us/04gas.html?_r=1. Also see section on groundwater contamination for more.

## Risks associated with unconventional gas extraction

The unconventional gas industry in the USA has been operating commercially for some years now, meaning that the longer-term consequences of extraction are becoming visible there, while the European industry is still in its infancy.

The human and environmental impacts of the boom in unconventional gas are probably best known from the 2010 'Gasland' documentary, which showed residents of Dimmock, Pennsylvania setting the water in their taps on fire because it was so contaminated with methane; and communities, unable to drink or even shower in their tap water, being supplied with portable water or purification kits by the gas companies.

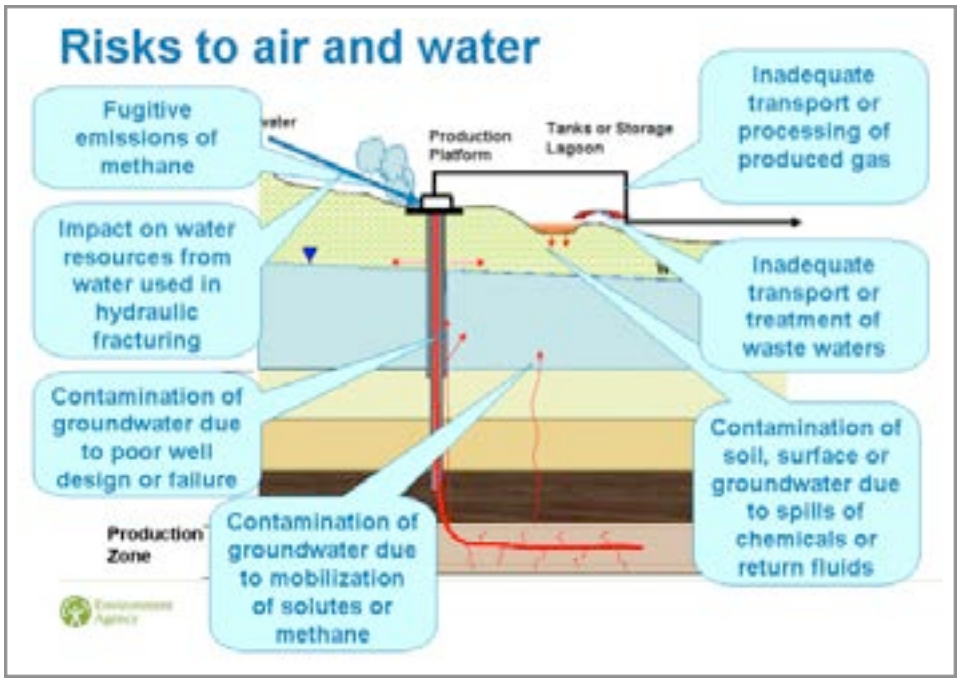
### Water contamination

A key risk associated with unconventional gas developments is contamination of groundwater and aquifers, leading to contamination of drinking water and water used for agricultural purposes, or finding its way into wildlife and ecosystems. Groundwater can be contaminated by chemicals used in frack fluid and by escaped methane gas, and wastewater extracted from unconventional gas wells can contain substances and toxins released from the shale or coal. Water that has been stewing in coal for thousands of years is far from pure, and in the USA, shale wells have been found to produce radioactive substances.[15]

Water contamination is possible during a number of different stages. Unconventional gas drilling can increase the 'mobility' (ability to move around and enter water source or air) of particles (including methane gas) already in the shale or CBM (and contained in any fracking fluid used). Up to 90 percent of the fracking fluid stays behind in the rock or seam, and it is largely unknown what happens to it.[16] Arguably contamination in this stage is more likely to happen in CBM than shale developments because of the relative proximity of coal seams to aquifers than shale. The Pavilion contamination happened in relatively shallow gas fields.

Leaks of methane or contaminated water from the wellhead or borehole casing can also happen due to faulty equipment, damaged casing or human error. The possible added impact of earth tremors from the fracking process can exacerbate this by damaging equipment and the borehole. The large number of wells for each development also increases the chances of something going wrong.

There is also the risk of accidental direct spillages of pure fracking fluid, water contaminated with frack fluid or water extracted from coal seams into ground water e.g. from lorries etc during transportation or a well blow-out. Illegal or inadequate disposal of industry wastewater can also result in groundwater contamination (see below).




*Pollutant pathways associated with hydraulic fracturing (Environment Agency 2011)*

[14] United States House of representatives Committee on Energy and Commerce Minority Staff, April 2011, Chemicals used in Hydraulic Fracturing http://democrats.energycommerce.house.gov/index.php?q=news/committee-democrats-release-new-report-detailing-hydraulic-fracturing-products

[15] Bamberger & Oswald, Impacts of gas drilling on human and animal health, New Solutions Vol. 22(1) 51-77, 2012 http://baywood.metapress.com/app/home/contribution.asp?referrer=parent&backto=issue,1,1;journal,1,56;linkingpublicationresults,1:300327,1

[16] http://ec.europa.eu/environment/integration/research/newsalert/pdf/275na3.pdf

A 2011 study from Duke University found links between shale drilling and methane contamination of drinking water in Pennsylvania and New York State,[20] and following increased public pressure and awareness, in December 2011 the EPA conducted a study in Pavilion, Wyoming, and found conclusive evidence for the first time that fracking fluid from shale wells had contaminated ground water.[21]

The EPA stressed that these findings were specific to Pavilion, but what's interesting about that study is that the fracking was being done on wells as shallow as 372m; this adds weight to the concern that fracking for CBM could be more risky than for shale because shale deposits are generally much deeper (1000-2000m below ground surface), and CBM much shallower and therefore closer to groundwater (the BGS count 'deep coal' as anything below 50m).

In response to concerns over the pollution of aquifers the government in New South Wales introduced a moratorium in 2011 on hydraulic fracturing and banned the use of highly toxic volatile organic compounds (BTEX chemicals: benzene, toluene, ethylbenzene and xylene) in coal seam gas developments because of safety fears.[22] A 2010 study of a single coal seam gas field at Tara, Queensland, Australia found that 44% of the wells tested were leaking methane.[23]

The headline findings of a widely publicised recent study from the University of Texas indicate that there is no evidence that fracking contaminates groundwater, however, scratch beneath the headlines and far from claiming the industry is safe the report found that many problems ascribed to fracking are common to all oil and gas drilling.[24] It's interesting to note however, that Shell recently signed a 5-year $7.5m contract with the University to research unconventional gas.[25] Water contamination is the impact most likely to ignite public opposition, therefore the industry will naturally be keen to disprove links.

*The CBM study that led to the 'Halliburton loophole'*
In 2004 the US Environmental Protection Agency published findings of a study into fracking in CBM developments in the Powder Basin that led to the exemption of fracking from the US Safe Drinking Water Act. [17] The study looked at CBM because of the relatively closer proximity of coal seams to groundwater than shale. It found no irrefutable evidence that fracking fluids from gas developments were contaminating groundwater, and concluded that fracking posed a 'minimal threat' in terms of contamination of underground sources of drinking water.

The study did not however examine the impacts associated with CBM production beyond the injection of fracking fluids, e.g. impacts from groundwater removal or production water discharge (although it did identify that citizens were concerned with these), nor contamination with methane. And, in spite of its findings, the report lead to the three companies responsible for 95 percent of fracking in the US to voluntarily pledging not to use diesel in fracking fluid because of fears of benzene contamination of water supplies.[18]

Subsequently, concerns have been raised about the objectivity of the report: according to an EPA whistleblower, an early draft was said to include information on possible evidence of aquifer contamination, while 5 out of 7 of the peer review panel were current or former oil and gas industry employees.[19]

[17] The study looked at 11 key CBM areas in the USA, including Powder River Basin in Wyoming and Montana, the San Juan Basin in Colorado and New Mexico, and the Black Warrior Basin in Alabama http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_coalbedmethanestudy.cfm
[18] http://www.epa.gov/ogwdw/uic/pdfs/cbmstudy_attach_uic_final_fact_sheet.pdf
[19] http://www.nytimes.com/2011/03/04/us/04gas.html?_r=1
[20] Osborn et al 2011 http://www.pnas.org/content/early/2011/05/02/1100682108
[21] http://www.guardian.co.uk/world/2011/dec/09/epa-reports-fracking-groundwater-pollution and http://www.epa.gov/region8/superfund/wy/pavillion/index.html
[22] http://www.trade.nsw.gov.au/policy/TI-O-120
[23] Queensland Government Investigation Report 2010, Leakage testing of coal seam gas wells in the Tara 'rural residential estates' vicinity http://mines.industry.qld.gov.au/assets/petroleum-pdf/tara_leaking_well_investigation_report.pdf
[24] Groat et al, University of Texas, Austin, Feb 2012 http://www.energy.utexas.edu/index.php?option=com_content&view=article&id=151&Itemid=160 The apparently independent study aims to separate fact from fiction in the shale gas debate, yet starts with the premise that 'Natural gas resources – and shale gas specifically – are essential to the energy security of the US and the world.'
[25] http://www.statesman.com/business/shell-university-of-texas-sign-7-5-million-1849560.html

## Water use & disposal

Hydraulic fracturing requires the use of vast quantities of water to be pumped into shale or coal seams under high pressure. A single shale gas 'fracture treatment' can use over 500,000 tonnes of water, but a well requiring multiple treatments may use several million tonnes.[26] In addition to putting pressure on local water resources, there are risks associated with the disposal of and possible leakage of contaminated water.

Fracking for coal bed methane requires less water than for shale because of the greater porosity of coal. With CBM, however, (whether or not fracking takes place) there is the additional problem of de-watering coal seam and the disposal of this water. This water can be very saline, and contain other substances absorbed from the coal. There is the added risk of depleting ground water and aquifers by extracting it from adjoining coal seams, and possible risks of subsidence.

Local water infrastructure may not be equipped to cope with the huge volumes of fluids needing to be disposed of, nor able to treat the toxins and hazardous chemicals contained in such wastewater. In the USA there have been numerous reported cases of illegal dumping of wastewater, which adds an additional risk of groundwater contamination and poisoning of local wildlife.[27]

## Climate change

Energy companies like to promote shale and CBM as natural gas, claiming that they are cleaner than conventional fossil fuels and a crucial 'bridging fuel' to ease the transition to a low carbon economy. However, not only are unconventional gas extraction techniques very energy hungry, but an additional risk lies in the possibility of methane leakage, or 'fugitive emissions' from the fractures and well bores. Methane is a potent greenhouse gas, with a global warming potential 25 times that of carbon dioxide over a 100 year period.

The IEA considers that shale gas 'produced to proper standards of environmental responsibility has only slightly higher 'well-to-burner' emissions than conventional gas, with the combustion of gas being the dominant source of emissions.'[28] However, they note that an increased share of gas is not enough to put us on the necessary decarbonisation path because while is displaces coal, and some oil, it also displaces nuclear! Their 'Golden Age of Gas' scenario puts emissions on a trajectory of GHG stabilisation at 650ppm, or 3.5$^{o}$C, well over the generally agreed safe limits. Even that scenario assumes that support for renewables continues, however the IEA notes that there is a risk that low gas prices might see 'government's resolve in this respect waiver'.

However a 2011 Cornell University study[29] by Robert Howarth found that over a 20-year period shale gas had at least a 20 percent greater GHG footprint than coal, and possibly up to 50 percent, largely due to fugitive methane emissions (methane is a major component of shale gas). The study has attracted a lot of criticism, and a number of subsequent studies have indicated that shale has a footprint of only about 11 percent more than conventional gas.[30]

Attempts to discredit Howarth's study seem focussed on the relatively short timeframe that looked at (and its lack of emphasis on increased use of green technologies).[31] Methane is a very potent GHG but has a relatively short lifespan, so in policy terms it makes sense to look at a shorter timeframe as high methane emissions now could make our 2020 and 2050 climate targets impossible to meet. Howarth and his Cornell colleagues published a response to these criticisms in 2012, defending the original paper and emphasising the urgent need to focus on short timescales to avoid 'climate-system tipping points'.[32]

[26] Andrews, Anthony et. al. 2009 'Unconventional Gas Shales: Development, Technology, and Policy Issues' Congressional Research Service. p 22 http://www.fas.org/sgp/crs/misc/R40894.pdf
[27] Bamberger & Oswald, Impacts of gas drilling on human and animal health, New Solutions Vol. 22(1) 51-77, 2012 http://baywood.metapress.com/app/home/contribution.asp?referrer=parent&backto=issue,1,1;journal,1,56;linkingpublicationresults,1:300327,1 72
[28] International Energy Agency, The Golden Age of Gas? 2011
[29] http://www.springerlink.com/content/e384226wr4160653/
[30] Cathles et al 2011 http://www.springerlink.com/content/x001g12t2332462p/ , Hultman et al 2001 http://iopscience.iop.org/1748-9326/6/4/044008/ , Jiang et al 2011 http://iopscience.iop.org/1748-9326/6/3/034014/
[31] In particular the response from Howarth's Cornell colleagues published in 2011 Cathles et al http://www.springerlink.com/content/x001g12t2332462p/
[32] Howarth et al 2012 http://216.250.243.12/HowarthIngraffeaarticleFINAL1.pdf

## Air pollution

Researchers from the National Oceanic and Atmospheric Administration (NOAA) found evidence to support Howarth's position on the climate impacts of shale when they undertook air sampling near an unconventional gas-drilling site in Denver.[33] The study not only found that methane loses into the atmosphere were more than twice the official industry estimates (and comparable with, if not higher than, Howarth's estimates), but also found that gas operations were leaking the highly toxic and carcinogenic benzene into the air.[34]

## Farming

A recent US study on the impacts of fracking for livestock highlighted not only the inadequacy of testing regimes, but also the severity of consequences of exposure to fracking fluid and contaminated water.[35] The study showed that in one case 17 cows died in one hour following the release of fracking fluid form a drilling rig into the adjacent pasture. In another case where goats were exposed to leaked fluids from a faulty tank valve, they suffered from reproductive problems for two years. Other examples included the death of pets that have consumed wastewater spread on roads as a form of disposal.

## Earth tremors

A 2011 report commissioned by Cuadrilla following an earth tremor that measured 1.5 on the Richter scale at their fracking site in Bowland, Lancashire confirmed that fracking was the likely cause.[36] Probably the most important risk associated with earth tremors of this low magnitude is that of damage to borehole casing, leading to increased risk of fugitive emissions and contaminated water/fracking fluid escapage. Additional risks include possible damage to sensitive equipment in data centres. Banking group Rabobank has been a key opponent to a fracking development in Boxtel in the Netherlands due to concerns over disruption to their new data centre.[37]

## Other impacts

Other environmental impacts from shale and CBM developments include lorry traffic to and from the wellheads. While the above ground infrastructure for an individual well head is fairly neat, each well head needs a larger area for all the water pumping trucks to sit on, and each development needs many wellheads.

In evidence to the Energy and Climate Change Select Committee the Tyndall Centre pointed out that: "the 'novel' risks associated with hydraulic fracturing of wells are not the only potential drawback of shale exploration, particularly when considering relatively highly populated countries such as the UK. More 'run of the mill' impacts such as vehicle movements, landscape, noise and water consumption may also be of significant concern locally and more generally, especially, when one considers the scale of development required to deliver significant supplies to the UK."[38]

*Typical Frack site in the USA (Frack Off 2012)*

[33] http://sciences.blogs.liberation.fr/files/gas-leakage.pdf
[34] http://researchmatters.noaa.gov/news/Pages/COoilgas.aspx
[35] Bamberger & Oswald, p72
[36] http://www.cuadrillaresources.com/cms/wp-content/uploads/2011/11/Final_Report_Bowland_Seismicity_02-11-11.pdf
[37] http://www.dutchnews.nl/news/archives/2011/03/rabobank_worried_about_gas_dri.php
[38] http://www.publications.parliament.uk/pa/cm201011/cmselect/cmenergy/writev/shale/sg12.htm

## Unconventional gas in Scotland

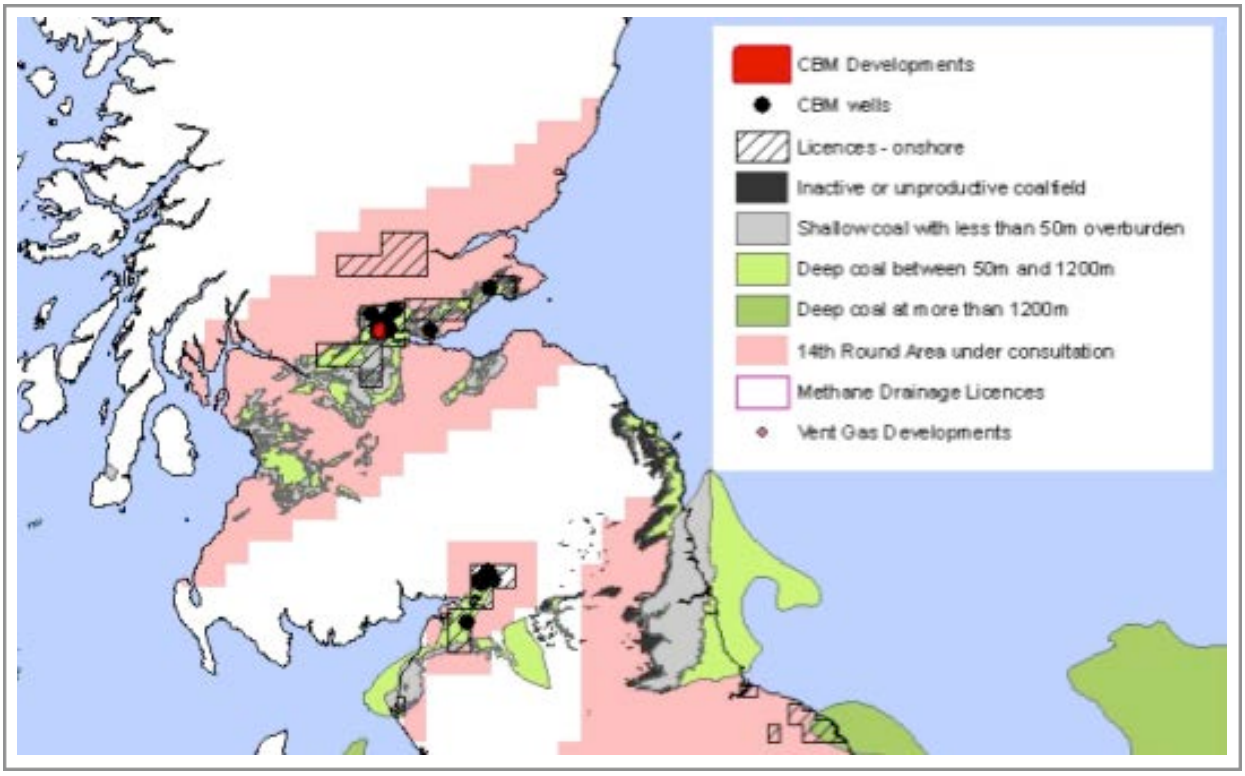
There are currently six areas in Scotland licensed for onshore oil and gas exploration and development. Two of these areas have fairly advanced CBM exploration projects.

The first is at Airth, near Stirling, where a company called Dart Energy is using horizontal and vertical drilling techniques, but not fracking, to extract CBM. Still in the testing stage, the project already has 14 wells drilled. Dart is aiming for early commercialisation of that project in 2012. They also hope to exploit shale reserves in the Lothian and Black Metal Shale in the area.

The second is in Dumfries and Galloway where a company called Greenpark Energy – also testing for CBM – was the first company to get permission to frack in Scotland, at a site near Canonbie. The company is currently seeking another fracking related license for a second site.[39] Again, although it's still in the testing stage, over 20 planning applications have been granted for this project already. Dart Energy recently bought out Greenpark's CBM licenses[40] and also has the exploration rights to an area in Fife, so is the company now leading Scottish CBM development.

A third company – REACH Coal Seam Gas – is hoping to develop CBM in North Lanarkshire, but recently withdrew a planning application for a development at Moodiesburn, following significant public opposition.[41]

It looks like CBM is going to be a bigger issue than shale for Scotland, simply because the central belt is covered with coal beds, and CBM exploitation is further developed than shale in the UK. In late 2012 the UK Department for Energy and Climate Change (DECC) will launch the tendering process for its 14th round of onshore licensing during which the entire central belt is up for grabs.[42]




*The areas in pink will be tendered for exploration in late 2012 (DECC 2010)*

[39] Greenpark were issued with a Trade Effluent Discharge Permit by SEPA that covers the disposal of liquid waste resulting from non-domestic or industrial activity.

[40] http://www.naturalgaseurope.com/uk-alkane-energy-acquires-greenpark-energy-4723 http://www.ogj.com/articles/2012/01/dart-energy-aggregates-unconventional-gas-business.html

[41] https://eplanning.northlan.gov.uk/Online/centralDistribution.do?action=dispatch&caseType=Application&caseNo=11/01318/FUL

[42] see DECC 2010 Promote UK The Unconventional Hydrocarbon Resources of Britain's Onshore Basins – Coalbed Methane (British Geological Survey)

## How is unconventional gas and fracking regulated?

Both government and industry in the UK are quick to point out that European and UK regulatory frameworks are much tougher than in the USA and it is unlikely that impacts would be directly replicated here. In 2011 the UK Energy and Climate Change Select Committee held an inquiry into shale gas, and concluded that hydraulic fracking for shale gas in itself wasn't inherently risky in relation to aquifer contamination; any risks were associated with the integrity of the well, which made the activity no different to conventional gas exploration. It's interesting to note however, that while the Inquiry looked only at shale, it pointed out that aquifer contamination from fracking was more likely in CBM projects since coal formations are shallow and can be very close to drinking water supplies.[43]

However a key difference between unconventional gas drilling and conventional gas drilling is the sheer number of wells required to exploit the resource. With conventional gas a single well is drilled to tap into the convenient pocket of gas. With unconventional gas, the gas is trapped (or 'adsorbed' in the case of CBM) in the rock and many more boreholes are required to extract it, as well as the additional stimulus of dewatering the seam (in CBM) and hydraulic fracturing (in shale and often CBM).

So if risks can be split into those related to the gas industry as a whole (e.g. inadequate wellbore casing, well blowouts, spillages etc) and those related to the unconventional gas industry (e.g. the use of toxic chemicals in fracking fluids, the fracking process itself triggering earth tremors increasing risk of damage to well casing, the de-watering of coal seams, possible subsidence and water disposal associated with that); then unconventional gas operations are at risk from all of these (give or take fracking related risks in some CBM developments) but multiplied by around 100 per field due to the sheer number of wells.

### Licensing

The UK Department for Energy and Climate Change (DECC) issues Petroleum Exploration and Development Licenses (PEDLs) across the whole of the UK, as aspects of energy policy are reserved to Westminster. PEDLs cover onshore exploration and development of shale gas and coal bed methane (as a petroleum byproduct) and monitoring of seismic activity, although CBM also requires permission from the Coal Authority for access to coal formations.

The license is made up of three different stages: an initial work programme; followed by a development programme; and finally a production phase. Unused or unsuccessfully explored licenses are 'surrendered' so DECC can issue them again in the next round. Companies have to demonstrate they have met the requirements of each stage of the licenses to move on to the next stage and avoid having to surrender it.

There are currently six live PEDLs issued in Scotland (the projects described above fall into three of these areas). The 14th licensing round is due in late 2012, and consultation on the SEA for DECC's licensing plans has ended. A vast area of Scotland, including the whole central belt, is essentially up for grabs in this new round of licensing.

### Environmental regulation

Activity that might affect Scotland's water environment are regulated under the Water Environment (Controlled Activities) (Scotland) Regulations 2011,[44] (more commonly known as the Controlled Activities Regulations (CAR)) by Scottish Environment Protection Agency (SEPA). The CAR regulations were introduced to implement the EU Water Framework Directive.

The Environment Minister Stewart Stevenson confirmed that in relation to fracking "SEPA's specific obligations under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 are to consider the risks to the water environment. Those are the only environmental factors considered by SEPA."[45] Energy Minister Fergus Ewing MSP added that "CAR licenses are only issued when SEPA are satisfied that any risks to the water environment are negated or within manageable tolerances."[46]

[43] UK Energy and Climate Change Select Committee report into shale gas, 107 http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79502.htm
[44] http://www.legislation.gov.uk/ssi/2011/209/contents/made
[45] In response to Alison Johnstone MSP Scottish Parliament Debate 17 November 2011
[46] In response to PQ S4W-04086

A company wishing to frack would have to seek permission from SEPA under CAR to do so, but the activity may be exempt from regulation by a technicality in the Water Framework Directive. A 2011 SEPA policy statement points to the loophole whereby if hydrocarbons are extracted from the seam or rock before the pollutants are released, the injection of fracking fluid, or 'discharge of pollutants into aquifers [from shale and CBM extraction] falls within the WFD exemption on the prohibition of direct discharges'.[47]

The license issued to Greenpark is a Trade Effluent Discharge Permit.[48] Greenpark referred to the permit as a 'fracking permit', although they are issued in relation to the disposal of any liquid waste resulting from non-domestic or industrial activity.

At an EU level REACH legislation (Registration, Evaluation, Authorisation & restriction of Chemicals) regulates the use of chemicals in certain quantities for industrial purposes. However, the various deadlines and requirements of REACH legislation means that information about chemicals is not automatically available to the public and REACH controls on fracking may not come into force for some time. While certain information may be made available under Freedom of Information legislation, companies involved in fracking in the EU (including Scotland) are not publicly disclosing exhaustive list of the chemicals used for each project, making it impossible to assess the environmental and health risks of fracking (including full life cycle impacts).

**Planning**

Above ground developments linked to shale and CBM projects go through normal planning processes, but communities may struggle to identify where developments on the ground relate to unconventional onshore gas, and specifically where fracking might take place.

For example, it appears that in Canonbie, Greenpark obtained planning permission for the above ground infrastructure for their CBM project and subsequently applied to SEPA for permission to frack the well. Unless the planning application was scrupulously clear about Greenpark's plans, locals would have had no idea that there was even a chance that fracking would be taking place until it was too late. It is also somewhat telling that Dart Energy put in a key planning application for its Airth CBM development a few days before Christmas in 2010.

Onshore oil and gas extraction needs to be referenced in Local Development Plans (LDP) in order for developments to comply with Scottish Planning Policy. A number of relevant local authorities are at key stages in their drafting of these plans.

## What the Government says about unconventional gas

A number of Parliamentary Questions have been asked on the subject of fracking and unconventional gas. The Scottish Government's response has been that the current regulatory system is well equipped to deal with fracking, as they have dealt with onshore oil and gas drilling for many years.

SEPA has publicly played down the risks from fracking. Malcolm Roberts, principal policy officer at SEPA has been quoted saying: "I don't associate the risks with fracking as being any more significant than a lot of other things we do….They are not high-risk operations provided they are done properly."[49]

The UK Energy and Climate Change Committee found that hydraulic fracking in itself wasn't inherently risky in relation to aquifer contamination, any risks were associated with the integrity of the well, which made the activity no different to conventional gas exploration, hence DECC's position that a moratorium is unjustified. DECC consider that the regulatory framework in the UK is sufficient to deal with any unwanted environmental impacts of fracking. Arguably this is supported by the fact that fracking has been suspended at the Cuadrilla site in Lancashire following last years' earth tremors pending a full investigation, however in actual fact it is little more than a 'gentleman's agreement'.

[47] SEPA WAT-PS-11-01: Regulating Underground Coal Gasification, CO2 Storage, Shale Gas and Coal Bed Methane Extraction Activities http://www.sepa.org.uk/water/water_regulation/guidance/all_regimes.aspx

[48] http://www.business.scotland.gov.uk/bdotg/action/detail?itemId=1080485240&r.i=1080480785&r.l1=1079068363&r.l2=1086048470&r.l3=1080480296&r.s=m&r.t=RESOURCES&site=202&type=RESOURCES

[49] http://www.scotsman.com/scotland-on-sunday/scotland/fracking_for_gas_given_the_green_light_1_1950654

## What Friends of the Earth Scotland says about unconventional gas

The unconventional gas is an industry in its infancy in Scotland and across Europe. Increasing evidence from the USA and Australia where the industry is better developed indicates inherent and unacceptably high environmental and health risks associated with shale and CBM drilling – whether or not hydraulic fracturing takes place – particularly in relation to groundwater contamination with methane and fracking fluids.

Even if the industry improves standards and is able eventually to demonstrate 'acceptable' levels of risk to the environment and human health – which it has proved incapable of after more than a decade of heavy industrial development in the US – developing this industry is a distraction we simply can't afford from developing renewables.

The UK Committee on Climate Change makes it clear that we need to decarbonise our energy sector by 2030, in order to meet 2050's carbon reduction targets and avoid runaway climate change. But investing in gas developments now risks locking us into a legacy of high carbon infrastructure incompatible with our climate targets. So even if the UK meets 2020 targets, using fracked gas as a 'bridge fuel' will make it much harder to meet future targets. We need to be weaning ourselves off fossil fuels, not exploring and developing new and risky ways of extracting difficult to get resources.

The crucial point is that even if exploiting these new sources of fossil fuels was proven to be 'safe', the impact of burning them on the climate will topple us into catastrophic global warming. As Professor James Hansen – NASA's top scientist – has pointed out, that in order to stabilize our climate at a safe level we need to:

- Phase out coal entirely by 2030;
- Cease oil and gas exploration immediately, and only use what we know we have;
- Stop mining the tar sands now.

As long as all these problems outlined in this briefing are not adequately addressed, we believe that no further CBM or shale gas activities should proceed, and call on the Scottish Government to suspend all ongoing activities, and put in place a moratorium on any new projects.


*Fracking protest NYC (Owen Crowley)*

## What you can do

### Object to planning applications in your area

As with all developments, companies planning to explore or extract unconventional gas in your area will need to apply for planning permission. One thing you can do is to keep an eye on applications in your area and object to applications for gas exploration or extraction.

In Moodiesburn, North Lanarkshire, REACH CSG recently withdrew an application to develop CBM when 200 people objected to it. If people are aware of the potential problems early, it is easier to stop developments.

One challenge is finding out if an application is related to unconventional gas, as sometimes planning applications can be difficult to decipher. 'Frack Off' has a list of companies involved in fracking and unconventional gas extraction on its website: http://frack-off.org.uk/bad-guys/. If there is a planning application from any of these companies it's worth investigating further. In Scotland the companies who currently hold PEDL licenses are Dart Energy and REACH CSG.

Sometimes however – as in the case of the Moodiesburn application – the planning permission can be submitted by a third party, e,g, the company that owns the land, rather than the company who holds the PEDL license, so its worth keeping a sharp eye out.

**Get together with others**
Opposing unconventional gas in your area will be much easier if you join together with others in your area. You can plan activities together, make use of everyone's skills and contacts, and send a clear message to gas exploration companies that they are not welcome in your area.

- Contact Friends of the Earth Scotland to ask if there are any groups or activists in your area.
- Go to http://frack-off.org.uk/ and enter your name and postcode to link up with others opposed to unconventional gas in your area.
- Hold a meeting, or a public screening of 'Gaslands' – a film about fracking in the USA http://www.gaslandthemovie.com/

**Become a 'fracking free zone'**
Some towns in the USA and Europe have declared themselves 'fracking free'. This is a smart way of pre-empting plans for unconventional gas, and warning potential developers that many local people will object to applications in the area. Later this year the Department of Energy and Climate Change will start issuing licenses for more exploration across the central belt of Scotland, so it's a good time to start raising awareness in your area.

To become a fracking free zone you should:

- Arrange talks for local community councils about unconventional gas, and ask them to sign up to your campaign, pledging that they will officially object to applications in the area.
- Speak to your local councillors and ask them to pass a motion against unconventional gas in the area. If a developer knows that the council is unlikely to grant planning permission they may not try.
- Feed into your council's local development plan, to ensure that unconventional gas is not part of the plan for your area.
- Spread the word about fracking in your area and ask businesses, schools, organisations and individuals to sign up, pledging that they will object to planning applications for unconventional gas.

**Keep in touch**
Friends of the Earth Scotland staff can help you to plan campaigns, start a group, get in the media and connect with other campaigners. We can also provide in depth briefings on this and many other environmental issues. Please get in touch on 0131 243 2700 to have a chat.

## Appendix - useful resources

**Websites**
Frack Off (Don't frack with the UK campaign) http://frack-off.org.uk/, with a handy map at http://frack-off.org.uk/bad-guys/locations/

Frack Off Scotland http://frackoffscotland.org.uk/

FoE EWNI have a shale gas & fracking campaign hub, http://forum.foe.co.uk/campaignhubs/index.php/board,27.0.html

A couple of interesting Australian sites from campaigns against CSG http://coalseamgasnews.org/ and http://lockthegate.org.au/

Irish campaign against fracking http://frackingfreeireland.org/

Global shale reserves http://en.wikipedia.org/wiki/File:EIA_World_Shale_Gas_Map.png

Underground Coal Gasification: http://groundtruthtrekking.org/Issues/AlaskaCoal/UndergroundCoalGasification.html

DECC 14th Licensing Round info: http://og.decc.gov.uk/en/olgs/cms/tech_papers/conf_papers/conf_papers.aspx

Free Range Energy: http://www.fraw.org.uk/projects/index.shtml

**Films**
Fracking Hell http://www.youtube.com/watch?v=dEB_Wwe-uBM

Gasland: trailer at http://www.youtube.com/watch?v=dZe1AeH0Qz8; feature film available from http://www.gaslandthemovie.com/

The Fracking Song, 'My waters on fire tonight' http://www.youtube.com/watch?v=timfvNgr_Q4

From closer to home, a FoE EWNI film about the campaign against fracking in Cumbria http://www.youtube.com/user/friendsoftheearth#play/uploads/9/ahcdnCro7eE

**Research**
- International Energy Agency, The Golden Age of Gas? 2011 www.iea.org/weo/docs/.../WEO2011_GoldenAgeofGasReport.pdf
- Andrews et al 2009 'Unconventional Gas Shales: Development, Technology, and Policy Issues' Congressional Research Service. p 22 http://www.fas.org/sgp/crs/misc/R40894.pdf
- Osborn et al, Duke University 2011 http://www.pnas.org/content/early/2011/05/02/1100682108
- Bamberger & Oswald, Impacts of gas drilling on human and animal health, New Solutions Vol. 22(1) 51-77, 2012 http://baywood.metapress.com/app/home/contribution.asp?referrer=parent&backto=issue,1,1;journal,1,56;linkingpublicationresults,1:300327,1
- Groat et al, University of Texas, Austin, Feb 2012 http://www.energy.utexas.edu/index.php?option=com_content&view=article&id=151&Itemid=160
- Caudrilla report 2011 http://www.cuadrillaresources.com/cms/wp-content/uploads/2011/11/Final_Report_Bowland_Seismicity_02-11-11.pdf
- Howarth et al, Cornell University 2011 http://www.springerlink.com/content/e384226wr4160653/
- Cathles et al, Cornell University 2011 (Howarth's colleagues response to shale twice as big ghg footprint as coal findings) http://www.springerlink.com/content/x001g12t2332462p/
- Hultman et al 2001 http://iopscience.iop.org/1748-9326/6/4/044008/, Jiang et al 2011 http://iopscience.iop.org/1748-9326/6/3/034014/ (other reports responding to Howarth's article)
- Howarth et al, Cornell University 2012 (responding to Cathles et al, defending 2011 study) http://216.250.243.12/HowarthIngraffeaarticleFINAL1.pdf
- The US EPA study on the effects of fracking on drinking water is at http://www.epa.gov/hfstudy/ draft Pavillion, Wyoming findings http://www.epa.gov/region8/superfund/wy/pavillion/index.html
- DECC's 'Promote UK' venture has commissioned reports from the British Geological Survey on the Unconventional Hydrocarbon Resources of Britain's Onshore Basins for both shale gas and CBM – they are easy to find with a google search but I can't cut and paste the link for some reason. Also saved on server.
- UK Energy and Climate Change Select Committee report into shale gas http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79502.htm and including evidence submitted to the Committee at http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/795vw01.htm