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Shale gas drilling in the Northwest Carboniferous (Lough Allen) and Clare Basins and the context to the technology known as 'fracking'

Briefing Paper for the Committee on Environment, Transport, Culture and the Gaeltacht

What does this Briefing Paper examine?

This paper examines some of the issues relating to the hydraulic fracturing (also known as fracking) extraction system in the context of licences issued for the Northwest Carboniferous and Clare Basins.

It then examines more general issues relating to fracking from an international perspective.

Contents

Introduction

This paper examines various issues in relation to the granting of licences in Ireland by the Department of Communications, Energy and Natural Resources.

Generally, information on petroleum licensing issues in Ireland can be found at the Petroleum Affairs Division of the Department of Communications, Energy and Natural Resources (http://www.pad.ie). This paper makes use of:

- the Department's Licensing Terms for Offshore Oil And Gas Exploration, Development & Production[1] (2007);
- the Petroleum and Other Minerals Development Act, 1960[2]; and
- details provided for applicants for Onshore Petroleum Licensing Options over the Northwest Carboniferous Basin[3] to answer the questions in relation to licensing.

It then briefly outlines some of the general issues relating to fracking, policy debates and developments at the international level.

[1] http://www.dcenr.gov.ie/NR/rdonlyres/48C3818F-02E7-4060-9E88-06D0C8332480/0/LicensingTerms2007Web2011.pdf
[2] http://www.irishstatutebook.ie/1960/en/act/pub/0007/index.html
[3] http://www.dcenr.gov.ie/Natural/Petroleum+Affairs+Division/NW+Carboniferous+and+Clare+Basins/

Licensing

1. Who was granted licences? Where are the licenses granted for?

The Minister of State at the Department of Communications, Energy and Natural Resources ("the Minister") invited applications for Onshore Licensing Options to be granted under the *Petroleum and Other Minerals Development Act, 1960*, in relation to the Northwest Carboniferous Basin and the Clare Basin.

Onshore Petroleum Licensing Options were offered to:

(i) Tamboran Resources PTY Ltd over 986 sq km in the Northwest Carboniferous Basin[4];

(ii) Lough Allen Natural Gas Company Ltd over 467 sq km in the Northwest Carboniferous Basin[5].;and

(iii) Enegi Oil Plc over 495 sq km in the Clare Basin[6]

The licensing options awarded are valid for a maximum of 24 months and may not be extended. Subject to this maximum period the actual period of the Licensing Option will be determined by the work programme agreed with the Minister.

Option-holders will be required to hold a Petroleum Prospecting Licence for the full duration of the Licensing Option. Petroleum Prospecting Licences are awarded under Section 9 of the *Petroleum and Other Minerals Development Act, 1960*. This licence allows companies to prospect for gas only.

[4] http://www.dcenr.gov.ie/NR/rdonlyres/5C2FDD2D-7D0C-4FE1-8310-87B2947A73D5/0/MapofareaofferedtotheTamboranResourcesPTYLtd.pdf
[5] http://www.dcenr.gov.ie/NR/rdonlyres/EBE131A4-3163-4B14-B822-847F6DE1A788/0/MapofareaofferedtotheLoughAllenNaturalGasCompanyLtd.pdf
[6] http://www.dcenr.gov.ie/NR/rdonlyres/3DC2AE9A-87B7-43EE-8782-4C71A291C4F1/0/MapofareaofferedtoEnegiOilPlc.pdf

Criteria and restrictions

2. What criteria did the company's awarded the licences have to fulfil?

Licensing Options are awarded on the basis of specified award criteria (see below) which places a particular emphasis on the proposed work programme's appropriateness for evaluating hydrocarbon prospectivity. Applicants are required to demonstrate that, if granted a Licensing Option, they will have the technical and financial capacity to undertake the work programme.

Award Criteria

In considering an application the following scoring system was applied:
(a) The overall approach proposed – 10 Marks.

(b) The quality of the work programme proposed by the applicant (marks will only be awarded for firm commitments made) – 40 Marks.

(c) The demonstrated technical competence and experience of the applicant – 25 Marks.

(d) Demonstrated financial capacity to fund the work programme proposed – 25 Marks.

Applicants had to achieve a pass mark of 60% in the case of a, b and c above and also had to demonstrate that they had the financial capacity to fund the work programme offered.

Furthermore, the following information was required from each applicant company:

(a) The full company name, registered address, billing address, and contact details of the applicant including details of the person who will serve as liaison with the Irish authorities;

(b) A copy of the charter or constitution of the applicant;

(c) Information concerning the applicant's place of registration, its principal place of business, its board of directors, its share capital and shareholdings;

(d) Information as to the form of the organisation, including, details of parent, subsidiary and group companies;

(e) Annual reports for the past two years together with copies of annual accounts including balance sheets and the profit and loss accounts for the same period;

(f) Information as to the manner in which exploration and development activities are to be financed and performance guaranteed;

(g) Confirmation that the applicant is chargeable, in accordance with the laws of Ireland, to tax in respect of profits and gains arising from, or connected with, exploration or exploitation activities carried out in a designated area or from exploration or exploitation rights;

(h) Information concerning the applicant's previous experience in exploration for and exploitation of petroleum, including experience relevant to any non-conventional plays (e.g. shale gas, tight gas sand) which may be the subject of the application;

(i) Information concerning any authorisation previously issued by the Minister to the applicant or to which the applicant was a party;

(j) A statement detailing the applicant's policy towards health and safety; and

(k) A statement detailing the applicant's policy towards the environment.

3. What restrictions have to be adhered to as a condition of the license?

The work programme which has been agreed with the Minister must be adhered to. This includes the:

(a) Procurement of all available and relevant technical data and studies; and

(b) New geological/geophysical studies and data acquisition projects, as considered necessary. The work programmes will not include drilling, but may include shallow geological sampling where subsurface penetrations would typically not exceed 100-200m.

There are also more general provisions contained in the 2007 Licensing Terms which must be followed. Many relate to good industry practice such as the welfare of employees and the protection of the environment:

Safety, health and welfare of employees

(1) The authorisation holder shall take all necessary steps for securing the safety, health and welfare of persons employed or undergoing training in or about the area of the authorisation.

(2) The authorisation holder shall comply with all statutory requirements in this regard.[7]

Protection of environment, property and strata

(1) All operations shall be conducted with due regard for the protection of the environment, protection of property and protection of petroleum (or water) bearing strata and shall be conducted in accordance with all relevant regulations and requirements.[8]

(2) In the event of pollution or the threat of pollution caused by operations conducted by or on behalf of the authorisation holder, the authorisation holder, in accordance with law and established procedures, shall at its expense immediately control and remove the pollutant and deal effectively with any threat of pollution.

Reporting obligations

4. Do the companies have to report to the department and if so how often?

The specific terms of the licensing options for the Northwest Carboniferous Basin require that companies with licences:

- submit, no later than three months prior to the expiry of the Option, an integrated assessment of the petroleum resource potential of the area together

[7] Article 59 of the Licensing Terms 2007
[8] Article 60 of the Licensing Terms 2007

with strategies, scoping economics and costed plans for further exploration / exploitation, and

- propose, no later than two months prior to the expiry of the Option, a detailed work programme for any follow-up authorisation(s) i.e. Petroleum Exploration Licence(s), for the approval of the Minister, which will include a drilling commitment/commitments.

Where a petroleum lease is granted then the company is obliged to submit an annual report to the Minister.[9] In other cases, such as licensing options, an annual report is not required unless it is a specific term of the petroleum prospecting licence.

Penalties for failure to fulfil obligations of the licence

5. What penalties are in place for failure to fulfil obligations of the licence?

S.9 of the *Petroleum and Other Minerals Development Act, 1960* does not contain any penalties for failing to fulfil the obligations of the licence. References to penalties could not be found in the 2007 Licensing Terms or in specific information in relation to the Northwest Carboniferous Basin and the Clare Basin. The licences granted are for exploration only and it is possible that if the terms of the licence were fundamentally breached that the Department would not grant a further licence, such as a petroleum lease.

Fracking Locations

6. Where has fracking taken place before?;

The hydraulic fracturing of deep shale beds has, for example, taken place in several U.S. states including Texas, Pennsylvania and Wyoming.

[9] See s.26 of the 2007 Licensing Terms

In the UK, drilling is under way near Blackpool. The House of Commons Energy and Climate Change Committee highlighted the global range of hydraulic fracturing in its Fifth Report, *Shale Gas*,10 May 2011:[10]

> "Cuadrilla Resources Holdings Limited describe themselves as an 'English independent oil and gas company … pursuing an unconventional hydrocarbon [oil and gas] exploration programme'[11]. Cuadrilla has drilled two wells so far... Cuadrilla began drilling for shale gas five miles east of Blackpool in August 2010. Cuadrilla completed Phase 1 of the exploration in December 2010, during which they found indications of natural gas. Phase 2 of the exploration commenced in 2011 and is expected to last three to six months.
>
> …..Shell drew our attention to existing shale gas exploration in Sweden, Germany, Ukraine, South Africa and China as well as coal-bed methane assets in Eastern Australia and China."

Problems related to Fracking

7. Have there been problems related to fracking before?

It was reported in the UK press in June 2011 that drilling near Blackpool may have caused two small earthquakes:[12]

> "Cuadrilla Resources: Drilling near Blackpool has been suspended by the shale gas explorer after scientists from the British Geological Survey said that the company's activities may have been connected to two small earthquakes that occurred in the area on April 1 and May 27."

Where it is being used, it has been alleged that fracking has three flaws:

- Possible contamination of the water supply;
- Possible contamination of the air; and
- Possible effects on the climate, in the form of greenhouse gas emissions.

[10] Report accessed at http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/795/79502.htm

[11] An "unconventional" fossil fuel means that additional procedures are required to extract it beyond regular drilling.A combination of directional drilling and a process called hydraulic fracturing have made accessible large amounts of natural gas locked up in the tight pores of shale formations at depths of 2 km or more.

[12] http://www.guardian.co.uk/uk/2011/jun/01/blackpool-earthquake-tremors-gas-drilling

8. What are the potential problems associated with fracking?

Possible contamination of the water supply,

The vast quantities of water used may deplete local ecosystems. Many shale deposits are under aquifers[13], and drilling and fracking can release extraction chemicals, or methane, into them. The mixture eventually returns to the surface, where it may contaminate both land and water. If methane enters the aquifer and this water is brought up out of the well into the tap, the methane bubbles out of the water and can be burned in the air. Generally speaking, natural gas does not get into aquifers, so what is causing this phenomenon? The House of Commons report explained the cause:[14]

> "There are many naturally occurring substances in the shale formation, and the process of hydraulic fracturing can affect their "mobility", which means their ability to move around and potentially enter a water source. These substances can include: naturally occurring 'formation' fluid (such as brine) found in the shale rock; gases, such as the target natural gas (mostly methane), carbon dioxide, hydrogen sulphide, nitrogen and helium; trace elements of substances such as mercury, arsenic and lead; naturally occurring radioactive material (radium, thorium, uranium); and 'volatile organic compounds' (VOCs) that easily vaporise into the air, such as benzene."

Such an event was reported in the town of Dimock, Pennsylvania: [15]

> "The real shock that Dimock has undergone, however, is in the aquifer that residents rely on for their fresh water. Dimock is now known as the place where, over the past two years, people's water started turning brown and making them sick, one woman's water well spontaneously combusted, and horses and pets mysteriously began to lose their hair."

[13] An aquifer is a geologic formation that contains sufficient saturated permeable material to yield significant quantities of water to springs and wells, constituting a usable supply for people's uses.
[14] See footnote 10
[15] *A colossal fracking mess: the dirty truth behind the new natural gas*.Vanity Fair, 21st of June, 2010. Accessed at http://www.vanityfair.com/business/features/2010/06/fracking-in-pennsylvania-201006

The local Department of Environmental Protection traced the contamination to drilling using hydraulic fracturing: [16]

> "The Department of Environmental Protection (DEP) has dropped its plans to build a 12.5-mile waterline from Montrose to Dimock Twp. in exchange for Cabot Oil and Gas Corp. agreeing to pay $4.1 million to residents affected by methane contamination attributed to faulty Cabot natural gas wells.....DEP has been investigating methane contamination in Dimock water supplies since January 2009, when a blast blew a concrete cover off a residential well. The agency has since traced the methane in the aquifer to improper casing and excessive pressures in Cabot's wells."

A report by Democrats in the US House of Representatives found that the waste water produced by fracking contains at least 29 chemicals that are known to cause or strongly suspected of causing cancer, including methanol, benzene, sulfuric acid and lead:[17]

> Some of the components used in the hydraulic fracturing products were common and generally harmless, such as salt and citric acid...And some were extremely toxic, such as benzene and lead. Appendix A [of the report] lists each of the 750 chemicals and other components used in hydraulic fracturing products between 2005 and 2009. The most widely used chemical in hydraulic fracturing during this time period, as measured by the number of compounds containing the chemical, was methanol. Methanol, which was used in 342 hydraulic fracturing products, is a hazardous air pollutant and is on the candidate list for potential regulation under the Safe Drinking Water Act. Some of the other most widely used chemicals were isopropyl alcohol (used in 274 products), 2-butoxyethanol (used in 126 products), and ethylene glycol (used in 119 products).
>
> Between 2005 and 2009, the oil and gas service companies used hydraulic fracturing products containing 29 chemicals that are (1) known or possible human carcinogens, (2) regulated under the Safe Drinking Water Act for their risks to human health, or (3) listed as hazardous air pollutants under the Clean Air Act. These 29 chemicals were components of more than 650 different products used in hydraulic fracturing. The BTEX compounds – benzene, toluene, xylene, and ethylbenzene – appeared in 60 of the hydraulic fracturing products used between 2005 and 2009. Each BTEX compound is a regulated contaminant under the Safe Drinking Water Act and a hazardous air pollutant

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[16] thetimes-tribune.com, 16th of December, 2010. http://thetimes-tribune.com/news/gas-drilling/dep-drops-dimock-waterline-plans-cabot-agrees-to-pay-4-1m-to-residents-1.1077910#ixzz1Qm6ld4Oz

[17] *Chemicals used in hydraulic fracturing*. United States House of Representatives Committee on Energy and Commerce Minority Staff, April 2011. Accessed at: http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf

> under the Clean Air Act. Benzene also is a known human carcinogen. The hydraulic fracturing companies injected 11.4 million gallons of products containing at least one BTEX chemical over the five year period.

The House of Commons Energy Committee summarised the issues thus:[18]

> 105. We heard during our visit to the US, that the US Environmental Protection Agency (EPA) believed that—from evidence it had gathered so far—that "if hydraulic fractures combine with pre-existing faults of fractures that lead to [drinking water] aquifers or directly extend into aquifers, injection could lead to the contamination of drinking water supplies by fracturing fluid, natural gas, and/or natural occurring substances".
>
> 106. During the fracturing process, some of the hydraulic fracturing fluid may flow through the artificially created fractures to other areas within the shale gas formation, in a phenomenon known as 'fluid leakoff'. Fluid leakoff during hydraulic fracturing "can exceed 70 percent of the injected volume if not controlled properly", which could result in fluid migrating into drinking water aquifers. In comparison, coal-bed methane formations are mostly shallow, so where hydraulic fracturing is used there is a risk that it could be happening in—or very near to—shallow drinking water supplies.
>
> 107. The US EPA has stated that proper well construction is 'essential for isolating the production zone from USDWs [underground sources of drinking water], and includes drilling a hole, installing a steel pipe [casing] and cementing the pipe in place'. There is therefore a risk of groundwater pollution from improperly constructed wells…."

A study published by scientists at Duke University in North Carolina found evidence that methane gas was leaking from shale wells into drinking water, creating an explosion risk:[19]

> "Directional drilling and hydraulic-fracturing technologies are dramatically increasing natural-gas extraction. In aquifers overlying the Marcellus and Utica shale formations of northeastern Pennsylvania and upstate New York, we document systematic evidence for methane contamination of drinking water associated with shale gas extraction. In active gas-extraction areas (one or

[18] See footnote 10.
[18] Stephen G. Osborn, Avner Vengosh, Nathaniel R. Warner, and Robert B. Jackson.Methane *Contamination of drinking water accompanying gas-well drilling and hydraulic fracturing Proceedings of the Natural Academy of the Sciences.* PNAS 17th of May, 2011 vol. 108 no. 20 8172-8176 Accessed at http://www.pnas.org/content/early/2011/05/02/1100682108.full.pdf+html?sid=bde16321-e169-437d-a59c-798e7f65c479

> more gas wells within 1 km), average and maximum methane concentrations in drinking-water wells increased with proximity to the nearest gas well and were 19.2 and 64 mg CH4 L−1 (n ¼ 26), a potential explosion hazard; in contrast, dissolved methane samples in neighboring nonextraction sites (no gas wells within 1 km) within similar geologic formations and hydrogeologic regimes averaged only 1.1 mgL−1 (P < 0.05; n ¼ 34)."

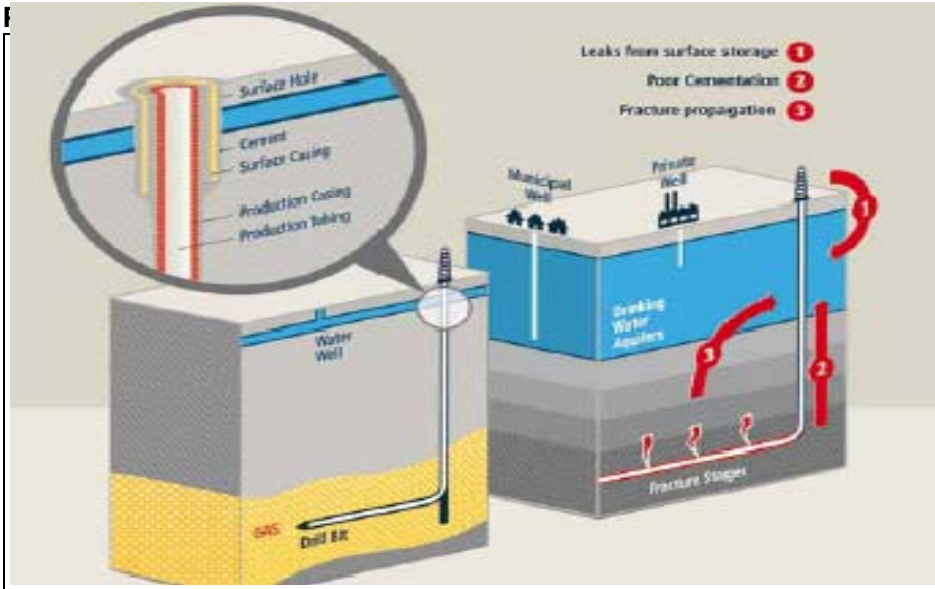
Three potential leak paths which could lead to the contamination of water aquifers have been described in a research paper by the European Centre for Energy and Resource Security (EUCERS): [20]

- Leaks on surface and migration of fluids: leakage of drilling fluids, fracturing-fluids and flow-back water can and does occur from poorly lined storage pits and is a source of groundwater contamination. However, this leak path cannot account for the leakage of gas into aquifers.
- Poor cementation: establishing a tight seal between the well casing and the formation can be technically demanding, especially in horizontal sections. Even if a good cement bond has been established, the fracturing process involves repeated cycling of hot and cold fluids and pressure changes, both of which can cause the creation of a micro annulus between the cement and the casing and/or formation and a potential leak path. This would provide a credible route for gas migration into an aquifer.
- Naturally occurring or induced fractures: this is thought to be unlikely because of the separation, often thousands of feet, between the fracture zone and the aquifers. It is possible to monitor real-time fracture propagation using micro-seismic and tilt meter observations and the authors are unaware of any evidence of interaction with aquifers to date. (pp.20-21)

A pictorial representation of these environmental risks is given in Figure 1 (over).[21]

[20] EUCERS (2011). *Strategic perspectives of unconventional gas.* Accessed at http://www.eucers.eu/wp-content/uploads/EUCERS_Strategy_Paper_1_Strategic_Perspectives_of_Unconventional_Gas.pdf

[21] Ibid, p.20.



The EUCERS research paper, however, goes on to state (p.21) that these leak paths can be prevented by:

> "good oil field practices and state-of-the-art cementation and fracture monitoring techniques which should prevent drilling fluids, hydraulic fracturing fluids, or natural gas from leaking into the permeable aquifer and contaminating groundwater."

However, the real risks of leakage are not discounted by EUCERS and they point out that each shale gas well is different. Not only does this represent differing scales of risk depending on the geological conditions but it also means that service companies adjust the proportion of fracturing fluid additives to the unique conditions of each well.

EUCERS points out that this leads them to highlight another major point of public concern, i.e. the reluctance of the industry to disclose the chemical composition used in fracturing-fluids, claiming commercial confidentiality. On a positive note, EUCERS reports that the United States industry has started to address this and that the relevant chemical composition is now often disclosed. In addition, EUCERS states that this is unlikely to be an issue in the European context because of the European REACH regulations.

REACH is the Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals.[22] The objectives of REACH are:

- to ensure a high level of protection from the risks that can be posed by chemicals;
- the promotion of alternative test methods;
- the free circulation of substances on the internal market; and
- to enhance competitiveness and innovation.

In addition, REACH makes the chemicals industry responsible for assessing and managing the risks posed by the substances they use and for providing appropriate safety information to their users. In parallel to this, the EU can take additional measures on highly dangerous substances, where there is a need for complementing action at EU level.

Possible pollution of the air

The House of Commons Energy Committee heard evidence of possible air pollution as a result of fracking:[23]

> "During our visit to the US, the Department of Energy provided us with a report that described how 'some air emissions commonly occur during [shale gas] exploration and production activities [...] NOx, volatile organic compounds [VOCs, such as benzene], particulate matter, SO2, and methane'.[272] NOx gases are responsible for the brown haze around areas of industry, and contribute to: acid rain; the destruction of lake ecosystems; and the formation of ozone smog, which has been linked to illness and death. In Texas, the US Environmental Defense Fund (an environmental organisation) expressed concern that "regulatory agencies were inadequately monitoring air quality. We analyzed the state's data and found that air pollutants including benzene […] were being emitted from the wells"
>
> 136. A study prepared for the US Environmental Defense Fund, stated that '[shale] gas production [...] can impact local air quality and release greenhouse gases into the atmosphere'."

[22] Further information available at: http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm
[23] See footnote 10

Concerns were raised about air pollution in the Forth Worth region of Texas, which, it was feared, was caused by hydraulic fracturing: [24]

> It is because of places like Dish [Texas] and similar sites from Colorado to Wyoming, that the U.S. Environmental Protection Agency (EPA) has launched a new review of the practice known as hydraulic fracturing, or 'fracking'…The picture from Dish is not pretty. A set of seven samples collected throughout the town analyzed for a variety of air pollutants last August found that benzene was present at levels as much as 55 times higher than allowed by the Texas Commission on Environmental Quality (TCEQ). Similarly, xylene and carbon disulfide (neurotoxicants), along with naphthalene (a blood poison) and pyridines (potential carcinogens) all exceeded legal limits, as much as 384 times levels deemed safe. 'They're trying to get the pipelines in the ground so fast that they're not doing them properly,' says Calvin Tillman, Dish's mayor. 'Then you've got nobody looking, so nobody knows if it's going in the ground properly…. '. Dish sits at the heart of a pipeline network now tuned to exploit a gas drilling boom in the Fort Worth region.

Responding to such concerns, the Texas House of Representatives voted to approve one of the nation's first requirements on oil and gas companies to publicly disclose chemicals used in hydraulic fracturing (aka "fracking"): [25]

> "Anecdotal reports suggest that living near gas extraction sites can cause health impacts, although little formal scientific study has been completed to date. For example, residents of Texas communities near hydraulic fracturing gas extraction operations have reported strange odors and health problems including nose bleeds, rashes, burning eyes, breathing difficulty, asthma, dizziness, fatigue, nausea, muscle aches, severe headaches and blackouts. Several residents have developed rare cancers. In Dish, Texas, tests have found a variety of hazardous pollutants related to gas extraction and processing in the air, in well water and in samples of residents' blood. HB 3328 (Keffer) requires drillers of natural gas and oil to publicly disclose each chemical ingredient used in hydraulic fracturing on each well."

[24] *What the Frack? Natural Gas from Subterranean Shale Promises U.S. Energy Independence--With Environmental Costs*, 20th of March 2010. Accessed at http://www.scientificamerican.com/article.cfm?id=shale-gas-and-hydraulic-fracturing

[25] http://www.environmentamerica.org/newsroom/more-news/more-news/texas-house-approves-fracking-chemical-disclosure-bill

Possible effects on the climate, i.e. greenhouse gases

Professor Robert Howarth argues in a recent paper[26] that although natural gas, when burned, produces only about half of the carbon dioxide emissions of coal, that calculation omits greenhouse gas emissions from the well-drilling, water-trucking, pipeline-laying, and forest-felling that are part of the production of hydraulically fractured natural gas. Combining the effects of combustion, production, distribution, and leaked methane from hydraulically fractured natural gas gives the fuel about the same greenhouse gas emissions as coal and about 30% more than diesel or gasoline,. according to the paper.

Citing preliminary data, Howarth estimates total greenhouse gas emissions from hydraulically fractured natural gas may be equivalent to 33 carbon grams of CO2, slightly more than 31.9 grams for coal, and well above the 20.3 grams for diesel or gasoline.

The data are partly based on methane leakage of 1.5% of natural gas consumed, a figure assumed by the federal government. Natural gas is mostly methane, which is a much more potent greenhouse gas, especially in the short term, with 105 times more warming impact, pound for pound, than carbon dioxide (CO2): [27]

> "Natural gas is composed largely of methane, and 3.6% to 7.9% of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the lifetime of a well. These methane emissions are at least 30% more than and perhaps more than twice as great as those from conventional gas. The higher emissions from shale gas occur at the time wells are hydraulically fractured—as methane escapes from flow-back return fluids—and during drill out following the fracturing. Methane is a powerful greenhouse gas, with a global warming potential that is far greater than that of carbon dioxide, particularly over the time horizon of the first few decades following emission. Methane contributes substantially to the greenhouse gas footprint of shale gas on shorter time scales, dominating it on a 20-year time horizon. The footprint for shale gas is greater than that for conventional gas or oil when viewed on any time horizon, but particularly so over 20 years. Compared to coal, the footprint of shale gas is

[26] Press release from Cornell University accessed at: http://www.news.cornell.edu/stories/April11/GasDrillingDirtier.html

[27] Howarth,Robert,W. Renee Santoro and Anthony Ingraffea. *Methane and the greenhouse-gas footprint of natural gas from shale formations:a letter*. Climatic Change,13th of March 2011. Accessed at http://www.sustainablefuture.cornell.edu/news/attachments/Howarth-EtAl-2011.pdf

at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years."

Policy Conclusions of some EU parliaments

The House of Commons Energy Committee concluded that a moratorium on fracking is not necessary in the UK:[28]

"Safety

The inquiry found no evidence that the hydraulic fracturing process involved in shale gas extraction – known as 'fracking' - poses a direct risk to underground water aquifers provided the drilling well is constructed properly. The committee concluded that, on balance, a moratorium in the UK is not justified or necessary at present. The MPs, nevertheless, urge the Department of Energy and Climate Change (DECC) to monitor drilling activity extremely closely in its early stages in order to assess its impact on air and water quality.

Tim Yeo MP, Chair of the Committee said: "There has been a lot of hot air recently about the dangers of shale gas drilling, but our inquiry found no evidence to support the main concern – that UK water supplies would be put at risk. There appears to be nothing inherently dangerous about the process of ' fracking' itself and as long as the integrity of the well is maintained shale gas extraction should be safe. The Government's regulatory agencies must of course be vigilant and monitor drilling closely to ensure that air and water quality is not being affected."

Greenhouse gas emissions

Greenhouse gas emissions from gas are lower than from coal, but are still much higher than many low-carbon technologies – like nuclear, solar or wind power. Concerns have been raised about shale gas, because it is made up of methane, a greenhouse gas far more potent than carbon dioxide. However, methane would only be released through leaks from the well or pipelines and the MPs are confident that this can be easily minimised through regulation and enforcement.

Tim Yeo MP, said: " Regulations in the UK are stronger than in the States and should stop anything of the sort from happening here."

[28] *Shale gas gets support from MPs in new report*. Accessed at http://www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/news/new-report-shale-gas/

By contrast, France has voted to ban the practice of hydraulic fracturing:[29]

> "French lawmakers have voted to ban a controversial technique used to extract shale gas and oil that opponents say contaminates the environment.
>
> If the vote by the lower house of parliament passes the Senate next month, France will be the first country to ban hydraulic fracturing, also known as fracking. The process injects water, chemicals and sand into rock formations to break them open and extract previously unattainable fossil fuel deposits. The overwhelming vote by the National Assembly follows months of protest across France against a technique that environmentalists say threatens to pollute the water table.
>
> Many were outraged at the beginning of the year when it was discovered that several exploration permits had been granted without public consultation. The issue has become highly political as the government prepares for a difficult presidential campaign next year. Far from claiming victory, environmentalists and opposition Socialists accused the government of yielding to industry lobbying, because last-minute amendments to the draft law will allow scientific research to be conducted on shale gas and oil and its environmental impact, albeit under the control of state entities.The government will deliver an annual report to parliament on the conditions of this research, due by the end of the year."

Is unconventional gas a game changer?

This question was posed at an expert round-table on the 15th of March 2011 jointly organized by Research Analysts at the British Foreign and Commonwealth Office (FCO) and the European Centre for Energy and Resource Security (EUCERS). Their views were published in a paper of May 2011 in which they also considered the environmental issues: [30]

> "But, is shale gas a game changer, or not? Some of the expert, geologists and industry representatives say it will be, some of them say it will not be.
>
> No matter what, shale gas has certainly changed North America´s natural gas market; and, within the evolving global natural gas market it has already had a causal effect on all markets, particular those in Europe. Shale gas enabled the

[29] *France moves towards fracking ban: Paris influenced by environmental fears.* Financial Times,12th of May 2011

[30] Kuhn,Maximilian / Frank Umbach, European Union Centre for Energy and Resource Security. *Strategic perspectives of unconventional gas: a game changer with implications for the EU'S energy security*. EUCERS Strategy Paper, 1st of May 2011. Accessed at http://www.eucers.eu/wp-content/uploads/EUCERS_Strategy_Paper_1_Strategic_Perspectives_of_Unconventional_Gas.pdf

US to remove its energy dependency and, furthermore, to reduce nearly all of its LNG [Liquified Natural Gas] import needs. The combination of this development with the economic recession, led to an oversupply of the international LNG market that placed strong downward pressure on gas prices around the world. So, regardless of how the European unconventional gas industry develops, the shale gas revolution in the U.S. has already changed the landscape of the international and first of all the European gas market. Shale gas development has changed the energy situation around the world; and, although it has changed the European market, other than one would have expected. Shale gas has not yet changed the overall energy balance in Europe, nor is it clear if it will materialize before 2020, although it has become a game changer for the European gas market.

The U.S. shale gas boom enabled a revolutionary domino-effect on the European market, with the contractual structure, based upon 20-years long term take-or-pay oil linked natural gas contracts that had hitherto dominated being re-negotiated. Consequently, shale gas is having an increasing influence on European gas prices and is anticipated to continue doing so through 2015.

Regardless of how the outlook on European unconventional gas development looks – whether or not it will enhance the EU's energy supply security by reducing dependence and/or increasing affordably and sustainably in the mid-to-long term in Europe – shale gas has already changed the European market; even before a single well has been drilled, or a single molecule of unconventional gas has been extracted from the European basins." (p.47)