An Taisce
The National Trust for Ireland

Presentation to the Oireachtas Joint Committee on Environment, Transport, Culture and the Gaeltacht on 'The environmental impact of hydraulic fracturing as against other methods of gas extraction'

Charles Stanley-Smith
Chair An Taisce The National Trust for Ireland
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Supported by:
Ian Lumley, Heritage Officer, An Taisce
Elizabeth Muldowney, Energy Officer, An Taisce
Aedín McLoughlin

1. Introduction

An Taisce welcomes this opportunity to make a presentation to the Committee, to raise and discuss issues and to explain our position on 'Fracking' (otherwise Hydraulic Fracturing) as a method of gas extraction.

We would recommend the following document that was prepared for the European Parliament in July of this year and we will refer to it and often précis it.

> IP/A/ENVI/ST/2011-07 Impacts of shale gas and shale oil extraction on the Environment and on human health. *Directorate General for Internal Policies, Policy Department A: Economic and Scientific Policy.* (we trust that your secretariat has made this available to you).

1.1. Sustainability

An Taisce feels that 'Sustainability' has become a much abused term. However, Sustainability is at the core of An Taisce's ethos and when we talk of sustainability, we include environmental, social and economic sustainability, because the three are irrevocably interlinked. The Economy resides within Society and Society is entirely dependent on the Environment.

1.2. Moratorium

Fracking has gained a very poor reputation in recent years, with many cases of environmental and societal damage recorded in the US. Much of this is due to the large amount of land used and proximity to population. Many would say that the pollution is caused by lax regulation in the past. Others say that Europe and Ireland can learn from the mistakes of the US and 'Frack' under 'Best Practices'. Ireland has an extremely poor history of environmental enforcement.

The environmental threats are many and due to the hundreds of sites involved will be cumulative. Against this, the benefits of shale gas as an alternative source of gas may not be large.

Can you really convince the People of Ireland that 'this time it will be OK'?

An Taisce is calling for a Ban on 'Fracking' until such time as the People of Ireland can be convinced that it is possible to regulate Fracking, so that it can be undertaken sustainably and as a result there will be no environmental, social or economic harm.

1.3. Life Cycle Analysis (Cost/benefit analysis)

An Taisce is also calling for full 'Life Cycle Analysis' to be undertaken on Fracking to see if it will really bring benefits to the People of Ireland and at what risk?

2. Shale Gas

When exploiting oil or gas, the most challenging deposits and prospects are always developed last. Shale gas is challenging, it is not the easy option.

2.1. What is Shale gas?

Shale gas is gaseous Hydrocarbons (mostly Methane) stored in shales and other very fine grained rocks. It can also include proportions of carbon dioxide, hydrogen sulphide and radon. The gas is stored in small fractures and the small pore spaces in the shale.

The porosity of rock or shale is the measure of space between the particles of the rock, which gives the volume of gas held within a given volume of rock. Permeability is the measure of the ability of a fluid or gas to travel through that rock.

Conventional gas wells are highly porous (good density of gas) and have a high permeability (it comes out easily). However, Shale gas is not nearly so porous, so has less gas per volume, and it has a very significantly lower permeability, so that is it only comes out with great difficulty.

Fracking, attempts to create a series of fractures and channels in the shale through which the gas can pass more easily and hence becomes easier to extract.

2.2. Where is it?

1. Lough Allen Basin - (Northwest Carboniferous Basin):
    - Leitrim, Cavan, Sligo, Donegal, Monaghan, Roscommon and Fermanagh
2. Clare Basin:
    - Clare, Galway, Limerick, Cork, Kerry

These are areas with a significant 'Karst' geology, that is rock, such as limestone, that is soluble and typically has networks of underground caverns, rivers and natural fractures.

2.3. How do you extract Shale Gas?

In order to extract Shale Gas you 'Frack' because the low permeability of Shale means that traditional methods of extraction do not work.

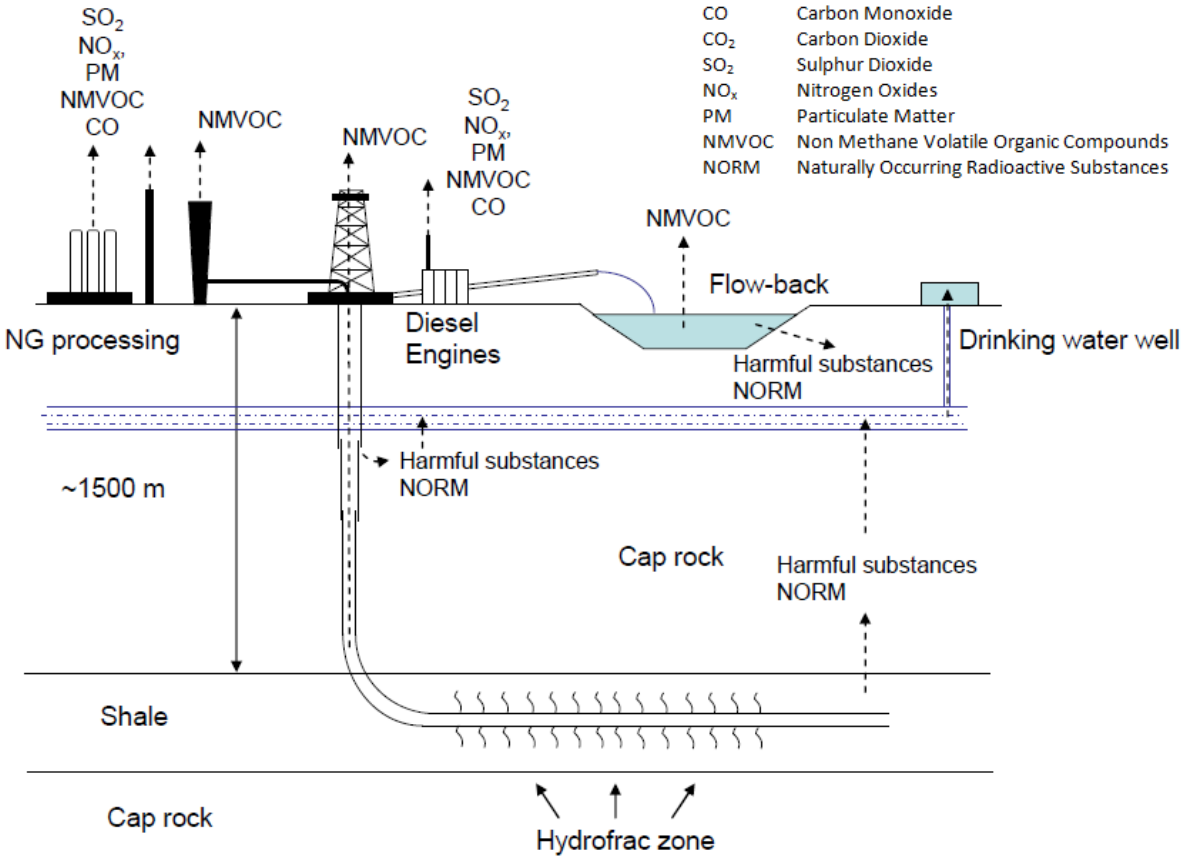
1. Drill down and remove and deal with the drilling mud, waste and rock from hole you are drilling. Do you drill 24 hours a day? Drilling rigs are rare and the best use needs to be made of them.
2. Be careful going through the water table – it is exposed when you drill through it.
3. And then drill horizontally approximately 1 mile, (8 or more wells per pad are constructed).
4. Seal the bore hole (annulus) with cement. This is a critical step, because if the cement fails, fracking chemicals, shale gas and other pollutants carried by the gas will escape and can migrate through natural fissures in the rock to the water table and atmosphere.
5. A perforating gun is lowered to the end of the bore and explosions are set off, fracturing or cracking the shale.

6. Fracking fluid, a mixture of water, sand and chemicals, is then pumped in under pressure to the extent of 2.5 million gallons or more of water per well. This enlarges the cracks in the shale and releases the gas. It could be possible to 'frack' without chemicals but this will require higher pressures and more water
7. Once the well is depressurized, 25% to 40% of the fracking fluid, now mixed with gas, salt, volatile chemicals, heavy metals and radioactive material, is forced back up the pipe. This is termed flow-back.
8. The gas is then treated and transported via tankers or pipes to a refinery.

As you can see, there are many opportunities for environmental damage.

3. Envronmental Impacts

3.1. Impact on Landscapes Pads and Connections Pipes



1. Land area consumption:
    a. Drilling/Extraction Pads are 1 to 5 acres in area, not including access roads and connection pipes.
    b. There are between 1 pad per 640 acres (at start) to one per 40 acres – 'infill wells'.
    c. 2 miles or less between pads.
    d. Is this the best use of that amount of land for deriving energy?
2. Pads Contain:
    a. Technical/Processing Equipment
    b. Drilling Rig
    c. Compressors
    d. Chemical Storage
    e. Water Storage
    f. Waste Water (flowback) Storage
    g. Access Roads
    h. Connection pipes

Satellite image of Gas Fracking area

Source: Photograpf by EcoFlight, courtesy of SkyTruth – www.skytruth.org

A quiet pad

Some other pads in the U.S.

3.2. Air Pollution and Soil Contamination

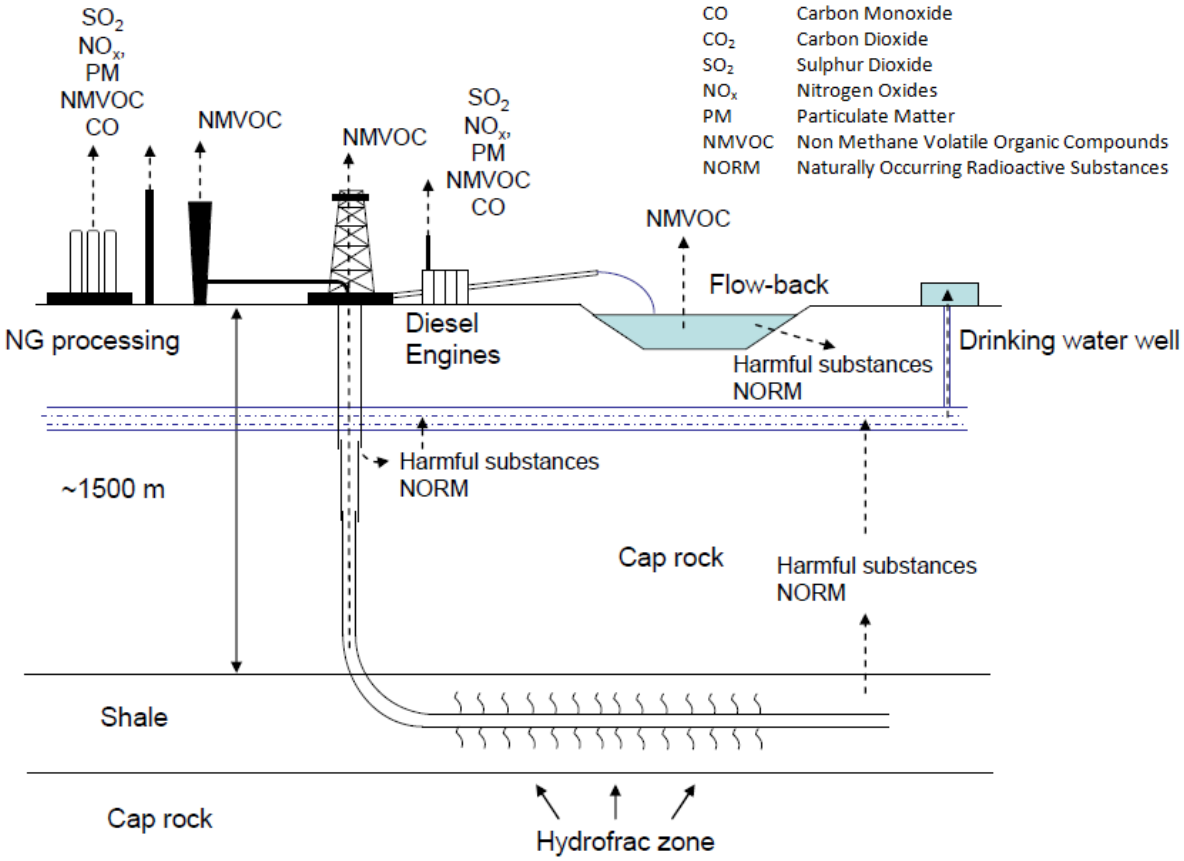


Diagram from IP/A/ENVI/2011-07

Air Pollution and Land Contamination:

1. We must consider the cumulative effects from hundreds of pads.
2. Emissions from drilling equipment, processing equipment and transport.
3. Evaporation from the waste water pond, flow-back contains hazardous substances and dissolved methane.
4. Spills and Blow outs, they have happened.
5. In US there has been 1-2% violation of all drilling permits.
6. Escape through natural geological faults and fractures. Though some claim that this is impossible over the 1,500 metres depth, the geology in Ireland could contain natural fractures and channels.

Aruba Petroleum (Photo: Tim Ruggiero)

3.3. Surface and Groundwater Contamination

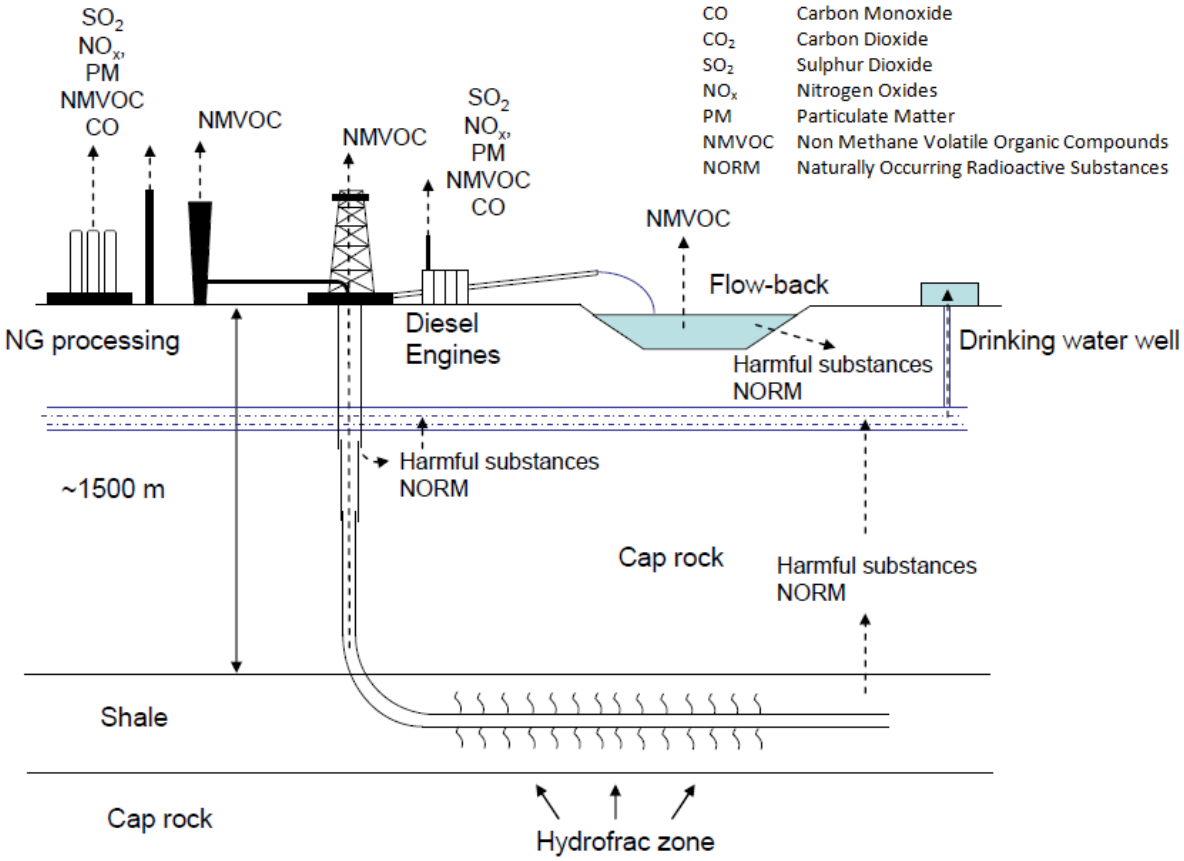


Diagram from IP/A/ENVI/2011-07

Surface and Groundwater contamination (again this is cumulative).

1. Water Usage:
    - A large amount of water is used during drilling; for lubricating and cooling the drill bit and to remove the drilling mud.
    - Much larger amounts of water are used in 'Fracking':
        i. Typically 15,000 m^3 per well
        ii. Potential hundreds of pads of 8+ wells each
    - Fracking Fluids can contain anything and have contained known carcinogens.
    - Flow-back, where between 20% and 50% of this returns to the surface and into a pond. This contains dissolved material including Radon (NORM) and other radioactive elements and heavy metals such as Arsenic, that have been leached out of the Shale.
2. Leaks can be caused by:
    - Drilling through the watertable.
    - Poor cementing of wells.
    - The escape of pollutants through natural geological faults and fractures.
    - Spills and accidents.

3. Proper recycling and treatment of waste water is required, normal sewage plants are not suitable. There are severe problems with improper disposal.
4. There are numerous documented complaints of drinking water contamination. They include: dissolved methane leading to the hazard of explosion. Stalinisation of drinking water by Potassium Chloride.

There is very real danger to water due to 'Human Error' – Best Practices are not being documented, followed or enforced.

Water Framework Directive- will require:

- Abstraction licences
- Water Quality – Improvement/Maintenance

3.4. Earthquakes

1. Shale Gas Fracking and Geothermal Fracking are known to induce small earthquakes.
2. Blackpool – operations suspended after two small earthquakes in 2 months.

3.5. Chemicals, Radioactivity and Human Health

1. Chemicals in Fracking Fluid have included chemicals that:
    - are in the Priority List
    - are Bioaccumulative
    - are Carcinogenic/Suspect Carcinogenic
    - are Mutagenic
    - affect Reproduction
    - are toxic to Aquatic Organisms
    - whose toxicity is unknown, because they are not revealed due to 'Trade Secrets'.
2. Radioactivity and Heavy Metals
    - Shales contain NORMs (Naturally Occurring Radioactive Materials) – Uranium, Radium, Thorium and Radon. Also Heavy Metals such as Arsenic.
        - This comes back up with drilling rock/waste.
        - This comes back up with 'Flow-back'
3. Human Health is affected by:
    - Groundwater contamination
    - Volatile Organic Compounds

3.6. Public Debates are required.

Under Aarhus, which Ireland will shortly ratify, the People have a right to environmental information and the right of real Public Participation in decision making.

3.7. Resource Consumption

1. Water – Very large amounts of water (Out of the Shannon system, how much compared to abstraction from Shannon for Dublin?).
2. Land – How many Pads at 5 acres a go, plus associated access roads.
3. Energy for drilling, treatment, compression, waste treatment and distribution.
4. Truck Trips – estimated at thousands per pad.

3.8. Greenhouse Gases

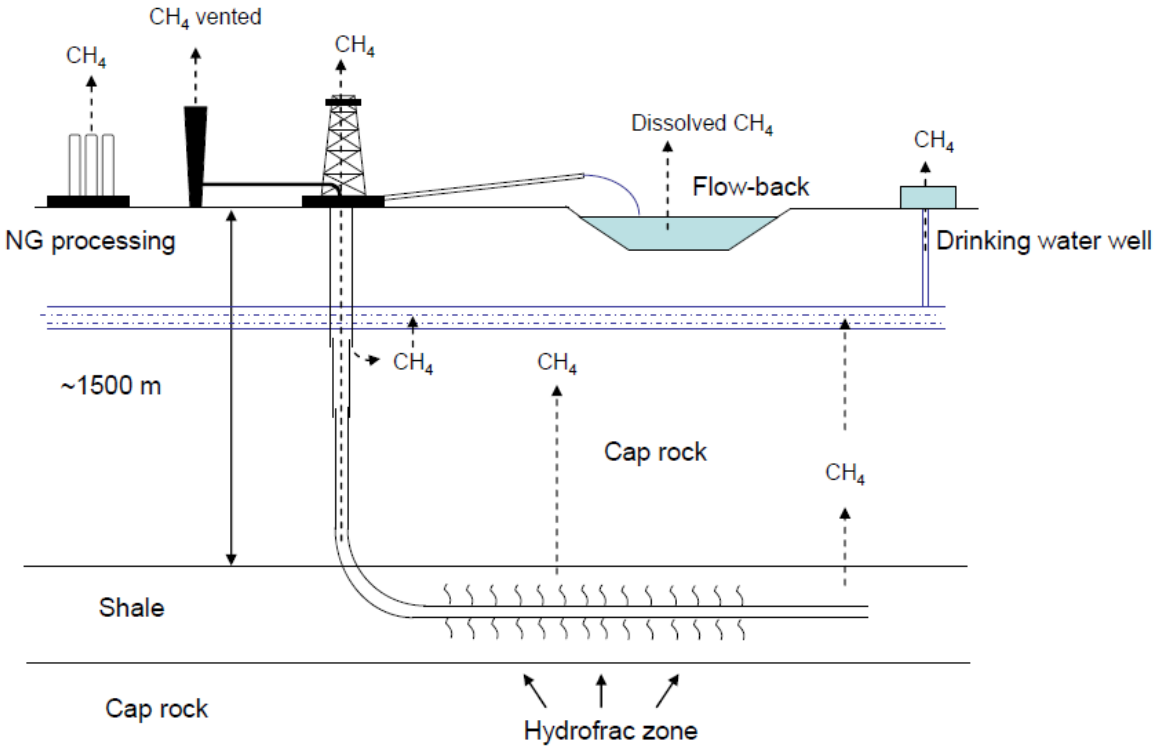


Diagram from IP/A/ENVI/2011-07

Methane (CH_4) is 20 to 25 times more Greenhouse damaging than CO_2.

1. Fugitive Methane escapes:
    - During drilling – shallow gas
    - During Flow-back
    - During processing and compression
    - During transport and storage
    - From damaged drillings – poor cement
    - From being dissolved in ground water
2. A further Greenhouse effect is the potential loss of Carbon sinks – will pads be placed on former forestry?
3. Depending on factors (and who you are), life time Greenhouse gas emissions for Shale gas relative to energy content range from the same as conventional gas to the same as hard coal.

4. EU and Irish Regulatory Framework.

4.1. GAPS

1. EIA threshold is set at 500,000 m^3/day – way too high – Though Minister Rabbitte is on record as saying EIA will be required.
2. What is in Fracking Fluids and 'Trade Secrets' – affect on REACH.
3. What chemicals remain in the ground – how to tell and how to regulate?
4. No Best Available Technique Reference on fracking – a baseline is required for much regulation.
5. Capacity of Water Processing facilities.
6. Lack of Public Participation – required by Aarhus.
7. Specific changes are required to Water Framework Directive priority substances.
8. LCA (Life Cycle Analysis) Overall benefit to society - Cost/benefit of Resource consumption (including land), Greenhouse gases etc

5. Conclusions

1. Sustainability means looking at the long term and being very wary of short term gain.
2. Ireland is critically dependent on imported fossil fuels. Gas demand is rising, especially in Japan and Germany, where Nuclear is being discontinued. Production in existing gas fields is dropping. Adaptation to Climate Change and Peak Oil should decrease total energy demands, if necessary by incentives. Development of Shale Gas will be short term and production will soon decline. However, shale gas may look appealing to deal with the declining availability of conventional gas. We believe that Investment is better used for transition technologies to a low Carbon economy.
3. There is a doubt on the amounts of gas available and that 'Fracking' in Europe and consequently a doubt that it will really contribute meaningful amounts of gas in Ireland and that the environmental risk is too high.

6. Recommendations

6.1. Develop a Gas Exit Strategy

6.2. Moratorium

An Taisce is calling for a Ban on Fracking until the until such time as the People of Ireland can be convinced that it is possible to regulate 'Fracking' so that it can be undertaken sustainably and as a result there will be no environmental, social or economic harm.

6.3. Otherwise (if you must allow Fracking)

1. Ban Fracking Chemicals or at least restrict them to a number of allowed safe chemicals. Ban 'Trade Secrets'.
2. Ensure EIAs are required and done.
3. Develop a model for EIA – relevant to Fracking to ensure that the right questions are asked and answered.
4. Apply other directives as required
5. Create cross Department/Agency group to ensure that we don't fall foul of split jurisdiction and things fall between the stools. (EPA/ABP/CER/Health & Safety)
6. Do Life Cycle Analysis – Including
    - Will it produce meaningful amounts of gas
    - what real effect will it have on our GHG targets.
    - Is there a better use of the land.
    - Resource usage (How much water? – from where? – is it equivalent to extracting water from the Shannon to Dublin).
    - Environmental risks.
    - Societal risks.
    - Economic risks (some say this is another bubble)
7. Involve the People with proper participation in decisions (Aarhus)
8. Call on Europe to develop a Directive on Fracking and strengthen others.
9. Ensure substantial bonds from developers and enforce against transgression. There is a litany of non enforcement through the land with millions spent after the trangressors have pocketed the money and gone. (Haulbowline, Silvermines and Transborder waste).

7. Appendix 1 : ENVIRONMENTAL IMPACTS

Key Findings from IP/A/ENVI/2011-07

- Unavoidable impacts are land area consumption due to drilling pads, parking and manoeuvring areas for trucks, equipment, gas processing and transporting facilities as well as access roads.
- Major possible impacts are air emissions of pollutants, groundwater contamination due to uncontrolled gas or fluid flows due to blowouts or spills, leaking fracturing fluid, and uncontrolled waste water discharge.
- Fracturing fluids contain hazardous substances, and in addition, flow-back contains heavy metals and radioactive materials from the deposit.
- Experience from the USA shows that many accidents happen, which can be harmful to the environment and to human health. The recorded violations of legal requirements amount to about 1-2 percent of all drilling permits. Many of these accidents are due to improper handling or leaking equipments.
- Groundwater contamination by methane, in extreme cases leading to explosion of residential buildings, and potassium chloride leading to salinization of drinking water is reported in the vicinity of gas wells.
- The impacts add up as shale formations are developed with a high well density (up to six wells per km^2).

8. Appendix 2 EU Regulatory Framework.

Key Findings from IP/A/ENVI/2011-07

- There is no EU (framework) directive governing mining activities.
- A publicly available, comprehensive and detailed analysis of the European regulatory framework concerning shale gas and tight oil extraction has not yet been developed.
- The current EU regulatory framework concerning hydraulic fracturing contains a number of gaps. Most importantly, the threshold for Environmental Impact Assessments to be carried out on hydraulic fracturing activities in natural gas or tight oil extraction is set far above any potential industrial activities of this kind, and thus should be lowered substantially. Along with this, the scope of the water framework Directive should be reassessed.
- A detailed and comprehensive analysis of declaration requirements for hazardous materials used in hydraulic fracturing needs to be carried out.
- In the framework of a Life Cycle Analysis (LCA), a thorough cost/benefit analysis could be a tool to assess the overall benefits for each individual Member State and its citizens.

9. Appendix 3 – List of some Important EU Directives

9.1. Extractive Industry Directives

1. 2006/21/ECMining Waste Directive (waste from extractive industries) – blow back waste.
2. 1992/104/EEC –(a Health & Safety Directive)

9.2. Other Directives that may impinge

1. 2000/60/EC - Water framework Directive (WFD)
    - Water abstraction licences (even if using own wells)
    - Water quality protection
2. 2010/75/EU - IPPC – Industrial emissions
    - Processing/Compressing/Flowback
3. Regulation 1907/2006 - REACH
    - Fracking Chemicals
4. 1996/82/EC – Seveso II
    - Accident hazards
5. 1992/43/EC - Natura2000
    - Site selection
6. 1985/337/EEC - EIA
    - Environmental concerns
    - Infrastructure – roads, gathering pipes
    - Cummulative effects of hundreds of pads
    - Split Jurisdiction
7. 2006/12/EC - Waste framework Directive
8. Noise Directive
9. 2003/35/EC (Aarhus) – Public Participation
10. 2001/42/EC SEA Directive
11. 1989/391/EEC – Health and Safety of workers
12. 1996/29/Euratom - NORM

10. Appendix 4 Climate Change and Peak Oil

Key Findings from IP/A/ENVI/ST/2011-7

- Many European countries have shale gas resources, but only a small amount of the gas in place might be converted into reserves and ultimately be produced.
- Gas shales extend over large areas with low specific gas content. Therefore, the extraction rate per well is much lower than in conventional natural gas extraction. The development of shale gas requires many wells with corresponding impacts on landscape, water consumption and the environment in general.
- The decline rate of shale gas wells is up to 85% in the first year. A typical regional production profile rises fast but soon slows down. After several years all new wells are used to

compensate for the decline of elder wells. As soon as the development of new wells stops, the overall production immediately declines.

- Even an aggressive development of gas shales in Europe could only contribute to the European gas supplies at one-digit percentage share at best. It will not reverse the continuing trend of declining domestic production and rising import dependency.
- Its influence on the European greenhouse gas emissions will remain small if not negligible, or could even be negative if other more promising projects are skipped due to wrong incentives and signals.