International Association of Oil & Gas Producers

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Shale gas in Europe

It is natural gas

Gas from shales, often called shale gas, is natural gas extracted from sedimentary shale rock composed of organically rich mud and clay. Geologists have known about these resources for a long time but their development was costly and uneconomic due to the low permeability of shale formations. In the late-1990s, a combination of two existing, proven technologies (horizontal drilling and hydraulic fracturing) made gas from shales commercially viable.

The benefits related to the use of natural gas from shales is equivalent to those of natural gas from sandstone reservoirs:

- **It's affordable**: Thanks to its abundance, flexibility, and continued improvements in technology, natural gas is an affordable, efficient energy source. Wider availability of European-produced natural gas, including potentially natural gas from shales, could reduce energy costs even further. Gas-fired power plants are comparably inexpensive to build (less than half the capital costs of coal, one fifth of nuclear generation plants[1]).
- **It has a lower environmental footprint**: Burning natural gas results in very low emissions of nitrogen oxides and sulphur dioxide- reducing acid rain and smog – and virtually no emissions of mercury, particulates (soot) or other solid waste. Natural gas-fired power plants use about 60% less water than coal fired power plants and 75% less water than nuclear power plants for the same amount of electricity production. Natural gas-fired power plants require the least amount of land per megawatt of capacity versus other new power generation options. Compared to natural gas, it takes 20 times more land to power the same number of homes using wind or solar.[2] The combustion of natural gas also poses a lower risk to human health than the combustion of coal due to lower particulate pollution.[3]
- **It's reduces CO_2 emissions**: As the world, and especially Europe, strives to reduce its CO_2 emissions from power generation, shale gas will provide greater availability of natural gas to rapidly reduce emissions in a cost-competitive manner. Natural gas used in power generation emits 350 kg of CO_2/MWh, compared to 850 kg of CO_2/MWh for hard coal and 1,200 kg of CO_2/MWh for lignite-fired power.[4] The conversion of all coal- and oil-fired power generation in Europe to best performance combined cycle gas turbine (CCGT) plants would cut emissions by 58% relative to 1990 levels.[5] In contrast to the claims put forward by Professor Howarth, most credible academic reports[6] show only small additional greenhouse gas emissions through the extraction of natural gas from shales, with the overall benefit remaining far greater than coal.
- **It's flexible**: Natural gas is used in every energy sector – as an efficient fuel for residential heating and cooking, as a fuel and feedstock for manufacturing, as a lower emissions vehicle fuel, and as a fuel source for power generation. Gas can be used to serve base load as well as to provide back-up for variable energy sources, such as wind and solar, reducing the technical challenges of grid balancing. Gas is also an efficient fuel for heating/cooling and numerous other industrial uses.

[1] Capital costs. Mott MacDonald, Update on UK Electricity Generation Costs Update 2011, prepared for UK Department of Climate Change and Energy
[2] US Department of Energy National Energy Technology Laboratory: Cost and Performance Baseline for Fossil Energy Plants 2010
[3] US Department of Energy National Energy Technology Laboratory: Cost and Performance Baseline for Fossil Energy Plants 2010
[4] Mott MacDonald Update on UK Electricity Generation Costs 2010
[5] IHS CERA 2011
[6] Carnegie Mellon University (Jiang, et al), *Life cycle greenhouse gas emissions of Marcellus shale gas*, Environmental Research Letters, August 5, 2011. See also: University of Maryland '*The greenhouse impact of unconventional gas for electricity generation*', Oct 2011; and Cathles et al, Cornell University, Press Release: *Response to Howarth et al's Reply* (February 29, 2012); Dan Lashof, Natural Resources Defence Council blog (12 April 2011)

- **It's abundant**: Although global gas production has doubled over the past thirty years, proven resources have constantly increased. According to IEA estimates, reserves of natural gas from shales, coal bed methane and tight gas worldwide almost double recoverable gas resources at current technology and prices[7].

Natural gas from shales can add to diversity of supply

Rapidly increased production of shale gas in the US has triggered a step change reduction in US natural gas prices, nearly eliminating LNG imports and providing a significant competitive advantage to US manufacturers. Shale gas is set to account for almost 50% of US gas needs by 2030[8] and, pending regulatory approval, will turn the US into a LNG exporter.

Shale gas resources are not unique to the United States; under certain conditions, it could be developed in other regions of the world. A number of studies[9] have concluded that several European countries could hold significant commercially recoverable shale gas reserves, but industry needs to carry out some initial exploration activities to determine the size and commercial viability of the potential resource.

Domestic production of natural gas from shales may provide additional economic benefits to local, regional and national economies, as well as expanding the diversity of natural gas supplies.

- **Economic effects**: Lower import costs and indirect economic benefits, such as employment, and the development of a supply industry could be important opportunities for the communities and the countries where production takes place. Further, benefits from tax revenues and royalties on both the regional and national levels represent positive additional value. An independent study calculated that natural gas from shales supports 600,000 American jobs in the United States, a number which will grow to 870,000 by 2015, contributing $118 Billion to the US economy. [10] [11] The nascent Polish natural gas from shales sector has already created numerous jobs and is leading to the development of a dynamic service industry.
- **Diversity of supply**: Natural gas from shales may offer an unprecedented opportunity for some Member States to further diversify their natural gas supply sources. As a result of the growth of production of natural gas from shales in the US, more LNG supplies are now available for Europe. A combination of increased domestic supply of natural gas and greater LNG availability provides attractive options for gas supply diversity.

The case for safe and responsible development of shale gas

Natural gas can be developed safely from shales in Europe in an environmentally responsible way and it is an industry priority to do so. There is some time before full development of shale gas in Europe would take place. Industry intends to use this time to engage with stakeholders at both EU and national level to find the right long-term solutions for Europe.

The exploration and production of natural gas in Europe is one of the most highly regulated processes in the world. The recently released study commissioned by DG Energy confirmed the EU's current regulatory framework is adequate for early exploration (seismic/test drilling) activities. Industry recognises that the effective implementation of existing regulations is an important factor in reducing risk in all gas operations.

Until early exploration work is carried out, the true potential of natural gas from shales for Europe will not be known. However, if exploration is successful, shale gas could potentially provide Europe with an additional source of secure, competitive and lower CO_2 emitting energy which could make an immediate, positive impact toward the EU reaching its ambitious CO_2 reduction targets while enhancing long-term competitiveness.

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[7] IEA, 2011. '*Are We Entering A Golden Age of Gas?'* Special Report.
[8] EIA, International Energy Outlook 2011
[9] EIA, 2011. World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States; Wood Mackenzie data, 2010. . IEA, *Are We Entering A Golden Age of Gas: World Energy Outlook*, 2011.
[10] IHS, *The Economic and Employment Contributions of Shale Gas in the United States*
[11] IHS, The Economic and Employment Contributions of Shale Gas in the United States

1. Transparency and communication

It is important that industry and authorities establish a dialogue and cooperate to address public concerns, through the open sharing of information and knowledge. Chemical substances are already registered and approved under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation. However, OGP supports disclosure of the contents of fracturing fluids to the public (for example, an initiative such as "Frac Focus" specifically for EU citizens).

2. What is involved in the production of natural gas from shales?

Horizontal drilling and hydraulic fracturing

Natural gas from shales is trapped in impermeable rock which does not allow it to flow to the surface. Additional stimulation is required to free the gas trapped in the rock. This stimulation is carried out through a process called hydraulic fracturing. Hydraulic fracturing is a technology in which water, sand and a small amount of chemical additives are pumped into an underground formation under controlled pressure. The fracturing fluid itself exerts pressure against the rock, creating a network of tiny fractures in the formation that allows natural gas to flow from the targeted formation to the well. Hydraulic fracturing is neither untested nor intrinsically complex. It has been used worldwide including in over two million wells globally, including more than 300 in Europe, since the 1940s.[12] Use of horizontal drilling techniques allows for fewer well locations and a smaller land footprint, as multiple wells can be drilled from a single location and each well can reach a larger portion of the target resource.

3. Managing our impact

Water usage and protection

Well casing, using multiple layers of steel pipe and cement, protect the aquifer if done correctly. The geological formations where hydraulic fracturing takes place are thousands of metres below drinking water aquifers and separated by multiple layers of impervious rock that provide natural geological barriers to the upward migration of fluids into freshwater aquifers.

Hydraulic fracturing fluids are composed of typically greater than 99% water and sand. The remaining 1% contains chemical substances regularly used in domestic cleaners, cosmetics and food. These chemical additives are necessary to reduce friction, combat corrosion and help suspend and transport the sand into the fractures.

According to the Massachusetts Institute of Technology, the water intensity of natural gas from shales ranks amongst the lowest of all fuel sources. Typically, between 10 and 70% of the water used for hydraulic fracturing is recovered during the first two to three weeks of hydrocarbon production.[13] The exact amount varies according to the geology of the site. The remainder stays in the formation, thousands of metres below drinking water. Returned fluids are recycled or disposed of at licensed waste disposal facilities, as permitted by competent authorities.

Induced Seismicity

While almost all seismic events are caused by naturally occurring releases of energy in Earth's crust, some human activities can trigger seismic events. These include geothermal development and mining and quarrying activities. Hydraulic fracturing can trigger extremely low level tremors that are generally too small to be felt at the surface by humans. Sub-surface geology is taken into account during the well planning process.

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[12] Carl T. Montgomery and Michael B. Smith, Journal of Petroleum Technology, *Hydraulic Fracturing: history of an enduring technology,*, December 2010
[13] International Association for Energy Economics, *Water Management Economics in the Development and Production of Shale Resources*.

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Responsible Community Practices

The industry acknowledges that the development of shale gas entails a temporary disturbance to communities and individuals. High activity levels typically last two to three months per well during the initial site preparation and well construction (drilling and completion) phase of the development, and drops off considerably during the productive life of a well which may last several decades. In some instances re-fracturing may occur but this is uncommon in horizontal wells as it is normally not economic to do so. OGP members pledge to engage local communities and discuss shared solutions to minimise the impact of developments on traffic, road quality, noise and light where development activities are being carried out. For example, at Groundbirch in Canada, Shell is investing in the construction of a reclaimed water plant for the city of Dawson Creek. The plant will treat sewage and other waste water to be re-used in our operations and by the local government for things such as cleaning roads and watering sports fields. Another example is of the high level of community engagement is through ExxonMobil's over 200 community meetings in Germany to explain their operations and address local concerns.

Beyond the initial exploration and drilling phase, the surface footprint of natural gas from shales is relatively small compared to the footprint from other energy sources. Often the surface footprint is further minimised by drilling multiple horizontal wells from a single pad or well site location. Sites are reclaimed to meet landowner preferences and government requirements when operations are complete.

Conclusion

- **As the Energy Roadmap 2050 acknowledges, "gas will be critical for the transformation of the energy system"**
- **Shale gas is potentially an opportunity for Europe**
- **An adequate regulatory framework for the *current* level of activity in Europe (exploration) exists**
- **Exploration and development activities of shale gas are covered by existing EU environmental legislation from planning until cessation**
- **EU environmental protection is strong**
- **Industry experience is that effective implementation of existing regulations reduces the risk of incidents**
- **We will work together for a long-term solution that is right for Europe**
- **Industry is investing in on-going R&D to understand and minimise the impact of shale gas production**