Shale gas in Europe

EXECUTIVE SUMMARY

1. Shale gas is natural gas – there is no difference in its chemical and physical properties.

2. European shale gas production can improve the region's security of energy supply by increasing the diversification of sources and by offsetting the decline of conventional indigenous gas production. It could reduce import dependency to as little as 60% of demand from an expected 89% by 2035.

3. EU production would also bring significant benefits for the economy and the people: new jobs, a contribution to growth, new investments as well as generating billions in government revenues.

4. The use of natural gas has huge benefits for the environment and the climate. It reduces harmful emissions such as sulfur dioxide and nitrogen oxides. Gas-fired power plants emit about half the CO2 of a coal power plant. Natural gas is the perfect partner for intermittent energy sources such as wind and solar.

5. Shale gas can be developed in an environmentally sound way. The impact of operations on the environment and water can be minimized using proven and reliable technologies. The technology used in hydraulic fracturing is well-known based on decades of experience and has become increasingly more efficient – dramatically reducing its environmental impact.

6. Exploration and production of hydrocarbons, including shale gas, is already highly regulated in Europe. 17 different pieces of EU legislation cover shale gas operations – and this does not take into account national legislation. Industry experience shows that effective implementation of existing legislation and deploying established good industry practices sufficiently limit the risk of incidents.

7. The industry considers transparency, communication and community engagement as crucial aspects of any shale gas development policy. OGP will work together with European stakeholders for a long-term solution that is right for Europe.

CONTEXT

Shale gas is natural gas – 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 they were not developed because of cost and productivity issues. The situation changed in the late-1990s, when a combination of two existing, proven technologies (horizontal drilling and hydraulic fracturing) and rising prices made shale gas commercially viable in the US and Canada.

Since then, production has consistently increased, as have the estimates of total global shale resources. According to the US Energy Information Administration (EIA), 32% of the total global estimated natural gas resources are in shale formations. Although global gas production has doubled over the past thirty years, proven resources continue to increase: the new global shale gas resource estimate (EIA 2013) – 7,299 trillion cubic feet – is 10% higher than the EIA's 2011 estimate.

1. The benefits of gas

1.1. Shale gas contributes to energy security and diversity of supply

The rapid increase in shale gas production in the US has triggered a dramatic drop in the country's natural gas prices, nearly eliminating LNG (Liquefied Natural Gas) 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 and, pending regulatory approval, looks set to transform the US into a LNG exporter before 2020.

- **Better diversification:** from a European perspective natural gas from shale may offer the opportunity for some Member States to further diversify and enhance the security of their gas supply sources. As a result of the growth in US production, LNG supplies are now more readily available for the European market. A combination of increased domestic supply of natural gas and greater LNG availability provides attractive options for supply diversification, potentially lower wholesale prices and potentially lower household gas and electricity prices.

- **Replacement of declining conventional gas production**: as the European Commission states in its May 2014 European Energy Security Strategy Communication[1], "producing oil and gas from unconventional sources in Europe, and especially shale gas, could partially compensate for declining conventional gas production provided issues of public acceptance and environmental impact are adequately addressed." The Joint Research Centre (Unconventional Gas: Potential Energy Market Impacts in the European Union) estimates that shale gas production in Europe could keep import dependency at the same level, by replacing declining conventional resources[2].

- **Potential reduction of EU energy import dependence**: a macroeconomic study by the independent consultancy Poyry and Cambridge Econometrics (The Macroeconomic Effects of European Shale Gas Production)[3] shows how shale gas production in the EU could reduce import dependence: EU production of shale gas could ramp up to 170 billion cubic meters per year, equivalent to a third of EU gas consumption. This scenario could reduce import dependency from about 90% of predicted 2035 demand to about 60%. However, this figure remains theoretical until exploration work can determine Europe's potential more precisely.

1.2. Positive economic impacts

Lower import volumes and indirect economic benefits, such as employment and the development of a supply chain, are important opportunities for the communities and the countries where production of shale gas may take place.

- **Significant new jobs:** An independent study calculated that by 2012, shale gas and oil activity in the US supports over 2.1 million jobs across a vast supply chain. About 60% of these jobs —1.3 million — were from shale gas activities, with the remainder from tight oil. The total number of jobs is expected to rise to 3.3 million by 2020 —with 1.8 million of those jobs from shale gas. According to the Poyry and Cambridge Econometrics study examining the prospects in Europe - shale gas could trigger the creation of between 400,000 and 800,000 new jobs by 2035, and between 600,000 to 1.1 million by 2050. Many of these jobs would be in industries most severely affected by Europe's economic crisis – and would be in net addition to any new jobs generated by other sectors, including the renewable energy industry.

- **Generation of tax revenues**: Benefits from tax revenues and royalties driven by hydrocarbon production paid by the shale gas industry at both regional and national levels represent positive additional value to societies and communities. In 2012 US shale activities added $74 billion to federal and state government revenues, and this contribution is projected to rise to about $125 billion by 2020. Europe's economy could also benefit from domestic shale gas production. According to the Poyry and Cambridge Econometrics study, shale gas could add a total of 1.7

1 http://ec.europa.eu/energy/doc/20140528_energy_security_communication.pdf

2 http://ec.europa.eu/dgs/jrc/downloads/jrc_report_2012_09_unconventional_gas.pdf

3 http://www.poyry.co.uk/news/poyry-study-investigates-macroeconomic-effects-european-shale-gas-production

trillion to 3.8 trillion euros to the economy between 2020 and 2050.

1.3. The climate and the environment

The **benefits** related to the use of natural gas from shale equate to those of natural gas from conventional reservoirs:

- **Lower environmental footprint**:
  - Burning natural gas results in very low emissions of nitrogen oxides and sulfur dioxide – reducing acid rain and smog – and virtually no emissions of mercury, particulates (soot) or other solid waste. The combustion of natural gas poses a lower risk to human health than the combustion of coal due to lower particulate pollution[4].
  - Lower overall carbon footprint for locally produced and consumed gas compared to imported gas (pipeline or LNG)[5].
  - Natural gas-fired power plants use about 60% less water than coal-fired power plants and 75% less than nuclear power plants for the same amount of electricity produced[6].
  - Gas power plants occupy the least amount of land per megawatt of capacity compared with other power generation options: it takes 20-30 times more land to power the same number of homes using coal, or 100 times more by using wind or solar[7].

- **Reducing CO_2 emissions**: As the world, and especially Europe, strives to reduce its greenhouse gas emissions from power generation, shale gas will provide greater availability of natural gas to rapidly reduce emissions in a cost-competitive way.
  - 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.[8] The conversion of all coal- power generation (oil electricity generation is marginal) in Europe to best-performance combined cycle gas turbine (CCGT) plants would cut emissions by 58% from 1990 levels.[9] Peer reviewed science [10] shows only small additional greenhouse gas emissions through the extraction of natural gas from shale, versus natural gas from conventional reservoirs, with the overall benefit remaining far greater than coal.

1.4. Essential role in developing a modern energy system

Natural gas is used in every energy sector – as an efficient fuel for heating and cooling, as a fuel and feedstock for industry and manufacturing, as a lower emissions transport fuel.

- In power generation it can be used to serve base load and to complement variable energy sources, such as wind and solar, reducing the technical challenges presented by grid balancing.

- Gas-fired power plants are comparatively inexpensive to build (less than half the capital cost of coal, one fifth of nuclear[11]), more efficient in converting energy to power (60% against 35% for coal) and easier to operate.

- Gas is feedstock used to produce petrochemicals, building blocks for products such as plastics.

4 US Department of Energy National Energy Technology Laboratory: Cost and Performance Baseline for Fossil Energy Plants 2010

5http://ec.europa.eu/clima/policies/eccp/docs/120815_final_report_en.pdf

6http://iopscience.iop.org/1748-9326/8/1/015031/article

7 US Department of Energy National Energy Technology Laboratory: Cost and Performance Baseline for Fossil Energy Plants 2010

8 Mott MacDonald Update on UK Electricity Generation Costs 2010

9 IHS CERA 2011

10 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), 'Measurements of methane emissions at natural gas production sites in the United States' http://dept.ceer.utexas.edu/methane/study/index.cfm

11 Capital costs Mott MacDonald, Update on UK Electricity Generation Costs Update 2011, prepared for UK DECC

2. Safe and responsible development of shale gas

Natural gas can be developed safely in Europe in an environmentally responsible way. Industry is committed to environmentally responsible development. It will take some years before shale gas in Europe could reach full development and industry is using this time to engage with stakeholders at both EU and national level to find the appropriate long-term framework for Europe.

2.1. European exploration and production highly regulated

- In the base case exploration and production of natural gas in Europe is one of the most highly regulated processes in the world and this regulatory regime applies equally to shale gas as it does and to gas from conventional reservoirs. The January 2014 EU Commission's Communication and Recommendations on "The exploration and production of hydrocarbons (such as shale gas) using high volume hydraulic fracturing in the EU"[12] confirm that the EU's current regulatory framework is adequate for early exploration (seismic/test drilling) activities. The Recommendations are provided for those Member States that plan to explore their indigenous shale gas potential.

- Until early exploration work takes place, the true potential of natural gas from shales remains unknown. OGP urges the EU to promote the Recommendations amongst Member States, underscoring the importance of exploration, as a means of identifying resource potential. OGP is ready to work with other stakeholders and the relevant authorities in order to implement the Recommendations in line with the current EU regulatory framework. Where necessary the industry is aligning its practices with the Recommendations (see OGP/IPIECA's Good practice guidelines for the development of shale oil and gas)[13].

2.2. Water usage and protection

- Hydraulic fracturing has been used for more than 50 years by the oil and gas industry. Standards exist for managing each element of the process including the acquisition, use and reuse or disposal of water. Implementing these standards helps to ensure safe and environmentally sound operations.

- Well casing - using multiple barriers of steel pipe and cement - protects the aquifers that wells may have to cross to reach shale gas resources deep underground. Geological formations where hydraulic fracturing takes place are thousands of meters below drinking water aquifers and are separated from them by multiple layers of impervious rock that create natural geological barriers to the upward migration of any fluids into freshwater aquifer zones.

- Hydraulic fracturing fluids are composed of typically greater than 99% water and sand. Less than 1% contains is comprised of chemical additive substances which are regularly used in domestic cleaners, cosmetics and food. These substances are needed to reduce friction, combat corrosion and help suspend and transport the sand into the fractures to keep them open and allow gas to flow.

- According to the Massachusetts Institute of Technology, the water intensity of natural gas from shale ranks amongst the lowest of all fuel sources. A UK water utility company recently stated that "even under the most optimistic assumptions for shale gas production in the North West (of England), the water required for hydraulic fracturing would amount to less than 1% of our current water production. We are confident we can supply these volumes without compromising our ability to supply water to our existing customers."[14]

- Typically, between 20 and 40% of the water used for hydraulic fracturing is recovered during the first weeks of hydrocarbon production. The exact amount varying according to the geology of the site. The remaining water stays in the formation, thousands of meters below drinking water zones.

12 http://ec.europa.eu/environment/integration/energy/unconventional_en.htm

13http://www.ogp.org.uk/pubs/489.pdf

14 http://corporate.unitedutilities.com/documents/uu-shale-gas-statement.pdf

- Any fluids returning to surface are recycled or disposed of at licensed waste disposal facilities, as permitted by competent regulatory authorities. Industry has decades of successfully handling recovered water using proven techniques (see *Recovered Water Management Study in Shale Wells*, ERM[15]). Treatment of recovered water should not therefore be a barrier to the development of the shale gas industry in Europe or elsewhere in the world.

2.3. 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, mining and quarrying activities and even traffic movements. Hydraulic fracturing can trigger extremely low level seismic activity that is generally too small to be felt at the surface by humans. Sub-surface geology is routinely taken into account during the well planning process. In a recent report, the UK Department of Energy and Climate Change (DECC) recognizes the low level of risk of induced seismicity below 3 on the Richter scale. It concludes such events are "unlikely to cause structural damage."[16]

2.4. Transparency, communication and engagement

It is important that industry and authorities maintain a dialogue and cooperate to address public concerns, through the transparent sharing of information and knowledge.

- Chemical substances used in hydraulic fracturing for shale gas are already registered and approved under the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) Regulation.

- OGP members are key supporters of the NGSfacts initiative (www.ngsfacts.org) which provides a platform for industry to voluntarily disclose chemical additives used on a well by well basis within the European Economic Area (EEA).

- OGP members are willing to cooperate with EU Commission to continually improve REACH registration.

- 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 nearly disappears during the productive life of a well, which may last several decades. OGP members pledge to engage local communities and discuss shared solutions to minimize the impact of developments on traffic, road quality, noise, dust and light where development activities are being carried out.

- Beyond the initial exploration and drilling phase, the surface footprint of natural gas from shale is relatively small compared with the footprint of other energy sources, including renewable energy. The surface footprint is further minimized by drilling multiple horizontal wells from a single pad or well site location. When operations are complete, sites are reclaimed to meet landowner preferences and government requirements.

- OGP welcomes the launch by JRC in July 2014 of the European Science and Technology Network on unconventional hydrocarbon extraction as a constructive initiative to bring together practitioners from industry, research, academia and civil society. The network will collect and review results from exploration projects and assess the development in technologies used to extract shale gas and oil. Such an initiative will exchange practical knowledge and help to build a broader understanding of shale gas activity across the stakeholder network.

15http://www.ogp.org.uk/index.php?cID=3149

16 Preese Hall shale gas fracturing — Review & recommendations for induced seismic mitigation (April 2012)

3. Conclusions

- Natural gas is recognised by the EU Commission in the recent Energy & Climate 2030 policy Package to play a key role in the transformation to a low carbon economy.
- Natural gas from shale is potentially an opportunity for Europe recognised in EU Commissions Communication on Strategic Energy Security Plan and Communication on Unconventional Hydrocarbons.
- EU environmental protection is strong.
- Industry experience is that effective implementation of existing legislation and established good industry practices minimizes the risk of incidents.
- OGP will work together with European stakeholders for the responsible development of shale gas.
- Industry continuously invests in on-going R&D to further minimize any potential negative impact of shale gas production.