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Shale gas: four myths and a truth

Rebecca Lawson, Luca Bergamaschi, Ingrid Holmes, Tom Burke

European Union (EU) dependence on energy imports is high and continuing to rise. In 2012, 55% of total EU energy supplies were imported at a cost of €400bn, equivalent to 3.1% of EU GDP.[1] European wholesale gas prices are currently 2-3 times as high as those in the United States (US)[2]. This is driving concern about the future competitiveness of European industry and is fuelling the debate over how the issue of rising energy prices can be effectively addressed in the context of the EU 2030 climate and energy package. In parallel, the crisis in the Ukraine has highlighted the risks of pinning the EU's energy supply future on Russia, with 21 of the 28 EU Member States dependent on Russian gas imports.[3]

Some argue that the solution to rising energy prices and energy security concerns lies not in cutting demand for energy imports by improving energy efficiency whilst expanding Europe's renewable energy capacity, but in exploiting the substantial European shale gas reserves. They point to the example of the US as showing the way forward. In the US the shale gas boom has seen liquid natural gas imports reduced by 77% from their 2007 peak by 2012[4] and US gas spot prices reduce from a 2008 average of $8.86 to $3.73 in 2013.[5] The US is expected to start exporting shale gas from 2015. Building on the US example, it is frequently argued that European shale gas represents a plentiful and cheap source of energy that will not just cut European energy prices but also improve energy security and help address climate change.

This briefing looks at whether the fundamentals underpinning the proposed EU shale gas revolution support these claims.

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[1] IEA World Energy Outlook 2013 and The European Commission ' A Policy Framework for Climate and Energy 2020-2030' January 2014.

[2] http://ec.europa.eu/energy/observatory/gas/doc/20130814_q2_quarterly_report_on_european_gas_markets.pdf and

[3] Gas data from Euroga, BP Statistical Review of World Energy 2013 and http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf

[4] http://www.ferc.gov/market-oversight/reports-analyses/st-mkt-ovr/2012-som-final.pdf

[5] http://www.eia.gov/naturalgas/monthly/pdf/table_03.pdf

Truth: The EU has significant shale gas reserves

It is estimated that the shale gas basins in EU hold somewhere between 80.5 – 621.5 trillion cubic feet of technically recoverable shale reserves. This represents between one-sixth and one-third of the technically recoverable shale gas reserves held in the US.[6] It is a significant volume. If recovered, it has been estimated it could supply between 2-3%[7] and 10%[8] of Europe's gas demand out to 2030.

Myth 1: Shale gas is cheap

Shale gas has been produced and sold cheaply (at times at prices below the cost of production) in the USA. But the US shale gas revolution took 20-30 years to happen. The conditions that have enabled the low cost of US shale gas production include favourable geological conditions – reserves are close to the surface, make the gas easier to extract; plenty of drill core data available to locate lucrative drilling sites; relaxed environmental regulation; property rights that created financial incentives for landowners to allow shale gas extraction (fracking); easy access to existing pipelines; and a favourable commodity supply gas market served by a dynamic and highly competitive supply chain.[9] Other factors have been less visible and driven by the State. These include generous tax breaks (amounting to subsidies of $0.5/MMBTu against production costs of between $3-$7/MMBTu)[10] and government spending on R&D in excess of $100 million from the late 1970s onwards.[11]

Many of these prevailing conditions do not exist in the EU and, as a result, EU production costs are expected to be 150%-250% higher per unit of gas extracted.[12] For example, European shale gas basins tend to be smaller and tectonically more complex than their US counterparts. The shale gas reserves themselves are deeper, hotter, more pressurised, fragmented and rich in clay making them more difficult to extract. In Poland – the most advanced and potentially biggest market in Europe - investors such as ExxonMobil, Marathon and Talisman have pulled out because the type of shale revealed by test drilling is incompatible with its equipment and, by implication, uneconomic. The lack of a mature supply chain and pipelines to transport shale gas also adds to costs. As a result, the

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[6] US reserves are estimated at 456.3-1,649.7 tcf - EU Joint Research Centre ' Unconventional Gas: Potential Market Impacts in the European Union' 2012 (Figures have been converted from trillion cubic metres to trillion cubic feet)

[7] IEA World Energy Outlook 2012

[8] Poyry, 'The impact of unconventional gas on Europe' a Report to Ofgem, 2011

[9] Paul Stevens, Chatham House 'Shale Gas in the United Kingdom' December 2013

10 IEA, "Are we entering the golden age of gas?," International Energy Agency, Paris, 2011.

[11] http://www.huffingtonpost.com/2012/09/23/fracking-developed-government_n_1907178.html and http://www.rff.org/RFF/documents/RFF-DP-13-12.pdf

12$7-12/MMBtu compared to $3-7 in the US

expected costs of shale gas are comparable with the current price of conventional gas in the EU ($10/MMBtu).[13]

Even in the US itself, the cheap energy revolution may be short-lived. The most economically lucrative sites have been identified and well quality and field production have begun to decline, pushing the price of production up.[14] As a result, US prices have already doubled since the all-time- lows experienced in 2012[15] and US producers are increasing pressure on the US Government to allow exports in a bid to take advantage of higher prices on the export market.

In summary, unless real world constraints and barriers to production can be overcome, shale will not be a cheap energy source in the EU.

Myth 2: Shale gas could reduce EU energy prices

Cambridge Econometrics has estimated that to achieve shale gas production levels at a scale to impact on EU gas prices 33,500-67,000 wells would need to be drilled in the EU by 2050.[16] Currently fewer than 100 such wells have been drilled. In addition, there are concerns about the supply chain. It is estimated that as production ramps up, 148-295 rigs a year would be required in 2035. Currently the EU has a rig manufacturing capability of 12-18 per year.[17]

Some of the legal and economic reasons behind the low number of wells drilled in the EU to date are set out above. But perhaps the most significant is the geological conditions. In Poland (the largest potential market) difficulties with test drilling resulted in the Polish Geological Institute cutting its estimates of the amount of Polish shale gas reserves by 90%.[18] In addition the proportionally large land mass that would be impacted in the EU compared to the US is a concern. For example, a surface area of land bigger than the Netherlands would need to be drilled in order for production levels of 2.65 trillion cubic feet a year to be reached to satisfy 10% of EU gas demand by 2030.[19] Gaining support for this activity will be challenging in Europe where the available surface area is more limited, population densities

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[13] http://ec.europa.eu/energy/observatory/gas/doc/20130814_q2_quarterly_report_on_european_gas_markets.pdf

14 Post Carbon Institute. In 2012 the capital costs of maintaining production in more than 7,000 wells was US$42 billion per year. In comparison, the value of shale gas produced in 2012 was only US$32.5 billion,

15 Bloomberg New Energy Finance, Michael Liebrich, 5 March 2014

[16] This is the amount of wells that would need to be drilled to recover 52-124 trillion cubic feet of gas between 2020-2050 according to Poyrys and Cambridge Econometrics 'The Macroeconomics of European Shale Gas Production' November 2013.

[17] Poyry and Cambridge Econometrics 'The Macroeconomics of European Shale Gas Production' November 2013.

[18] In 2011 uncoventional gas reserves were recorded as from 186.03 trillion cubic feet. In 2012 they were revised to 12.1-26.95 trillion cubic feet, Cited in Centre for European Reform 'Can shale gas transform the EU's energy landscape?' July 2013(figures converted from tcm to tcf).

[19] Florence Geny 'Can unconventional gas be a game changer for European Gas Markets?' Oxford Energy Institute 2010, and Poyry, 'The impact of unconventional gas on Europe' a Report to Ofgem, 2011.

far higher, environmental regulations more stringent and the level of public resistance to fracking stronger than in the US. Fracking is currently banned in 5 of the 14 Member States with estimated reserves, including in France, which has the second largest reserves after Poland.[20] The costs of policing 2013 public protests against test drilling at just one site - in the UK village of Balcombe - was $6.65m.[21]

In summary, there are very significant barriers to extraction that make it unlikely a scale of production could be reached that would meaningfully impact on EU energy prices. In addition, the scale of land and, therefore, the number of people impacted by the exploration and extraction processes, has been underplayed by both the industry and governments. [22] This will create additional and significant public acceptance issues that will be difficult to overcome if it cannot be demonstrated that such exploration will produce meaningful gas price reductions.

Myth 3: Shale gas will improve our security of supply

21 of the EU 28 Member States import gas from Russia.[23] Even under the most optimistic scenarios, shale gas is projected to meet just 10% of European gas demand by 2030.[24] Most commentators agree that 2-3% by 2030 is a more realistic estimate.[25] Therefore, even in the best case scenario, the volumes of EU shale gas production achieved will be too small to meaningfully impact on EU security of supply concerns.

Myth 4: Shale gas can help us address climate change

Barack Obama has described shale gas as "the transition fuel that can power our economy with less carbon pollution". Similarly, shale gas has been suggested as a 'third way' for addressing climate change and delivering Europe's 2030 energy and climate goals because it emits around half the CO_2 of coal per unit energy produced.[26] However, there are concerns that methane leakages from shale gas extraction may cancel out any CO_2 reductions achieved and, even if technology can be developed to contain such leakages, production is not expected to come on stream fast enough or in sufficient quantities to displace coal in the EU power generation mix.[27]

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[20] The Economist, February 2013 'Unconventional Gas in Europe: Frack to the Future.'
[21] http://www.telegraph.co.uk/earth/energy/fracking/10586964/Fracking-protests-in-Sussex-cost-taxpayer-4m-to-police.html.
[22] Population density in the EU was 3.5 times higher than the US in 2012 – Eurostat.
[23] http://ec.europa.eu/energy/publications/doc/2013_pocketbook.pdf
[24] Poyry, 'The impact of unconventional gas on Europe' a report to Ofgem, 2011
[25] IEA World Energy Outlook 2012
[26] 423-535g CO2e/kWh(e) vs 837-1130g CO2e/kWh(e) –(*Parliamentary Office of Science & Technology, June 2011, 'Carbon Footprint of Electricity Generation*').
[27] Howarth, R. W., R. Santoro, and A. Ingraffea. 2011. Methane and the greenhouse gas footprint of natural gas from shale formations. Climatic Change Letters, doi: 10.1007/s10584-011-0061-5.

In fact, shale gas is more likely to increase emissions by weakening commitment to and investment in renewable energy and by locking the EU into energy and emission intensive capital stock. For example, the UK's Tyndall Centre has estimated that a $53.2bn investment in shale gas could displace 12GW of offshore or 21GW of onshore wind capacity (the equivalent of 13,000 wind turbines), the carbon footprints of which are 80-98% lower than shale gas.[28]

In summary, the fundamentals of the EU shale gas industry mean it cannot materially help the EU to address climate change.

So if not shale, what energy revolution should the EU be pursuing?

Shale gas does not represent a credible or cost effective route to improving energy security, managing energy costs or addressing climate change in the EU. Whilst a different set of prevailing geological, legal and economic conditions may have enabled shale to lower energy prices in the US, these prices have not translated into a competitive advantage for US industry.

European energy intensive goods continue to dominate global export markets despite the widening disparities in energy prices since 2008 and the IEA forecasts that the EU will keep that lead. [29] For example, in the chemicals sector, despite a severe economic crisis and cheap US gas prices, between 2005 and 2010 the EU chemicals industry grew by +1.6% per annum whereas the chemicals industry in North America had a negative growth rate of -1.4%[30] The EU has retained its competitive advantage because it is better than the US at doing more with less, the bloc consumes three-quarters of the energy of the US per unit of economic output. This greater efficiency shields the EU from the impact of higher energy prices.[31]

The debate about shale gas and its role in delivery of the EU's climate and energy targets is at best a distraction. There is a need now to focus on technologies that can deliver. Combining a strong push on energy efficiency and renewable energy with improved interconnection of the European grid would create a real energy revolution in Europe. It would enable Europe to protect its competitive advantage while managing energy prices, improving energy security and addressing climate change. A key priority must be to unlock the vast untapped energy efficiency potential in the EU, estimated by the Fraunhofer

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[28] Tyndall Centre ' Shale gas: a provisional assessment of climate change and environmental impacts' 2011. Carbon footprint of onshore wind is 20-96 gCO2e/kWh and offshore wind 5-13g CO2e/kWh, Parliamentary Office of Science & Technology, June 2011, 'Carbon Footprint of Electricity Generation'

[29] The International Energy Agency (2013) *World Energy Outlook*

[30] European Chemical Industry Council, The European chemical industry in a worldwide perspective, http://www.cefic.org/Documents/FactsAndFigures/%28Offline%29%202011/FF2011_Full%20Report_Chapter/Cefic_FF%20Rapport%202011.pdf

[31] BP and World Bank data (2012)

Institute to equal 57% of final energy demand in 2050 – with annual cost savings of $695bn.[32]

Some argue green policies – and renewables in particular - are unaffordable and driving up energy prices. In fact the costs of renewable energy subsidies represented just 8% of electricity prices for industrial users (before any exemptions are taken into account).[33] In fact the primary driver of increasing energy costs in Europe is rising global energy demand. For example, China, which has overtaken the US as the world's leading energy consumer, is projected to account for the largest share – 40% - of the growth in global energy consumption over the next 30 years, with its natural gas consumption expected to rise by more than 360%.[34] In the UK, 54% of electricity price increases in the past few years have driven by increases in gas prices not green policies.[35] Both in the UK and in Germany the price paid by the average household for natural gas for heating has increased by ~130% and ~30% respectively between 1996 and 2010.[36]

With the costs of green technologies falling, it makes sense to build on the progress made to date. Average operational and maintenance contracts for onshore wind farms fell by nearly 40 percent during 2008-2012[37]; costs of photovoltaic technology fell 50% during 2001-2011[38]. In some Southern European Member States, these cost reductions mean that the levelised cost of solar electricity (the total cost of building and operating a plant over its financial life) is down to €0.06-€0.08 per kWh.[39] Demand side technology cost reductions are even more startling: for example the cost of energy efficient LED lights has dropped 98% during 2001-2011.[40]

Renewable energy has already significantly diversified the European energy supply mix. The current share of renewables in EU final energy consumption has increased from 8.3% in 2004 to 14.1% in 2013 and is projected to reach 20% by 2020.[41] Meeting a 30% renewables target by 2030 would not just reduce carbon emissions, but could also save the EU $626bn in

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[32] Fraunhofer ISI (2012) Policy report: Contribution of Energy Efficiency Measures to Climate protection with the European Union until 2050. 2005 prices used. Ecofys indicate that energy efficiency savings of between $1.39 trillion to $2.78 trillion could be made between 2020-2030 - 'Saving energy: bring down Europe's energy prices in 2020 and beyond' November 2013

[33] EC Communication on Energy Prices and Costs 2014. The value of these exemptions is considerable. For example, in Germany, 2000 energy intensive companies (including BASF) have been exempted from renewable levies at a cost to ordinary consumers that will rise as high as €5.1 billion in 2014

[34] US Energy Information Administration, International Energy Outlook 2013, http://www.eia.gov/forecasts/ieo/

[35] UK regulator OFGEM calculated that between 2004 and 2011, £35 of the £65 increase in the average UK electricity bill was due to gas price increases.

[36] See http://www.theccc.org.uk/wp-content/uploads/2012/12/1672_CCC_Energy-Bills_bookmarked.pdf

[37] Bloomberg New Energy Finance (2012) Wind farm operation and maintenance costs plummet, Press Release

38 Berkley Lab (2013) Tracking the Sun. Data for panels sized ≤10kW

39 Franhofer ISI 'Levelised cost of electricity and renewable energy technologies' November 2013.

40 See Peter, L. & Wright, M (2012) 'LED lighting market to grow while LED component market goes flat', LEDs Magazine, March cited in http://www.theclimategroup.org/_assets/files/LED_report_web1(3).pdf

41 Eurostat News Release 10 March 2014

avoided fuel import costs.[42] In the medium term, analysis by the European Climate Foundation has found that combining large scale deployment of renewables with improved energy efficiency and greater interconnection of the European grid could reduce carbon emissions 80% by 2050 and power generation gas demand in the EU by 80% compared to 1990 baselines.[43] This could eliminate the need for European dependence on Russian gas.

In summary, if Europe is serious about delivering an affordable low carbon, secure and competitive energy system, it needs now to agree a 2030 climate and energy package that scales up investment in energy efficiency, renewable energy and interconnection. Not place bets on a shale gas revolution that cannot feasibly deliver.

42 http://www.businessgreen.com/bg/analysis/2333312/ambitious-green-energy-target-could-save-eu-eur260bn. In addition, meeting the EU's energy efficiency target for 2020 could reduce fossil fuel imports from predicted levels of 62% back down to the 1990 level of 45%.

43 Scenario includes 80% RES by 2050 and EE improvements of at least 2% per year being realised – European Climate Foundation 'Roadmap 2050: A Practical Guide to a Prosperous, Low-Carbon Europe.