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Shale Fever:
Replicating the US gas revolution in the EU?

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Introduction

The US natural gas industry is abuzz. Until recently the United States seemed poised to become one of the world's largest importers of liquefied natural gas (LNG). However, the development of two innovative drilling techniques – hydraulic fracturing and horizontal drilling – has led to the emergence of new unconventional gas supplies, the majority coming from gas trapped in shale formations, transforming the American energy scene. Today, shale gas is responsible for roughly 20% of total US production with expectations that it could reach 50% by 2035 – an astounding feat given that it represented only 1% back in 2000.[1] The increase in US shale gas production also contributed to the US displacing the Russian Federation as the largest producer of gas, with its production of 624 billion cubic meters (bcm) trumping Russia's 582 bcm.[2] In addition, it has caused LNG demand to sink and sent prices tumbling, turning the market upside-down.

The ripple effects of the US 'shale gale' are already being felt abroad. With the US market awash with natural gas and prices plummeting to around $4/mBtu (million British thermal units), LNG tankers have been re-routed to more lucrative markets in Europe, upsetting the status quo with Gazprom losing market share to cheaper gas sold on the spot market. This has even led to some countries such as Algeria calling for coordinated cuts in production *à la* OPEC by the Gas Exporting Countries Forum (GECF) in order to prop up market rates.

In addition, this so-called 'quiet revolution', a term coined by BP Chief Executive Tony Hayward, is getting louder. Shale fever is now spreading beyond the borders of the United States, entering national discourses in the European Union where it is seen to provide energy independence and jobs, as well as cheaper and more environmentally-friendly fuel.

This is particularly the case in Poland, where a veritable land grab is underway for some of its finest shale acreage. Poland has also been one of the first member states to call on the EU to increase its focus on shale gas, with Foreign Minister Radoslaw Sikorski stating that it should be at the heart of the EU debate on energy security.[3]

Such enthusiasm, however, also needs to take into account the unique European context so as not to create unreasonable expectations. This CEPS Policy Brief hopes to provide a balanced and concise overview of the development of and concerns surrounding shale gas in the United States, and to explore the extent to which this success story could be replicated in the European Union. It does not aim to investigate how the overall global development of shale gas will affect the EU and its focus is primarily on shale gas as opposed to unconventional gas in its entirety due to the fact that shale gas reserves are larger (particularly in the US), have been more developed and consequently received more attention in political discourse.

[1] *Fueling North America's Energy Future*, IHS CERA Special Report, IHS Cambridge Energy Research Associates, Cambridge, MA, 2010.

[2] "U.S. Overtakes Russia as Biggest Natural Gas Producer", *Bloomberg*, 12 January 2010.

[3] "Poland calls on Europe to emulate US shale gas development", *Bloomberg*, 8 April 2010.

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The US revolution in shale gas

Although shale gas has only recently entered mainstream debates, its history is in fact extremely long, with the first commercial well drilled in New York in the late 1820s.[4] By the early 1980s there were over 10,000 wells in the US with an annual production of around 4 bcm. What led to a drastic increase in shale production, however, was the development of new innovative drilling techniques pioneered by Mitchell Energy in the 1980s, namely horizontal drilling and hydraulic fracturing ('fracking'). These new processes allow companies to drill downwards for up to 7,000 meters and then turn their drills horizontally to continue drilling sideways for up to 2,000 meters, after which a fine mixture of water, sand and chemicals is blasted through the opening, fracturing the surrounding shale and allowing the trapped gas to escape.

The major energy companies, however, were unconvinced of the value of shale gas, instead concentrating their efforts on locating new gas fields and thereby leaving the field open for small US wildcat drillers that pioneered these new drilling techniques with tremendous success. These independent prospectors have been able to procure more and more acreage opening up many shale 'plays', the term used to designate areas where oil and gas companies are targeting exploration activity. More than 30 states are already involved in this sector.[5]

Several additional factors have been key to this development. First, the US has been quick to identify its shale potential and most important shale plays, with large areas leased at a fast pace. Second, the US wildcatters have continuously experimented with and adapted their drilling techniques, reducing costs. This is particularly crucial given the fact that no one shale formation is alike, requiring production processes to be continuously tweaked and improved. Third, there has been little resistance to the development of shale gas by local communities due to the fact that population density is relatively low and local residents are given lucrative royalties in exchange for their mineral rights. Fourth, the environmental concerns surrounding shale gas, as outlined in more detail below, have not (yet) obstructed its development. Fifth, the development of shale gas has benefited from existing pipeline networks and sufficient local infrastructure to support its exploitation. Last but not least, the natural gas industry has received strong political support in the form of advantageous tax breaks.

The unconventional has therefore turned conventional, with the development of shale gas dramatically increasing estimates of American gas reserves. While around three years ago the US was expected to have about 30 years' worth of resources, today the US is believed to hold 100 years' worth at present usage rates.[6] Production particularly increased during the mid-2000s when natural gas prices were high, as shale plays are often cheaper to develop than conventional sources of natural gas.[7]

The significance of these developments remained unappreciated, however, until 2008, and even then only started to enter the US national energy debate in the second half of 2009, as policy-makers realised the extent to which shale gas could change the US energy landscape. Shale gas unlocks a whole new range of options, particularly in the context of a carbon-constrained world and the heated debates surrounding climate legislation in Washington. Steven Chu, the US energy czar, has confirmed this, stating that natural gas will play an increasingly important role in the power sector as the US moves towards carbon regulation. Increased natural gas supplies are therefore expected to displace aging coal power plants with cleaner gas-powered alternatives, which work well in tandem with renewables. Such an alliance in electricity supply could also meet greater electricity demand arising from the development of electric cars, which would reduce CO_2 emissions from the transport sector. In addition, natural gas itself can be used as a transport fuel.

It is therefore not surprising that shale gas has attracted a lot of political attention. Last year, for example, a lobbyist group which representing North America's leading independent natural gas exploration and production companies – America's Natural Gas Alliance (ANGA)[8] – was formed, in addition to a Natural Gas Caucus in both the US Senate and House of Representatives. Launched in October 2009, the latter initiative already includes over 40 bipartisan representatives and aims to promote awareness and develop policy in Congress on the importance of natural gas in the US energy portfolio in terms of climate change and energy security.

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[4] K. Shirley, "Shale gas exciting again", *AAPG Explorer*, American Association of Petroleum Geologists, March 2001.

[5] Amongst the most noteworthy are the Barnett play in Texas – the birthplace of the shale revolution – holding roughly 7 billion barrels of oil equivalent (boe), the Marcellus shale bordering Pennsylvania, New York and West Virginia, holding roughly 44 billion boe, the Haynesville shale straddling Louisiana and Texas with 41 billion boe as well as Fayetteville located in Arkansas and Oklahoma, home to 7 billion boe. The *Financial Times* provides an excellent map on its website (http://www.ft.com/unconventional).

[6] *Fueling North America's Energy Future*, IHS CERA Special Report, Cambridge Energy Research Associates, Cambridge, MA, 2010.

[7] Ibid.

[8] See http://www.anga.us/

Concerns surrounding shale gas

There are numerous concerns surrounding the production of natural gas from shale formations, which have gained greater attention with the emergence of a broad debate on shale gas supplies. The particular process under scrutiny is hydraulic fracturing. Critics claim that the large quantities of water mixed with chemicals used to fracture the rock can enter aquifers, thereby contaminating wells and general drinking water. Several cases of dead livestock exposed to potassium chloride in water have been recorded as have complaints from residents of skin rashes and vomiting after using their water. While the industry claims that most fractured wells are thousands of metres below any potable water supplies and harmful chemicals are therefore unable to enter groundwater, numerous political actors have nonetheless taken decisive actions. Philadelphia officials, for example, have already asked their state regulator to ban hydraulic fracturing until its effects on drinking water have been sufficiently studied and New York Mayor Bloomberg wants to ban fracking within the City's watershed, which extends into prospective shale production areas.[9]

On Capitol Hill, several legislators are also aiming to propose new federal regulations on fracking; Colorado Democrat Diana DeGette and New York Democrat Maurice Hinchey, for example, are putting forth a Fracturing Responsibility & Awareness of Chemicals (FRAC) Act, which would regulate the practice under the existing Safe Drinking Water Act and force industry to disclose the chemicals used in the process. This would be quite a reversal from 2005 when Congress exempted chemicals used in this technology from the Safe Drinking Water Act, an episode often dubbed the 'Halliburton loophole' after then Vice-President and former head of Halliburton Dick Cheney. Many companies, however, have so far resisted these proposals, arguing that disclosure of their fracking fluids would give away commercial secrets and affect their competitiveness. Congressmen Waxman and Markey have also attempted to bring more transparency to the sector by sending a letter to eight oil service companies, including Halliburton, Schlumberger and BJ Services, requesting details of the chemicals used as well as the health and environmental data related to hydraulic fracturing.

The US Environmental Protection Agency (EPA) is also conducting a study on the impact of hydraulic fracturing on drinking water, taking a life-cycle assessment starting with the immediate impact of fracking fluids and ending with years after the chemicals have been pulled out of a formation and disposed of. This study is estimated to cost roughly $6 million and is expected to be ready by 2012, after which it could strengthen the case for new regulation in this sector.

The fear of new regulation putting the brakes on hydraulic fracturing, and with it the development of shale gas, has been so acutely felt within the industry that ExxonMobil has even inserted an exit clause in its $30 billion acquisition of XTO Energy – a US gas independent with solid fracking experience – stipulating that Exxon can walk away from the deal should new regulations on fracking damage the commercial potential of shale gas.

The life-cycle emissions of natural gas produced from shale formations might also at some point become a contentious issue. A preliminary two-page paper by Robert Howarth of Cornell University claims that "when the total emissions of greenhouse gases are considered, HVSWHF (high-volume, slick water hydraulic fracturing)-obtained natural gas and coal from mountain-top removal probably have similar releases, and in fact the natural gas may be worse in terms of consequences on global warming".[10] However, Dr Howarth openly states that his estimates are "highly uncertain" and that his numbers "should be treated with caution". While these concerns regarding life-cycle emissions have so far not entered the political debate, it cannot be ruled out that they might gain greater influence in the future.

Other pertinent concerns include the rapidity of well depletion and the water-intensive nature of the industry. According to Matthew Simmons, CEO of the energy-focused investment bank Simmons & Company International, roughly 265 billion litres of potable water are needed for the Barnett play, which has also experienced high flow rates at the beginning of production followed by a rapid decline. A study conducted by the International Energy Agency (IEA), for example, estimated that on average "horizontal Barnett wells have declined by 39% from the first to the second year of production and by 50% from the first to the third year…[while] vertical wells have declined almost as rapidly".[11]

In spite of these concerns, the development of shale gas has powered ahead. A recent report by Houston-based analyst Tudor, Pickering, Holt (TPH) asserts that shale gas is wiping out US LNG demand, predicting shipments to the US in 2010 will fall to 51 million

[9] "Bloomberg wants ban in New York", *Upstream*, 29 January 2010.

[10] Robert W. Howarth, "Preliminary Assessment of the Greenhouse Gas Emissions from Natural Gas obtained by Hydraulic Fracturing" (draft paper), Cornell University, 17 March 2010.

[11] International Energy Agency, *World Energy Outlook* 2009.

cubic meters (mmcm) of gas per day while US regasification capacity is close to 425 mmcm per day dispersed among nine different terminals on the Gulf of Mexico and Atlantic coasts. This is also congruent with the Short-Term Energy Outlook forecasts by the US Department of Energy. According to the TPH report, this would "render US LNG imports nearly unnecessary over the next five to 10 years".[12] It is important to note, however, that this assessment does not include possible effects of future climate legislation on the American power market, which would strengthen gas use in electricity production, thereby raising demand and boosting prices. Be that as it may, the LNG wipe-out in the US has major implications for the European Union as those tankers will re-direct to the European market, which is expanding its LNG re-gasification base, thereby putting pressure on prices and particularly traditional players such as Russia's Gazprom.[13] Shale gas will therefore have an influential indirect effect on the European gas market; whether the EU, however, can emulate the US in its shale gale is far from certain.

Shale gas in the European Union

Europe is witnessing growing enthusiasm for shale gas inspired by its success in the United States. In the context of increasing sensitivity about import dependency in the wake of two gas crises, many consider the EU's potential shale gas reserves as a silver bullet for Europe's energy security problems. Tapping these reserves, they believe, would also not only boost the EU's onshore industry and create more jobs but also provide cheaper gas, thereby benefiting the overall economy and boosting global competitiveness. It would also provide a steady supply of a fuel that is more climate-friendly than other fossil fuels; natural gas is 30% less carbon-intensive than oil, 50% less than coal and has negligible emissions of sulphur dioxide (SO_2), mercury and nitrogen oxides (NOx) when compared to other conventional fuels. This makes natural gas a crucial fuel of the future in terms of climate change, particularly in combination with the expansion of renewables; the flexibility of natural gas power plants allows quick and efficient changes in their level of output in order to accommodate any variability in electricity demand and supply in the grid that might arise due to the intermittency of renewable energy.

On the surface, the European Union also appears structurally well-prepared to emulate the shale gas success story. Not only is it home to a large and increasingly integrated gas market with relatively high prices and expectations of a steadily rising demand, the EU also has an established pipeline infrastructure. Most important, however, is the presence of large shale gas deposits in the EU. According to the International Energy Agency (IEA), Western Europe alone may hold around 15 trillion cubic meters in shale gas,[14] enough to supply Germany for roughly 175 years.[15] Poland is considered to be a particularly attractive location. A study by Advanced Resources International found that Poland alone could have recoverable reserves of 3 trillion cubic meters – more than 200 years of its own consumption. The Polish government is also currently verifying and documenting shale gas resources on its territory, hoping to have the first results of that evaluation by the end of 2010.[16]

Another dynamic strengthening the case for a European shale revolution is that, contrary to the United States, shale gas development in the EU is spearheaded by some of the major oil and gas companies. More than 40 companies are already engaged in exploring Europe's shale potential, with investigations underway in around 10 countries. Poland's plays are particularly sought after, with over 40 exploration licences awarded to major players such as Chevron, ConocoPhilips and ExxonMobil, the latter of which also holds significant acreage in the Lower Saxony Basin of Germany.

Having realised their lost opportunities on the American shale market, these large companies are naturally eager to catch up and emulate its success abroad. This has led to a plethora of deals between independent US oil and gas companies and their larger counterparts in order for the latter to acquire the experience and technical know-how of the former. For example, BG Group has launched a joint venture with Texas-based Exco, Mitsui & Co. has acquired a stake in the Marcellus Shale through a deal with Anadarko Petroleum, BP is negotiating a deal with Lewis Energy

[12] "Shale gas destroys US LNG demand", *Upstream*, 20 April 2010.

[13] See, for example, Roderick Kefferpütz, "Gazprom's Changing Fortunes", CEPS Commentary, Centre for European Policy Studies, Brussels, 30 November 2009 (http://www.ceps.eu/book/gazprom's-changing-fortunes).

[14] Many of these reserves are located in Europe's three major regional shale plays. One of the oldest and most sought after being the Lower Paleozoic play, stretching from Eastern Denmark into southern Sweden and to the north and east of Poland, while the second major play runs from the Cheshire Basin in northwest England across the Anglo-Dutch Basin as well as Northwest German Basin and the third regional play similarly extending from southern England to the Netherlands, northern Germany and Switzerland. There are also numerous local plays such as the Vienna and France basins.

[15] Correspondence with the International Energy Agency, March 2010.

[16] Correspondence with Polish government officials, December 2009.

for a joint venture agreement in the Eagle Ford shale in south Texas, ExxonMobil has struck a $41 billion all-stock takeover of XTO Energy, and both Statoil and Total have increased their acreage position in the US shale market through deals with Chesapeake Energy, the second biggest natural gas producer in the US.

There are also several joint ventures taking place in Europe to develop shale. ConocoPhilips, for example, is joining forces with Lane Energy Poland, a subsidiary of UK-based 3Legs Resources, while GDF-Suez has forged an alliance with the small explorer Schuepbach Energy. These deals are beneficial to the extent that they pool the majors holding large financial balance sheets with smaller companies holding significant experience and know-how.

These factors have led many to believe that the EU will also witness a game-changing rush towards shale gas in the coming years.[17] In reality, however, the demographic, political, regulatory, environmental and social differences between the US and the EU are putting the brakes on the development of shale gas in Europe.

First of all, concrete geological data on and experience with shale gas is still in its infancy in Europe. Efforts to tackle this knowledge gap include GASH (Gas Shales in Europe), the first European shale gas research initiative launched in 2009 and sponsored by a number of mostly European oil and gas companies.

Second, gaining the support of local residents for shale gas would be much more difficult in the European Union than in the US. Not only is Europe much more densely populated than the United States, it is also impossible for many Europeans to reap some of the direct benefits enjoyed by their American counterparts. Local residents in the US can make impressive sums from shale gas by selling the mineral rights they own. In New York State, for example, some residents are offered as much as $5,500 an acre, with 20% royalties on whatever gas is extracted. Conversely, in many EU countries, those rights are owned by the state, which leaves local residents with all of the trouble and few of the benefits. In addition, one could argue that environmental awareness in the EU is higher than in the US and that this could lead to particularly stiff opposition by locals due to the possible contamination of water supplies. In Sweden, for example, local residents filed a complaint with the administrative court in Dalarna (subsequently rejected) demanding Shell to stop drilling for shale.

Third, the European Union faces severe equipment shortages in comparison to the United States. The US is home to many rig facilities companies and an experienced drilling workforce and has up to 2,000 onshore gas-drilling rigs operating at any one time. Europe, conversely, has little more than 50 with, for example, only seven of those located in Poland according to Bernstein Research.[18] Companies such as PGNiG and BNK Petroleum have already cited these particular constraints, as bringing in foreign expertise and companies would delay action and could act as a bottleneck for development.

Fourth, water sourcing and local infrastructure might also present difficulties given the fact that the fracking process requires large amounts of water that may need to be transported in and subsequently removed for disposal.

Fifth, labour costs in the European Union are higher, as are regulatory and environmental standards, slowing the development of shale gas and making it more costly. This, in combination with European geology, where shale is generally deeper and hence more expensive to drill, will make shale gas economically less attractive in the EU. While studies by BENTEK Energy and WoodMackenzie estimate the break-even gas price for some US shale plays to lie between $3 and $7/mmbtu, estimates for the EU tend to put that price above $10/mmbtu.[19]

Sixth, there is no significant political dynamic inside the European Union to promote the development of shale gas. So far the only indirect mention of shale gas reserves can be found in the Second Strategic Energy Review, which states that the European Commission will commence discussions in the Berlin Fossil Fuel Forum "on which additional measures could be taken at Community and national level, and in particular in partnership with Norway, to further promote the increased cost-effectiveness and environmentally-compatible access to indigenous EU fossil fuels". In October 2009, the Forum set up an additional working party focusing exclusively on indigenous fossil fuel production. However, the group's working documents have at best given only limited attention to shale gas and present no concrete policy suggestions. It is even doubtful that the potential of shale gas has been included in the figures used by the Commission to draft its key energy scenarios and policy documents. Parliamentary questions posed by the European Parliament to the Commission with regard to shale gas have also, to date, remained unanswered.

Last but not least, while the major oil and gas groups looking for shale in Europe can leverage large finances

[17] "Shale gas could fuel European energy demand", *Moscow Times*, 22 March 2010.

[18] "Europe, the new frontier in shale gas rush", *Financial Times*, 7 March 2010.

[19] Andreas Korn, "Prospects for unconventional gas in Europe", Power Point Presentation, *E.On*, 5 February 2010.

and expertise, their drawn-out decision-making processes and risk-averse mindset could also, as mentioned by Florence Gény of the Oxford Energy Institute, slow down efficiency and development, two key factors needed to increase the commerciality of shale.

These factors make it highly unlikely that the European Union will undergo a shale gas revolution transforming its gas market any time soon. The decline in EU conventional production is unlikely to be replaced by shale gas in the near-term, meaning that LNG and pipeline imports will remain important for the foreseeable future.

One particular country that is trying to buck that trend is Poland. Poland holds some of the most attractive shale gas deposits in Europe: high quality, relatively shallow and often situated in sparsely populated areas, lowering the likelihood of resistance from local residents. The political administration is eager to make use of these deposits in order to improve the country's energy security[20] and, according to some officials, strengthen the EU's position in negotiations with non-EU gas producers and suppliers. Poland is therefore undertaking large evaluations of its shale gas reserves and handing out many exploration licences to major companies such as ConocoPhilips, Marathon Oil, Chevron and ExxonMobil in addition to offering particularly attractive fiscal terms, hoping that this will create enough of a commercial incentive to develop its shale gas reserves. Given the other aforementioned constraints, however, such as the problems of water sourcing, equipment shortages and environmental regulations, it remains to be seen whether Poland will indeed be able to fully reap the benefits of its shale gas stocks.

Conclusion

The obstacles facing shale gas development in Europe will not make it a game-changer but neither are they insurmountable. While a large-scale European dash for shale gas is unlikely to take place, some countries, most notably Poland, are better positioned to develop shale resources than others – although they too will have to overcome several obstructing factors – and are eager to exploit their potential given the relevance of shale gas for the energy landscape. In this context, it is important that EU institutions pay adequate attention to this issue considering the possible energy security and environmental implications.

A first step would be to establish a regular dialogue with the United States in order to exchange experiences and increase research and development cooperation in this field in the vein of the recently launched US-China Shale Gas Resource Initiative. The EU-US Energy Council seems particularly well-placed to act as such a forum. Such a partnership would not only avoid any possible duplication but could also strengthen cooperation on some of the more contentious issues related to shale gas, such as its water intensity as well as the hydraulic fracturing process and its possible contamination of water supplies.

The European Union would also be well-advised to incorporate shale gas in its energy security assessments and policies. In this context, it will be interesting to see the extent to which the Commission envisages a role for shale gas in its forthcoming EU Energy Action Plan 2010-2014, to be released shortly. More importantly, however, the Commission cannot afford to neglect shale gas supplies in its upcoming Energy Infrastructure Package for the 2020/2030 horizon, envisioned for late 2010, which amongst others will look at measures aiming at diversifying gas supply sources.

Last but not least, it is important to note that the global development of shale gas and unconventional gas in general will undoubtedly have some knock-on effects on the European gas market. In fact, it has already done so with displaced US-bound LNG having started to flood the market, pushing out more expensive Russian gas. To what extent this phenomenon will continue, however, is hard to predict due to the numerous variables affecting supply and demand (economic recession, climate and energy legislation, pricing, etc.). What seems to be relatively certain, however, is that Europe will not create its own home-grown gas revolution any time soon.

[20] Poland imports roughly 72% of its natural gas from Russia.

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