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OF UNCONVENTIONAL FOSSIL ENERGY

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- The shale gas boom, the recent and rapid commercialization of large-scale shale gas production, has made the US self-sufficient in natural gas and has considerable export potential. Gas is set to become the biggest fuel in the US energy mix and has helped the US to curb its greenhouse gas emissions. Cheap gas is also reinforcing the trend of rising industry investment in the US.
- The impacts of the US shale gas boom are already being felt in Europe and Asia, for example via cheaper coal. The 'coal renaissance' in Europe can still be avoided either by a carbon price or other forms of regulation. Restoring the ability of the European Emissions Trading System to guide investments is the best solution, and can be done simply by setting an adequate emissions cap for the post-2020 period.
- Globally, the rise of unconventional fossil energy sources means that the energy markets of the coming decades will move towards a more competitive and fragmented order, in which many energy importing countries also utilize significant domestic resources, and are able to balance their imports with regional exporters and the major global players.
- These developments point to a weakening Russian grip on the European gas market, and problems for Russian export revenues in general. Other states lag far behind the US in shale gas technology, but will try to replicate the US experiment, while Russia will strive to prevent this from happening in its neighbourhood.

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The recent success story of commercializing large-scale shale gas production in the US can be considered among the most significant events in global energy and climate politics in decades. What does the US shale gas story suggest about global and European climate politics? Is the US shale gas boom merely the first sign of a new strategic world map, as was recently suggested by a prominent analyst in *Foreign Affairs*?¹ This briefing paper presents an analysis of and preliminary findings on these multifaceted dilemmas. While many open questions still linger around the global potential of unconventional gas and oil, it is already recognizable that their triumph in the US is affecting patterns of trade, production and climate policies elsewhere.

A grey revolution: Shale gas in the US

Shale gas, namely natural gas trapped in shale formations, is the most significant subcategory of so-called ‘unconventional gas’ resources, which also include tight gas (natural gas in solid rock) and coalbed methane (natural gas in solid coal). The large-scale exploitation of these resources has begun only recently, enabled by the combined progress in two key technologies: horizontal drilling and fracking. Hydraulic fracture stimulation, or ‘fracking’, is a technique in which water, sand and certain chemicals are pumped into the drilled holes to create a large number of fractures in the shale rock, in order to untap the natural gas trapped in shales. Similarly to unconventional gas resources, many different kinds of unconventional oil reserves (oil shale, tight oil, oil sands and others) have been taken into commercial use, mainly in North America.

There are large potential reserves of shale gas in many parts of the world, notably China, the US, Europe and Australia. According to International Energy Agency (IEA) estimates, unconventional sources have added 325 trillion cubic metres (tcm) to the current global natural gas reserves, with conventional sources accounting for 462 tcm (Figure 1). There is always considerable uncertainty associated with the assessment of reserves and resources for gas and oil. Most estimates are provided by governments or private companies without clear analysis or verification. There are no agreed standards for

concepts such as ‘proved’, ‘probable’, ‘possible’, ‘recoverable’ or ‘reasonable certainty’. Unconventional gas resources in regions that are richly endowed with conventional gas are often poorly known and could be much larger. Time-series studies on specific regions show a notable rising trend. The IEA is already talking about ‘the golden age of gas’.²

Natural gas is well on its way to becoming the largest source of energy in the US due to the shale gas boom. It currently contributes about 27 per cent of the total primary energy supply and will overtake oil in the mid-term to become the largest fuel in the primary energy mix. Unconventional gas reserves have already made the US self-sufficient in natural gas for the foreseeable future, and provide considerable export potential. Several analysts say that the US, or at least North America, is also likely to become energy self-sufficient in a couple of decades due to unconventional gas and oil. Even the Organization of the Petroleum Exporting Countries (OPEC), the conventional oil exporters’ trade bloc, acknowledged for the first time in 2012 the importance of ‘recent significant increases in North American shale oil and shale gas production and their effects’.³

Moreover, the rise of shale gas in the US power sector has been astonishingly rapid. In 2010, when the production of shale gas was already taking off, coal accounted for 42 per cent of US electricity production. Just 18 months later, coal had dropped about a *quarter*, contributing one-third of the total, approximately on a par with natural gas. The main reason for this dramatic drop in coal consumption was the increased supply and cheap price of natural gas. The spot price for natural gas in the USA had fallen from its peak of \$13/million British thermal units (mBtu) in mid-2008 down to an incredibly low \$2/mBtu in April 2012. These rock-bottom prices can be partly explained by valuable side products, liquid carbons, the inelasticity of gas production once started, and the ensuing oversupply. However, mid-term and long-term prices in the US are also predicted to stay low, around \$4–6/mBtu (Figure 2).

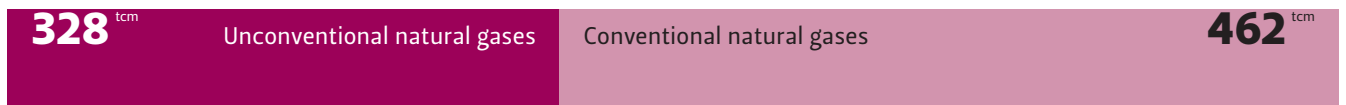
1 Tucker, A. ‘New Power Map’, *Foreign Affairs*, 2012.

2 International Energy Agency, ‘World Energy Outlook 2012’, OECD / IEA 2012.

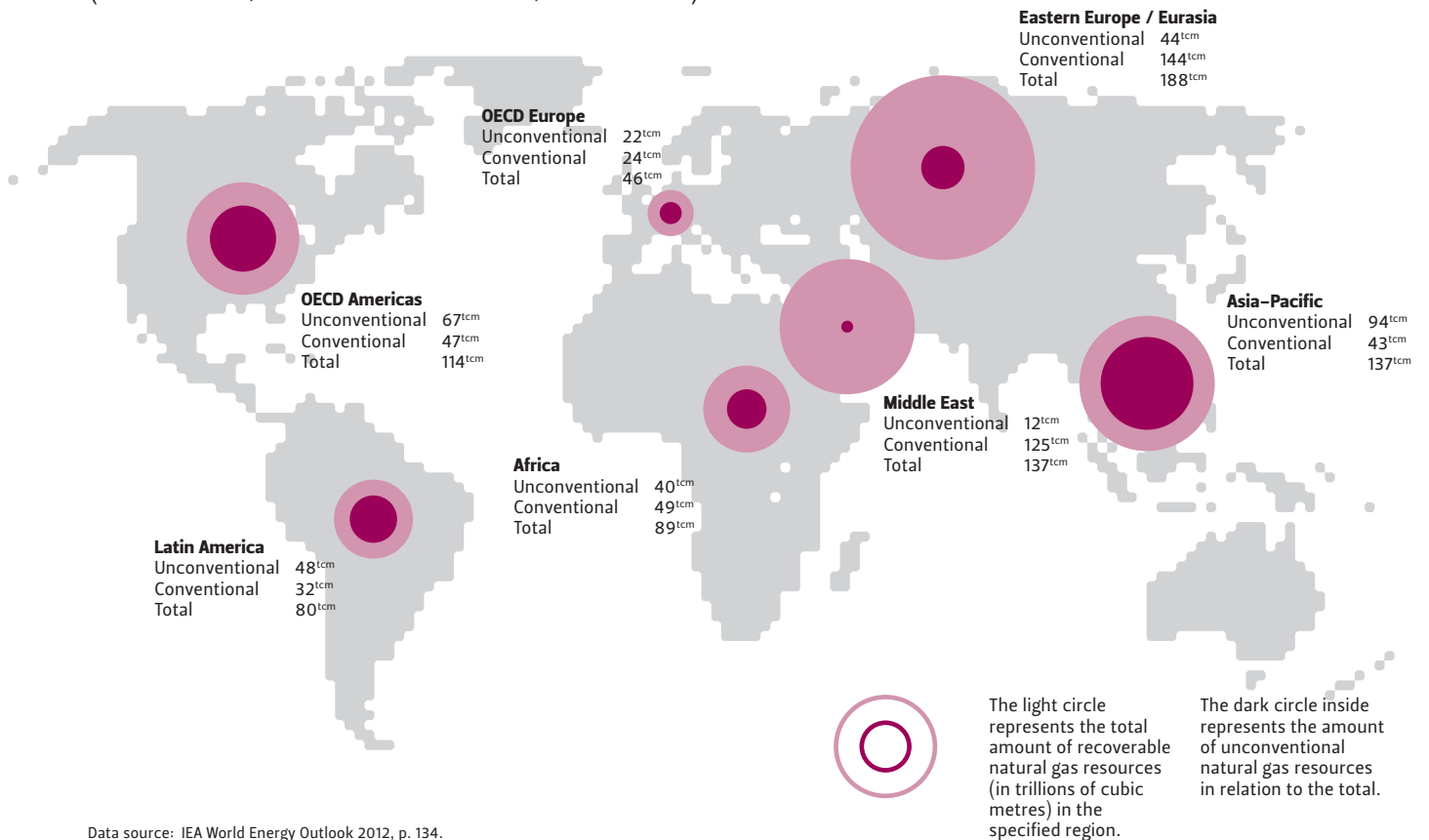
3 Reuters, ‘OPEC acknowledges shale oil supply may be significant’, 8 November 2012.

Figure 1: REMAINING 'TECHICALLY RECOVERABLE' NATURAL GAS RESOURCES ACCORDING TO IEA'S LATE 2011 ESTIMATE

SHARE OF GLOBAL CONVENTIONAL AND UNCONVENTIONAL NATURAL GAS



GLOBAL DISTRIBUTION OF CONVENTIONAL AND UNCONVENTIONAL (SHALE GAS, COALBED METHANE, TIGHT GAS) RESOURCES



Data source: IEA World Energy Outlook 2012, p. 134.
Image: Daniel Foster.



SHALE GAS

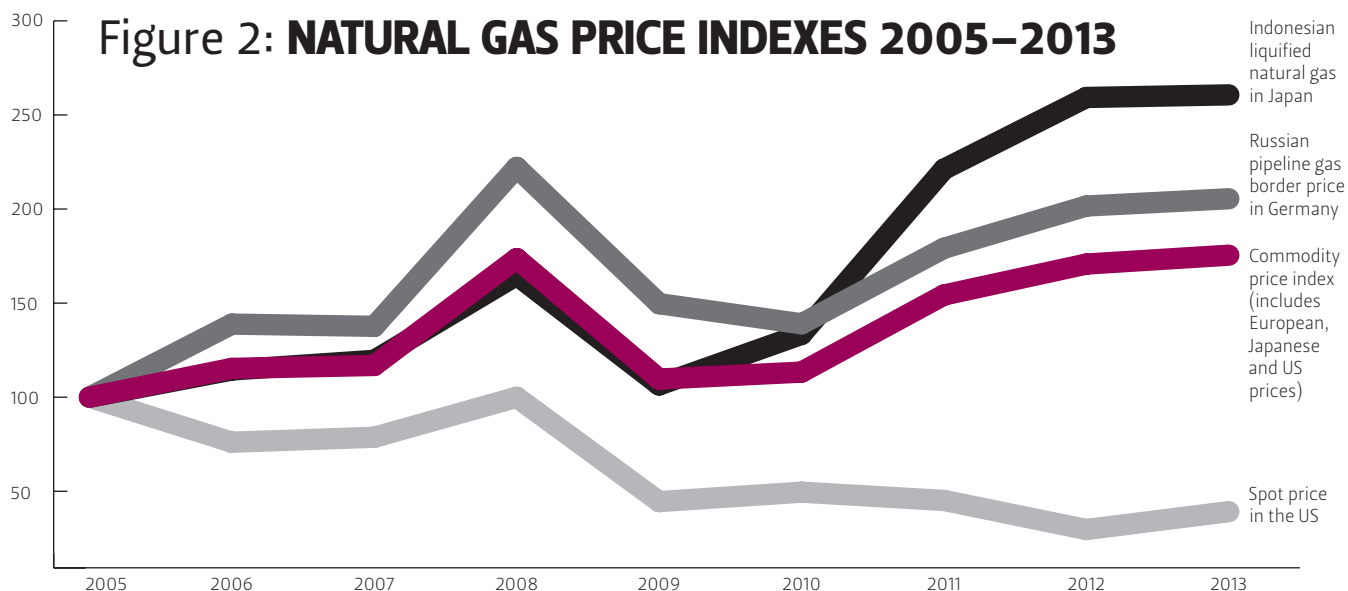
Small amounts of shale gas have been produced for more than 100 years in the US, but recently its production has boomed due to technological advances.

TIGHT GAS

Some natural gas reservoirs are locked in extraordinarily impermeable hard rock, making the underground formation extremely "tight."

COALBED METHANE

Coalbed methane is distinct from a typical conventional gas reservoir, as the methane is stored within the coal by a process called adsorption.



Data source: IMF, World Economic Outlook, 2012, p. 31.

While the price of gas has recovered slightly, the trend of gas being cheaper than coal seems to be holding steady in the US. In the broader economy, cheap gas is reinforcing the trend of ‘back-sourcing’ or ‘repatriation’ of industry in the US. In the period 2006–2011, the fastest growing US sector by far was the mining, oil and natural gas industries, where jobs expanded by nearly 60 per cent, creating a total of 500,000 new and relatively highly paid jobs. Petrochemical, fuel, fertilizer and steel companies are also among those that have committed to or are considering large investments based on their ability to source cheap energy and feedstocks. Dow Chemicals recently reported that manufacturers have already announced 90 billion worth of new investment in the US to ‘take advantage of its cheap natural gas’. A report by PricewaterhouseCoopers predicts that energy-intensive industries will create a million new jobs in the US by 2025.

Climate policies all gassed out?

US emissions have decreased considerably due to the fuel switch from coal to gas. After the Obama administration failed to push through the cap-and-trade legislation in 2009 and 2010, many were highly sceptical of whether the US would reach its international pledge of a 17 per cent reduction in greenhouse gas emissions below 2005 levels by 2020. Now it seems that the US may actually meet this goal, although additional policies and measures are needed: the total greenhouse gas emissions have

already dropped almost 11 per cent from the 2005 baseline. In retrospect, the US would also have reached its target for the first commitment period of the Kyoto Protocol had the country ratified the treaty it originally signed in 1997. Shale gas and renewables are the main contributors to the decline in US emissions. The energy production-related CO₂ emissions climbed almost every year between 1990 and 2007, but since the 2007 peak they have fallen by an estimated 13 per cent and in 2012 were at their lowest since 1994. The US case shows that if unconventional gas replaces coal, it can be an effective tool for cutting greenhouse gas emissions.⁴

From a global perspective, the picture is not so rosy. For one, the American coal sector has adjusted to the shale gas boom in two ways: by shutting down production and increasing exports. Coal production fell 100 million tonnes in 2012, which is around 10 per cent of the total. Second, US coal exports rose about 25 per cent, up to 66 million tonnes. The influx of American coal, coupled with the somewhat slowing Chinese demand, decreased coal prices in Europe by

4 The lifecycle emissions of shale gas have been the subject of numerous studies recently. They are estimated to be 1–8 per cent higher than conventional pipeline gas, and approximately on a par with conventional LNG imports. However, in comparison to coal, shale gas emissions are significantly lower, with estimates ranging from 41 to 49 per cent. See ‘Climate impact of potential shale gas production in the EU’, Report for European Commission DG CLIMA, 27 June 2012.

a third between August 2011 and August 2012. Large quantities of US coal arrived in Europe, where the expansion of coal use is supposed to be discouraged by strong climate policies, and triggered a wave of media stories about a ‘coal renaissance’ in Europe. In 2011 and 2012, coal use in electricity production grew steadily in the UK, Germany and Spain, and there was even investment activity in new coal-fired plants. Whether this will develop into a real comeback for coal remains to be seen: according to an IEA analysis, cheap coal will be a temporary phenomenon, with gas recovering its position by 2017.

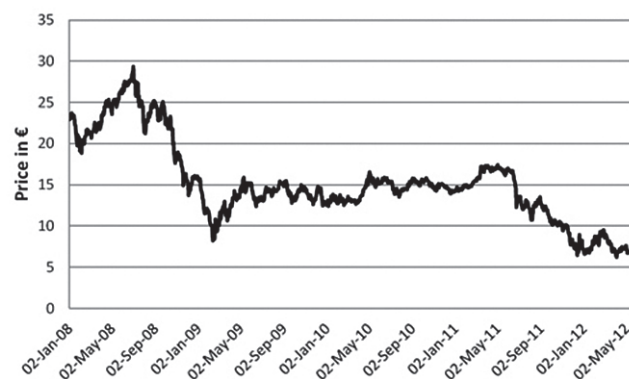
However, the influx of coal has already highlighted the weakness of the European climate policies, most importantly the political challenges of regulating the EU’s principal tool, the Emissions Trading System (EU-ETS). Over-allocation, coupled with the effects of the financial crisis, recession, and a large number of credits (800 million) from developing countries via flexible mechanisms, has led to a large surplus (2.1–2.4 billion credits) in the market, and consequently a low permit price (Figure 3).

From a narrow point of view, things are going as planned: the EU is on track to meet the targets of the ETS directive, the 20 per cent reduction from 1990 levels by 2020. But it is equally clear that the current price of around five euros per tonne of carbon does not deliver what the ETS was supposed to achieve in a broader sense: it does not drive investment to sustainable energy, efficiency, innovation and global leadership in new climate-friendly technologies. The current emissions cap is just too loose to do that. The US shale gas boom made this very concrete as coal sneaked back to expand its share in Europe.

Furthermore, cheap fossil fuel prices affect climate policies in several other ways, even if coal were not more competitive than gas in Europe. Cheap fuels discourage investment in energy efficiency. When considering such investments, companies typically require a short break-even time of just some years. As a significant proportion of the saving is expected to come from reduced fuel costs, cheaper fuels push projects out of the investment horizon. This is troubling from the environmental perspective, as well as from the broader social and economic point of view: the IEA has made a convincing case for how energy-efficiency improvements can bring multiple benefits. These include health and well-being impacts, energy-provider and infrastructure

Figure 3: PRICE DEVELOPMENT IN THE EU EMISSIONS TRADING SYSTEM (EU-ETS)

Data source: European Commission.



benefits, job creation, and reduced energy-related public expenditures.

In a similar vein, the cheaper the fossil fuels, the more expensive the policies promoting renewables such as feed-in tariffs become. This in turn affects the political acceptance of these subsidies. Serious questions can be posed on whether the equation of cutting welfare-state policies and retaining large subsidies for renewable energy is politically sustainable in the mid and long term. Some renewables – notably biomass and wind power – are already mature technologies that are close to competitiveness in several contexts. For many other climate technologies, the outlook is bleak. Carbon capture and storage (CCS) features in various roles in most scenarios of global emission reductions up to 2050, including the IEA’s World Energy Outlook 2012. Currently, it seems that not even pilot projects are taking place on the ground, while in the corridors many actors strongly question the future viability of CCS. It will continue its life in the liturgy of future energy scenarios, as a climate policy *deus ex machina*, but it is becoming harder and harder to imagine how and where the continuous investments in CCS will come about.

As the ETS does not create markets for clean energy, renewables have to be subsidized in other ways, and with feed-in tariffs the polluter-pays principle is turned into familiar taxpayer-pays (i.e. Finland) and ratepayer-pays (i.e. Germany) practices. This development makes the current and future emission reductions more expensive and uncertain. Other instruments such as investment subsidies are even less effective policy tools than feed-in tariffs. As economists are apt to say, ‘You cannot push with a rope’.

The lack of effectiveness of the EU-ETS is well known in Brussels, but the European Commission faces epic battles at every turn in order to restore the credibility of its famed climate policy tool. Renegotiations on addressing the oversupply of permits via means such as ‘back-loading’ or ‘set aside’ have been painful, drawing resistance from strong industrial lobbyists and several new member states, most notably Poland. The financial crisis and the continuous political battles concerning the future of the Union are not conducive to enabling the Commission to act as an effective regulator of greenhouse gas emissions trading.

Second-best regulation may consequently be the only way forward on both sides of the Atlantic as carbon prices are not coming about. The US has failed to pass the legislation on emissions trading, and the EU seems to be failing in regulating its ETS effectively. Efficiency standards and controlling local pollutants are not as effective climate policy instruments as a carbon price would be, but may nonetheless drive the development of sustainable energy forward. Energy efficiency improvements in the industry are already driven by standard-setting from Brussels.

All in all, environmental experts and advocates in Europe and elsewhere must realize that the absolute scarcity of fossil energy – which according to some popular science books seems to be forever just around the corner – will not drive energy production towards sustainability, at least not in a time period relevant for preventing dangerous climate change. There is no shortage of fossil fuels, but there might be a shortage of conventional oil and gas.

Many researchers and NGOs still promote the neo-Malthusian narrative in which early action on renewables, energy-saving, and energy-efficiency investments will be rewarded by sharply rising prices, the so-called ‘peak-oil’, and thus represent a true economic win-win opportunity. Several authors have claimed that the growing Asian demand coupled with the rising production costs of new oil and gas fields are finally making the 1970’s predictions of absolute scarcity and the end of affordable energy a reality. However, this story has lost some of its appeal, as it does not include the *mid-term* prospects of rising non-conventional and non-OPEC fuel supplies. As Greenpeace noted recently, reducing global fossil fuel consumption for

reasons of resource scarcity alone is not mandatory, even though there may still be substantial price fluctuations and regional shortages.

More relative scarcity and high prices may still be a feasible consideration for the long term, although it is becoming increasingly difficult to predict resource prices for 2035. If successful, large-scale and *global* climate policies can bring considerable co-benefits through decreased demand and reduced fuel prices. As the low carbon pathway in the IEA’s World Energy Outlook points out, even with a significant discount rate, reduced fuel prices and supply-side investments would result in massive savings.

The changing geoeconomics of gas and oil

The transformation of the US into producer and potential exporter of liquefied natural gas (LNG) has freed up considerable amounts of supplies aimed at the US market from countries like Qatar. This, combined with the high oil-linked prices of Russian gas, has made LNG an affordable competitor to pipeline gas in Europe. More effects in a similar vein are set to follow: increased LNG production in the US and Australia will make the markets more competitive and integrated for North America, Europe and Asia, and cheaper prices will continue to increase LNG’s share in energy mixes around the world. The US and the Middle East will aim for the European market, and Australia for post-nuclear-power Japan and elsewhere in Asia. Considerable investment will be directed towards liquefaction and regasification capacity in exporting countries and main consumers.

Furthermore, there is pressure on longstanding arrangements such as oil-linked gas contracts for pipeline natural gas, notably those between Russia and Europe. Empowered by the prospects of diversifying their gas supply, European customers have begun to renegotiate their contracts with Gazprom. The recent Polish agreement with Gazprom to cut the gas price by 15 per cent is the latest in a series of cases where Gazprom has agreed to amend contracts with big European customers including Germany’s Eon and RWE, Italy’s Eni, and France’s Gaz de France. The trend is pointing towards spot purchases – short-term contracts with market prices – as opposed to long-term deals in which the price is dependent on that of oil (which Gazprom strongly favours). It is expected in the long term that the

oil and gas prices will no longer be linked. The EU Commission has also felt bold enough to rebel and has launched formal investigations into Gazprom's pricing and anti-competitive practices.

The Kremlin does not allow Gazprom to use market prices domestically, and domestic sales account for 60 per cent of Gazprom's production. To keep on subsidizing Russian households, municipalities and industry, the remaining 40 per cent has to be sold abroad with a wide margin. The shale gas boom is hitting Gazprom's production growth prospects, pricing power and revenues. Still in mid-2010 Gazprom CEO Alexey Miller implied that non-conventional fossil fuels will remain a marginal, luxurious product: 'If you like foie gras, that doesn't mean you no longer need a regular steak'.⁵ However with the US poising itself to become the energy giant of the 21st century due to shale reserves, such witty metaphors sound hollow.

Meanwhile, unofficially, Russia has been active in slowing down the efforts of its neighbours to utilize their shale gas reserves. The common accusation is that Russia imposes conditions on the companies it cooperates with – you cannot do business in Russia *and* invest in shale gas in Central and Eastern Europe. Perhaps the most significant example which has been floated was the exchange of a cooperation agreement on Arctic oil with ExxonMobil for its withdrawal from the potentially large shale gas deposits of Poland. In January 2013 Shell announced its \$10 billion investment in Ukrainian shale gas, and a couple of days later, Gazprom handed Ukraine a \$7 billion invoice for gas the country had promised to buy but did not need. If Ukraine holds on to its plans, it will become self-sufficient in gas supply, and before long, a potential exporter to the European market.

The US, on the other hand, has launched shale gas diplomacy and cooperates with China, India, Jordan and Poland under its Unconventional Gas Technical Engagement Program.⁶ The US interest in global

shale gas development is partly commercial, as it possesses the leading technology and knowledge on the complexities of shale gas production. But Washington would also like to see increasing energy independence in these countries.

The recent dramatically high oil prices of \$130 a barrel are related to a string of short-term supply disruptions in Iraq, Syria, Yemen, Sudan, the North Sea, Brazil and the Gulf of Mexico, as well as uncertainty concerning Iran. With the rise of unconventional production from North America and conventional oil in Brazil, oil prices may well dip back to below \$90 or \$80 a barrel in the mid-term; such numbers feature in many scenarios. Consultancy firm PricewaterhouseCoopers recently said that global unconventional production could push down oil prices by as much as \$50 a barrel in 2035. The key issues are the rise of the Asian demand in relation to this growing supply, and the political unrest in many producing countries.

Several of the fundamental conditions that gave rise to the tight markets over the past ten years still exist, most notably political tensions and supply disruptions. However, it is reasonable to assume that unconventional sources add to the supply and competition and do reduce prices in the mid-term. Even abundant unconventional energy reserves will not stop the short-term fluctuations in the oil market, but in the long term they may act as a backstop which pushes prices down, as high energy prices further stimulate the development of unconventional sources. In the case of oil this has been estimated to take place as long as prices remain above \$70-\$80 a barrel.⁷

The oil market is also set to face changes as the unconventional oil production rises by large volumes in Canada and the US, and conventional production gets going in Brazil. The Middle East will be one pillar of the new oil market, but no longer the centre of gravity. This will undoubtedly lessen the strategic importance of the Middle East as a region, and some analysts have highlighted this point to the extreme in the context of North American 'oil independence'. However, the supply from the Middle East will continue to have effects on oil prices

5 'Gazprom's Miller: shale gas is 'foie gras' but can't replace 'steak'', Russia & CIS Business and Financial Newswire, 10 June 2010.

6 For an overview of the Unconventional Gas Technical Engagement Program (UGTEP), see <http://www.state.gov/s/cea/ugtep/index.htm> [accessed 16 February 2013].

7 IMF, 'World Economic Outlook', 2012, pp. 54-55.

globally, so the region will remain important for major consumers.

Next in the pipeline

From a global perspective, many questions still remain about how easily unconventional gas resources can be developed outside North America. The US shale gas boom is based on an efficient gas market, flexible pricing and large indigenous unconventional resources. Shale gas was easy to dismiss when there were doubts over the size of the resource, and when the US example did not exist. Currently, it sets a powerful example for others. The US experience also suggests that initial 'expert opinion' on the potential geological resources and feasible production has been consistently pessimistic, and in many cases downright wrong.

China *probably* holds the world's largest reserves of shale gas. According to the Ministry of Land and Resources, China's geological shale gas reserves and recoverable shale gas reserves have reached 134 trillion and 25 trillion cubic metres respectively. However, test drilling in China has only just begun. In early 2013, 16 companies (14 state-owned, 2 private) won a bid to explore 19 shale gas fields. However, government-capped prices together with limited extraction capacity, know-how, pipelines and other infrastructure will make the development of Chinese unconventional gas slower than the boom in the US. According to British Petroleum, above-ground factors mean that 'North America will continue to dominate production' and the pace of development elsewhere is likely to be notably slower, 'given the lengthy checklist of factors required for development of shale gas'. In addition, Chinese geological conditions might not respond well to hydraulic fracturing techniques – although there is no evidence that this would be a probable scenario.

Europe might have a shale gas resource approximately on a par with the US, but dense population, high local environmental standards and legal frameworks concerning land ownership pose challenges for shale gas production. As noted by the IEA, a level of environmental performance and public acceptance is needed to maintain or earn the industry a 'social license to operate' within a given jurisdiction, paving the way for the development of unconventional gas resources on a large scale. Vocal

public concerns have been raised in several European countries against fracking, and France, with one of the largest estimated reserves in Europe, has declared a moratorium on it. In the eastern parts of the continent, Russian political and commercial influence will continue to postpone investments, but is in all probability unable to prevent them. Poland, Ukraine, Lithuania and Romania are likely to round up the first group of European shale gas producers. This will ease the European thirst for security of supply and competitive prices, especially in the context of diminishing conventional gas reserves.

It will take several years – probably until 2020 – before we know the full global potential of unconventional energy sources, including European and Chinese shale gas. But in case either one even partially succeeds, lower fossil fuel prices are to be expected. Increased competition will limit the market power and political clout of mega-suppliers such as Russia, Saudi Arabia and Venezuela. In this scenario, the energy markets of the coming decade will move towards a more competitive and fragmented order, in which many energy importing countries also utilize significant domestic resources, and are able to balance their imports with regional exporters and the global big players. The spread of shale gas production will inevitably reduce demand for Russian gas, particularly at oil-linked prices. The scale and pace of this significant transformation are still uncertain, and many of these uncertainties lie above ground, in the political realm.

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