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Shale gas and EU energy security

SUMMARY

While the United States has abundant supplies of cheap gas thanks to the 'shale revolution', the EU remains dependent on gas imports. The Ukrainian crisis has given rise to increasing concerns about the security of the EU's gas supply. At the request of the European Council, the European Commission has analysed the situation, and published a European Energy Security Strategy. Among other elements, the strategy focuses on increasing energy production in the EU and diversifying external supplies.

This briefing addresses the question whether, and to what extent, shale gas can contribute to European energy security. Some European regions have significant shale gas resources, but more exploration is needed to find out whether they can be developed commercially. Most analysts agree that shale gas in Europe will be more expensive than in the US, due to different geology and the need to address public acceptance and environmental impact. Shale gas will not resolve short-term energy security issues as exploration and development will take 5 to 15 years. In any case, the volumes produced will not make Europe self-sufficient in gas, but could help to reduce gas prices.

The increased production of shale gas in the US has already reduced global gas prices by reducing US demand for liquefied natural gas (LNG). Future gas exports from the US will contribute further to this trend, but prices for exported gas will be higher than domestic US prices due to the cost of LNG transport. Moreover, many analysts believe that exports of US shale gas will go to Asian markets. Prices in Asia are higher than in Europe, where ample supplies of conventional pipeline gas compete with LNG. Analysts agree that Russia will remain an important gas supplier for the EU.

Shale gas drilling in the province of Lublin, Poland.

In this briefing:

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Glossary

Energy security: the uninterrupted availability of energy sources at an affordable price. The International Energy Agency distinguishes short-term energy security (the ability of the energy system to react to sudden changes in the supply-demand balance) and long-term energy security (timely investments to supply energy in line with economic and environmental needs).

Hydraulic fracturing (fracking): injection of water, sand and chemicals at high pressure into an underground rock formation, in order to break up the rock and extract gas or oil.

Liquefied Natural Gas (LNG): natural gas which is turned into a liquid by cooling it to -162°C, reducing its volume 600 times. It is transported in special ships.

Shale gas: natural gas which is trapped in shale, a fine-grained sedimentary rock consisting mostly of clay particles. It is extracted by horizontal drilling and hydraulic fracturing.

Background: the 'shale revolution'

Over the past decade, the United States has experienced spectacular growth in the production of shale gas, thanks to technological innovations such as horizontal drilling and hydraulic fracturing (fracking). This new supply of energy has led to falling gas prices and a reduction in energy imports. Low gas prices have benefitted households and industry, especially steel production, fertilisers, plastics and basic petrochemicals.

Environmental concerns about fracking persist, and are being addressed by industry and regulators in Europe and North America. The replacement of coal by gas for electricity production has led to a drop in US greenhouse gas emissions. The future climate impact of shale gas would be positive if it replaces carbon-intensive coal, and methane emissions can be minimised. On the other hand, it would be negative if cheap gas discourages investments in energy efficiency and renewable energy sources.

The shale revolution in North America has changed global energy flows. North America imports less energy, so that more liquefied natural gas (LNG) is available for Asian markets. More US coal is exported to Europe and Asia, as it has been replaced by gas for electricity generation in the US. To enable gas exports from the US, it is planned to convert LNG import terminals (which had been built in the expectation of rising gas imports) to export terminals.

The shale boom in the US has been enabled by specific geological, geographic, industrial, financial and regulatory factors in North America.

In the light of considerable uncertainty about the extent of the ultimately recoverable shale gas and oil resources, analysts are divided about the longer-term outlook for North American energy production. Some look forward to a century of abundant energy supplies while others fear that the shale revolution is a short-lived financial bubble and that gas prices will rise.

Europe's gas imports

The EU imports 53% of its energy needs. In 2013, the EU imported 305 billion cubic metres (bcm) of natural gas – 66% of its consumption. Russia supplied 39% of EU gas imports by volume, Norway 33%, and North Africa (Algeria and Libya) 22%. Six EU Member States are dependent on Russia for their entire imports of natural gas. Conversely, Russia depends on the EU as a customer – 71% of Russian gas exports go to the European market. The EU's dependence on gas imports is expected to increase with declining indigenous production of conventional gas. Worldwide energy demand is

projected to increase by 27% up to 2030, which also has an impact on Europe's energy security.

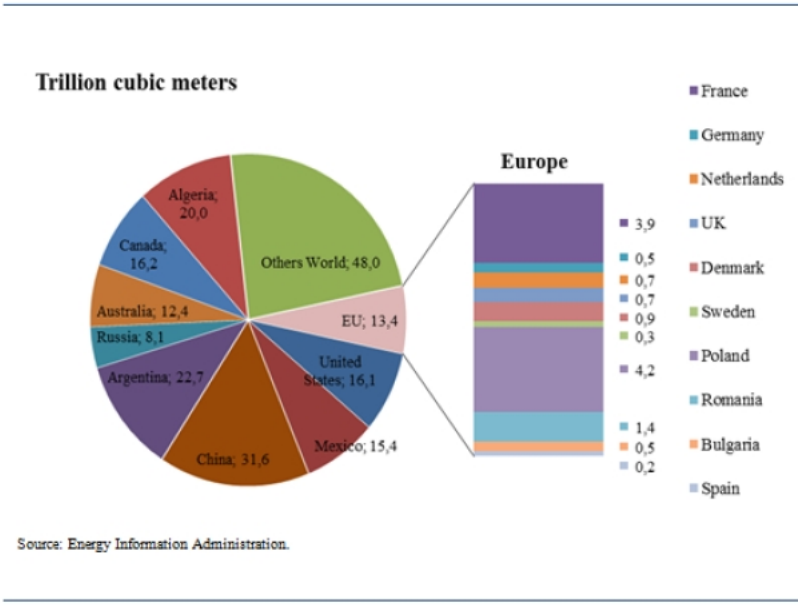
Europe is well connected to its principal gas suppliers by a network of pipelines with a total capacity of 530 bcm/year. Although roughly half of Russia's gas exports to Europe is transported through Ukraine, there are alternative routes through Belarus and under the Baltic Sea (Nord Stream), which have some spare capacity. New pipelines are under construction to bring gas from the Caspian region, and later maybe from Iraq and Iran, to Europe via Turkey and Italy. The construction of a new Russian pipeline (South Stream), which was to connect Russia with the Balkans and Austria, has been suspended due to non-respect of EU common market rules.

In addition to pipelines, Europe has 19 LNG import terminals, with more under construction. Due to higher LNG demand from Asia, the EU's LNG imports have fallen to 37.4 billion cubic metres (bcm) in 2013, down from 76.5 bcm in 2011. In the first eight months of 2014, only 16% of the current capacity of 207 bcm was used. Europe currently has enough LNG import capacity for over a third of its total gas demand.

Shale gas resources in Europe

According to the 2013 energy study by Germany's Federal Institute for Geosciences and Natural Resources (BGR), technically recoverable shale gas reserves in Europe amount to 14 trillion cubic metres (tcm), and exceed Europe's conventional natural gas reserves – estimated at 5.2 tcm. Poland and France have the largest estimated shale gas resources in the EU. However, only a few exploration wells have been drilled in Europe so far, so these estimates come with a lot of uncertainty and are subject to revision. Moreover only part of the reserves is economically recoverable. Other unconventional hydrocarbons, such as tight oil, have much less potential in Europe.

Figure 1 – Unproved technically recoverable shale gas resources



Unproved shale gas Technically Recoverable Reserves[2]		
Tcm	2011	2013
Total EU	15,8	13.3
Of which		
France	5,1	3,9
Germany	0,2	0,5
Netherlands	0,5	0,7
Norway	2,4	0
UK	0,6	0,7
Denmark	0,7	0,9
Sweden	1,2	0,3
Poland	5,3	4,2
Bulgaria	/	0,5
Spain	/	0,2
Romania	/	1,4
Total US	24,4	16,1
Of which		
Marcellus	11,0	5.3
Total World	187,5	203,9

Source: Energy Economic Developments in Europe, European Commission, 2014

According to the Commission's In-depth study of European Energy Security, shale gas resources in the EU appear to be significantly smaller than in the US. Thus shale gas production in the EU is unlikely to achieve the same volumes and costs as in the US. Moreover, potential reserves in the EU are spread across several countries, which may

limit economies of scale. IHS, a consultancy, expects that European shale production will only be 4 bcm a year by 2020, compared with over 70 bcm in America today.

Shale gas resources in the EU's neighbourhood

Algeria, Africa's leading gas producer, has the world's third largest shale gas resources, according to US (EIA) estimates. Several energy companies have signed exploration agreements, and Eni SpA has already begun exploration. Depending on the outcome of the exploration, Algeria could double its gas production in the next two decades. Algeria already has pipeline connections to Spain and Italy.

Ukraine has potential shale gas reserves, and signed agreements with Chevron and Royal Dutch Shell for exploration and development in 2013. Some commentators have argued that Russia's attitude towards Ukraine is in part motivated by the desire to gain control of offshore gas resources in the Black Sea and to hinder Ukrainian shale gas production.

Turkey started hydraulic fracturing operations in 2013 to extract shale gas in the Thracian and south-eastern regions. The development of shale gas in Turkey may help reduce the country's dependence on energy imports, but Turkey is not expected to become a gas exporter. Over the past decade, Turkey has diversified its gas suppliers through the opening of pipelines to the Caspian region.

Developments in EU Member States

Those Member States with shale gas resources have taken very different approaches. While some countries, notably Poland and the UK, are enthusiastic about shale gas development, others have banned all exploration or production. A third group of countries takes a cautious approach.

Public opinion on shale gas is divided, and varies greatly between Member States. Proponents argue that the risks are manageable and point to long-term economic benefits and reduced energy dependence. Opponents are concerned about water use, air and water pollution, earthquakes, disruption of natural habitats, as well as disturbance of local communities by truck traffic and drilling noise. Addressing these environmental and social concerns is considered to be critical for the successful development of shale gas, and will add to the costs of shale gas development. Former NATO Secretary-General Anders Fogh Rasmussen has accused Russia of supporting environmental organisations that oppose the development of shale gas.

Bulgaria imposed a moratorium on fracking in January 2012, and revoked licences for shale gas exploration. A recent study indicates that shale gas development in Bulgaria could create 25 000 to 39 000 jobs, and increase GDP growth by 0.6 to 0.74 percentage points over a 40-year period.

Denmark approved exploratory drilling in Jutland in 2014. A majority of Danes support shale gas exploitation.

Germany is taking a cautious approach to shale gas development, in line with a recent report from the federal environment agency. New legislation is in preparation, based on strict principles agreed by the environment and economics ministries.

Spain: The Spanish government supports shale gas development. About 70 exploration permits (for different types of hydrocarbons) have been issued, and a further 75 await authorisation, according to the Spanish Oil and Gas Association (ACIEP). Most shale gas reserves are located in the Basque-Cantabrian basin in the north of Spain. In 2013, the region of Cantabria banned fracking, but the Spanish constitutional court declared the

ban unconstitutional in June 2014. According to a study on the potential economic impacts of shale gas in Spain, the country could become independent of gas imports by 2030, and export gas by 2050.

France has some of the largest estimated shale gas reserves in Europe. However, the French government banned fracking in 2011 and cancelled exploration licences. In October 2013, France's constitutional court upheld the ban. President François Hollande has promised to maintain the fracking ban as long as he is in office.

Netherlands: Shale gas exploration in the Netherlands has been suspended, while a study (to be completed in 2015) on its environmental and social effects is carried out.

Lithuania is in the process of introducing 'investor-friendly' shale gas regulations. Earlier this year, oil company Chevron, which had won a tender to explore for shale gas in Lithuania, pulled out of the country citing an uncertain legal framework.

Poland has the largest shale gas resources in Europe, according to US (EIA) estimates. However, the first exploration wells have shown disappointing results, and prompted some operators to leave Poland. By June 2014, 64 exploratory wells had been drilled in Poland, and 20 more are planned for this year. In order to encourage shale gas exploration, domestic shale gas extraction will be tax-free until the end of 2020, and taxes will not exceed 40% after that. In August 2014, Poland amended the 2011 Geological and Mining Law to streamline licensing procedures and strengthen supervisory powers. The European Commission opened legal proceedings against Poland in June 2014, on the grounds that the new law infringes the environmental impact assessment (EIA) directive by allowing drilling at depths of up to 5 000 metres without having assessed the potential environmental impact. A majority of Poles support shale gas exploitation.

Romania: Romania lifted an earlier ban in 2013, and is supportive of shale gas. In May 2014, Chevron started exploratory drilling in Romania. A 2013 report shows that Romania has good potential for shale gas development.

UK: The current government is in favour of shale gas development, and has adopted regulations. Licences for shale gas exploration have been issued. According to industry, it will take five years and the drilling of 20 to 40 fracking wells to judge whether the UK has a viable shale gas industry.

EU approach

Security of gas supply

The security of EU gas supply has been a priority since Russia cut off gas deliveries to Ukraine – an important transit country for European imports of Russian gas – in 2006 and 2009. EU Member States have diversified gas suppliers and supply routes, built LNG import terminals and expanded gas storage capacity, so that today Europe is much better prepared for such disruption.

Recently, events in Ukraine and the related Russian-Ukrainian dispute about gas prices and payments have given renewed prominence to concerns about the security of EU gas imports. To address these concerns, the March 2014 European Council requested the Commission to develop a European energy security strategy, which was published in May 2014. Besides energy efficiency and completion of the internal energy market, the strategy proposes to increase domestic energy production in the EU and to diversify supplier countries and routes. According to the strategy, shale gas 'could partially

compensate for declining conventional gas production provided issues of public acceptance and environmental impact are adequately addressed'.

European energy security is to be strengthened further by establishing an Energy Union. This is one of the priorities of the new European Commission, to be coordinated by Vice-President Maroš Šefčovič. Member States are to pool resources, combine infrastructure and negotiate with one voice vis-à-vis third countries. Security of supply is to be achieved by diversifying energy suppliers and routes of energy imports, and reversing energy flows if necessary.

Energy trade is also a subject of the negotiations towards an EU/US Transatlantic Trade and Investment Partnership (TTIP).

Shale gas

As the choice of energy sources remains the competence of Member States, there is no legal basis for a specific EU policy with respect to the development of shale gas. However, the environmental impacts of shale gas development fall under the EU's competence in the environmental field.

In January 2014, the Commission adopted the non-binding Recommendation 2014/70/EU concerning the use of hydraulic fracturing for the exploration or production of shale gas/oil. The Recommendation mostly concerns the environmental aspects of hydraulic fracturing, which can have cross-border impacts. The public should be informed about any chemicals used in the process. Member States remain free to choose whether they go ahead with exploration or choose to ban fracking. Member States that opt for fracking were invited to apply the recommendation by July 2014, and report annually to the Commission. The Commission will review national measures within 18 months, and decide if the voluntary approach is working or if EU legislation is needed.

In order to strengthen the scientific/technological knowledge base, the Commission launched a European Science and Technology Network on Unconventional Hydrocarbon Extraction in July 2014.

Shale gas exports from the US

US natural gas exports to overseas markets would be in the form of liquefied natural gas (LNG). Import terminals that were built in the expectation of rising LNG imports into the US are now idle and could be converted to LNG export terminals. US LNG export projects will have a cost advantage over projects in other parts of the world because much of the required infrastructure is already in place.

All exports of natural gas from the US must be authorised by the Department of Energy, in a slow two-stage process. Exports to countries with which the US has no free trade agreement are only allowed if it can be shown that they are in the national interest. In the US, 45 applications for LNG export licences have been made, and 39 US projects had been approved as of October 2014. Exports are expected to start in late 2015. IHS estimates that the US export capacity will reach 66 bcm/year early in the next decade. US gas exporters are profit-oriented companies who will try to get the best price for their product on the global market. With the enlarged Panama Canal due to come into use in the next couple of years, large LNG carriers will more easily be able to transport gas from the US Gulf coast to Asian markets where gas prices are higher. Several European energy companies (Iberdrola, Fenosa, Endesa) have recently signed long-term LNG supply contracts with Texas-based Cheniere Energy, despite analysts' expectations

that US producers are more likely to export LNG to East Asia. During his visit to Brussels in March 2014, US President Barack Obama stressed that the EU should not rely on US exports, but make its own efforts to ensure its energy security, including through the development of indigenous sources.

Role of the European Parliament

The European Parliament considered the issue of shale gas development and adopted two resolutions on 21 November 2012. The resolution on the industrial, energy and other aspects of shale gas and oil calls for 'robust regulatory regimes', and the application of environmentally friendly processes and best available techniques in order to achieve the highest safety standards. The resolution on environmental impacts proposes a thorough analysis of existing EU regulations applicable to shale gas. It calls for special plans for water use, recycling of water, and disclosure of chemicals in fracking fluids. These requests were taken up to a great extent in the above-mentioned Commission Recommendation.

In March 2014, the EP adopted a revision of the Environmental Impact Assessment Directive, following a compromise agreement with Council. Despite EP requests, the agreement does not include mandatory environmental impact assessments for the extraction and exploration of shale gas. However, new aspects of gas projects will have to be considered, notably human health risks due to water contamination, use of soil and water as well as the quality and regenerative capacity of water underground. If Member States decide that no environmental impact assessment is needed, they will have to provide a justification.

Economic impacts

It is unlikely that shale gas in Europe can be produced as cheaply as in the US. According to the International Energy Agency, production costs in Europe may be twice as high due to geological and geographical differences, higher population density, and lack of natural gas infrastructure in many places. Bloomberg New Energy Finance estimates that the cost of shale gas in the UK will be 50% to 100% higher than in the US. Estimated prices for shale gas produced in Europe vary between US$6 and US$15.5 per million British thermal units (BTU – approximately 0.3 megawatt-hours, or 28 m^3 of gas). However, these prices may come down with improvements in drilling productivity, and European shale gas may become competitive with LNG and even pipeline gas.

A study carried out on behalf of the International Association of Oil and Gas Producers compares three scenarios for European shale gas production: a baseline scenario with no shale gas, a scenario with some shale, and a 'shale boom' scenario that would require the drilling of 33 500 to 67 000 wells up to 2050. Compared to the baseline, wholesale gas prices are 6% lower in the 'some shale' scenario, and 14% lower in the 'shale boom' scenario. Gas import dependency in 2035 would rise to 89% in the baseline, while it would be 78% in the 'some shale' scenario and 62% in the 'shale boom' scenario. In the 'some shale' scenario, GDP in 2035 would be 0.3% higher than the baseline, and 0.8% higher in the 'shale boom' scenario.

Daniel Gros of think-tank CEPS argues that indigenous shale gas production is uneconomical now, as conventional gas can be produced more cheaply, and suggests keeping shale gas reserves in the ground for a later time when the economics are more favourable.

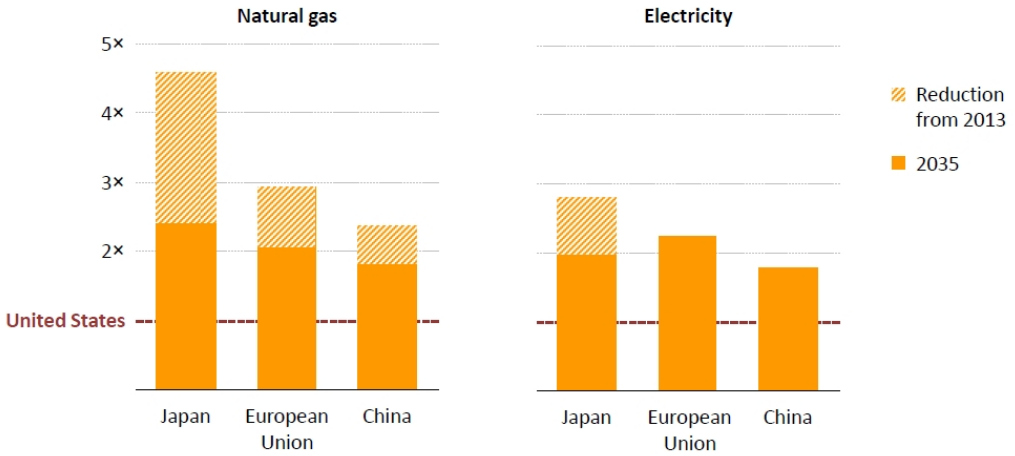
A recent study for the European Commission concludes that the choice of different environmental risk management policies for shale gas has almost no impact on energy production, energy prices or energy demand, and therefore no impact on the economy.

The increased production of shale gas in the US has already reduced global gas prices by reducing US demand for liquefied natural gas (LNG). When US gas can be exported, the US (Henry Hub) spot price could become a global benchmark for gas prices. Where LNG transport is required, the cost of liquefaction, transport and regasification must be added (estimated to be around US$6 per million BTU for transport to Europe, and around US$5-8 for north-east Asia).

Future US LNG exports may reduce world gas prices, according to an analysis by the Center on Global Energy Policy at Columbia University. Europe would benefit the most from US LNG exports, which could lead to an estimated 11% drop in European gas prices. Although Russia is expected to remain a major supplier to Europe, it will suffer economically from a small drop in export volumes and a large drop in the sales price, according to the economic modelling.

US LNG exports would lead to somewhat higher domestic gas prices in the US, an increase in gas production and a slight decrease in gas consumption, according to a 2012 study carried out for the US Energy Department. A 2013 report on macroeconomic impacts concludes that allowing gas exports will lead to net economic benefits for the US. The International Energy Agency (IEA) expects regional differences in gas prices to narrow, but to persist for decades. Fatih Birol, IEA Chief Economist, warned that 30 million European jobs are at risk due to the US shale gas boom, as energy-intensive industries move operations to the US where energy costs are far lower.

Figure 2 – Ratio of industrial energy prices relative to the United States



Source: International Energy Agency, World Energy Outlook 2013

Outlook

With respect to shale gas production in the EU, most experts seem to agree that:

- There are great uncertainties in the resource estimates, and more exploratory drilling is needed to assess the real extent of technically and commercially recoverable resources in Europe.
- Shale gas will not be produced commercially in the short term, due to the time needed for exploration and licensing. It could take a decade or more before many of the reserves can be developed, according to John Watson, CEO of Chevron. Shale gas development in Europe will be more evolution than revolution.

- European shale gas will not be as cheap as in the US, due to different geology, higher environmental standards, and a less developed drilling services industry.
- The volumes produced will be lower than in the US, but can compensate at least in part for the decline of conventional gas production in Europe.
- The EU can learn from developments in the US, in order to avoid environmental problems such as methane leaks.
- The EU will continue to depend on imports of natural gas, and Russia will remain an important supplier despite all diversification efforts.

While indigenous shale gas production will not dramatically change the energy situation for the EU as a whole, it can help prevent a further increase in import dependency and contribute to economic growth and job creation in those Member States that choose to develop their shale gas resources.

With respect to exports of natural gas from the US, most experts agree that:

- US gas prices will rise, as gas exports reduce supply on the US market. However, the IEA expects US gas prices to remain well below European prices until 2035.
- Imported US gas will be more expensive in Europe than in the US, due to the cost of LNG (liquefaction and regasification) and transport.
- Most US exports will go to Asian markets where price levels are higher.
- Increased LNG supplies lead to a larger, more liquid and more diversified gas market, and may mean the end of long-term gas contracts linked to oil prices.

In conclusion, shale gas will not make a contribution to the EU's energy security in the *short-term*, as it will take years before indigenous shale gas production starts, or before significant US exports are on the market. Short-term supply security must be ensured by gas storage, exchange of gas between EU Member States (reverse flows), switching to alternative fuels and LNG imports. Recent energy security stress tests carried out by the European Commission concluded that households in most Member States can be supplied with gas, even if Russian gas imports are cut for six months.

In the *medium and long term*, according to most analysts, indigenous shale gas production can offset declining European production of conventional gas. However, it is less clear whether shale gas will be competitive with conventional gas supplied by pipeline from outside the EU. If this is not the case, tax breaks or other government incentives would be needed to support indigenous shale gas production.

Moreover, the relationship of shale gas with the EU's climate policies needs to be considered. According to the European Commission's 2050 Energy Roadmap, gas can play a key role in decarbonising the economy by replacing carbon-rich coal. On the other hand, higher carbon emissions would result if shale gas developments lead to additional gas consumption or to reduced investments in renewable energies. Some analysts argue that investments in renewable energy sources and in energy efficiency can make a stronger contribution to European energy security than shale gas. Others point out that intermittent renewables like solar or wind must be backed up by flexible generation capacity, for which gas is very well suited.

Energy security analysts believe that Russian gas will continue to dominate European markets, as long as suppliers are chosen on the basis of price, and not out of political considerations. Even if Russian gas remains important, diversification of suppliers is considered as essential, as it can lead to lower prices and reduce the possibility of using energy supplies as a political weapon. The Oxford Institute for Energy Studies points out

that economic and political considerations may diverge. In this case there may be an economic price to be paid for achievement of political energy-security objectives, just as following a purely economic logic may come with a political cost.

Main references

Technically recoverable shale oil and shale gas resources: an assessment of 137 shale formations in 41 countries outside the United States / Energy Information Administration, 2013.

Macroeconomic effects of European shale gas production: A report to the International Association of Oil and Gas Producers / Pöyry and Cambridge Econometrics, November 2013

Macroeconomic impacts of shale gas extraction in the EU / ICF GHK, March 2014

Unconventional Gas: Potential Energy Market Impacts in the European Union / Ivan Pearson et al., European Commission Joint Research Centre, 2012

Shale gas in Europe: Much ado about little? / Tania Zgajewski, Egmont paper 64, March 2014

The shale gas 'revolution': challenges and implications for the EU / Iana Dreyer and Gerald Stang, EU Institute for Security Studies, February 2013

Shale gas: what it could really mean for Europe / Alexander Gusev, Energy Post, June 2014

Shale gas in Europe: revolution or evolution? / EY Global Oil & Gas Center, 2013

Shale gas in the United Kingdom / Paul Stevens, Chatham House, December 2013

Getting ready for UK shale gas: Supply chain and skills requirements and opportunities / Ernst & Young LLP, April 2014

The Impact of Shale Gas on Energy Markets / House of Commons Energy and Climate Change Committee, April 2013

The shale gas 'revolution' in the United States: global implications, options for the EU / European Parliament DG EXPO, April 2013.

Unconventional gas and oil in North America / Gregor Erbach, European Parliamentary Research Service, June 2014

Golden rules for a golden age of gas / International Energy Agency, 2012.

In-depth study of European Energy Security / European Commission, July 2014

American gas to the rescue? The impact of US LNG exports on European security and Russian foreign policy / Jason Bordoff and Trevor Houser, Columbia|SIPA Center on Global Energy Policy, September 2014

Business as usual: European gas market functioning in times of turmoil and increasing import dependence / Tim Boersma et al., Brookings Energy Security Initiative, October 2014

The EU's energy security made urgent by the Crimean crisis / Pasquale De Micco, European Parliament DG EXPO, April 2014

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