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# An Overview of Economic Impacts of Shale Gas on EU Energy Security<sup>1</sup>

Karel Janda\* and Ivan Kondratenko\*\*

## Abstract

This paper analyzes the possible shale gas development in the EU in context with raising problem of energy security. Based on the experience of shale revolution in the USA the transfer of US model to the EU is discussed. The results show that shale production affects the price negatively and that US model is successful due to multiple reasons, primarily presence of experienced companies, geological structure and strong regulation rules. This paper shows the unsuitability of the US model for the EU market. After the first enthusiasm for shale plays research in late 2000s the multiple barriers for drilling have risen up; the most significant are the environmental worries; both on governmental and public levels. US companies have lost interest in the EU and moved to other parts of the world. The shale gas development is not able to affect the energy security of the EU on European, international level.

### **JEL Classification**

F15, F52, Q43, Q47, Q53

### **Keywords**

shale gas, European Union, energy security, shale revolution, energy market, US

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# 1 Introduction

This paper focuses on shifting the balance of energetic transformation, a phenomenon that is recently becoming more apparent but which is yet in the phase of its formation and development but which brings about unprecedented changes to the world market of energy. This paper attempts to denominate and to analyze the changes in energetics of the US as a result of what is sometimes called „shale revolution“. Moreover, it aims at evaluating the impact of these changes on global energy markets and specifically to measure their outcomes for the European Union energy politics.

Shale gas represents one of the novel energy sources that might shift the balance of power in economic relations and energy security in the world. Explored and developed in the US, shale gas is found in abundance in many EU countries which might use it as an alternative to the gas imported mainly from the Russian Federation, the process that might result in enhanced energy security in Europe.

The political aspects are crucial for future of energy market in the European Union. In the first half of 2014, the state of affairs has changed in connection with Ukrainian crisis in context of supplying energy to the EU. Russian Federation is at odds with the Ukraine about the natural gas and there is significant risk the delivering of gas through Ukrainian pipelines to the EU will stop at any moment. Therefore, in May 2014 the EU together with US started to work on first contracts, which should allow US exporters to sell US shale gas to the EU customers. On the other hand, Algeria is aware of power of shale fields, advantage of location (near the EU) and developed infrastructure – Algeria has LNG terminals on the coast and theoretically is ready to transport shale gas to the EU. Therefore, Algerians are planning to explore all known reservoirs already this year. In fact, Algeria can be the most predominant player in the energy market of the EU and possibly it can be the biggest supplier of natural/shale gas to the EU.

In context with energy security of the EU, there are many uncertainties regarding EU directive “20-20-20” (the EU growth strategy for one decade), which proposes to approach 20% of renewable resources used in energetic, decrease by 20% emissions which lead to greenhouse effect and to increase by 20% effectiveness of energy usage, before 2020. European politicians

are asking now, why ecological targets are more important than economical and social, why nobody asks to improve well-being of society by 20%. (Europe 2020, 2010)

The question is not so hollow. Actually, Europe is starving because of lack of energy. And when consumers in the EU found out that it is cheaper to buy US coal than Russian gas, at the time when old coal power stations started to being renovated, the new logical question took place. Why not to use own coal? Even not as pure as American coal, but easier to access, and cheaper? At this moment the request for environment-friendly economics of the European Union began to be a barrier for energetic regeneration of European economy. Largest European economies began to asking themselves, if the low-coal politics is indeed needed. The answer to this question is so far unclear, and nobody in the EU is willing to refuse to follow unrealistic climatic aims.

In 2012, the environmental department of the European Union issued 300-pages long report (Broomfield, 2012) about negative influence of substances, which are used in process of shale gas drilling, to human health and environment. This threat is more significant than consequences of all other types of fuels. At the same time, this field is not regulated by the EU. Therefore, environmental department considers necessary to regulate this sphere. According to authors, the negative consequences of shale gas drilling could be observable in the quality of air, ground and underground waters. Hence the shale gas drilling using U.S. technology should be allowed only in that places where underground water is not used for drinking.

The European Union issued at the same time several reports (European Commission, 2015) dedicated to shale gas problematics. In one of these reports is said that shale gas drilling will not affect the gas market in Europe at all. It looks like the damage of environment in shale gas drilling is designed only for the EU. France, where is one of the biggest shale field in Europe, already banned all possibilities of shale gas drilling on its territory. Poland tries to attract investors by various instruments, but the investors are skeptical, e.g. the ExxonMobil left Poland in summer 2012. The solution of the EU is not likely to solve problems, but as it appears, can make them worse.

This paper deals with the economic impact of shale gas development in the context of energy security of the EU. The shale gas is “hot topic”, which has changed the map of energy world in last decade and has started multiple discussions on world level. After the shale revolution in the US the economic debates have started, whether this model can be used also in other parts of the world. The economic implications of shale gas development and usage will

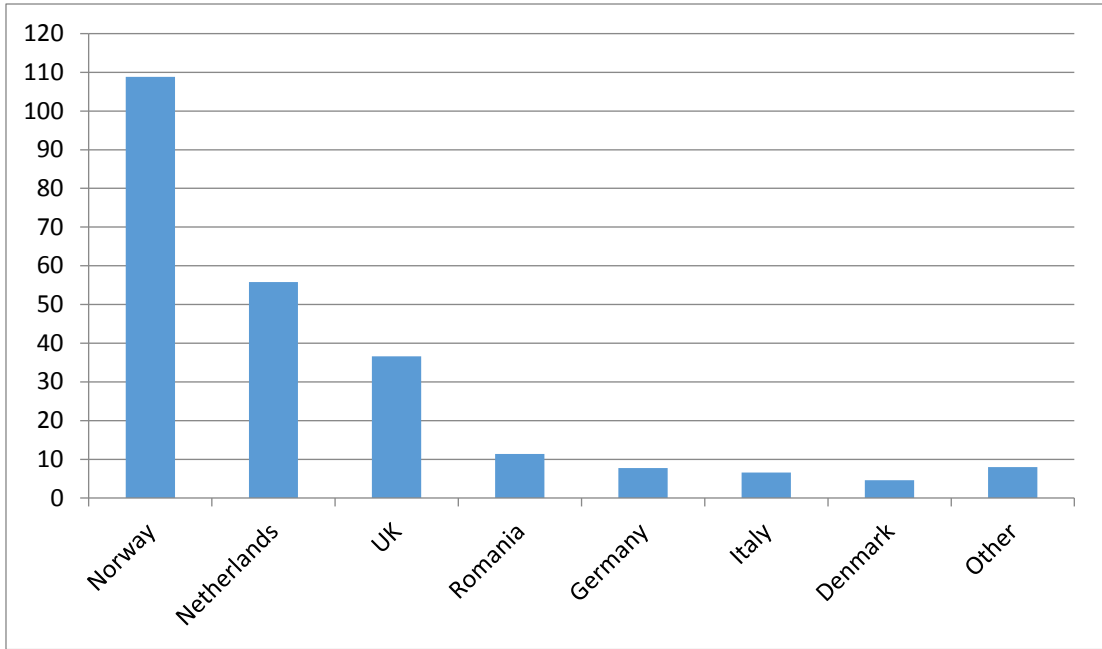
be considered, as well as discussed their impact on the energy security in the European Union. Few scenarios will analyzed to produce the results that might be of a special interest both for energy economists and for the policy-makers and stakeholders.

## 2 Energy security of the European Union

The European Union is targeting ambitious plans to combat global warming problem and at the same time is trying to be the economic world leader. The EU was probably facing the problem of energy security more severely than the rest of the world back in 1990s and in the beginning 2000s. However, due to the rapid processes linked to the shale revolution in the US (natural gas price decreasing, transformation of world market, starting discussions of energy security etc.) on the natural gas market in the last decade the gas aspect of energy security of the EU does not appear so troublesome, as it seemed few years ago. This was caused by a new era of the globalization of energy sector, which manifested in two basic tendencies. Firstly, it is the new prospect of unconventional resources of natural gas in the whole world. Secondly, different conditions for realization of the key element of energy security politics – diversification of import supply. The first tendency is linked to the processes at world gas market, which the former CEO of BP Tony Hayward called the “Quiet revolution“. (House of Commons, 2011, p.8)

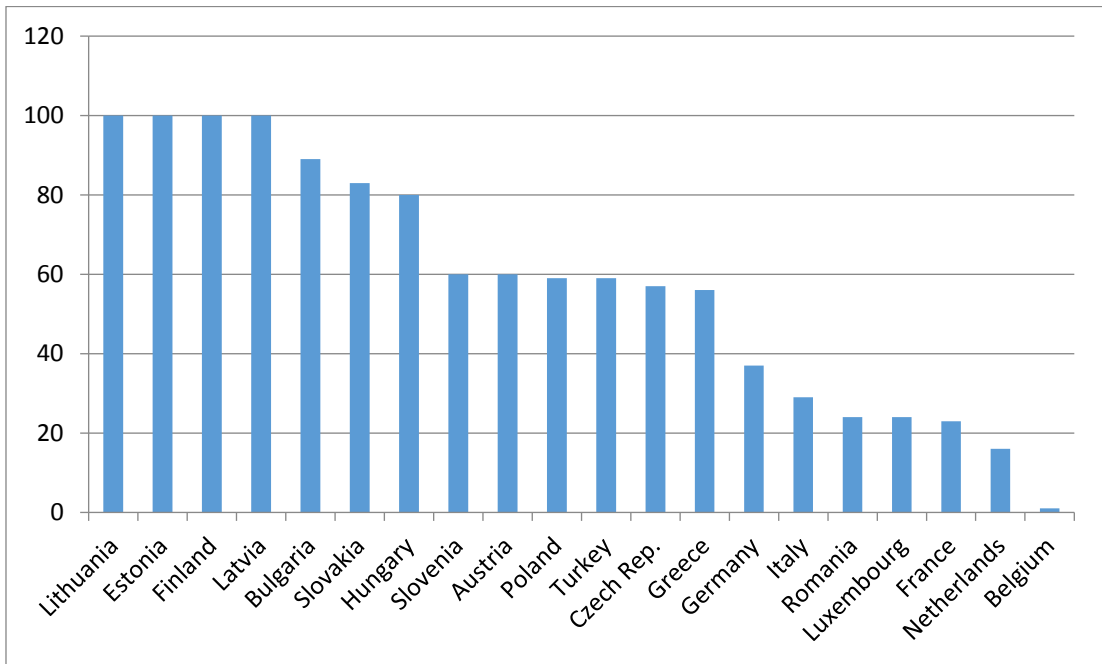
### 2.1 Dependence on import – raising pressure to solve energy security problem

The European Union annually consumes approximately 450 billion cubic meters of gas while the net production of the EU is only 167 billion cubic meters, only 38% of total consumption. (EIA, 2014) Gas is being imported either by pipelines (specifically from Russia and Norway, with total share of 86%) or in the form of LNG (e.g. from Algeria). The major supplier, Russia, exports 76% of the fuel (oil and gas together) to the EU; therefore the dependence is mutual.



**Figure 1. Natural gas production in EU + Norway (in billion of cubic meters), 2014**

Source: own figure, based on BP (2015)



**Figure 2. Natural gas import from Russia dependence (% of total consumption), 2012**

Source: own figure, based on Eurogas

Russia with the largest natural gas reserves in the world is neighbor of the EU, hence Russia is a logical option for solving the issue of lack of energy resources. Export of natural gas to the EU makes 65% of total export of Russia – the rest is intended for Turkey, Ukraine and Belorussia. This export does require too much logistical maintenance, since all Eastern countries are connected to pipelines built during the Soviet era. As was already mentioned, costs for transport and storage are in case of natural gas higher than costs for oil transport, therefore there is nothing like global natural gas market.

The problem of Russia, as a partner, is instability of supplies. Approximately 40% of Russian gas pipelines crosscut Ukraine and due to unstable Ukrainian economic situation, natural gas (together with oil) is used as a tool for political pressure. The longest gas crisis in 2009 was not the first case of political gas blackmailing. In the early 1990s Russia stopped to supply Baltic countries to reinstate order at the time when Baltic countries tried to become independent. In 1994 Russia had energy network dispute with Ukraine, between 1998 – 2000 Lithuania had to solve energy security due to lower imports from Russia, when Litva was trying to sell pipelines and refining companies to foreign investors. Nevertheless, two crises in 2006 and 2009 were the most serious ones because they affected the whole Europe. In both cases the reason was Ukrainian insolvency.

Despite Russian Gazprom was not to blame, this created doubts about the stability of supplies as a whole and energy security itself. Transit countries could cause serious energy problems in final customer countries due to political situation in Eastern Europe and customers in Western Europe do not have tools for immediate solution of these difficulties. However, the EU has practically two ways how to increase its energetic security. Firstly, the EU member countries should be united at bargaining process. Secondly, the EU constantly wants to increase energetic independency. The shale revolution in the US came in the very right moment as a possible way how to deal with energy security in the EU. In 2009 – at the time when success of shale gas drilling in the US was already proved and after the Ukrainian gas crisis – the European Commission started to consider shale gas as a major tool for becoming energetically independent.

**Therefore two possible solutions for the EU energy security problem could be:**

1. Own drilling wells, usage of European shale gas reserves
2. Import of shale gas from non-EU countries



## 2.2 Shale gas – current situation in the EU

As was already mentioned, shale gas miners use special drilling technology – horizontal drilling and subsequent hydraulic fracturing because shale cannot be separated using the conventional drilling technology. Due to higher cost of hydraulic fraction, this method is used to mine classical hydrocarbon extraction (natural gas) only exceptionally. This method was limited to some conventional reserves in the North Sea in Europe, in United Kingdom and some other countries, like Netherlands, Denmark or Germany. These drilling activities did not produce much gas and did not lead to substantial profit. The list of usages of this method in Europe is provided below (Broomfield, 2012).

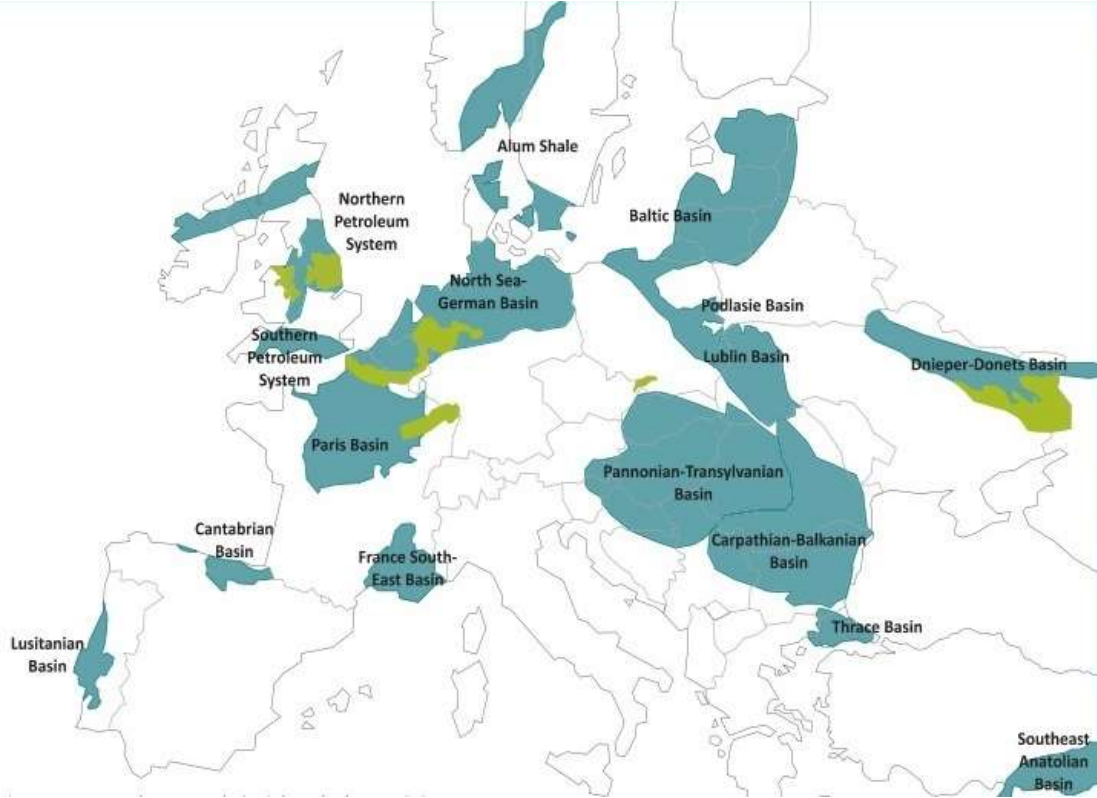
	<b>2011</b>	<b>2013</b>
<b>Total EU</b>	<b>18.1</b>	<b>13.3</b>
- France	5.1	3.9
- Germany	0.2	0.5
- Netherlands	0.5	0.7
- Norway	2.4	0
- UK	0.6	0.7
- Denmark	0.7	0.9
- Sweden	1.2	0.3
- Poland	5.3	4.2
<b>Total US</b>	<b>24.4</b>	<b>16.1</b>
<b>Total World</b>	<b>187.5</b>	<b>203.9</b>

**Table 1. Unproved shale gas technically recoverable reserves (in trillion of cubic meters)**

*Source:* Own table, based on EIA (2013)

The most significant resources of shale gas in Europe are in Poland, France and Denmark (Table 2). At the same time, Poland also possesses huge reserves of methane in the coal plays. (Gény, 2010) However, we have to consider that all estimated workable reserves of unconventional gas outside the US are very approximate. The most accurate estimates of

reserves is provided by the U.S. Energy Information Administration (EIA) of Department of Energy, which estimates only the reserves of shale gas.



**Figure 3. Shale plays in Europe**

*Source:* Aitken (2012)

As we can see on Figure 3, the large reserves of natural gas in unconventional resources are placed in the countries of Eastern Europe, which consume much less of gas in comparison with the Western Europe countries. These countries have greater potential for growing consumption of energy resources and they have more possibilities for its diversification by increasing the share of natural gas in the energetic mix.

### 2.2.1 Case study: Poland

The most auspicious country in Europe where the shale technologies can be used not only theoretically but also practically is Poland, which historically was always energetically dependent on the Russian Federation and was trying to find alternative way of gas import. In

2009, the 9.15 billion m<sup>3</sup> of shale gas were imported to Poland, whereas 7.15 billion were supplied by Russia and 1.5 billion by Uzbekistan (BP Statistical Review of World Energy, 2015) through Russia, which means that more than 90% of imported gas was controlled by Russia. However, the portion of gas consumption is only 14% of total primary energy consumption in Poland (European Commission, 2014). Natural gas has not acted among the primary energetic sources in Poland, therefore the significance of dependence on Russia is politicized without any economic reasons. (Liuhto, 2010).

Nowadays, Russia imports to Poland approx. 9-10 billion m<sup>3</sup> of gas per year, and due to the contract, signed in the end of 2010, this can be even 10% higher. Under conditions of energetic policy of the EU, which is concerned about the global warming, Poland will have to raise the consumption of natural gas. Up until recently there was no alternative to Russia as a supplier. Nevertheless, the progress of drilling the gas by unconventional methods can markedly change the conditions of energy security of Poland. According to Gény (2010) this is only theoretical project of politicians. The price of such gas would be much higher than the price of Russian gas from pipelines, as well as the price of LNG imported from Middle East and Arctic Sea. (Gény, 2010)

On the other hand, the unconventional gas development viewed from the political side in Poland could be well-founded. Based on the pessimistic estimations (Gény, 2010), the production of gas by unconventional methods could be 4.2 billion m<sup>3</sup> in 2020. If, for example, the majority of this gas will be drilled in Poland, it can lower the demand for gas from Russia by one third. And if we will take optimistic scenario, which predicts between 800 and 1000 wells every year (Gény, 2010) and expects European countries to achieve the level of 28 billion m<sup>3</sup> of natural gas drilled from unconventional resources, this will produce double volume of gas consumed in Poland.

Geological conditions and political willingness are only a part of necessary conditions for successful development of gas drilling by unconventional methods. Appropriate law regulations are significant for success too. Poland is far ahead of other member states – at least in the sense of adaptation of this law. Poland, together with India and China, has become one of the key partners of the US in the Global Shale Gas Initiative (GSGI) program, which was launched by the US government in April 2010. Its goal is co-operation in the exporting of shale revolution to the other countries. This program was a result of co-operation of China and the US in the field of searching for unconventional gas, which was confirmed in November 2008.

Within the framework of this program the government of the US declares the support in terms of reserves estimation, technical support of drilling perspectives, estimation of economic potential of reserves and performing seminars linked to technical, ecological, economical, law and tax aspects of gas extraction. Furthermore, the US can administrate support to other countries in dealing with various American companies.

Creation of favorable regime allows Poland, as well as to other countries, to attract the private companies with suitable technologies to develop the gas extraction by unconventional methods. In compliance with these difficulties the suitability of realization of any projects will depend not on economic but mostly on political conditions. That is why we should not expect wide-scale production of gas by unconventional methods in those countries, which have already successfully diversified the import of natural gas – e.g. Spain, France, Great Britain or Netherlands. In Germany the popularity of “green” political parties is growing, but Germany still remains the leader between science centers in the area of studying the unconventional methods of gas drilling. Project GASH was already launched in Potsdam (Gas Shales in Europe), which should analyze the geology of European shale gas plays in detail.

The Polish example demonstrates tendency, which can completely change the understanding of the term “energy security” – firstly, among the Eastern countries, and after that in the rest of Europe. The primary source of these changes will be the “silent” shale gas revolution in the US; countries of the Eastern Europe could feel consequences directly and the rest of Europe indirectly. One way or another, these changes seem to be the serious challenge for Russian gas companies and for large-scale Russian projects. Whereas not only as a competitor but also as a contributor to formation of unique energy market of the European Union and creation of united energy policy.

Poland had the biggest ambitions in shale gas drilling among the EU countries in November 2014, with 67 exploration wells done at that moment. (BP Statistical Review of World Energy, 2015) It was not much but an increase was expected. However, in January 2015, the drilling concern Chevron followed ExxonMobil, Total and Marathon Oil companies that ended research of shale gas plays in Poland. Decrease of world oil prices forced these companies to lower the expenses and cancel low-profit bringing investment projects. Even though the shale gas reserves created lots of promising space to change the energetic structure in the Eastern Europe, depending on Russian import; the reality was not able to meet the expectations. Despite the corporations were expecting largely profitable and economically

effective gas plays, after they have started to drill exploration wells, the initial estimations were lowered, geological conditions appeared to be very complicated and government regulations inflexible. Another major mining company, British Cuadrilla Resources opened its first office in Poland in 2009. It was convinced that the biggest country in the middle Europe will turn into “European Texas“ for miners, thanks to large reserves of shale gas. Still, after six years of preparation Poland has not started do drill even experimental wells. These are very low indeces for a country, which has the biggest enthusiasm for own shale gas drilling among countries in the EU. The costs of the exploration wells have appeared to be much higher than in the US and legislative regulation was also proven to be tougher than in the US.

After all, Poland has still not lost all hope for unconventional gas resources. The biggest Polish refinery group PKN Orlen will continue in exploring of shale gas plays in Poland, despite most of other companies has already ceased from drilling due to bureaucracy and difficult geological conditions. The general director of company Jacek Krawiec has announced that the technology will evolve in near future in favor of economically-effective drilling. (PKN Orlen Press Release, 2015). According to Polish National Geological Institute there are large resources of the so-called tight gas in the north and in the central part of the country. Tight gas is drilled from sandstone in the US for almost 30 years. Except for the US it is also being drilled (obviously in much lower amount) in Germany, Netherlands, Russia and Argentina.

## 2.2.2 The EU countries – high level of enthusiasm with uncertain future

Since the shale gas plays are not presumed to be located in all EU member states, only short review of the situation in main EU candidates for commercial shale gas drilling is provided, besides Poland. Broomfield (2012) provided structural overview of estimated reserves in Europe, according to data from 2011. This overview can be found in Appendix.

### *Hungary*

In November 2014, Hungarian representatives announced they would like to start shale gas drilling, irrespective of all ecological worries. According to Attila Nyikos, the Vice-president for international relations of the Hungarian Regulatory Office (ERU, 2014) the country would like to be more independent on Russia (currently 80% of all consumed gas is imported from Russia) and become one of the EU countries, which are going to use unconventional gas plays. Hungary has already done hundreds of exploration wells on shale

gas plays and one of these wells is being already used by Canadian company Falcon TXM. According to exploration wells there are around 1500 bn m<sup>3</sup> of shale gas in low-permeable plays, which would cover the current demand for gas in Hungary for 120 years. (BP Statistical Review of World Energy, 2015)

### ***United Kingdom***

According to the report by Green (2012) for UK Department of Energy and Climate Change, only one well (in Preese Hall, Lancashire) is used for shale gas drilling in Great Britain. Available data for this specific well show high volume of shale gas reserves. British reserves of shale gas are probably greater than initially expected. According to provided estimation there are more than 4810 cubic kilometers of natural gas on the surveyed land in the northern part of Great Britain. This is twenty times more than was claimed before. Andrew Austin, director of IGas (one of the companies, which were permitted to research and mine) has stated that this estimation shows that this amount of gas is sufficient for 10 to 15 years without need of import of any kind. (Green, 2012) However, IGas still does not know how much of this gas is economically-effective to drill.

The French oil syndicate Total has announced in 2014 (Total Annual Report, 2015) its ambition to drill shale gas in Great Britain. It plans to invest more than EUR 36 million in exploration wells in this country, as the first supranational oil company. French giant can intensify the effort of British government to enlarge the area of possible shale plays exploration and gas drilling. Total should receive around 40% share at Lincolnshire in middle-east England from local companies Dart Energy, Egdon Resources, IGas and eCORP (BP Statistical Review of World Energy, 2015), which have already got licenses for exploration wells but have not started yet. Current (2015) British government with David Cameron as prime minister supports the unconventional technique of gas drilling.

### ***Romania***

Romania is the excellent example of so the called “shale illusion”. In 2011, at the time when no exploration were done, the EIA made estimation of 51 bn m<sup>3</sup> of shale gas reserves in Romania, which should cover Romanian gas consumption for approximately 100 years (EIA: Annual Energy Outlook, 2011). The US Chevron mining company was attracted by EIA estimation and the exploration works started to be prepared in 2012. However, in the end of

2014 company Chevron announced (EIA: Annual Energy Outlook, 2015) that shale gas production in Romania has no future potential. Specifically, the internal Chevron analysis has shown that project of shale gas production in the Black Sea region cannot be economically profitable as another project, in which Chevron invested; and company has officially refused to continue in production due to uncompetitiveness. No other investments in shale gas drilling in Romania are planned at this time (September 2015).

### *Czech Republic*

The natural gas consumption in the Czech Republic is approx. 8.7 bn m<sup>3</sup> per year, whereas 2% of gas is originally Czech and 98% is imported. The Czech Republic imported about 78% of its consumption from Russia and about 20% from Norway in 2013 according to Czech Statistical Office (ČSÚ) statistics.

Four companies in total has sent official requests for shale gas research in the Czech Republic – BasGas Energia Czech, Cuadrilla Morava, Hutton Energy and Cuadrilla Resource Holdings, all of them in 2011 and 2012. (Osička, 2013) Five regions were chosen for exploration wells – areas of Karlštejn, Trutnov, Hodonín, Zlín and Nový Jičín.

Local representatives in cities and regions around the territories intended for research are against drilling; dozens of non-government organizations and civil associations actively promote the same opinion. The civil association “STOP HF” was established in 2012 to warn public against hydraulic fracturing because of high risks of ground water pollution and a petition for national prohibition of this technique was signed by more than 36 thousand inhabitants. (Osička, 2013) Due to the lack of public support and significantly negative perception, Czech government amended legislation for shale gas drilling using hydraulic fracture. Based on the environmental issues hydraulic fracture is not prohibited but legal formal barriers apply, making the ability of drilling for private companies almost impossible<sup>2</sup>. Some requests were rejected by authorities; the rest of them gave up due to high bureaucracy and strict state regulation. The last company, Cuadrilla Morava, ceased its operations in February 2015.

Hydraulic fracturing method with vertical wells was used in **Germany** already in 1980 at the Soehlingen field but only for experimental purposes. In 1999 and 2000 several horizontal wells with hydraulic fracturing were realized. None of the wells was economically successful.

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<sup>2</sup> Law of the Czech Republic: zákony 44/1988 Sb., 61/1988 Sb., 62/1988 Sb., 100/2001 Sb.

Due to environmental risks, German representatives do not plan to realize any more exploration wells in Germany today (Broomfield, 2012). More promising situation is in **Denmark**, where 130 exploration wells using hydraulic fracturing have been installed in North Sea since 2000, with 10 to 20 fracture stages each but due to the limits of reserves no commercial drilling is being considered (Broomfield, 2012). Method of hydraulic fracturing was used in **Netherlands** for the first time in Europe already in 1950s and after that approximately 200 wells in the depths between 1600 – 4000 meters were drilled (Nogepa, 2012). Nowadays there is a similar situation as in Denmark.

## 2.3 Possible importers of shale gas

### 2.3.1 Import from the US

Despite huge reserves of gas in the US it is too far away from being exported to Europe. This is mitigated to some degree by difficult geopolitical situation in Europe and Russian threats. One can ask if this could be crucial moment for energy security of the EU.

US President Barack Obama, despite the resentment of American industry, promises to release tariff barriers and flood Europe by shale gas. In March 2014, during the press-conference summing up the US – EU summit in Brussels president Obama declared that the US have the possibility to share their resources with the European market. According to Obama, the US have moved forward sufficiently in elaboration of new technologies and US government is ready to release new licensees for export. So far export of American gas is intended for open market and not for specific consumers. (The White House, 2014a) In the official summit statement it is stated that “*We welcome the prospect of U.S. LNG exports in the future since additional global supplies will benefit Europe and other strategic partners.*” (The White House, 2014b)

According to CEDIGAZ (2014) data, countries of the EU imported 64 billion m<sup>3</sup> of LNG in 2012 and this number decreased to 47 billion m<sup>3</sup> in 2013, in comparison to 161.5 billion m<sup>3</sup> of gas imported from the Russian Federation. In Spring 2014, the US Department of Energy (DOE) certified seven projects for LNG export, in total of 96 billion m<sup>3</sup> per year. At the same time, the Federal Energy Regulatory Commission (FERC) agreed to launch only one project – Sabine Pass, presented by the company called Cheniere. This was the only project for export of 22.7 billion m<sup>3</sup> per year, which was confirmed by the DOE. All other projects are still not confirmed; even though they received required certification. That is why the declaration of



Obama should rather be understood as moral support for the EU efforts to diversify the sources of energy imports.

On the other hand, Obama's optimism is based on official prognosis of the EIA, which predicts the US will become net exporter of natural gas before 2018 (EIA Annual Energy Outlook, 2014). According to this prognosis the amount of exported LNG will reach 56.6 billion m<sup>3</sup> per year in 2020 and 99 billion m<sup>3</sup> per year in 2029. Nevertheless, this amount would cover not even a half of European gas demand and at this time it is destined for ATP gas and oil company market. Conjunction of local markets will be crucial for further development. Many factors can affect this conjunction – not only the demand for gas or import of LNG from other parts of the world, as it is discussed later on, e.g. Middle East, Africa, China or Australia, but also extension of Panamanian canal (and building Nicaraguan canal), economic and political conditions in producing countries etc. In any case the export of American gas to the EU will be possible no sooner than before president Obama's term of office will expire.

### ***Legalization of gas export from the US***

Based on Natural Gas Act (NGA) from 1938 US federal government regulates the export and import of natural gas. The main aim of this law is to protect public interest. On 29<sup>th</sup> May 2014 the DOE announced changes in the system of issuing certifications for LNG export. The procedure of certification for 48 countries, which are not members of the Free Trade Agreements (FTA) has already started. In relation to the EU the analysis of both macro- and microeconomic consequences has to be done, as well as legalization of whole trade.

The first step would be to have FTA between the EU and the US, which is currently being negotiated between the two continents. Czech diplomats advocate for simplification of export and appropriate changes in American law. Once the FTA is in place, the process of granting permission to export gas to Europe will be much easier. Instead of several years, acquiring a license to export will take only few months.

Meanwhile, many experts are skeptical and hold back premature euphoria. Establish gas import from the US is not a matter of a few months. Realistically, we cannot expect that it would be possible for the US to export gas sooner than in four or five years. G7 countries support the steps that lead to the use of shale gas in the US and Canada for future replacement of supplies from Russia. This was stated at G7 meeting in May 2014. The strategic decision has been taken recently and began to take action due to the fact that Russia uses energy as a blackmail instrument.

The legislative process is so complicated and costs for transportation are so high, that the most realistic estimation is that drilling companies in the US are planning to export gas to the end of the decade, around year 2020. The import of shale gas from the US seems to be not possible up to September 2015, as it is restrained by laws and weak infrastructure. Ukrainian crisis and willingness of the European Union to become independent on Russia have increased the chance that the gas fields of North America could in future supply domestic households in Europe.

***Terminals & pipelines***

The only way how to get gas from US drilling wells to the European pipelines is to liquefy it and transport by boat across the Atlantic to European port terminals where it is again converted to gas. It is expected that the cost of transportation will more than double the price of gas, not mentioning the costs of building a necessary infrastructure. Although there is already 20 (KPMG, 2014) port terminals in Europe most of them are located in the west and south of Europe, as we can see on Figure. For the Czech Republic the important terminal lies in Świnoujście in Poland. In the first phase, however, Poland expects gas supplies from Qatar. Shale gas from the US might be imported only after the opening of the US market.



## **Figure 4. LNG terminals in Europe (February 2014)**

*Source: KPMG*

### **2.3.2 Algeria**

According to the 2013 annual report by the U.S. Energy Information Administration (EIA: Country Analysis Brief: Algeria, 2014), Algeria disposes of one of the biggest shale gas reserves in the world. The total reserves of technically recoverable shale gas are estimated to over 20 trillion cubic meters of gas. Only two countries – Republic of China and Argentina – are expected to have more shale gas than this African country. The reason, it is necessary to focus on Algeria is the location of the country. It is situated much closer to Europe than other countries from list of the top shale gas holders. Algeria is one of the main importers of natural gas to southern Europe, especially to Italy, so that basic infrastructure for transport and LNG (Liquefied Natural Gas) stations are already present. Therefore, the transportation costs are going to be much lower than in other cases.

According to the EIA statistics (EIA: Country Analysis Brief: Algeria, 2014) Algerian oil reserves and natural gas reserves are not that extensive as it was expected and the actual production of these two crucial fossil fuels is declining over past several years. In 2005, according to state energy company Sonatrach (Sonatrach Annual Report, 2010), Algerian drilling companies drilled out 65 billion cubic meters of gas. Since then the production was constantly declining to 45 billion cubic meters in 2013. Algeria has to consider other unconventional methods of energy drilling. Algeria officially announced in May 2014 it will start with the exploitation of the country's shale gas reserves in near future (possibly in 2016). Algerian government has started to look for foreign investors in order to exploit its fields. If the expectations of the EIA are based on true values and the reserves will be commercially exploitable, Algerian officials claim that 11 shale gas wells will be drilled around 2020 – 2025. (EIA: Country Analysis Brief: Algeria, 2014)

Since the exploration wells confirming the presence of large shale gas reserves in Algeria were not drilled yet, status remains to be uncertain. And even in case of confirmation the first liquefied shale gas can be expected to be imported not sooner than in 10 years from now.

### 2.3.3 Iran

Iran tries to take advantage of unstable political situation in Europe and proposes its own solution to the European Union. Iran announced recently (April 2014) that it is willing to supply natural gas to Europe in case of Russian supply interruption. (Critchlow, 2014) Similarly to other countries of Persian Gulf Iran is able to supply gas in large volumes to other countries; in fact, Iran is owner of the second largest natural gas field in the world. However, too many questions remain to be unanswered.

The first one is sanctions of the European Union against Iran because of its nuclear program. Nevertheless, US have already broken this energy sanctions, and in 2013 Iran contracted a deal with the UN to limit the nuclear program. If Tehran will be willing to rebuild business contracts with Europe, it will have to accept European conditions..

Secondly, Iranians are in need of financial support as they plan to invest around USD 14 billion to develop both oil and gas shared-fields with its neighbors in the Persian Gulf. (Critchlow, 2014) Discovered in late 1980s, development of drilling wells in the Persian Gulf area has been accompanied by several problems, including contractual disputes or the already mentioned sanctions that forced big international oil and gas companies to step back. Some European oil companies, such as Norwegian Statoil, invested money to development of gas fields in the Persian Gulf, years before sanctions were applied and they are willing to reconsider cooperation with Iranians and support more investments in the area. With additional investments from various stakeholders this area could become the largest exporter of LNG in the world and a global energy superpower.

Finally, there are significant issues with transportation. Up to date, there is no pipeline, which connects Europe with the Persian Gulf. The project “Nabucco”<sup>3</sup>, which planned to build pipeline from Iran to Azerbaijan failed to be realized in 2013. The second possibility is gas in the form of LNG, which would be transported to LNG terminals (directly to the European market) but they would have to be built with high costs and shipping would be too long and too costly. The question of economically effective transportation remains to be solved.

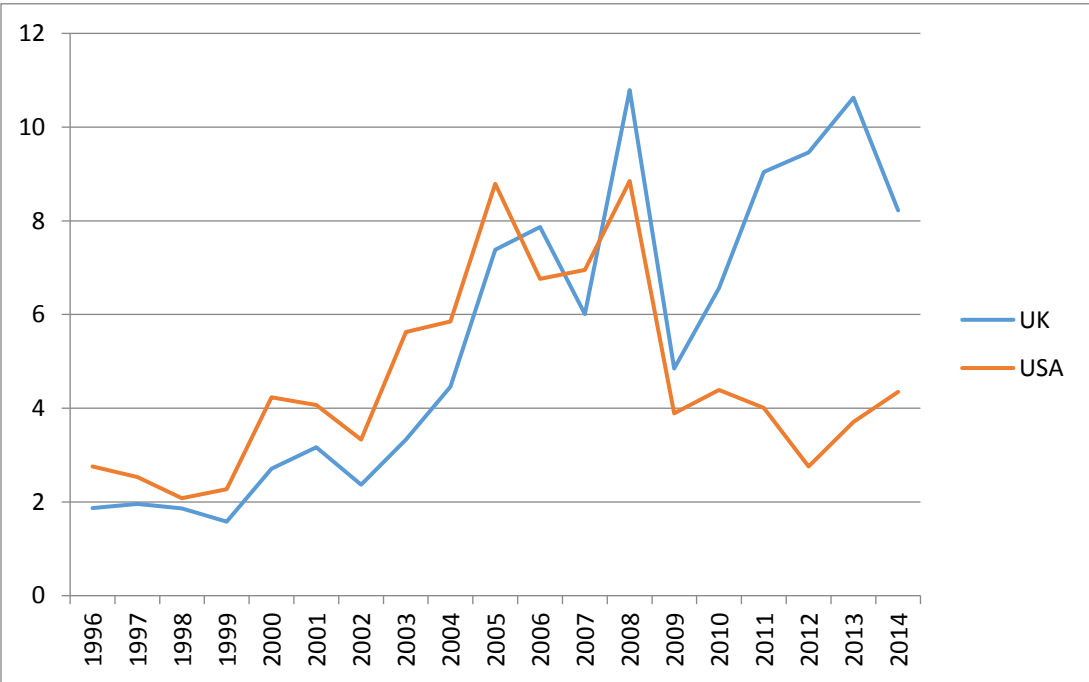
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<sup>3</sup> **Nabucco-west pipeline project** was proposed gas line connecting Azerbaijan and Iran with the European Union, via Georgia and Turkey to Bulgaria and Romania. Preparations for this project started in 2002 and intergovernmental agreement was signed in 2009. However due to political and legislative reasons the project was stopped in 2013 and Nabucco consortium was sold to Shah Deniz, subsidiary company of BP.

# 3 The convergence of the US standards and the standards of the European Union

The development of shale gas industry in the US has inspired the biggest economies in the world. Besides countries like China, Argentina or South Africa, the US model is being considered to be applied also in the EU. Several major energy companies and government representatives promote improvement of the US model and its application in Europe to minimize the natural gas import dependence. Multinational mining companies, which missed the initial growing phases of shale gas production in the US, aspire to get the official permissions for exploration wells and acquire lands in the EU for promising prices and sufficient reserves expectations.

After natural gas import crises in 2000s, the European Council expressed emphasis on targeting maximal self-sufficiency and improvement of energy security, to change the natural gas market in the EU in short-term (in the same way, as it happened in the US), and to decrease natural gas price. In February 2011, the European Council stated in a cover note that *“in order to further enhance its security of supply, Europe's potential for sustainable extraction and use of conventional and unconventional (shale gas and oil shale) fossil fuel resources should be assessed.”* (European Council, 2011)



## **Figure 5. Residential price of natural gas – comparison of UK and US, in US dollars per MBTU**

*Source:* own figure, based on BP data (2015)

As mentioned before, the European gas market is highly different from the US market and adaptation of American model to the EU would be problematic due to the following reasons.

In general, the differences in market structure are crucial. The US is historically the biggest oil and gas producer in the world, which makes it highly favored. While in the US the energy industry including shale gas (or natural gas) drilling is one of the fundamentals of the US economy, there is no similar historical precedent in the EU. US miners have decades of experience, developed infrastructure and millions of people employed, directly or indirectly. The US regulation is therefore strong and binding for market participants, opposed to the situation in the EU, where no common rules have been applied yet. It is crucial that the shale gas production experience and special technology knowledge are needed and in the US there is a network of companies providing services and utilities for gas drilling. There is a limited number of US companies with these skills in the US and the EU market is not the most attractive option for them in a global context; instead, these concerns are self-assertive in Argentina, Canada and China. (Kuhn and Umbach, 2011) The institutional background and needs of society have to be kept in mind. European countries with complex barriers for drilling (which are discussed in this paper) are not able to compete with countries with large reserves, providing more suitable conditions for drilling – both political and economic. For the business strategy the EU is considered as a possible consumer by the US companies. Europe is much more environmentally cautious as there are massive protests of ecological associations keeping close track of environmental hazards. Intergovernmental regulations (environmental standards on the EU level) and also legislation and prohibitions on governmental<sup>4</sup> level need to be considered too.

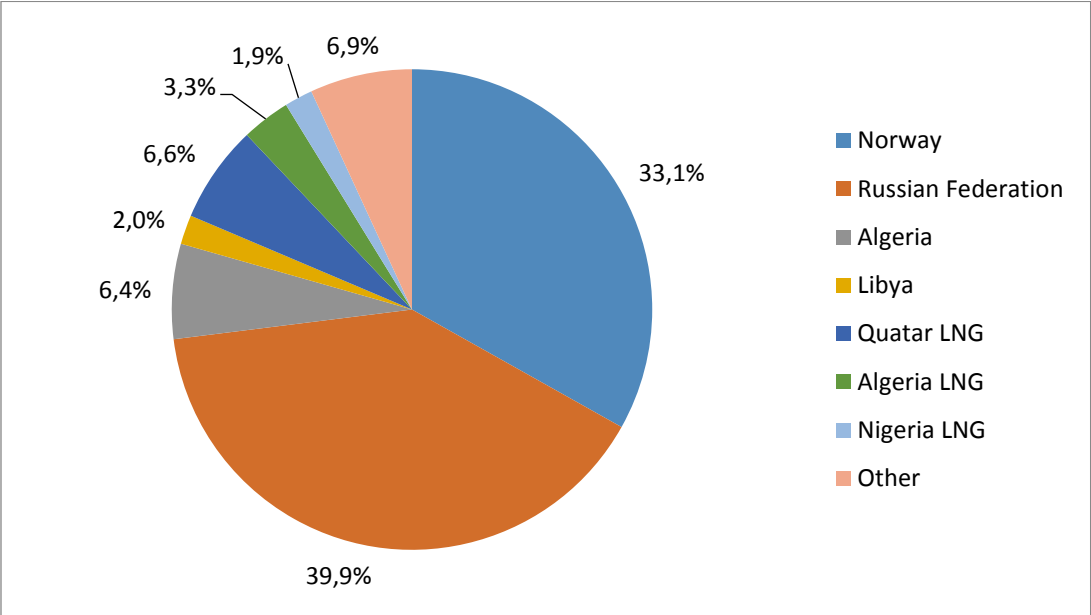
Due to a high number of wells drilled on the US territory the US mining companies have extensive datasets for geological composition, particularly statistics for shale reserves. The exploration wells are not needed and the initial costs are lower than in any other country. It has turned out the shale (proved) reserves are satisfactory enough to become substitute for

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<sup>4</sup> Hydraulic fracturing was prohibited e.g. in France, Bulgaria, Denmark, or the Czech Republic.

conventional methods, at least till 2040 (EIA 2014). The EIA (2012, 2013, 2014) makes the estimation of reserves in the EU every year, however exploration wells were done only in few EU countries (mostly Great Britain, Germany, Poland and the Netherlands). The drilling requirements are associated with higher fixed costs and in most of the EU countries there were not done at all. Therefore these estimations are rather imprecise. In some cases the initial estimations were optimistic but after exploration wells were done, reserves proved to be lower than estimated. In general, the location of shale plays in the EU is more adverse than in the US, the depths of deposits range between 1500 to 4000 m.

Due to long-term contracts with Norway and Russia there is only a limited domestic production of natural gas in the EU. Other factors also need to be considered, for example different geological structure or density of population – in comparison to the US the EU is more densely populated area. The shale production requires a lot of space – infrastructure to be built, water pool and engineering background. Companies in the US have easy access to wells thanks to larger unoccupied territories. While the spacing between conventional wells can be few kilometers, the spacing for shale wells has to be hundreds of meters apart from each other at most.



**Figure 6. Natural gas import to EU by country of origin (2014)**

Source. own figure, based on BP (2015)

Last but not least, the property rights laws are different in the EU from those in the US. Land owners in the US own not only the land but also everything underground; therefore if the mining company buys the land it automatically gets permission to drill minerals or other resources and also a permission to sell it. In the EU property rights for resources located underground belong to a country, therefore it is more complicated for companies (coming from the US) to drill shale gas. This is linked to higher production costs that translate to higher cost of wells. Together with unwelcoming public opinion of the EU citizens the environment for shale gas development in the EU is challenging.



## 4 Conclusions

Since the energy politics was historically the concernment of separate sovereign countries, the pathway towards common energy security politics was not simple. All power delegations lead to partial loss of sovereignty. On the other hand, if the EU steps out as single unit, the bargaining power is much stronger. European countries result from different views on resources utilization and environmental issues. Function of energy security has been changing over the years – at the end of the WWII it was meant to avoid internal European conflicts, which became evident in highlighting international cooperation and in united energy market. The breakage in energy security reception raised in 1970s; due to world oil crisis the need of energy vulnerability decreasing raised up. Therefore the EU in last two decades has been adopting directives with declaration of interest in common energy politics; the most contributing was the Lisbon Treaty, which in 2009 entered into force and energy security reached the primary law.

The updated analysis of the EU energy market in context to shale revolution in the US was provided. The big enthusiasm in the EU for US model after gas crisis in 2009 led to evolving of plans for areal shale drilling in the EU. However, as we have pointed out, the multiple barriers for increasing the energy security by this way have risen. There is absence of skilled workers for service of shale wells facilities in the EU. Chance to find appropriately educated employees is from bad to worse even in the US for American companies in mining industry; in addition for reasonable price. Since this is rising problem in the US, we can presume the same problem (in worse scale) in the EU. Secondly, density of habitation is much higher in the EU than in the US, which increases the probability of local disfavor of drilling. Civil associations are organizing themselves, most significantly in Sweden, France, the Czech Republic, Romania and in some parts of Germany.

Densely populated area is afraid of unfavorable ecological impacts of this drilling, particularly resources of drinking water pollution. Shale gas drilling impacts on environment play one of the most important roles, particularly hydraulic fracturing of shale massifs with chemicals, sand and water. That brings risk of water resources contamination. This problem arises also in the US, therefore the US government representatives have already started to prepare legal standards. E.g. Parliament of state of New York has already prohibited using hydraulic fracturing of shale rocks on the territory of its state. This regulation will stay valid

until the safety of shale gas drilling will be proved. Lastly, the West Virginian representatives have issued regulation significantly constraining possibility of drilling. European Commission has not made the appropriate legislation changes yet. Only the environmental official studies were done and regulation rules are kept to be made by sovereign countries at national level, until the more information on shale gas reserves will be available.

Initiation of shale gas drilling in the European Union could have far-reaching consequences for structure and functioning of European gas market. It can bring the higher role of consumer to the demand-supply relationship and lead to increasing of energy security of the EU. Another consequence could be higher integrity of global natural gas market, redirecting the LNG flows to new customers. Russian Gazprom, Italian, French, British mining companies could be competed with American concerns. Therefore liberalization of the European gas market would be logical spin-off of the EU shale gas production. The European Union is today one of the most valuable natural gas consumers in the world (together with China), so that the development of commercially usable shale gas drilling would stigmatize the equilibrium on European gas market. Arrival of US companies would bring significant weight of Russia as a strong energy player. We can generally observe the negative attitude of European (Gazprom) and Arabic suppliers towards the shale enthusiasm of the European Commission. Major energy companies in the EU oppose to shale gas drilling development, in form of lobbying at national governments or the EU representatives, or supporting the civil associations of public protests against exploration wells. All these forms of objection are using the security risks of shale plays drilling or environmental issues.

To be specific, we can summarize the risks of potential shale gas drilling in Europe into few points:

- the absence of skilled companies and workers in the EU
- costing and complex technology needed (in compare to conventional plays)
- different attitude to property rights to land
- different geological structure
- higher density of population
- environmental issues in the EU
- negative public opinion
- developed existence of pipelines network across the EU and long-term contracts with Russia

We have to keep in mind that energy market, and particularly the oil and gas markets, is dynamic; commodity prices are evolving. Since the political situation in last decade is unstable, the unconventional methods are being used for commercial reasons less than decade and technology for shale gas drilling is still changing, the predictions for development in shale gas drilling industry evolve too. To understand completely the economic influences of shale revolution in the US, we will have to wait for at least one more decade. In context with energy security of the EU – process of legalizations and approvals of unconventional methods of drilling on EU territory will take years, and therefore we cannot expect the first commercial success of shale gas drilling before 2020.

In this context it is not presumptive that shale gas will cause revolution in the European energetics; the “shale revolution” is not going to happen in the EU. However European willing to support this boom in some countries will stigmatize the EU. Besides trying to follow American success we should also remember to deal with risks of this possible source of energy. This means the North American economy can still be based on oil and gas independently of stretch in world economy. The European Union will probably have to choose one of two scenarios – long-term dependency on fossil fuels import or costing transition to renewable resources of energy (together with nuclear-based power energy), which could be economically highly non-effective.

The UK, Hungary and possibly also other EU members may start their own “shale revolution” in few years. Therefore, there is a space for future research to study the model applied in these countries with additional data and predict the future of shale gas in the EU energy market. Finally, after Lisbon Treaty the “energy security” is term widely used in the EU legislation and qualitative research of effects of increasing emphasis on this term to future of the EU energy market should be done.

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