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Update on Shale Gas

Content

1 Introduction

This report summarizes and analyzes the latest development in the field of unconventional oil and gas resources. Current development and facts still indicate that unconventional resources can cause U.S. to become self-sufficient in gas supplies and that so-called re-industrialization produced by low energy and raw materials prices takes place in the U.S. The natural gas (in contrast to oil) is so cheap that for instance from more distant areas in North Dakota it is not profitable to transport it to places with the highest consumption and it is rather flared up in such a volume that it is visible from the space.

The attitude of Europe is rather cautious. There is often repeated opinion that exploration of shale gas should be regulated if not banned. Suggested regulation is often at such level that exploration becomes unprofitable for E&P companies.

This autumn, the European Commission intends to submit a proposal on Europe-wide regulation of potential shale gas exploration. At present public consultations are underway (open until March 20). Issues linked to shale gas are solved by several European Commissioners as on one side it is perceived as a threat to the environment, however, on the other side shale gas production could help to lower CO_2 emissions and increase competitiveness. Therefore, the legislation proposal, which should be made public in autumn, will be a joint work of the European Commissioner for the Environment Mr. Janez Potočnik, the European Commissioner for Climate Action Connie Hedegaard and the European Commissioner for Energy Günther Oettinger.

It can be said that at present Europe more likely puts a resistance to shale gas, which is partially consequence of environmental lobby and Russian lobby fearing of rival companies. Out of European countries, hydraulic fracking was banned by France and Bulgaria. By contrast, U.K. government gave the go-ahead for a firm to resume the controversial fracking to exploit gas in Lancashire last December. Test fracking by the Cuadrilla company near Blackpool stopped in 2011 when two earthquakes were felt at the surface.

In addition to change in energy mix after phasing out nuclear power plants and higher utilization of RES, shale gas is vividly discussed in Germany. There are voices either for or against exploration.

China is interested in utilization of shale gas as well. Its natural gas consumption should quadruple by 2035 according to IEA. This is also why Chinese state companies buy shares in Canadian and U.S. E&P companies and attempt to gain access to technologies and know-how. Only some tens of survey rigs have been drilled, new industrial production is far away. The largest reserves are located in remote areas without necessary infrastructure and water, which is key input for shale gas exploration. Estimated Chinese reserves are deposited 6 km underground - deeper than in Poland or U.S. Nevertheless, the Chinese government has approved strategy, how to start to develop shale gas extraction until 2015. Survey, exploration and construction of infrastructure will require huge investment. As it is a strategic field of economy, only domestic companies will be allowed to take part in the development. Six of them were granted a license for exploration during the first round of allowances distribution in June 2011.

In Europe, the biggest progress on its path towards shale gas extraction has been made by Poland. More than 30 companies have received permit for survey drilling, first provable results are expected at earliest in 2014. However, in contrast to 111 granted concessions only 39 rigs were drilled. Foreign companies complain about complicated bureaucracy and missing legislation; Government is preparing legislation, which would regulate and tax potential profits from shale gas, only now. But the process is quite complicated as the ministry of environment has already postponed publication of the whole act for several times.

Critical agreement on shale gas exploration was signed in January 2013 by Ukrainian government with Shell company. Ukraine has the third largest estimated shale gas reserves in Europe (after Poland and France). This year survey drilling should start. Industrial production of shale gas would, for Ukraine, mean decrease in dependence on Russian natural gas imports. Ukrainian government next prepares other agreements with Chevron and ExxonMobil.

Because of growing shale gas production U.S. think about its export. This issue is solved mainly by the U.S. government which cautiously assesses applications by particular companies. These have constructed set of ports and liquefaction plants as they expected LNG import and were surprised by the fact that domestic production jumped up and consequently price of natural gas dropped.

In 2012, the average annual price of gas was USD 98 per 1,000 cm according to EIA, a year earlier it was USD 142. Wholesale prices in 2012 were the lowest since 1999.

Nevertheless, until now only one company out of fifteen that have applied was granted export permission. U.S. natural gas is also allowed to export only to countries with which U.S. signed FTA (only 18 states in the world). Out of these states only South Korea and Singapore import LNG.

And it is not just about the price. In the USA, industrial groups are lobbying for the ban of export to have secured a long-term supply of cheap energy. Besides, geopolitical argumentation has also appeared that in case of reduced dependence on oil and gas imports from the Middle East U.S. could reduce its political and military involvement in the region.

Shale gas has not caused revolution only in natural gas prices, but also in oil prices. Due to new natural gas exploration technologies also domestic unconventional oil exploration has developed in U.S. EIA estimated that in 2014 U.S. would import the lowest volume of oil since 1987 (6 mil. bar. per day). EIA claims that in 2020, U.S. will be the biggest oil producer in the world.

Cheap gas damages also coal as a source of energy. According to EIA forecast gas will be for tens of years cheaper, but also more environmentally friendly source of energy reflecting the fact that natural gas has approximately two times lower emissions of CO_2 than coal. Although European Union boast about program with lower emissions than U.S. it is this country that in reality decreases emissions due to cheap gas. Construction of gas power plants in U.S. is cheaper and faster that construction of coal ones.

American coal is, in Europe, cheaper than Russian gas, supported by the fact that its import to EU (according to the Economist) went up by one third in half of 2012. Besides, share of coal in Europe increases also because of the new energy strategy of Germany. As coal (having world market and prices) is cheaper than natural gas (prices of which are determined at regional level), standby capacities for unstable RES sources are often coal power plants.

Cheap natural gas in U.S. represents significant competitive advantage for American industrial companies. Following this fact, American firms announced, at the end of 2012, investment amounting to USD 90 bn confirming industrial renaissance in U.S. The biggest American companies recorded high profits and fast growth. Investment will concern mainly petrochemical, fuel and steel companies and firms producing inorganic fertilizers.

Since the beginning of 2010 until the end of 2012 industrial production in U.S. increased by 12%, in contrast in U.K. it decreased by 3% (in Japan even by 6%). European companies are quite afraid of potential loss of competitiveness. Example can be Dow Chemical, which intends to build new USD 4 bn petrochemical plants in Texas and Louisiana instead of Europe.

2 Latest development in the U.S. and impacts on global NG market

As the shale gas revolution has started in U.S., let have a look on current situation and data on natural gas production etc. there and then let pass to the rest of the world by analyzing potential impacts of the development in the U.S. and other changes in oil and gas industry on the world oil and gas market.

The latest data show that in 2011, the United States produced[1] 651 bcm and consumed 690 bcm of natural gas, the largest volume it ever had while paying some of the lowest market prices for natural gas in the world. This means that at present, U.S. is the world's leading producer of natural gas, having surpassed Russia in 2009, and the world's leading consumer.

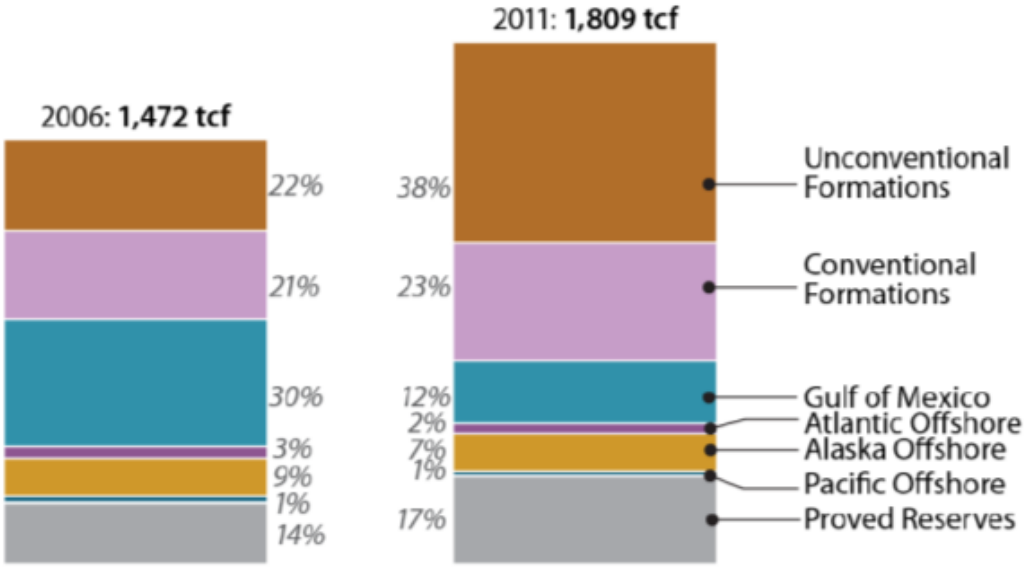
Table 1: Comparison of U.S. and Russian natural gas production

	2006	2007	2008	2009	2010	2011	Change 2011/2010	2011 share of total
U.S.	524.0	545.6	570.8	584.0	604.1	651.3	7.7%	20.0%
Russian Federation	595.2	592.0	601.7	527.7	588.9	607.0	3.1%	18.5%

Source: BP Statistical Review of World Energy June 2012

Following figure captures data on estimates of U.S. reserves indicating to what extent U.S. natural gas supply could saturate world gas demand. It is estimated that in 2011 undiscovered, technically recoverable resources plus reserves accounted to 1,809 tcf (79 years of production at 2011 levels). However, what the figure below should illustrate is the uncertainty contained within forecasts – just in 5 years the estimates changed substantially as nobody really knows what is really underground.

Figure 1: Natural gas reserves



Source: Natural Gas in the U.S. Economy: Opportunities for Growth, Congressional Research Service, November 2011

In 2011, natural gas was the most produced fuel, on a tone of oil equivalent basis, in the United States, surpassing coal for the first time. This change was driven by mentioned success of shale gas development. EIA estimated in its 2013 Annual Energy Outlook that overall U.S. natural gas production will be up by 31% in 2040 in comparison with 2011. Shale gas will grow by 53%. In

[1] The production figure means dry gas, which has been processed for consumption purposes.

2040 it will achieve almost 51% share of that production, up from 34% in 2011. Again the predictions in 2012 and 2013 Annual Energy Outlook differ. Changes made in forecasts nowadays speak in favor of shale gas.

The same concerns import of natural gas to the U.S. During observed period the U.S. is expected to become from a net importer of natural gas by pipeline and LNG to a net exporter by 2020 (in 2012 scenario in 2022)[2]. The United States is expected to change to net LNG exporter by 2016.

Table 2: U.S. natural gas production, import and prices

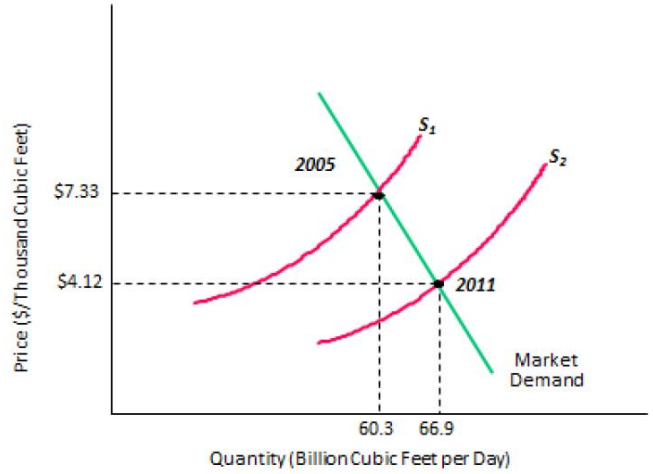
	2010	2011	2015		2020		2025		2030		2035		2040
			R13	R12	R13	R12	R13	R12	R13	R12	R13	R12	R13
Production and Supply													
Associated Gas (Onshore)	1.47	1.54	2.21	1.52	2.14	1.54	1.99	1.41	1.43	1.18	1.26	1.00	1.09
Tight Gas	6.34	5.86	5.85	6.08	6.40	6.06	6.56	6.17	6.67	6.07	6.96	6.14	7.34
Shale Gas	***4.86***	***7.85***	***8.85***	***8.24***	***11.05***	***9.69***	***12.84***	***11.26***	***14.17***	***12.42***	***15.33***	***13.63***	***16.70***
Coalbed Methane	1.69	1.71	1.64	1.83	1.71	1.79	1.66	1.77	1.69	1.74	1.73	1.76	2.11
Other	4.18	3.58	3.29	3.82	2.97	3.40	2.61	3.03	2.31	2.70	2.07	2.44	1.87
Lower 48 Offshore	2.44	2.11	1.89	1.88	2.07	2.34	2.19	2.38	2.34	2.58	2.81	2.72	2.85
Alaska	0.35	0.35	0.30	0.29	0.28	0.27	0.73	0.25	1.19	0.25	1.18	0.23	1.18
U.S. Total	**21.3**	**23.0**	**24.0**	**23.7**	**26.6**	**25.1**	**28.6**	**26.1**	**29.8**	**26.9**	**31.4**	**27.9**	**33.1**
Henry Hub Spot Price (2011 USD MBtu)	**4.46**	**3.98**	**3.12**	**4.38**	**4.13**	**4.68**	**4.87**	**5.75**	**5.40**	**6.42**	**6.32**	**7.52**	**7.83**
Net Imports	**2.6**	**1.95**	**1.42**	**1.73**	**-0.14**	**0.35**	**-1.58**	**-0.79**	**-2.1**	**-0.89**	**-2.55**	**-1.36**	**-3.55**

Source: EIA

It is obvious that rapid increase in natural gas supply had to exert downward pressure on prices.

[2] Compare - In EIA's 2011 Annual Energy Outlook the agency predicted that there was no time period in which the United States was forecast to be a net exporter of natural gas.

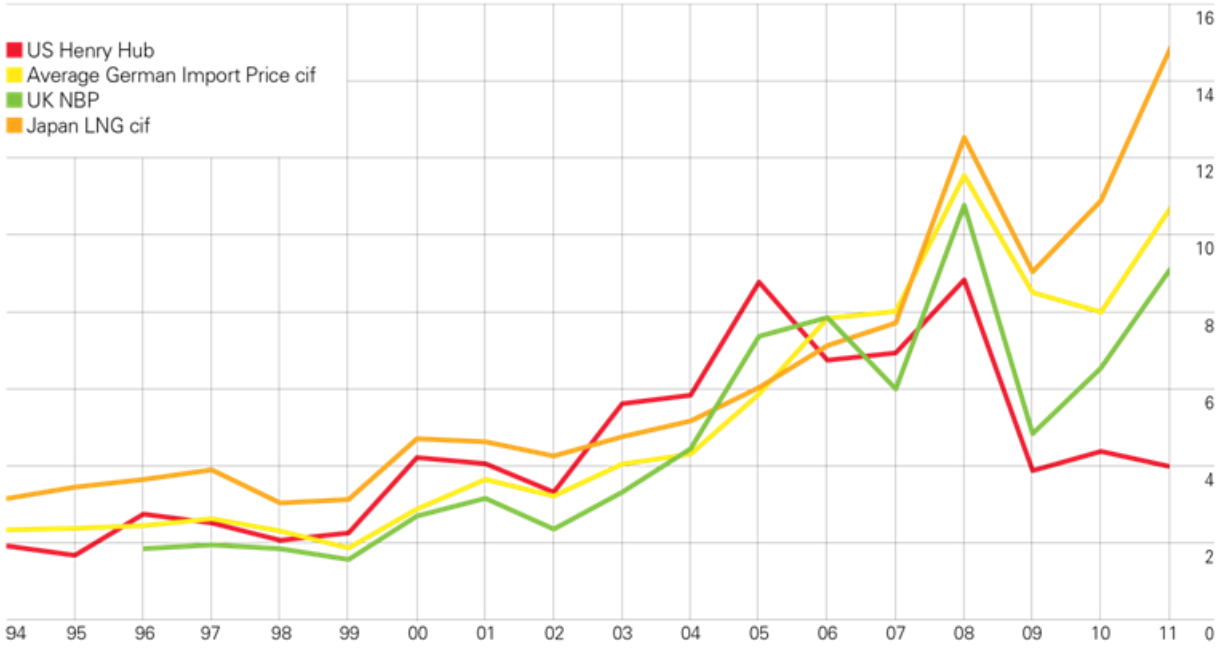
Figure 2: Boom of Shale Gas Resulted in More, Less Costly Supply of Natural Gas



Source: EIA

The result is that at present U.S. spot natural gas prices are relatively low compared with domestic prices over the last decade as well as international prices over the last few years (see following figure).

Figure 3: Comparison of selected natural gas prices (USD/Mmbtu)



Source: BP Statistical Review of World Energy, June 2012

These lower recent prices together with optimistic expectations about domestic supply changed the view of U.S. energy trends in future. They presented U.S. as country with sufficient supplies of natural gas available at low cost well into the future.

Boom of shale gas and the decline of U.S. natural gas prices has attracted global attention and prompted countries to try to replicate the U.S. success in developing their own unconventional gas resources. Nevertheless, no country has achieved the level of development as the United States, except from Australia, which succeeded in developing their coal seam gas. Canada has also been moving ahead with its shale gas development, but still lags behind the United States.

As can be seen in previous figure, U.S. shale gas was beginning to come to market in 2007/2008 and by 2010/2011 it changed the trajectory of U.S. natural gas prices from those of the rest of the world. In 2011, the rest of world faced higher prices than in 2010 for natural gas, the United States saw its natural gas price decline.

Although many factors can influence natural gas prices in a particular market for a certain period (nuclear accident in Japan etc.) the growing differential shows how the American natural gas market is insulated from external impacts and consequences of the expanding U.S. natural gas resource base.

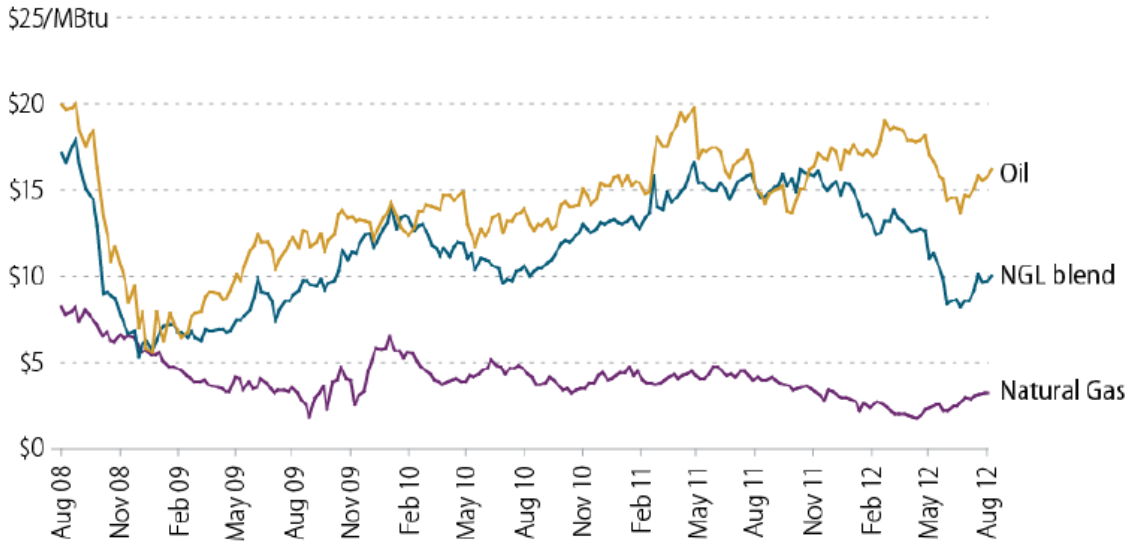
Low U.S. natural gas prices have supported other changes:

1. Companies started to seek markets for natural gas and have applied for permits to export natural gas as LNG.
2. Production of natural gas has become less profitable. Therefore many NG companies started to invest into oil-assets, particularly to tight-oil formations and support growth of U.S. oil production. With oil becoming the focus of production, investment to natural gas infrastructure lagged behind. Key consequence has been flaring of large gas volumes in some areas of the United States.

2.1 NGLs production

As shale gas production increased and prices dropped down E&P companies turned their attention to natural gas liquids (NGLs) - ethane, propane, butane or pentanes. Each NGL has its own market. As the price for dry gas fell down because of the increase in supply, the natural gas industry began to produce more wet gas in order to increase their revenues. Historically, prices of NGL products have been linked to oil prices. Since oil prices have remained higher relative to natural gas ones, they have supported wet gas production while maintaining production of dry gas as a by-product despite its low price.

Figure 4: Natural gas, oil and NGL prices



Source: Natural Gas in the U.S. Economy: Opportunities for Growth, Congressional Research Service, November 2011

Another issue, connected with increased NG production and dropped prices, is flaring. The boom in natural gas production has made the US one of the world's worst countries in this area. The volume of gas flared in the US has tripled in just five years, according to World Bank estimates and is now fifth highest in the world, behind Russia, Nigeria, Iran and Iraq (*www.ft.com*).

As it has been already mentioned, flaring is a result, in large part, of the low price of natural gas in North America, which make uneconomic to build infrastructure to process the gas released by oil production. It is often the safest way how to dispose of the redundant gas. At present the volume of flared gas is so high that the lights of the flares burning in the Bakken and Texas' Eagle Ford shale fields can be clearly seen in night-time satellite photography. In night-time satellite images North Dakota's Bakken shale, the oilfield, that has transformed US production in the past five years, shines almost as brightly as Chicago

Flaring highlights a less than sparkling side of the US shale boom: how development has outpaced investment in infrastructure to manage the unwanted associated gas that is released alongside oil production.

An example can be the Bakken field. At 15,000 square miles, the Bakken is one of the largest continuous oilfields in the world. But hundreds of miles from any major cities, it is almost among the most remote. Oil production from the Bakken shale is doubling every 18 months and the field is now responsible for 10 % of total US output but pipeline connections have failed to keep pace. More than 1,000 wells were connected to the gas-gathering system in 2012, but that has not been enough to cut the proportion of the state's gas being flared, which has remained stuck at about 30 %.

The problem is being repeated across the U.S. In Texas, where production from the Eagle Ford shale rose almost 30-fold from 2010 to 2012, the number of flaring permits increased six fold over the same period (1,963 permits to flare in 2012, more than six times the number of 306 in 2010). By last spring, gas sufficient to provide power for more than 400,000 homes was being flared in the state. It is claimed that if oil production was restricted to reduce flaring, the cash flow from oil wells would have to be reduced fivefold. But as companies compete with each other there are no incentives to decrease it.

Obviously, flaring has a significant effect on GHG emissions. Although emissions for US-produced crude are often lower than for imports from countries such as Saudi Arabia, much of that advantage is lost for U.S. oil once flaring is taken into account. Regulators can require companies to reduce oil production to cut flaring. But state governments, which are enjoying revenues from oil and gas royalties, are reluctant to impede production. North Dakota forecasts surplus revenues of more than USD 1bn in its 2013-2015 budget.

The latest attempts to curb flaring in the state involve carrots rather than sticks. A bill being considered in the state legislature would provide tax incentives to bring gas to market. State agencies are also encouraging the use of gas-fired generators to power drilling equipment at oil wells.

North Dakota Pipeline Authority is optimistic that more gas pipelines will be built, as it becomes clear that Bakken gas does have economic value, thanks to the concentration of natural gas liquids such as propane and butane, which are used as feedstock in the petrochemical industry. Nevertheless, that will take significant additional investment.

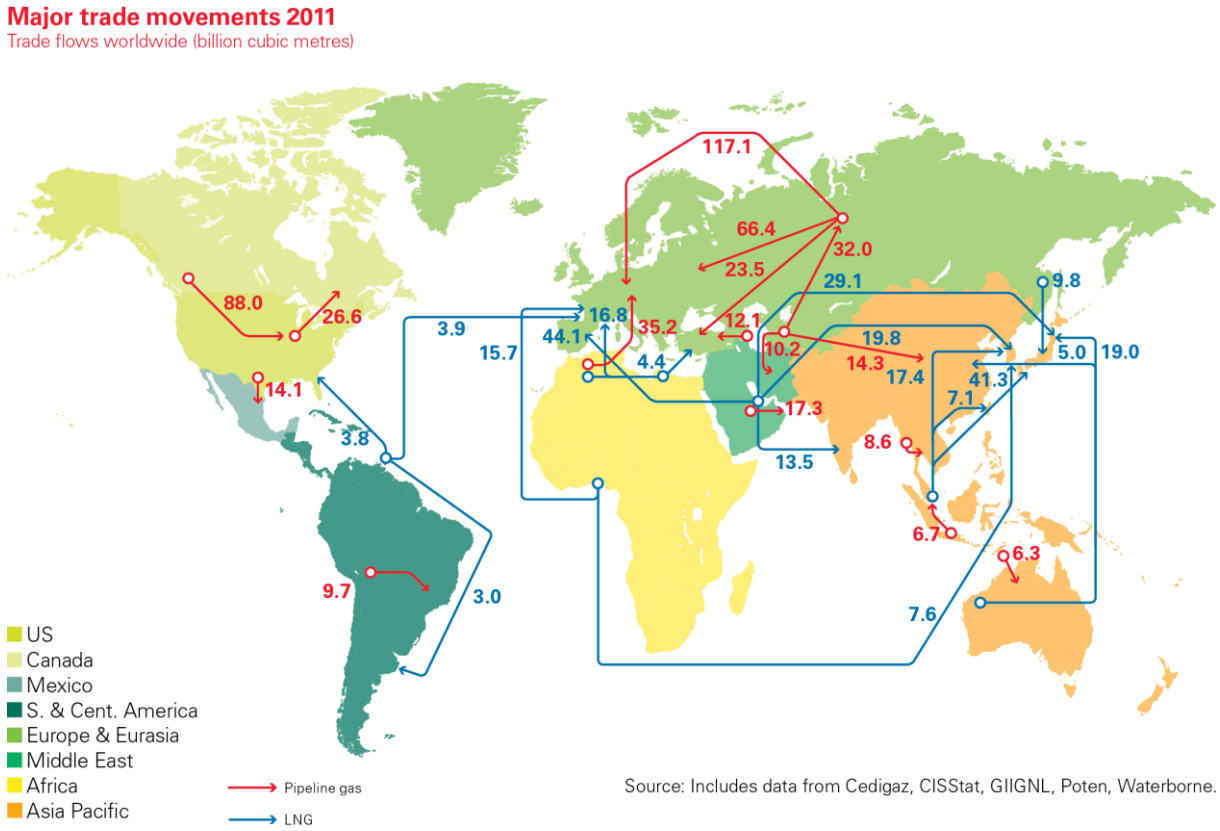
Gas flaring has been recognized as a problem for decades. Flares blazing in the Niger Delta or the deserts of Iraq have epitomized the pollution and disruption caused by oil production in developing countries. It is only recently, though, that they have emerged as a growing concern in the US. Under pressure from shareholders, environmental groups and the World Bank, oil companies cut their worldwide flaring by 20 % during 2005-10. In 2011, however, there was a slight increase, caused in part by a steep rise in the US. (*www.ft.com*)

Besides, some sees it as a threat to the industry's growth as excessive flaring is not only environmentally damaging but also a waste of a valuable resource.

The way how the companies will deal with this problem is going to influence costs of oil production and therefore its supply. Important role will be played by development of natural gas infrastructure[3] or new technologies to help E&P companies to treat this issue.

2.2 U.S. export and LNG market

Following picture depicts major natural gas trade movements in 2011. There is no direct export from U.S. Next parts of the report should discuss how U.S. LNG exports can change the global gas market and chances that such development will occur.



Source: BP Statistical Review of World Energy, June 2012

In the middle of the last decade, the U.S. faced declining domestic production and the prospect of increasing dependence on LNG imports to meet NG demand. Just several years later, the boom of shale gas allowed the U.S. to come back to its self-sufficiency with low and stable domestic gas prices. However, many of the regasification terminals built in anticipation of increasing LNG imports do not operate and on the other side several Gulf Coast and eastern seaboard LNG facilities plan major investments to add liquefaction capacity to allow domestically

[3] The location of shale formations has changed the routes of natural gas supplies to consuming markets in the United States. Traditionally gas flowed from the Gulf Coast to the Northeast. The discovery and production from the Marcellus Shale formation, which underlies much of West Virginia and Pennsylvania, southern New York, eastern Ohio, western Maryland, and western Virginia, has changed the need for gas from the Gulf Coast as the Marcellus is much closer to Northeast markets. The shift of supply centres and consuming markets requires building of new infrastructure, including processing facilities (plants that remove NGLs, carbon dioxide, etc).

produced gas to be exported to Europe and Asia. At first glance, the export economics seem attractive but there are significant obstacles that need to be overcome.

The challenge for the developers will be to go through complex approval and permitting processes. There are effectively three levels:

- ✓ Federal Energy Regulatory Commission (FERC) having authority under the Natural Gas Act to approve the location of and health and safety related aspects of LNG facilities;
- ✓ Department of Energy (DoE) granting approval to export natural gas to both free trade and non-free trade countries;
- ✓ there are also a series of approvals required at a state level which allow a state veto over proposals.

Even after permission is granted, opposition groups have various possibilities how to react to get the project delayed or even cancelled. The result is that the DOE has granted only one approval (2.2 bcf from Cheniere Energy's Sabine Pass facility) to export LNG to countries with which the US has a Free Trade Agreements (FTA) in place. Nevertheless, only few LNG importing countries have currently a FTA signed with the US, which represents main barrier for the prospects for LNG exports.

This attitude could influence trade arrangements in the world. *"If the DoE insists on restricting exports to FTA countries, the status of the various FTA negotiations could exert a significant influence over the global gas market. The UK and Germany have recently made comments supporting a proposed FTA between the EU and the US. This could have the effect of creating a partial fragmentation of the global gas market with the US supplying significant volumes to Europe whilst other LNG producing countries focus their efforts on selling into the Asian market. The approval process for Canadian projects is likely to be less onerous as they are less likely to meet such vocal opposition to those in the US."* (*Source: www.timera-energy.com*)

Opposition to the export projects is based on argumentation about losing NG self-sufficiency and the associated risk and cost for the whole economy - change to domestic gas pricing dynamics. US gas prices have been relatively low and stable since the US stopped importing significant volumes of LNG. These market conditions have undoubtedly supported the US economy performance, particularly manufacturing and protected it from recent global economic turmoil to some degree. The logical outcome of any significant volume of LNG exports is price convergence with destination markets. US gas prices would rise and become more volatile as the domestic market would be directly influenced by global events. On the other side, project developers point to the fact that DoE currently allows gas to be exported to Canada and Mexico where it could be liquefied and exported, thereby side-stepping the need for approval in the U.S. Besides, it seems a somewhat contradictory policy to place restrictions on LNG exports when U.S. diplomats are travelling the world petitioning for FTAs.

Even if impeded by administration procedures main factor influencing number of realized projects and volume of gas for export will be their economics. These economics are far from certain in the longer term as the ability of the U.S. to maintain the current level of shale gas production for competitive price is questionable. However, the possibility of gas exports from North America promises to add an interesting new driver of European gas pricing dynamics. But doubts about the sustainability and economics of the revolution remain[4].

[4] There is little dispute over the scale of shale gas reserves, but there is significant uncertainty as to whether production can be maintained at current levels. Shale gas well production rates decline much quicker than those of conventional gas fields. Therefore new wells must be drilled with greater regularity to enable producers to maintain production levels. This can be difficult for a number of reasons. Firstly, a high proportion of yield from shale gas plays typically come from wells in concentrated sweet spots, many of which have been already extensively drilled. Secondly, a recent report from the US Environment Protection Agency formally linked shale

Impacts of U.S. export on European prices can be multiple:

- ✓ *"These exports will add another arbitrage or substitution play to the European market. Under conditions where North American LNG exports flow across the Atlantic to supply Europe, European hub prices are likely to be supported at the delivered cost of the LNG. If European hub prices fall below this level it will act to choke off US supply as exporters are unwilling to deliver cargoes. However this relationship may break down in conditions of global LNG supply surplus, for example if European gas hubs are used as a 'sink' for surplus Middle Eastern cargoes." (Source: www.timera-energy.com)*
- ✓ If gas hub prices are below oil-indexed contract prices, contract deliveries will be lowered to 'take or pay' levels putting upward pressure on prices.
- ✓ The opposite situation will occur if hub prices are below contract prices. It should be pointed out that necessary condition for this development is significant not utilized 'take or pay' volume of NG in the market.
- ✓ The export of substantial volumes of LNG from North America and its ability to influence European price development adds another interesting dynamic to interact with the two described above.

Now we should proceed towards issues connected with global LNG as U.S. LNG exports represent significant part of it.

It still can be stated that the global LNG market is its relative infancy. Only a small portion of global gas consumption is currently saturated by LNG. And only a minor share of those LNG supplies is flexible in terms of prices, although these flexible cargoes can have a disproportionate influence on global gas prices given their influence on marginal pricing. This lack of global LNG supplies flexibility is currently reflected in the regional price divergence across Asia (tight market after Fukushima), Europe (broadly tracking oil-indexed contract supply) and the US (satisfied by domestic shale gas).

The optimal output of this period of fast development in the LNG market should be price convergence across regional hubs towards transport differentials. New LNG infrastructure should support dynamics of the market and strengthen global gas price influence on regional markets. But there is significant uncertainty about the path of development that the LNG market will follow over the next decade. Besides other, pursuant factors can affect it – surely already discussed U.S. exports, Australian LNG capacity, general attitude to nuclear power, Chinese LNG demand or macroeconomic conditions.

Table 3: Key factors influencing global LNG market in the near future

Factor	Note
Australian LNG capacity	Around 70% of liquefaction capacity currently under development is located in Australia. If this capacity is brought to market as planned then Australia is set to overtake Qatar as the world's largest exporter of LNG by the end of this decade. However, Australian key weakness is high project costs (high production costs, transport costs, high labor costs or unprecedented strength of the Australian dollar). Australia projects are currently satisfying incremental demand growth from a gas hungry Asia. But there are two key threats to project development: exports of cheaper gas from the US and a slowdown in Asian demand growth.
US exports	already discussed

gas extraction with pollution of groundwater aquifers. If this leads to more strict it may slow the rate at which new wells are approved. (www.timera-energy.com)

Fukushima disaster	None of Japan's 50 nuclear reactors that were closed after the Fukushima disaster are currently in operation. Given Japan is the world's largest LNG importer, nuclear closures have been a huge factor driving LNG demand in the Asian market. While the increase in Japanese demand has been dramatic, it is a one-off factor whose impact will diminish over time. Because of unfavorable economic conditions Japan decided to return the first of its reactors to service. The pace of return will be a key driver of Asian demand over the next few years.
Chinese LNG demand	see below
Global growth	While future macroeconomic development is a key source of uncertainty impacting all energy markets, the LNG market is particularly exposed. A sharp fall in Asian growth would have a disproportionate impact on global LNG demand given that Asia is the key driver of incremental demand growth. At the same time LNG supply development is vulnerable to tightening capital constraints from a deterioration of the financial crisis, given that liquefaction projects are very capital intensive.

Source: www.timera-energy.com

BOX 1: Case of China

Just few numbers at the beginning to give reasons why the development in China in the field of LNG should be a key factor affecting global LNG market: China is predicted to become the world's second largest LNG importer by 2020 (second only to Japan); if the penetration of gas increased by just 1% in China's primary energy consumption it would mean an increase in NG demand by approximately 27 bcma of gas; if that volume were to be met by LNG alone, it would mean an increase in imports of 20MT per year.

However the volume and timing of China's influence on global demand is subject to considerable uncertainty given the wide range of factors that are underlying China's import demand.

The primary drivers of Chinese gas demand (as distinct from LNG demand) will be the rate and energy intensity of economic growth and the degree to which stricter environmental policies result in a switch from coal fired power generation to gas.

Questionable is the sustainability of the Chinese economic growth.

"China's growth over the last two decades has been driven to a large extent by exports to debt fuelled consumers in developed economies. That growth model has been fundamentally compromised by the global credit bust and onset of the financial crisis. Since 2009, Chinese growth has been supported by government stimulus (both fiscal and monetary) and there is strong evidence that this growth has been focused on the energy intensive development of infrastructure and industrial over capacity. In the last year the Chinese government has shifted its focus to deflating a domestic property and credit bubble, both bi-products of its stimulus policies. To sustain current growth rates, China either needs a strong recovery in developed economy growth to spur export demand or a rapid increase in domestic consumption." (www.timera-energy.com)

Concerning environmental measures, China proclaimed its clear intention to increase the share of gas power plants in its power production. The key factor driving this is unbearable pollution level. Samely as in Europe, Chinese coal power generation is significantly cheaper than gas on a marginal cost basis. It is then questionable to what extent the government would continue to promote investment in cleaner but more expensive gas fired generation in case of economic slowdown..

Among other factors influencing Chinese gas and particularly LNG demand, alternatives sources of gas supply are important. According to Chinese estimates the country should have more than 25 tcm of shale gas reserves (the world's largest reserves). But the timing and volume of reserves that can be brought to market is much less clear. After domestic production is netted off demand, LNG imports will compete with incremental pipeline imports from Turkmenistan, Kazakhstan, Myanmar and Russia adding a geopolitical dynamic. An added complexity will be the extent to which the lifting of domestic price controls will allow importers to pass on market prices to consumers.

2.3 Impact on other industries

Shale gas boom in the U.S. had impact on only on NG industry as itself. We will again start with the U.S. economy then passing to European companies.

Expanded supply together with low natural gas prices contributed to a transformation of important sectors of the U.S. economy. Increased output and employment, expanded investment, income growth, improved competitiveness, and a reduction in the foreign trade deficit were outcomes.

Direct beneficiaries were those industries that use natural gas as a raw material or as an important input in a production process – petrochemicals, fertilizers, steel industry. For instance in 2012, a number of chemical companies announced plans to invest in new plant capacity, expand existing facilities, or re-open plants near shale gas supplies (Dow Chemical, Shell Chemical, Chevron, Phillips Chemical, etc.). Many of these investment plans, if they are realized, will result in new production capacity becoming available over the next five years. However, these investments with time lags of up to five years before they generate cash flow suggest that the companies believe that the United States is entering a period of sustained low natural gas prices and growing supply. Without supply growth, the increase in demand from these facilities would likely push prices up.

BOX 2: Revival of U.S. refining industry

According to the news, U.S. refining industry has been enjoying a remarkable revival thanks to the shale oil (and originally shale gas) boom, the industry has become more internationally competitive, enabling it to export record volumes of oil products such as diesel fuel. Shares in companies such as Marathon Petroleum and Tesoro were the best-performing of any large energy companies worldwide last year. In general then US refiners rose by between 57 and 105 per cent, making their strongest recoveries since the collapse in oil prices and refining profit margins in 2008-09.

The foundation for the revival in US refining has been the shale oil boom. Onshore production in states led by North Dakota and Texas has opened a wide gap between prices for inland US oil and internationally traded crude. Refiners that can secure supplies of those cheaper crudes have a competitive advantage, both increasing their margins in the US and making them more competitive in export markets, particularly in emerging economies such as Mexico where – unlike in the US – fuel demand is still growing. Inland refineries closer to the new production have been the principal beneficiaries.

However, coastal refineries have also been able to secure cheaper supplies, sometimes by reversing the flows of pipelines or by moving oil on trains. The wider distribution of cheap crude has meant that even Valero, which has half of its refineries in the Gulf of Mexico region, has benefited.

US refiners have also been helped by the cheap price of natural gas – another result of the shale boom – which is a big input cost for refineries.

It is expected that with the US oil boom continuing, the refining industry's strength will continue, for a year or two at least. However, as new refining capacity comes on stream, profitability will come under pressure. There are several new hydro-crackers for diesel planned to come on stream in the US and Europe. Then the tight supply-demand balance that there has been for diesel will start to loosen. Margins will flatten and potentially start to decline. *(Source: www.ft.com)*

Industries experiencing indirect benefits included construction, airline industry or capital goods producers that contributed to the supply chain for the investment projects undertaken by expanding natural gas consumers.

In the international economy, those U.S. industries affected by expanded supply and low natural gas prices experienced a competitive advantage over the producers of similar goods in other countries, resulting in increased exports from, and decreased imports to the United States.

Viewed from the other side of the market – Europe companies quite fear over U.S. energy gap. Europe's ability to compete against the U.S. as a manufacturing centre is being damaged by rising energy costs as North America benefits from cheap natural shale gas - Germany's biggest

companies have warned. For instance, German industrial companies such as Bayer and BASF are among those alarmed over the gap. Some executives fear a growing divide between European and U.S. energy costs could see energy-intensive manufacturers divert investments that might have gone into Europe to the US instead.

2.4 Environmental considerations

Lot of has been written on environmental impacts of shale gas exploration. Just to briefly summarize - natural gas is cleaner when burnt than other hydrocarbon fuels - emitting less CO_2, particulate matter, sulfur dioxide, and nitrogen oxides, on average, than either coal or oil. Nevertheless, the use of new technology has led to other environmental concerns. These concerns pointed to water quality issues, including the substantial use of water during hydraulic fracturing as well as the potential contamination of water by chemicals and wastewater disposal. Concerns then incorporated other issues, such as land use changes, potential for induced seismicity from produced water injection, infrastructure requirements, and emissions of air pollutants from extraction operations and transport. These fears have led to some political opposition, and calls for regulatory actions and moratoria at the local, state or federal levels.

A tighter regulatory environment for natural gas exploration and production, if it raises costs significantly, would likely result in slower supply growth and could reduce some of the economic benefits described above. If demand increased as the result of expectations of rising supply and low prices, but then regulation slowed supply growth, a price would jumped up. A price hike could reduce market confidence and set back the use of natural gas, especially in the industrial sector as some companies in the industrial demand sector have made significant investments predicated on the supply being available and prices remaining low. However in general, it is difficult to generalize regarding the potential effect of regulations. For example projects that the capture of natural gas required under its new air rules could have a net positive benefit for natural gas producers because of the value of the gas that could be saved and sold.

Nevertheless, what can be surely stated is that the political sensitivity of environmental issues connected with shale gas production is such that a serious environmental incident could trigger a significant clamp down on shale gas production in a relatively short time period. If this happened and the US had to switch to become a net importer of gas, this would have a significant impact on the Atlantic LNG market, limiting and increasing the cost of LNG supplies to Europe. This shock might also have the likely knock-on effect of downgrading the outlook for unconventional gas production in Europe, and elsewhere in the world, limiting supplies of unconventional sources in the future.

3 Shale gas in Europe

Feasibility of shale gas exploration in Europe is tightly connected with its concerns about energy security as domestically produced shale gas could partially serve as an alternative fuel to gas imported to Europe nowadays.

Energy security links national security with the availability of natural resources for energy consumption and ability to react on domestic or external shocks so that demand for natural gas would be saturated. Next paragraphs should indicate whether there are some reasons for Europe for disconcerting itself reflecting expected future development of demand and supply side of European as well as global natural gas market.

Concerning the European demand for natural gas we should take into consideration several factors such as the share of gas in power generation, its relative costs of gas with other fuels, the

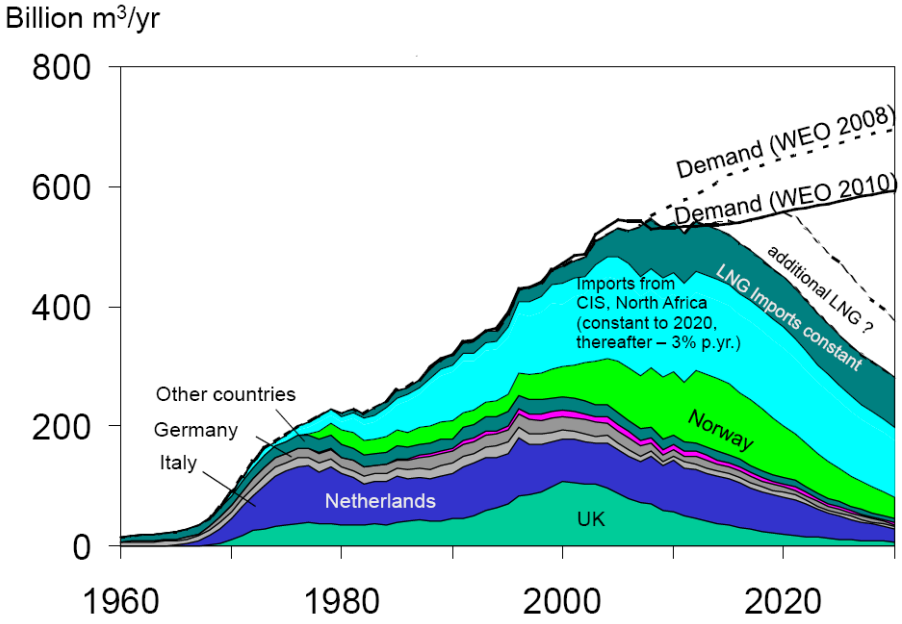
impact of European legislation on fossil fuels, the amount of RES power, nuclear capacity, the impact of carbon reduction policies in other areas and other factors that influence the price of gas. All these variables include large portion of uncertainty, which is then projected into the prediction of natural gas demand development.

This uncertainty can be illustrated by significant differences in predictions of gas demand in several scenarios for the EU countries:

- two EC scenarios in "EU Energy Trends to 2030 – Update 2009" suggest a change between -4% and 1% to 2020 compared to the level in 2009-2010 and between - 9% and -13% from 2010 to 2030;
- two IEA scenarios from WEO 2011 estimate increases from interval 8 - 17% to 2020 in comparison to 2009/2010 and from interval - 4% to 23% from 2010 to 2030.

On the supply side, projections, in general, suggest that European production gas in Europe will fall from app. 2015 onwards. And exactly this decline could be balanced by natural gas production from unconventional gas sources, if possible, to preserve sufficient "level" of energy security in Europe. As frequently discussed, the largest resources are expected to lie in Poland followed by Germany, the Netherlands, and France, even though estimates are subject to a high degree of uncertainty as the timing of the projects, their costs and resource accessibility are rather questionable. Resource accessibility has been questioned again after the recent withdrawal of ExxonMobil from drilling in Poland, which stated that the shale was too tight to use standard hydraulic fracturing techniques. Following figure illustrates expected development of demand and supply of natural gas in Europe and the need to replace missing production after 2015 by gradually growing imports.

Figure 5: Gas production and supply of Europe

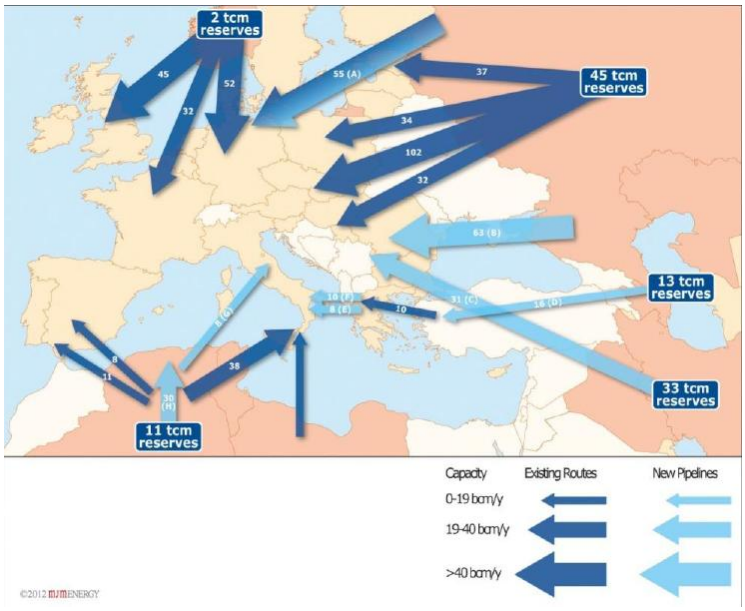


Source: Shale Gas – European Perspectives, ASPO Annual Meeting, Vienna, 30th May 2012

The European Union currently covers by imports around 60% of its needs of natural gas. 40% of this volume originates in Russia. Projections show import dependence in the EU rising to over 85% by 2035. Much of this forecasted increase is expected to be saturated by global LNG supplies, although several pipelines projects have been proposed to enhance import capacity to Europe. Some of these pipelines should provide new supply routes for Russian gas to Europe, flows of which the IEA predict to continue to grow, even if at a slowing pace. By 2030, the IEA

predict that Russian supplies to Europe should move around 200 bcm, up from app. 150 bcm today. (WEO 2011)

Picture 1: Existing and proposed European pipeline infrastructure



Source: Gas Security of Supply Report, Ofgem report to Government, November 2012

Supply of natural gas (and potential unconventional gas production) will be also affected by the way how the European NG markets will function, as well as by other the market and regulatory arrangements. Historically, most European countries have not had large domestic supplies of natural gas, and instead have tended to rely on imported gas using long-term, take-or-pay gas contracts (with certain flexibility to adjust gas flows). Additional security of supply and flexibility has been provided by gas storage facilities.

Key determinant for functioning of European NG market (and potential shale gas extraction, which will be influenced by relation between world NG prices and European costs of shale gas production) will be development on the world gas market. There the global demand for natural gas is projected to increase significantly by 19 - 27% over the period to 2020, and between a further 6 - 22% by 2035 (WEO 2011). This is driven largely by economic growth of non-OECD, primarily Asian, countries. Some estimates propose even higher growth - nearly 30% between 2020 and 2035 (IEA - Are we entering a golden age of gas?).

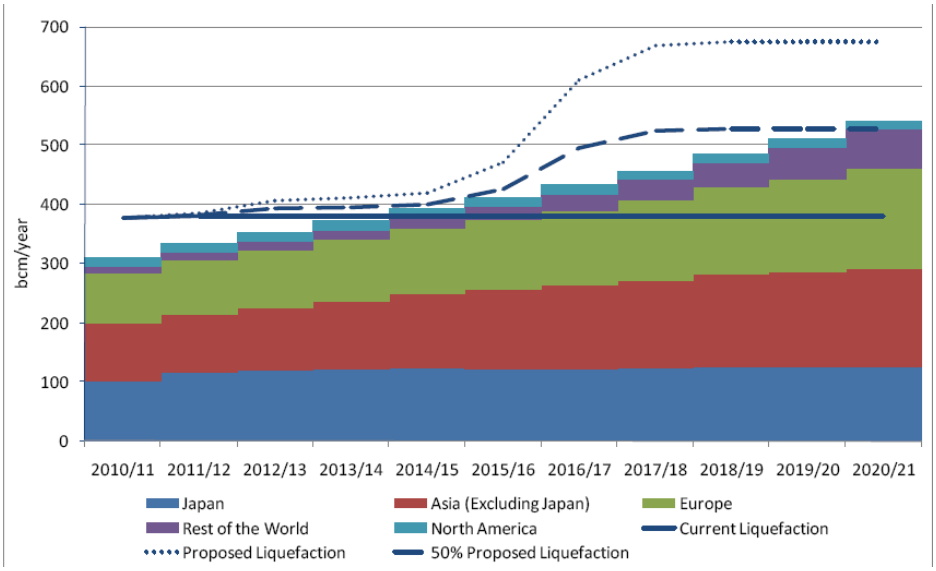
Nevertheless, currently it seems that world resources should be sufficient to meet even the highest demand projections **provided these resources can be developed and brought to market in right time.** While global gas production is projected to come primarily from conventional sources in 2035, under one of the IEA's scenarios – the New Policies scenario, the global share of unconventional gas production is expected to rise from 13% to 15% by 2020 and to 22% in 2035. Therefore *"...the abundance of natural gas means that resource levels in themselves do not present a security of supply risk"*... It is expected ...*"that NG production will become increasingly spread across the globe enhancing the role for inter-regional trade and transport infrastructure - in 2011, inter-regional trade of gas by pipeline and LNG was around 1 tcm (around one third of global gas demand) and is projected to grow by around 35% by 2017..." (Gas Security of Supply Report, Ofgem report to Government, November 2012).*

Functioning of world LNG market has direct impact on the European gas market and significant importance to security of supply and gas prices. Trade in LNG has grown substantially in recent years and is expected to continue to grow. As shown in following figure, Europe expects increasing LNG imports and will have to compete with other regions for LNG supply - in particular with Asia where demand is expected to grow rapidly. Of potential concern is the

possibility that, in the near future, LNG demand might grow faster than supply. Then LNG market could become increasingly tighter in the middle of the decade.

The figure below shows expected global LNG liquefaction capacity against forecast global demand. The large illustrated increase in liquefaction capacity around 2015 will occur if the large Australian LNG projects are launched. Fewer projects are realized more tighter markets are. Or whether and when this tightness materializes will depend on demand growth and any delays in new capacity. In particular, a prolonged slowdown in global economic growth could mitigate tightening.

Figure 6: Future LNG market tightening



Source: Gas Security of Supply Report, Ofgem report to Government, November 2012

Any tightness in the LNG market could lead to reduced availability of LNG on spot markets. This is because *"...significant amounts of LNG are already under relatively inflexible buyer-nominated long-term contracts ... in particular by Asian customers where market prices for sellers are favorable and suppliers will have to ensure these contractual commitments are met first before selling residual un-contracted LNG onto the spot market..."(Gas Security of Supply Report, Ofgem report to Government, November 2012).* The tightness could make LNG spot cargoes harder to use them to resolve the impact of potential domestic and external shocks to gas supplies and therefore constitute a threat for European energy security.

Lack of domestic resources and the need to import natural gas from abroad requires necessary investments in gas infrastructure, LNG facilities, transmission pipelines or storage. Activities in this area are influenced by several behavioral aspects, which distort market environment and decrease efficiency of results.

The first aspect is short-termism that results in investors placing greater weight on near-term earnings than those further in the future, i.e. market participants do not respond rationally in investment decisions. Concerning infrastructure investments (gas storage, import terminals, i.e.) short-termism causes investors to follow strategies maximizing short-term profits. Such a strategy is likely to overlook large infrastructure investments that have payback periods over many years.

Besides, investments in gas infrastructure are highly capital intensive. This means there are specific challenges around financing such investments when returns are dependent on volatile and uncertain prices. This could lead to equity investors requiring a higher rate of return for their investments or limit the level of gearing that investors can apply to the project. Both these effects are likely to lead to an increase in the cost of capital for the investment. A higher cost of capital

will affect whether a project goes ahead or not. The lack of infrastructure projects will also negatively affect European energy security.

The previous paragraphs identified key threats for energy security of European countries – growing import dependency, certain rigidity in conditions of LNG supplies, growing demand of Asian countries, insufficient investment incentives etc. Some of these issues could be partially solved by indigenous shale gas production. However, as energy policies of EU member states differ reflecting their not equal footing concerning energy sources reserves so do even their attitudes towards shale gas extraction. Following part assesses positions of particular member states and their impacts on European NG market.

3.1 EU level

Within the EU, member states are aware of substantial impacts that shale gas has had in the US on energy prices, energy security and job creation. However, they continue to take very different positions on shale gas exploration, driven by their own political agendas, and shaped by their individual energy policies and energy security concerns. Environmental issues continue to dominate headlines and influence the debate.

Position of the EU is expressed via documents produced by the EU authorities:

- ✓ The Energy Roadmap 2050 – published in December 2011

  The EU is committed to reducing GHG emissions to 80 – 95% below 1990 levels by 2050, and the Commission's own projections show that current energy policies will deliver barely half of that target. The EU is therefore exploring the challenges of decarbonisation. The aim of the Roadmap is to develop a long-term European framework for energy supply which would complement national, regional and local efforts to modernize energy supply. In the Roadmap the Commission confirmed that gas has a key role to play in the transition to decarbonisation, and that gas could become a low-carbon technology if CCS becomes commercially available on a large scale basis.

- ✓ The European Commission's study on the legal framework for shale gas

  In January 2012 the EC published its study on the legal framework for shale gas. The study concluded that the existing regulatory framework in Europe is adequate for shale gas activities as they currently stand and that a new directive dedicated to shale gas is not immediately required. Existing EU and national laws cover, for example, authorizations for exploration/production, water protection and the use of chemicals. The requirement for an Environmental Impact Assessment as well as public access to environmental information is covered by general legislation (the Environmental Impact Assessment Directive and European legislation implementing the Aarhus Convention).

3.2 Poland

The latest development in the field of shale gas in Poland does not speak in favor of this unconventional energy source much even if Polish government proclaimed shale gas exploration and extraction is its priority. So far, 111 exploration concessions have been granted to about 30 companies, both state-owned and international, on a territory of more than 35,000 square miles – nearly a third of the country. However, despite the enormous infusion of capital and promises that production could start as early as 2015, Poland's gas industry has not taken off yet. Impeded by difficult geology, weak service sector, lack of adequate infrastructure, as well as uncertain regulatory and tax environment, there have been few exploratory wells drilled. That has delayed assessment of the actual size of reserves and left in doubt whether the industry could ever be commercially viable.

Just to remind - in 2011, the U.S. EIA published figure of 5.3 tcm of gas in estimating the natural gas reserves in Poland, which generated the initial burst of political and investment enthusiasm. Then in 2012, the Polish Geological Institute together with the U.S. Geological Survey, using stricter methodology, decreased those figures by a factor of 10.

Studies have offered various growth scenarios, but all of them agree that if Poland's shale gas industry is to have a real economic impact, a substantial number of wells would be necessary. The Kosciuszko Institute assumes that Poland would drill an average of 500 wells per year to create 155,000 jobs over a period of 10 years. The Oxford Institute for Energy Studies has calculated 700 to 1000 drillings per year. That is much more than Poland has already drilled. Over a period of three years, only 33 test wells were drilled, with 10 of those hydraulically fractured, out of which just two were horizontally drilled and fracked – the definitive procedure for assessing potential.

Results have not been encouraging. Exxon Mobil withdrew from Poland in 2012, saying its wells had failed to demonstrate sustained commercial hydrocarbon flow rates, while ConocoPhillips relinquished its 70% option in three concessions in northern Poland, although it retains three more. Moreover, it has been reported that Canada-based Talisman Energy also has started talks to sell off its Polish exploration licenses.

Meanwhile, with market uncertainty growing, the share price of small independent companies engaged in unconventional gas exploration in Poland has dropped significantly, which has forced them to nearly halt operations.

In addition, Polish shale gas has proved to be on average 1.5 times deeper than most formations in America. Even with higher gas prices in Europe, this makes the commercial viability questionable.

And the last barrier - the government has made plans to introduce a new hydrocarbon law that would give the state a minority stake in each concession and would, reportedly, raise taxes to around 40 percent of gross profits. The idea is to have legislation comparable to that in Norway, Denmark and the Netherlands.

3.3 U.K.

The U.K. has been the best informed Member State in that it was the first to carry out detailed studies on diverse aspects of shale gas exploration and production. A UK Select Parliamentary Committee report in May 2011 concluded that there is no direct risk to water aquifers, so long as the well-casing is intact. Concerns were however raised following seismic activity near Cuadrilla's drilling site in Blackpool, in the North West of England in spring 2011. A report published by the British Geological Survey in December 2011 concluded that it was highly probable that the seismic activity resulted from Cuadrilla's activities, but that it was too low to feel. As a response the Department of Energy & Climate Change issued a draft report on the seismic events in April 2012, recommending that hydraulic fracturing be allowed to continue with appropriate safeguards and mitigation measures.

Another rather positive report was elaborated on probability of water contamination.

In summary, UK currently does not see the need for further EU or U.K. legislation on shale gas activity, it simply requires the freedom to explore and understand the extent of its shale gas opportunity.

3.4 France

In France, shale gas activity stalled in July 2011, with a ban on the exploration and exploitation of hydrocarbons by hydraulic fracturing (the technology used to extract the shale gas) and the

cancellation of exploration permits which had been granted. However, in March 2012 the government published its expert study, which was clearly in favor of exploration. At the same time it issued a decree setting up a National Commission of Orientation to evaluate the environmental issues involved in shale gas.

3.5 Ukraine

On January 24, 2013 in the presence of Ukrainian President Viktor Yanukovych and Prime Minister of the Netherlands Mark Rutte, the Ukrainian government and Royal Dutch Shell signed a shale gas deal on the development of the Yuzivske field as part of the World Economic Forum in Davos. The deal, reportedly worth USD 10 bn, contains a production sharing deal for 50 years. It is the biggest contract in Europe to extract natural gas. Besides, the production-sharing agreement could become by far the largest foray by foreign investors into the state of former Soviet Union. It is a potentially big step in reducing Ukraine's reliance on costly imports from Gazprom in what is the Russian monopoly's largest foreign customer.

The agreement could also help restore momentum to efforts to develop unconventional and shale gas in Europe. These have been hit by environmental moratoriums in several countries on the controversial "fracking" technology used to exploit shale gas, and downgrades of reserve estimates.

Ukraine, estimated to hold Europe's third-largest shale gas reserves, hopes to lead the way in Europe in repeating the North American shale gas boom that has transformed the US in the past decade from net importer to prospective gas exporter.

Shell won the right last May to explore shale and other unconventional gas resources in eastern Ukraine's vast Yuzivska field, which by some estimates could hold as much as 4 tcm of natural gas and coal-bed methane. The agreement allows exploration to begin this year, with an initial investment by Shell of USD 400 mil. Some opposition parties are protesting over the environmental risks of shale gas. But Mr Yanukovich appears to have sufficient command over government and parliament to push ahead.

Kiev's focus would now shift to signing production-sharing agreements with two US energy giants. Chevron won a second tender last year to explore shale gas opportunities in western Ukraine, though it faces much stronger local opposition. An ExxonMobil-led consortium, also including Shell, was chosen to explore for gas off Ukraine's Black Sea coast.

3.6 Romania and Lithuania

Romania and Lithuania have followed Ukraine in giving high-level backing to shale gas exploration, in a sign the political tide may be turning as central and eastern Europe looks to break free from reliance on Russian energy. Romania last week reversed a de facto freeze on "fracking", after the prime minister said he supported shale exploration. It issued planning certificates to Chevron to explore for shale gas in eastern Romania.

Samely, Lithuania's president gave support to planned shale exploration, also by Chevron, despite opposition from some parliamentarians and environmentalists. Both the president and prime minister had acknowledged the importance of conducting exploration activities, so that Lithuania is able to understand more about its hydrocarbon potential. However, they also stressed the importance of protecting the environment and working closely with local communities.

The developments came days after Ukraine signed a breakthrough deal with Royal Dutch Shell to explore for unconventional gas in the former Soviet republic.

Development of domestic gas resources could threaten the energy dominance of Gazprom. Analysts caution, however, that the projects are early-stage, with any production years away.

Central and eastern Europe are thought to hold some of the continent's most promising shale reserves. Momentum was then lost after several countries followed France in imposing moratoria on fracking, often amid local protests. ExxonMobil of the US last year pulled out of shale exploration in Poland, one of the biggest shale gas enthusiasts, after disappointing results from test wells. But recent developments suggest the lure of lower energy prices and escaping Russia's grip may be emboldening political leaders to try to win the environmental arguments.

Chevron, which has made a strategic push into shale gas in central Europe, won a tender to explore three shale gas blocks in Romania last spring. But work was suspended after environmental protests proposed a fracking moratorium. Though Romania's upper house did not support the moratorium, the issue remained in limbo until December's 2012 election. After election the prime minister backed moving ahead with shale. He stated that he supported exploration. Then, once it was confirmed that gas resources were or were not there (about five years) the Romanian government would make a final decision to exploit shale gas, in compliance with all European and international environmental standards. The issue also is that Romania risked losing competitiveness against Poland – pressing on with shale exploration despite Exxon's departure – and could not ignore the possibility of cheaper energy.

Lithuania, like Ukraine, gets all its natural gas from Russia and complains about a higher price than many west European customers pays. It became even more reliant on gas after closing its Ignalina nuclear reactor in 2009. Some geologists estimate Lithuanian shale gas reserves could be enough to meet its needs for 60 years.

4 Conclusions

The aim of this report was to summarize and analyze the latest data and news in the shale gas exploration and production industry and its consequences for global NG, particularly LNG market. Concerning the U.S., most experts see the changes in the natural gas industry as positive to the overall U.S. economy. Industries that use natural gas as an input have seen prices fall. Producers have expanded the U.S. resource base tremendously, including for oil. Low prices have forced producers to be innovative and drive down production costs. Similarly, environmental concerns are prompting companies to be more proactive in addressing these issues. Also responding to environmental concerns, a number of major natural gas and oil producing states have revised their rules, which has not appeared to have inhibited production in those states.

Concerning assessment of the impacts of this shale gas revolution on European gas market one must be more careful. It is clear that replication of U.S. success in Europe is not achievable. If there were some shale gas reserves discovered, economics of their exploration would be questionable. Europe can then benefit from the development in other parts of the world. The more gas produced, the lower price for European customers – however, only in case of liberalized trade with this commodity. For the time being, unless export of U.S. natural gas is approved, the European industries will lose because of their high production costs in comparison with the U.S. From this point of view, the shale gas revolution has not brought substantial benefits to Europe.

As was stated above in particular chapters, future development will depend on many factors – macroeconomic development of supplying as well as demanding countries, regulatory environment, development of technology in the field of production or environment protection etc. Therefore at least next five years will be telling whether proposed projects will be either realized, be postponed, or cancelled. Investment decisions are being made given under existing conditions and future expectations about the development on the market. Currently, there is too much unknown variables that even expert are not sure about their predictions and forecasts of future development greatly vary among different institutions.