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Security Dimensions. International & National Studies nr 2 (12), 46-68

2014

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SECURITY DIMENSIONS
INTERNATIONAL & NATIONAL STUDIES
NO. 12; 2014 (47-68)

SHORT INTRODUCTION TO SHALE GAS EXTRACTION AND PRODUCTION IN POLAND

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ABSTRACT

The economic significance of shale gas in Poland cannot be underestimated. In 2010 Poland was considered among the most promising of European countries for replicating the American shale gas boom. A study undertaken in 2011 by the United States Energy Information Administration placed Poland first among European countries in terms of technically recoverable reserves. Later reports downgraded the estimate of recoverable gas. In the EU member states were increasing reliance on imports from outside the EU, especially from Federation of Russia. For instance France currently imports gas from Algeria, the Netherlands, Russia and Norway, the UK from Norway and the Netherlands and LNG from Qatar. In addition, geopolitical factors may make shale gas in the EU more expensive to produce, and there are also infrastructure challenges. Other challenges include fracking litigation both in the United States and UK with the potential aftermath for European courts. In the United States, landowners often stand to benefit financially from drilling on their property—if they own the underground resources, they may receive a bonus or royalties upon leasing to an oil company in order to develop the resources. On the other hand, among the many obstacles in further development of shale gas might be the possible impacts of hydraulic fracturing on the environment and on human health.

ARTICLE INFO

Article history
Received: 29.08.2014 Accepted 03.11.2014

Keywords
shale gas extractions and regulation, European Commission, gas prices, federal regulation in the USA, environmental, risk, hydraulic fracking litigation in the USA & UK.

"*America and Europe have done extraordinary things together before. And I believe we can forge an economic alliance as strong as our diplomatic and security alliances—which, of course, have been the most powerful in history. And, by doing that, we can also strengthen the multilateral trading system. So this Transatlantic Trade and Investment Partnership is going to be a priority of mine and my administration*."

U.S. President Barack Obama, on the Transatlantic Trade and Investment Partnership,
Lough Erne, Northern Ireland,
June 17, 2013

This paper provides an analysis of the legal, policy, and environmental challenges associated with the development of shale gas in the EU and the USA in the aftermath of Crimean crisis, and describes the prospect of exploration of hydrocarbons in Poland.[1] At the present European shale gas, including Poland is expected to be at

[1] Unfortunatally we can not present the results of planned very interesting and importantUnconventional Gas & Oil Summit, which will take place on 2 - 4 June 2014, London, UK. This event is one of the leading international

least twice as expensive to extract as in the US due to deeper geological layers, tougher regulations and a less competitive and more oligopolistic oil and gas service sector.

The paper also explains the importance of shale extraction for public environmental rights and environmental protection and assesses the energy sector and economic impacts of the shale gas in the EU along with the potential for the member states to successfully replicate the US expertise. In addition, the paper discusses American and European laws, fracking litigation in both USA and UK, along with regulations that affect EU member states, which have developed a different legal environment concerning shale gas. It must be stated that the present European regulation concerning hydraulic fracturing, which is the core element in shale gas and tight oil extraction, has a number of problems because gaps the threshold for environmental impact assessments to be carried out on hydraulic fracturing activities in hydrocarbon extraction is set far above any potential industrial activities of this kind in the EU.

In the final remarks it is observed that the future of shale gas in Europe will depend on its production costs, and thus it remains uncertain and surely more seismic testing, well sinks and further economic analysis are required to forecast whether Europe's shale plays will be as productive as those in the US.

INTRODUCTION

It will be helpfull to define the subject matter of our investigation. Conventional gas reservoirs are created when natural gas migrates toward the Earth's surface from an organic-rich source formation into highly permeable reservoir rock, where it is trapped in sedimentary rocks formed by the solidification of mud deposits in ancient tidal flats and deep water basins and belongs to the category of unconventional natural gases, which also includes coal-bed methane, gas from tight sandstones („tight gas") and methane hydrates.[2] Gas-producing shales are predominantly composed of consolidated clay-sized particles with a high organic content. High subsurface pressures and temperatures convert the organic matter to oil and gas, which may migrate to conventional petroleum traps and also remains within the shale. However, the clay content severely limits gas and fluid flow within the shales Shale gas is considered an unconventional source as the gas is contained in difficult-to-produce reservoirs, which require special completion, stimulation and/or production techniques to achieve economic production.[3] We shale noted that shale formations and other tight plays can also produce crude oil, lease condensates, and a variety of liquids processed from wet natural gas.

Recent technological advancements have spurred a rapid, commercial-scale extraction of unconventional fossil fuels in the United States (hereinafter called as **U.S.)** and there is no commercial-scale exploitation in the Euroepan Union (hereinafter called as **EU**). The most important techniques deployed in unleashing potential of shale gas and coal bed methane are horizontal drilling and hydraulic fracturing (fracking) –, which have been used in combination for just a decade, and should not be confused with well stimulation techniques used for the extraction of conventional fossil fuels due to the combination of these two techniques and the scale of intervention involved.[4] Hydraulic fracturing is a common practice in oil and natural gas development—90 percent of oil and gas wells in

conferences exploring the latest trends in unconventional gas and oil

[2] Natural gas seeping from rocks was first reported in 1669 in Ontario County, New York, by the French explorer, Mr de La Salle, and a French missionary, Mr de Galinee. Shallow shale gas formations were also first exploited in New York, with the first commercial natural gas well drilled in Fredonia in 1821 by William Hart, a local gunsmith. By the 1880s, natural gas was widely used in the State of New York for lighting and heat and to supply energy for the drilling of oil wells.

[3] See more at http://www.energy.alberta.ca/NaturalGas/944.asp

[4] Any type of fossil fuel and minerals extraction involves potential risks for human health and the environment; whereas it is essential that the precautionary principles are applied to any future decisions about the development of fossil fuel resources in Europe, taking into account potential impacts from all stages of the exploration and exploitation process

the U.S. undergo fracturing to stimulate production. It has been used since the 1940s in more than 1 million wells in the United States. In hydraulic fracturing, a fluid comprised of more than 99 percent water and sand and less than 1 percent chemical additives is pumped down the well at a high pressure for a short period of time, usually hours. This creates a network of cracks in the rock that allows trapped natural gas to flow to the well. The sand helps keep the fractures open and gas flowing[5]

Shale gas has become potentially important new sources of supply in Europe[6] and substitution of coal and oil with gas in the short to medium term could help to reduce GHG emissions depending on their Lifecycle, but it must be stressed that by 2035, shale gas is estimated to be meeting no more than between 3-10% of EU gas demand.[7] Europe's energy service industry and rig counts are much smaller; its geology – and land access – are less accommodating; public acceptance is less of a given; urban density is far higher; and environmental regulations are more stringent.

ASSESSMENT OF SHALE GAS RESOURCES WORLDWIDE

Energy Information Administration (hereinafter called as **EIA**) agency of the United States Department of Energy (hereinafter called as **DEO**) estimated for 2013 a total "wet natural gas"[8] resource of 2,431cubic feet (Tcf), including both shale and conventional gas. Shale gas was estimated to be 27% of the total resource.[9]

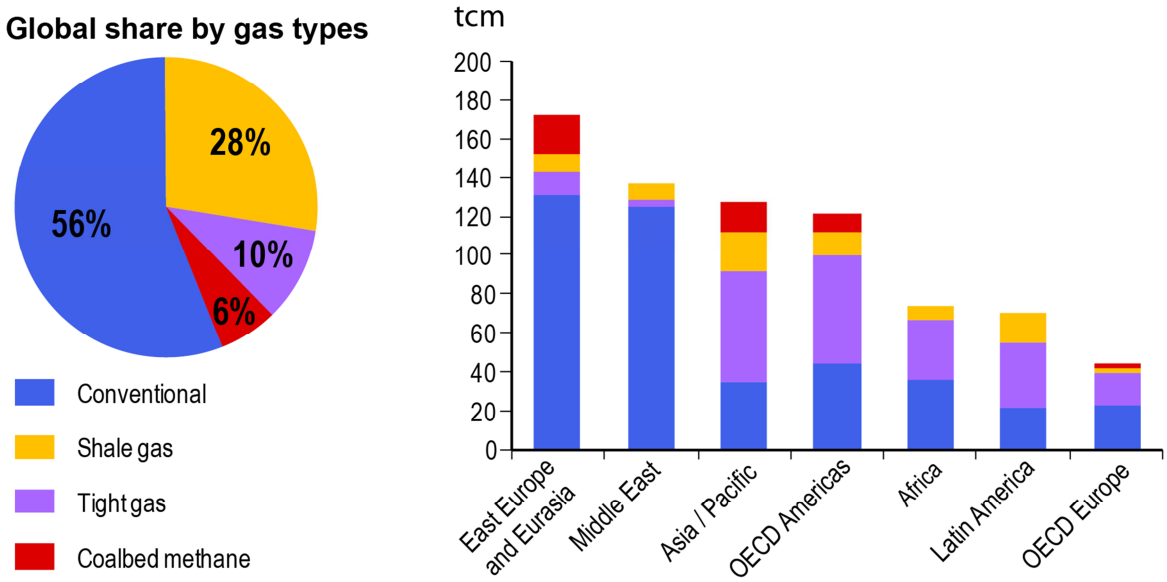


Figure 1. Assessment of global share
Source: (US) Energy Information Administration

[5] See more at http://www.chevron.com/deliveringenergy/naturalgas/shalegas/howweoperate/

[6] In 2012, the EU imported 34% of its natural gas from Russia, according to the Congressional Research Service. Germany, the largest gas consumer, obtained 40% of its gas from Russia, while other nations, such as Finland, Sweden, and the Baltic states relied on Russia for 100% of its gas imports

[7] Even under the most optimistic scenarios for shale gas exploitation, the EU would remain a significant importer of gas and oil and EU prices would continue to depend on high international prices http://www.euractiv.com/specialreport-industrial-renaiss/Europe-abandons-shale-gas-revolution-news-533546

[8] "Wet natural gas" is methane plus natural gas liquids, and is more valuable than dry gas

[9] Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States". *Analysis and projections*. United States Energy Information Administration. 13 June 2013.

In an initial assessment of shale oil resources and an update of shale gas reserves, shale deposits could add 345 billion barrels of oil to global reserves, increasing the total to 3,357 billion barrels according to the EIA predictions.[10] Shale gas added 7,299 trillion cubic feet of natural gas, or 32 percent of the world total, according to the EIA report estimatations. The biggest resources can be found in China (1,115 trillion cubic feet)[11], followed by Argentina (802 trillion cubic feet) and Algeria (707 trillion cubic feet) and the United States ranks fourth with 665 trillion cubic feet.[12]

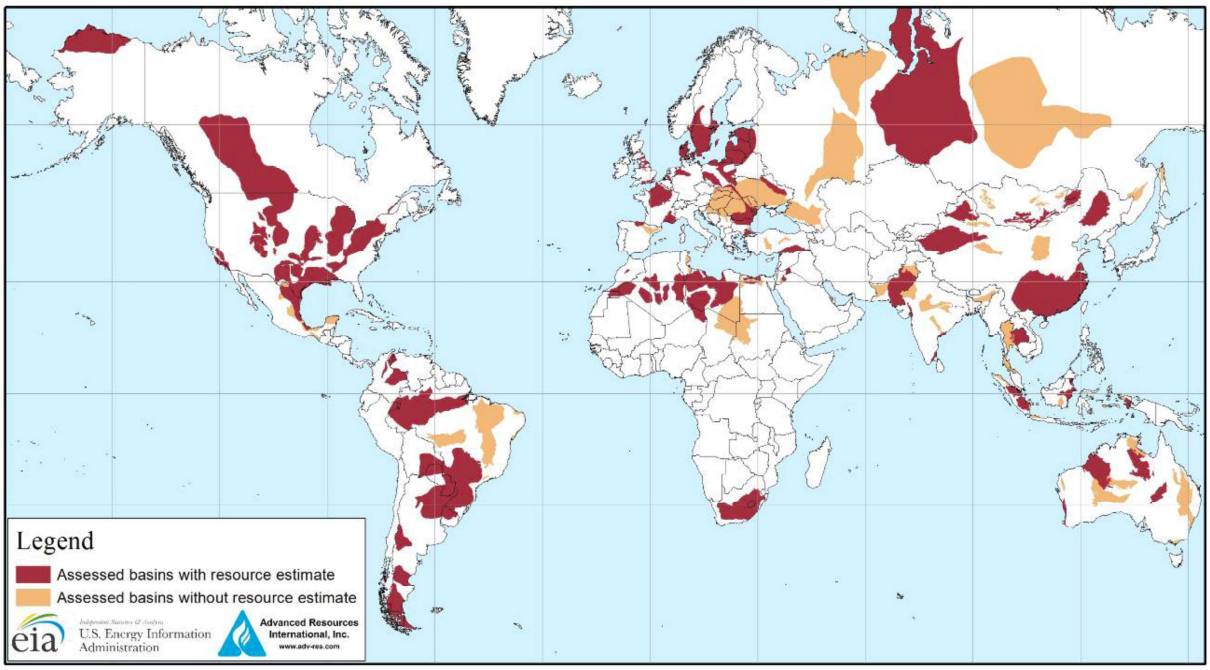


Figure 2. Map of basins with assessing shale oil and shale gas formations May 2013
Source: United States basins from the U.S. Energy Information Administration and United States Geological Survey; other basins from ARI based on data from various published studies

[10] (US) Energy Information Administration (EIA) (2013a), "Europe's Energy Security: Options and Challenges to Natural Gas Supplies Diversification", Washington, D.C.

[11] In 2012, China consumed an estimated 10.2 mb/d, namely about 11.5% of the total world demand for oil. Between 1992 and 2012, the Chinese oil consumption increased from roughly 2.6 mb/d to 10.2 mb/d, i.e. + 292% (EIA, 2014). The IEA estimates that the pace of China's oil demand should grow by an average of 3.7% per year until 2020. Starting from that year, the Chinese appetite for oil should increase by only 1.3% per year (IEA, 2013).

[12] EIA, Technically Recoverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, June 2013, p. 10,

ASSESMENT OF SHALE GAS RESOURCES AND LEGISLATION IN CHINA

Already in 2010, the Chinese government began to explore shale gas production. While there are no official statistics, it is estimated that China has over 1,275 trillion cubic feet of shale gas deposits.[13] China has seven major onshore shale basins (see map below). Two basins —Sichuan and Tarim both wel*l* suited for commercial development and containing marine shale with sufficiently high organic content and sufficiently low clay content to make the quality of the natural gas (based on the organic matter) worth the development costs.[14]

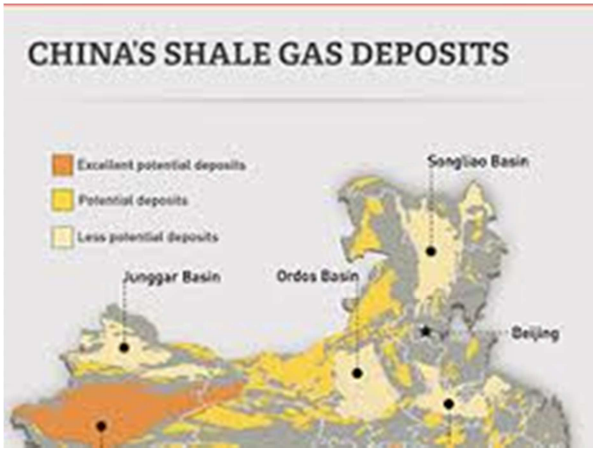


Figure 4. Shale gas deposits in China
Source: The Wall Street Journal

Shale gas could be China's largest onshore source of energy, and the country is looking to develop this resource in order to decrease dependence on foreign natural gas sources from Russian, regardless signing on May 25th 2014 a deal with Gazprom.[15] China and Russia signed natural gas supply deal worth US$400 billion, and under the agreement, Russia's Gazprom will supply China National Petroleum Corporation China's largest oil company, with 38 billion cubic metres of gas annually for 30 years, with implied price was $350-$390 per 1,000 cubic metres of gas, beginning in 2018.[16]

According to the EIA China has 1,115 trillion cubic feet, or 36 trillion cubic meters, of recoverable shale gas resources in two basins Tarim and Sichuan, located in northwestern and southwestern China, respectively.[17] No meaningful exploration has begun in the Tarim Basin due to its rough terrain and lack of water. The country plans to raise annual shale-gas output to 6.5 billion cubic meters by 2015 and as much as 100 billion cubic meters by 2020, but it could reach barely a 10th of its 2020 target.

China's latest five-year plan places great emphases on the exploration of non-traditional/alternative energy sources, such as coal seam, petroleum gas and oil sands. China's target is to fulfill most of its energy needs from alternative sources by 2020. As part of this strategy, China plans to enter into strategic partnerships with foreign companies in order to help China acquire the skills and technologies needed to develop and exploit its shale gas reserves. China's shale gas deposits are geographically different than those in the United States, and so it is uncertain if U.S. methods of retrieving the gas can be duplicated. While water is relatively abundant in the Sichuan province, it is also needed to support agriculture in the region, which supplies 7 percent of China's rice, wheat and grains. China's Ministry of Resources has invited some major oil and gas companies to pitch for shale gas exploration work, offering four

[13] http://thinkprogress.org/climate/2011/10/24/350356/china-shale-gas/

[14] The Chinese government thus far has only issued permits for the Sichuan basin, which is located much closer to China's urban and industrial demand markets and therefore offers a much better business case for developers http://thinkprogress.org/climate/2011/10/24/350356/china-shale-gas/

[15] An intergovernmental deal, to be negotiated by the end of the year, would confirm that both countries would effectively subside the contract through tax exemptions

[16] The agreement could pave the way for even more gas export deals. Once developed, the east Siberian fields will supply not only the China pipeline but also a planned liquefied natural gas plant in Vladivostok, which will export LNG to China as well as other Asian countries such as Japan, Korea and Taiwan http://www.ft.com/cms/s/0/d9a8b800-e09a-11e3-9534-00144feabdc0.html#axzz32oZAXNt8

[17] U. S. Energy Information Agency Technically Re coverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, June 2013; see more at http://online.wsj.com/news/articles/SB10001424127887323401904578156710038647662

licenses[18] for exploration in western China. As shale gas production is in its infancy, there is no regulatory framework in place in China. We should remember that shale is a very-low-permeability reservoir rock that must be fractured to allow conduits for gas to migrate to the production well bore. This is typically accomplished using multiple horizontal wells drilled from a common well pad, with multiple slickwater hydraulic fracture treatments in each (from as few as 5 to more than 20 fracture treatment stages per well). Because of the very low permeability of shale, minimum well spacing of 40 to 80 acres37 or less is required—much closer than well spacing for conventional gas drilling, which is typically 160 acres or more.

China is pursuing joint ventures with foreign companies to help build up know-how in shale gas exploration and extraction, and it appears likely that the Chinese government will continue to promote and support shale gas development.[19] The shale gas initiative with the United States from 2009 led to multiple U.S.-China industry partnerships. Chevron, Shell, BP, EOG Resources, Newfield Exploration, ConocoPhillips, Schlumberger, and Baker Hughes and other foreign firms:

a) Royal Dutch Shell has taken the lead among major IOCs, signing China's first shale gas PSC for the Fushun-Yongchuan block in the Sichuan basin. It is planning to spend US$ 1 billion per year to develop shale gas resources in the country;
b) other prominent IOCs involved in China include ExxonMobil, Chevron, ConocoPhillips and Eni. ConocoPhillips and Eni have entered into JSAs with PetroChina and its parent company CNPC as part of overseas farm-in deals. These can be converted into PSCs if commercial discoveries are made during exploration.

As shale gas has been identified by the Chinese authorities as a new type of mineral resource, it is subject to a separate legal regime from conventional oil and gas. To date, a clear regulatory framework and detailed regulations for shale gas are lacking. However, Chinese authorities have started to build on the existing regulatory system by issuing some regulations and policy statements in relation to shale resources. China's shale gas sector is regulated mainly by four major governmental authorities, namely, the MLR, the NDRC, the National Energy Administration (NEA) and the Ministry of Finance (MOF). MLR is responsible for the general administration of mineral issues, from organising the researching and planning of potential shale gas production blocks to the registration and issuance of exploration and prospecting licences. NDRC is involved in designing the pricing system for oil and natural gas and is expected to introduce reforms in the pricing mechanism for shale gas in the near future. MOF is responsible for providing fiscal support to the shale gas players in the prospecting phase.

The current legal framework is based on the Notice Regarding the Strengthening of Shale Gas Exploration, Prospecting, Supervision and Administration (the Notice) circulated by MLR following China's 12th Five-Year Plan for Shale Gas. The Notice serves as a guideline to both private enterprises and local governmental administrative authorities engaged in shale gas activities. In the Notice, MLR emphasised the strategic importance of shale gas as a clean energy source and urges better regulation for the market to ensure its healthy and sound development in the long run. MLR is responsible for the administration and registration of shale gas exploration and prospecting rights. The exploration rights will mainly be conferred by public bidding and licensing. All parties are encouraged to participate in exploration activities as long as they are independent entities with sufficient funding and hold, or partner with the holders of, licences for exploration of oil, gas, or any other kinds of gas minerals. Foreign enterprises with shale gas mining and exploration technology are especially encouraged to create

[18] Licences authorise a certain entity with the exclusive right of exploration and/or exploitation of hydrocarbons in a specific geographical area for a defined time.

[19] *China Begins to Tap Its Shale Gas, Despite Daunting Technological, Environmental Hurdles*, New York Times, October 14, 2011.

joint ventures to invest and actively participate in the industry to promote further growth.[20]

On 26 October 2012, the Ministry of Land and Resources ("MOLAR") issued a Notice Regarding the Strengthening of Shale Gas Exploration, Prospecting, Supervision and Administration,[21] which has been effective for five years and spells out in broad terms the requirements and guidance of MOLAR for establishing and granting shale gas exploration rights and exploitation rights, as well as for the exploration and exploitation activities of the right holders. In particular, the Notice gives existing holders of conventional oil and gas, mining rights three months from the date of its issuance to apply to MOLAR for amendment of their mining rights, to include shale gas deposits located in the blocks covered by such mining rights. It further provides that failure to apply for such amendment may result in MOLAR granting mining rights over such shale gas deposits to new applicants. The Notice also requires an exploration right applicant to provide MOLAR with an undertaking as to its investment amount, work commitments, work progress, relinquishment, liability for breach and similar matters. This requirement applies both to amendments of existing licenses (to add shale gas) and grants of new licensees through bidding rounds. On 30 October 2013, the National Energy Administration ("NEA"), which is part of the National Development and Reform Commission ("NDRC") and regulates the energy sector, issued a Shale Gas Industry Policy ("Policy"). The Policy contains, among other things, general principles on industry regulation and policies on industry technologies, markets, transportation, energy conservation, environmental protection and fiscal support. For example, the Policy encourages diversified investors (including private companies) to invest in shale gas exploration and development and requires market pricing of shale gas "*ex-works*". The Policy also encourages Chinese companies engaged in shale gas exploration or development to co-operate with "*foreign entities with advanced shale gas technologies*" in order to bring to China their shale gas exploration and development technologies as well as their production and management expertise.

It should be reminded that U.S. President Barack Obama and Chinese General Secretary Hu Jintao recognized the importance of shale gas development to their nations by agreeing to the U.S.-China Shale Gas Resource Initiative in November 2009 which fosters cooperation between these two nations by providing U.S. assistance to assess, develop, and promote investment in China's shale gas reserves and to help develop operational best practices and effective environmental safeguards in China.[22]

[20] *Shale gas handbook A quick-reference guide for companies involved in the exploitation of unconventional gas resources*, Rose Fulbright – November 2013, p. 50

[21] See more at http://www.lehmanlaw.com/resource-centre/faqs/energy-and-resources-law/energy-and-natural-resources.html

[22] http://www.americanprogress.org/issues/green/report/2011/10/21/10407/making-fracking-safe-in-the-east-and-west/

TABLE 1
Shale gas production in China and United States

	China	United States
Shale gas reserves	1,300 trillion cubic feet	862 trillion cubic feet
Shale gas production 2010	0	4.8 trillion cubic feet
Shale gas production 2015	229 billion cubic feet*	7.2 trillion cubic feet
Shale gas production 2020	2.8 trillion cubic feet*	8.2 trillion cubic feet
Major environmental threats from shale gas production	Methane, carbon dioxide and hydrogen sulfide release; water use in a country already facing severe water shortages	Surface and groundwater contamination; air pollution; methane release
Primary regulatory body	China does not yet have a specific regulatory framework for shale gas, but the critical regulators will be the Ministry of Land and Resources (exploration permits), the Water Ministry (water use and wastewater treatment), and the Ministry of Environmental Protection (emissions monitoring)	States regulate toxic chemical disclosure, groundwater contamination; Federal govt. sets air and water pollution standards; no controls on methane

*=Chinese targets based on the latest proposals from China's National Energy Administration. They do not yet have higher-level approval, and senior leaders may reduce them to account for environmental and water conservation concerns. These NEA targets are included to illustrate China's intentions rather than provide an accurate projection of future shale gas production.

Sources: Energy Information Administration; CAP research

Figure 5. comparison of shale gas production in China and the U.S.
Source: United States EIA

ASSESSMENT OF SHALE GAS RESOURCES IN THE UNITED STATES

Application of fracturing techniques to stimulate oil and natural gas production began to grow in the 1950s, although experimentation dates back to the 19th century. The application of horizontal drilling to oil production began in the early 1980s, by which time the advent of improved downhole drilling motors and the invention of other necessary supporting equipment, materials, and technologies, particularly downhole telemetry equipment (i.e., measurement-while drilling) brought some applications within the realm of commercial viability. The proliferation of drilling activity in the Lower 48 shale formations has increased dry shale gas production in the United States from 0.3 trillion cubic feet in 2000 to 9.6 trillion cubic feet in 2012, or to 40 percent of U.S. dry natural gas production. Dry shale gas reserves increased to 94.4 trillion cubic feet by year-end 2010, when they equaled 31 percent of total natural gas reserves.[23]

In 2000 shale gas provided only 1% of U.S. natural gas production; by 2010 it was over 20% and unconventional gas production grew at a rate of 48% between 2006-2010.[24] By 2035 the U. S. will produce 342 billion cubic meters of shale gas or 47% of its total gas production as opposed to 16% in 2009.[25]

[23] U. S. Energy Information Agency Technically Re coverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States, June 2013

[24] NATO Parliamentary Assembly, The Economic and Strategic Implications of the UNCONVENTIONAL Oil and Gas Revolution, 11 March 2013

[25] US natural gas production will increase by an estimated 44% in the next 25 years, and the majority of this will be due to exploitation of shale plays. World Pipelines Volume 14 number 3 2014

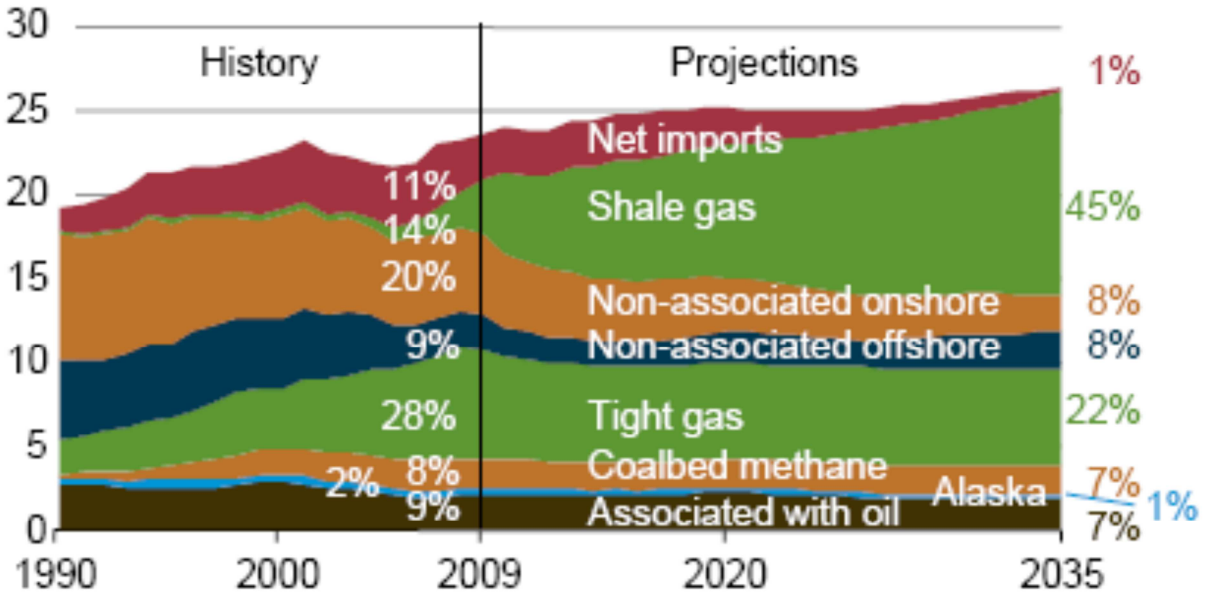


Figure 6. US gas supply 1990-2035 (trillion cubic feet / year)
Source US Department of Energy, *Annual Energy Outlook 2011 – Early Release Overview*, US DOE – EIA

Four of the largest gas resources include:[26]

a) 114 trillion cubic feet (25 percent) in the Marcellus Shale, more than a mile beneath portions of Pennsylvania, New York, Ohio and West Virginia. Range Resources began producing the first gas from the Marcellus shale in 2005.
b) 75 tcf (17 percent) in the Haynesville Shale, more than two miles below the surface of northwestern Louisiana, southwestern Arkansas and eastern Texas. Chesapeake Energy and Encana were among the first to begin drilling in this play in the mid-2000s.
c) 43 tcf (10 percent) in the Barnett Shale, about one and a half miles under north Texas, including the Dallas/Fort Worth area. Mitchell Energy (now Devon Energy) first paired large-scale horizontal drilling with fracking here in 1995, and the play took off in 2003.
d) 32 tcf (7 percent) in the Fayetteville Shale, which varies in depth from 1,500 feet to 6,500 feet under north central Arkansas. Southwestern Energy pioneered development of this shale in 2003.

ASSESSMENT OF SHALE GAS IN EUROPEAN UNION

European countries together account for roughly 10% of the total global shale gas reserves. The petro-physical properties of these deposits, however, differ substantially and each poses unique drilling and collection challenges. It is not yet known how much of these reserves are economically recoverable. Europe has besides another energy sources, estimated shale gas reserves of 639 trillion cubic feet (18.1×10^{12} m^3) compared with America's 862 trillion cubic feet (24.4×10^{12} m^3), but its geology is more complicated and the oil and gas more expensive to extract, with a well likely to cost as much as three-and-a-half times more than one in the United States.

[26] The U.S. Energy Information Administration (EIA) released its Annual Energy Outlook 2012 Early Release Overview, which estimated 482 trillion cubic feet (tcf) of unproved technically recoverable onshore shale gas resources in the lower 48 states. In a July 2011 analysis (modified by the 2012 outlook), the EIA focused on discovered shale plays totaling 454 tcf.

Estimates of unproved technically recoverable resources of shale gas (in TCM)

Europe	13,16
Bulgaria	0,48
Denmark	0,90
France	3,83
Germany	0,45
Netherlands	0,73
Norway*	0,00
Poland	4,14
Romania	1,43
Spain	0,22
Sweden	0,28
United Kingdom	0,73
United States	15,88

** Norway does not have any shale gas. It has, however, become one of European Union's major external suppliers thanks to its conventional gas reserves (2.04 TCM proved).*
Source : US Energy Information Administration, June 2013

Figure 10 shale gas in European countries - estimates

Different levels of exploration are underway in Austria, Germany, Hungary, Ireland, Poland[27], Sweden, the UKand Ukraine. Poland, , France and Ukraine appear to have large potential deposits but France has imposed a moratorium on exploration. Ukraine has an estimated 42 trillion cubic feet (tcf) of technically recoverable shale gas reserves, according to the U.S. Energy Information Administration (EIA), ranking its deposits as the fourth largest in Europe behind Poland (187 tcf), France (180 tcf) and Norway (83 tcf).

Very recently ambassadors from Hungary, Poland, Slovakia and the Czech Republic support Boehner's call for increased LNG exports. A similar letter was expected to be sent to Senate Majority Leader Harry Reid. Those four Central European nations, known as the Visegrad Group, are urging the United States to boost natural gas exports to Europe as a hedge against the possibility that Russia could cut off its supply of gas to Ukraine. The ambassadors warn that the unrest in Ukraine has brought back Cold War memories and that energy security threatens the region's residents on a daily basis and pointed out that gas-to-gas competition in this part of Europe is a vital aspect of national security and a key U.S. interest in the region

But Europe has had a relatively mild winter in 2014(January and February), therefore, gas supplies are at or above normal levels, and even if the U.S. did approve more export licenses, it would take until the end of 2015 for gas to be delivered.

In 2010, the EU relied on imports for about 63.5% of its gas consumption. At present contracted gas supply is not enough to meet increasing European demand. New import arrangements are needed for 2015 onwards.

[27] The Polish government has awarded a number of exploration concessions to over 30 companies covering a territory of 35 thousand square miles or a third of the country. Polish officials had initially hoped to begin commercial exploitation by 2014 and to achieve some degree of gas self-sufficiency by 2035

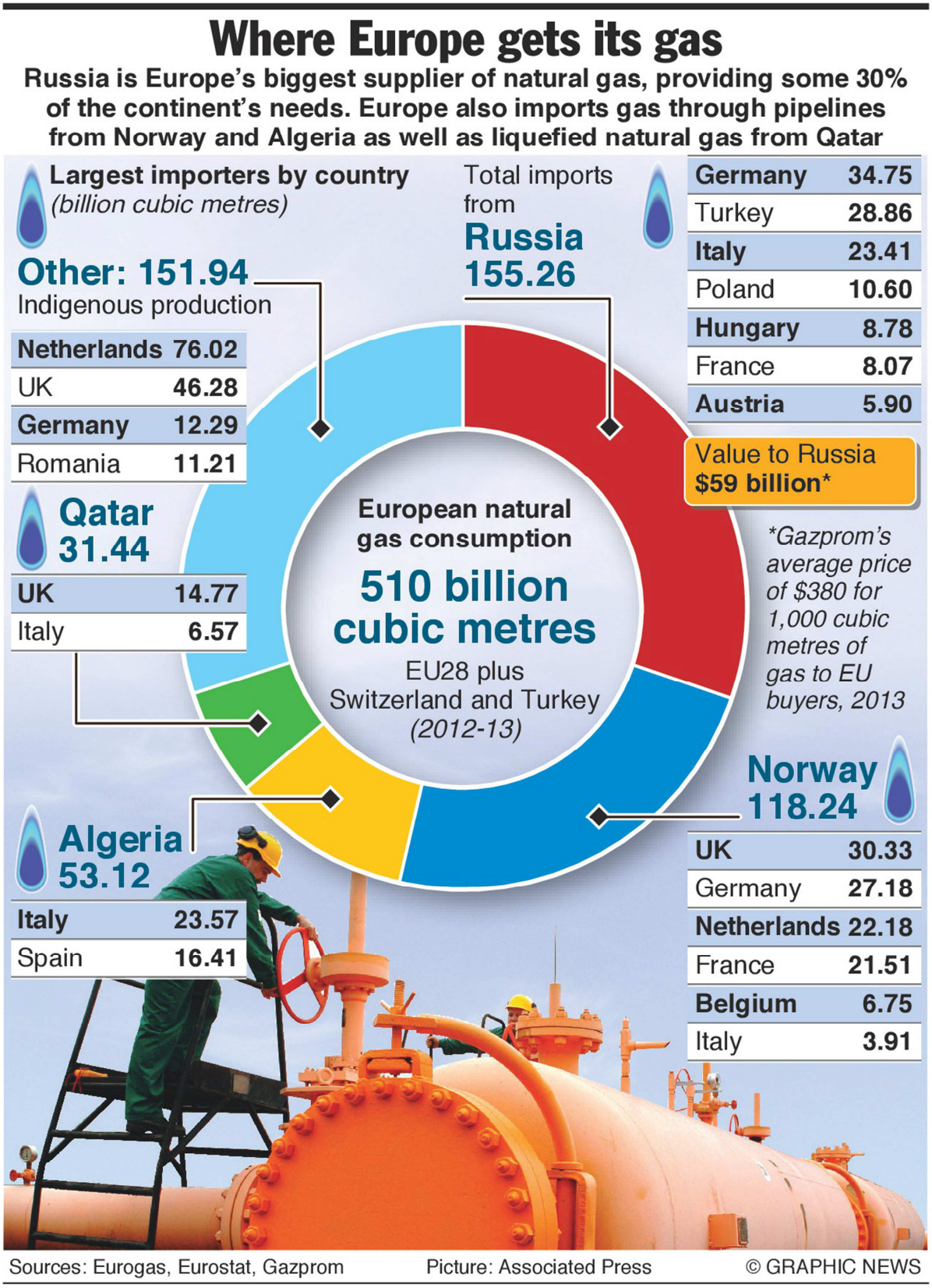


Figure 13. Sources of gas supplies in EU

It is obvious that Russia's importance in world energy markets is a key factor deterring the EU members states from responding more vigorously to the annexation of Crimea. The annexation of Crimea by Russia has encouraged the Poland and UK as well as the EU and many of its member states, to search for ways to reduce dependence on imports from Russia's OAO Gazprom (OGZD), the main supplier of gas to EU.[28]

SHALE GAS IN FEDERATION OF RUSSIA

According to the U.S. Geological Survey, the West Siberian Basin is the world's largest oil and natural gas repository with oil-equivalent reserves estimated to be 360 billion barrels.[29] The basin is responsible for about 70 percent of Russia's oil production and has allowed the country to match and occasionally out-produce Saudi Arabia Until last year, oil companies were able to retain only about $22 out of every $110 of the Urals-grade crude they produced in Russia. The rest went to the state in the form of export duties and mineral extraction taxes. In June 2013, the EIA estimated U.S. technically recoverable shale oil at between 48 and 58 billion barrels. But American shale oil resources rank second on the planet. Russia ranks first with reserves estimated to be 75 billion barrels, nearly half again more than those in the States.

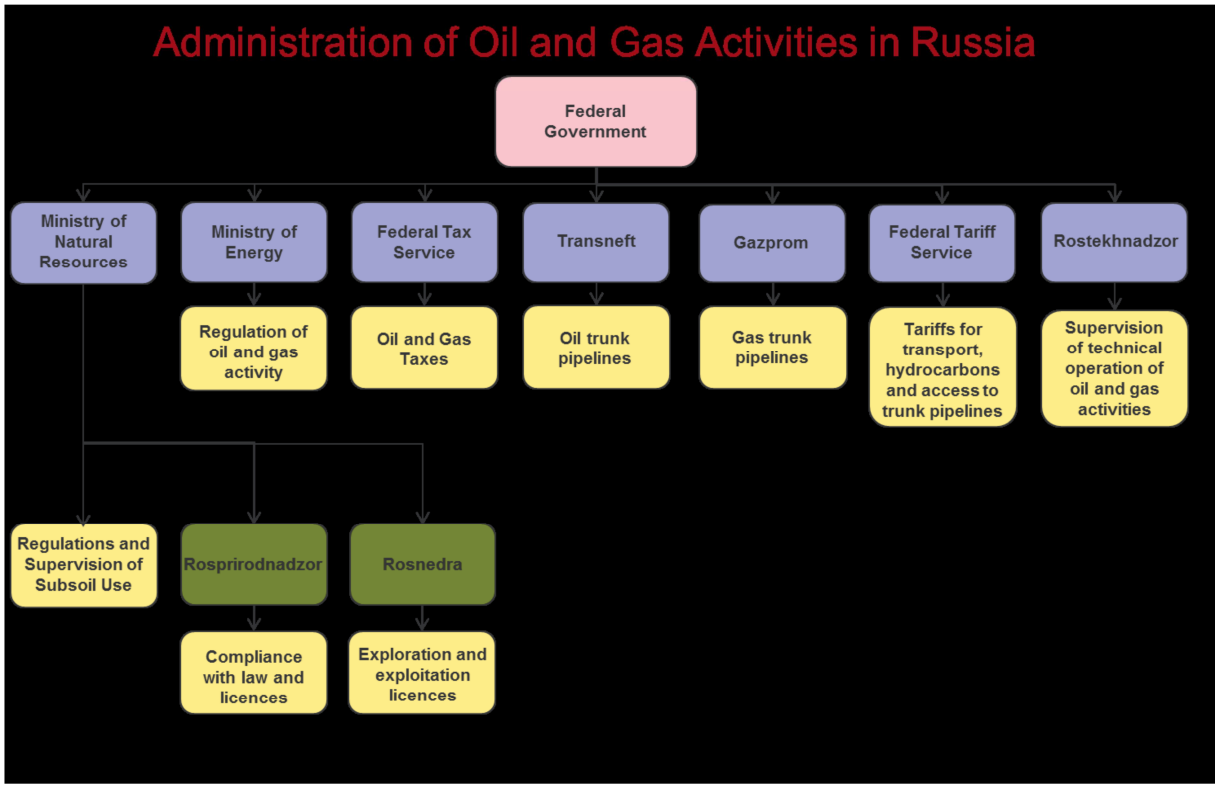
All hydrocarbon reserves while in the soil belong to the Russian state. Once extracted, the reserves generally belong to the licence holders. Russia does not have specific regulations for unconventional hydrocarbons. Their exploration, production and protection is governed by the general rules established by the Subsoil Law of 21 February 1992 ("**Subsoil Law**") and by the Federal Law on Production Sharing Agreements of 30 December 1995 ("**PSA Law**"), which are applicable to all hydrocarbons. Exploration licences may be granted for a term of up to five years for onshore fields (or seven years in certain specific regions of Russia) or for up to 10 years for offshore deposits. Exploration licences are generally extendable subject to certain conditions. An extension may be granted for any period required for the completion of the work but, in practice, it is usually granted for an additional five year period. There are no restrictions with respect to the number of extensions Development and production licences may be granted for the term required to complete development of the deposit but, in practice, they are usually granted for a 20 year period. They are generally extendable subject to certain conditions. An extension may be granted for any period required for the completion of the work. There are no restrictions on the number ofextensions. Combined licences (exploration and production) are usually granted for a 25 year period and are also generally extendable subject to certain conditions.[30]

Figure 7. Adminstrative structure of gas and oil in Russia

[28] In March 2014, David Cameron said that energy independence and the production of shale gas should top Europe's political agenda and suggested the shale gas reserves in South-eastern Europe, Poland and the UK could be a means to decrease dependence on Russia.

[29] In February 2014 Russian energy giant Gazprom Neft signed an agreement with U.S. oil services firm Schlumberger to explore shale resources in western Siberia. As part of its technology-sharing agreement, Schlumberger is shipping equipment and drilling crews from shale drilling sites in the U.S. to Russia

[30] Shale Gas, an International Guide*2014 Baker & McKenzie (1st edition: 23 January 2014,*



Shale developers in Russia face obstacles not only from government red tape but also from the harsh Arctic climate, but the prospects for success at tapping Duma eased rules for shale producers, reasoning that the cost of producing oil is far higher from shale than from conventional wells. A law enacted in July eliminated the mineral taxes on oil produced from Bazhenov and three other major shale fields for the next 15 years, giving a powerful incentive for development.[31] Russia's shale are better than anywhere else in the world outside the U.S. Russia also has an extensive infrastructure of pipelines and oil processing facilities that serve the oil fields in western Siberia that lie on top of the Bazhenov formation and are the main source of Russia's oil production. We shall not forget that even Russia entered shale exploration market with a joint venture between Shell and Gazprom Neft to drill in Western Siberia. In January 2014, a joint venture between Royal Dutch Shell and the Russian natural gas giant Gazprom began drilling the first of five horizontal wells into the Bazhenov shale. The $300 million pilot program, which will take two years to complete, will also use multi-stage fracking techniques. In December, Russia's OAO Rosneft, the world's largest publicly traded oil company that was at first skeptical about shale development, signed an agreement with Norwegian counterpart Statoil to explore the Domanik shale formation in the Samara region, near Russia's southwestern border with with Kazakhstan. The companies said the tax breaks provided a green light for the deal. The Bazhenov formation could be the world's largest deposit of shale oil. For the total Bazhenov shale prospective in the West Siberian Basin, and it is estimated a risked shale oil in place of 1,234 billion barrels, with 74.6 billion barrels as the risked, technically recoverable shale oil resource. The assesmtent of a risked shale gas in place of 1,920 trillion cubic feet with 285 trillion cubic feet as the risked, technically recoverable shale gas resource.[32] Another sources gives estimatation of

[31] See more Ulmishek, G.F., 2003. "Petroluem Geology and Resources of the West Siberian Basin, Russia." U.S. Geological Survey Bulletin 2201-G, U.S. Geological Survey, Reston, Virginia.

[32] June 2013 report, EIA

the amount of shale oil trapped in the Bazhenov formation in western Siberia alone range up to 2 trillion barrels, of which 22 billion to 360 billion barrels is recoverable today using hydraulic fracturing and horizontal drilling technologies developed by U.S. producers.[33]

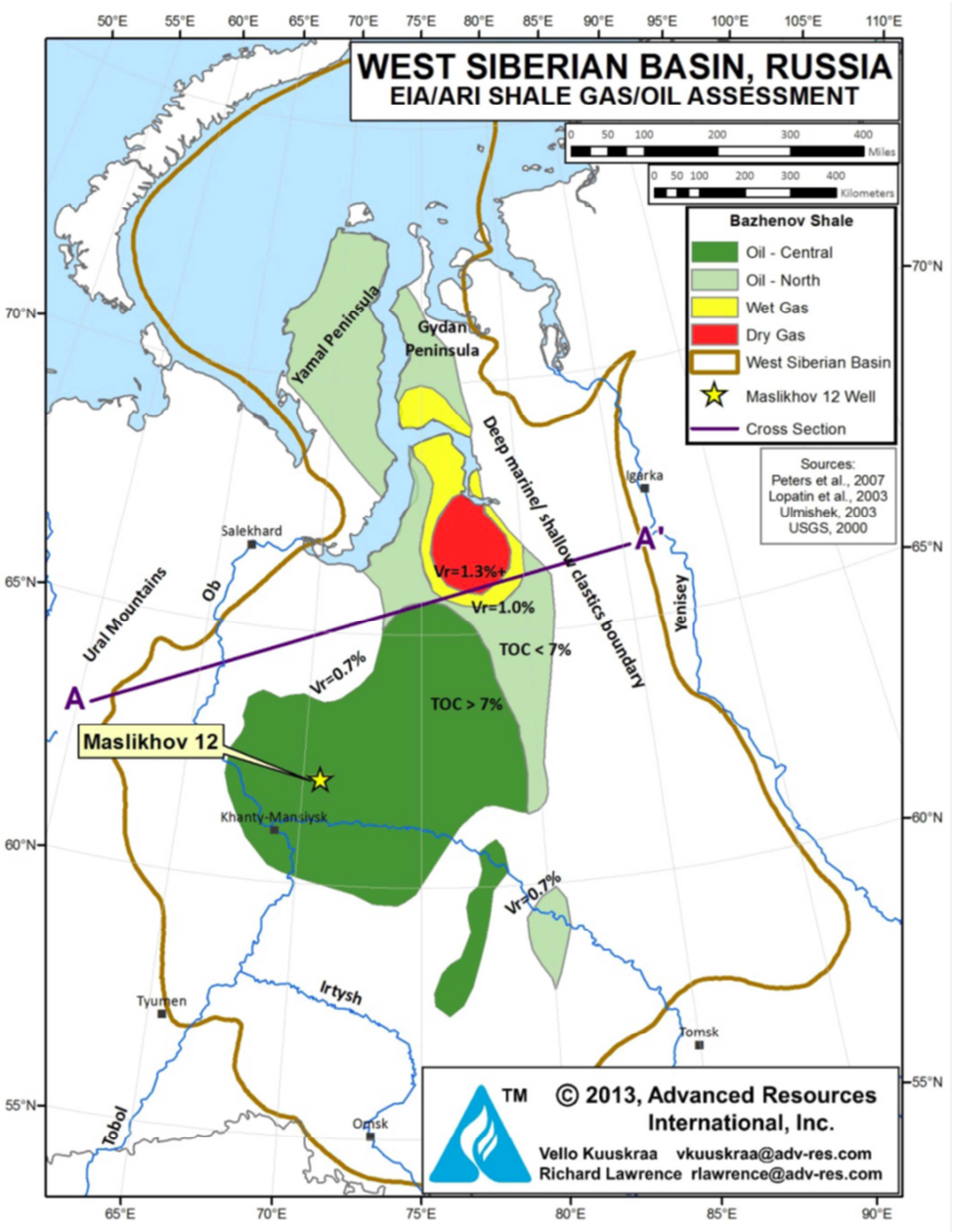


Figure 8. West Siberian Basin, Prospective Areas for Shale Gas and Shale Oil
Source: ARI, 2013

[33] Read more: http://www.washingtontimes.com/news/2014/feb/18/siberian-shale-find-fuels-russias-fracking-future/#ixzz32TOMSSyB

It covers 570 million acres, which is the size of Texas and the Gulf of Mexico combined. It could possibly be 80 times as big as the huge Bakken shale in North Dakota, USA. No other geologic formation is considered to have been the source rock for so much oil and natural gas as has the Bazhenov. Today, Russia accounts for about 16 percent of world oil exports, which, in turn, account for nearly one-half the country's income. Bazhenov already has significant oil pipeline infrastructure running across it, due to its proximity to other oilfields.

There are a number of companies that have begun exploration in the Bazhenov region of the West Siberian basin, including:

• Lukoil, Rosneft, Gazprom Neft and ExxonMobil in a joint venture with Rosneft; and

• Royal Dutch Shell in a joint venture with Gazprom.

In addition, Rosneft and Statoil have recently signed a joint venture agreement to exploit shale oil in the Domanik shale formation in the Samara region. The joint venture will spend three years on a pilot program assessing the potential for commercial production, planning to drill at least six exploration wells in the region before 2021.

Russia is a key supplier of natural gas not only for Ukraine[34] but also for Poland, which at present cannot get by without energy from Russia without developed production of shale gas.

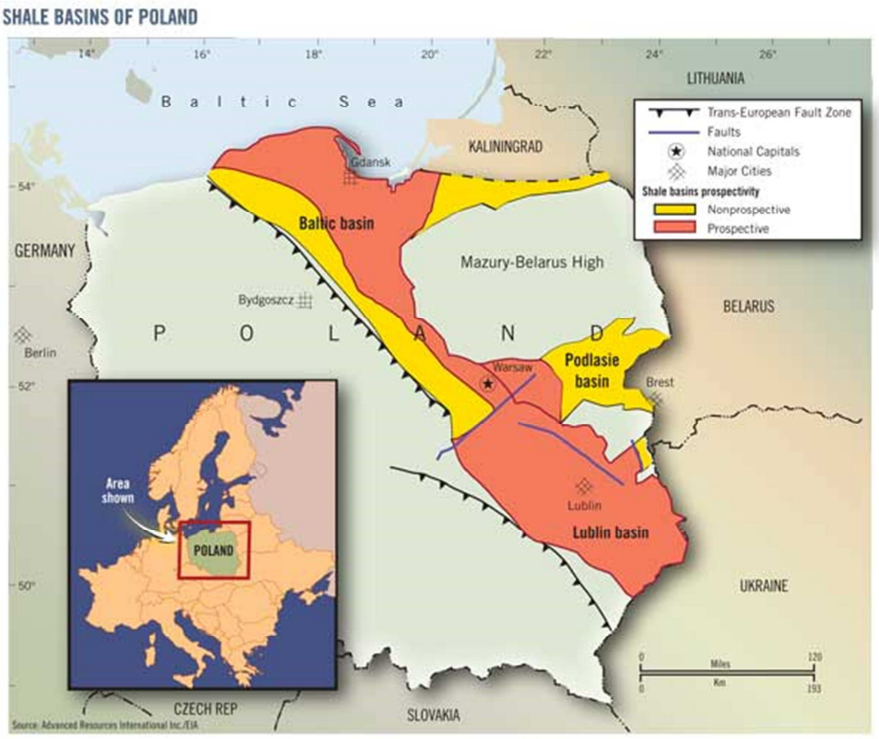


Figure 9. Shale basins in Poland

[34] Ukraine is heavily dependent on Russian natural gas, and previous disputes between Ukraine and Russia have led to gas supply cuts. Russian state gas company Gazprom has increased the pressure on Ukraine's new government, which now owes $1.89 billion for Russian natural gas, by warning that if Ukraine doesn't pay off its debt, there could be a repeat of 2009, when Russia cut off supplies to Europe because of a pricing dispute with Ukraine.

In the case the U.S. or Europe will try to respond to recent events by imposing further economic sanctions, one possible response would be a partial embargo by Russia on sales of energy to those countries, including Poland that would be most vulnerable to such a disruption.[35] . The White House has argued that Russia's dependence on gas revenues makes it unlikely that the country will cut off supplies to Europe despite the ongoing crisis in the Ukrainian region of Crimea, where the Russian military still conducts military operations disregarding international law.

Kremlin-controlled Rosneft Rosneft[36] and partners Exxon Mobil and BP prepared a campaign of drilling and fracking across Siberia, determined to find gas to send not to Europe, but to China. In December 2012, Exxon Mobil signed an agreement with the Russian oil company Rosneft to start a $300 million pilot program, which will last through 2015. Rosneft will be the senior partner with a 51 percent share of the proceeds from commercial production. State-operated Rosneft will gain valuable horizontal drilling expertise, which it will apply to other tight shale oil reservoirs in Siberia as well as off-shore in its Arctic territorial waters. Rosneft has also reached an agreement with Statoil, Norway's national oil company, to pursue ventures similar to that with Exxon Mobil. In addition Rosneft and Exxon Mobil in 2013 have announced plans to begin drilling the Bazhenov Shale, after completion of their geologic study. Gazprom Neft and Shell, as part of their West Siberia JV, proposed to start drilling the Bazhenov Shale in early 2014 near the Salym oil field, which has a history of Bazhenov Shale oil production. Lukoil has announced plans to test the Bazhenov reservoir in two area of West Siberia.[37]

Figure 10. Potential shale gas deposits in Russia
Source: Gazprom

[35] Recently as of April 10th 2014 President Vladimir Putin sent to 18 European leaders, as provided in English by the Kremlin warning that Russia could cut natural gas supplies to Ukraine if the country fails to pay its gas bills on time and warned there could be a reduction in onward deliveries to Europe. It was sent to the leaders of Germany, France, Italy, Austria, Hungary, the Czech Republic, Poland, Slovakia, Slovenia, Croatia, Serbia, Bosnia, Bulgaria, Romania, Macedonia, Greece, Turkey and Moldova

[36] Rosneft Oil Company, 2011. Annual Report.

[37] See more at http://www.lukoil.com/

Needless to mention is the seizure by Russia of Crimea, which includes a takeover Ukraine's offshore gasfields[38]. The March 2014 seizure of Crimea extended Russian's maritime boundaries in the Black Sea to include offshore oil and gas resources. The dispute over the boundary between Russia and Ukraine through the Kerch Strait and Sea of Azov remains unresolved despite a December 2003 framework agreement and ongoing expert-level discussions; Moldova and Ukraine operate joint customs posts to monitor transit of people and commodities through Moldova's break-away Transnistria Region, which remains under the auspices of an Organization for Security and Cooperation in Europe-mandated peacekeeping mission comprised of Moldovan, Transnistrian, Russian, and Ukrainian troops.[39]

ASSESSMENT OF SHALE GAS POTENTIAL IN UKRAINE

The most promising are two large shale gas deposits, one (the Lubin basin) in the Ukrainian speaking west, which extends from Western Ukraine into Poland, and another (the Dniper-Donets basin) in the Russian speaking east. The eastern one has nearly 76 trillion cubic feet (Tcf) of potentially recoverable gas, the western basin shared by Moldova and Poland another 72.5 (Tcf).[40] These deposits are therefore sizeable and close to existing pipelines making both production for domestic consumption and export possible. If Ukraine could attract investment to develop these fields then it could measurably improve its energy and economic independence from Russia.[41]

Source: IHS CERA. 10503-16

Figure 11. Assessment of fossil fuel in Ukraine

[38] Guidelines set forth by the 1982 Law of the Sea Treaty. The agreement lets coastal states claim what are known as exclusive economic zones that can extend up to 230 statute miles from their shores. Inside these zones, states can explore, exploit and manage deep natural resources, living and nonliving.

[39] Nations divide up the world's potentially lucrative waters according to guidelines set by the 1982 Law of the Sea Treaty. The agreement lets coastal states claim what are known as exclusive economic zones that can extend up to 200 nautical miles (or 230 statute miles) from their shores. Inside these zones, states can explore, exploit, conserve and manage deep natural resources, living and nonliving. https://www.cia.gov/library/publications/the-world-factbook/fields/print_2070.html

[40] See more at http://openeuropeblog.blogspot.com/2014/03/could-ukrainian-shale-gas-break.html

[41] Russia's state-owned Gazprom, controlling nearly one-fifth of the world's gas reserves, supplies more than half of Ukraine's gas annually, and about 30 percent of Europe's. It has often used this as political and economic leverage over Kiev and Brussels, cutting gas supplies repeatedly over the past decade (in the winters of 2005-2006, 2007-2008, and again in 2008-2009), leading to energy shortages not only in Ukraine, but Western European countries as well.

Shale gas is not yet commercially produced in Ukraine, although drilling has commenced in one of the earliest operations, led by Polish company Kulczyk Oil Ventures in a license area it acquired in June 2010. Ukraine's government has signed two deals for shale exploration:

- one with Royal Dutch Shell in January 2013; and
- one with Chevron in November 2013.

An oil and gas development must comply with the Law on Oil and Gas. Pursuant to that law, an entity interested in developing a resource must first go through a tender process to receive a special permit to develop the resource. The holder of the successful tender would have to negotiate a lease that would define additional conditions for the development. The local government would also have to approve the exact siting of the wells and associated facilities. The proposed oil and gas operation would go through an environmental analysis process and have to comply with all relevant environmental laws (including laws on air protection, water protection, waste management, species protections, and natural lands). The complexity of these procedures and the need to navigate many different layers and organs of government created a situation whereby approvals had become extremely difficult to obtain, discouraging the inflow of investment and technology in the oil and gas sector. In an attempt to streamline some of this complexity the Parliament of Ukraine passed a Law on Production Sharing Agreements. This law explicitly provides for exemption from ordinary environmental and natural resources laws, reduces the role of local governmental units, centralizes signing authority in one ministry and provides for internal specification of tax, arbitration and other provisions; circumventing some of the more tortuous elements of the older Oil and Gas Law. [42] Changes were introduced in November 2013 to the legislation regarding the distribution of revenues received by Ukraine under PSAs, which require that 10% of Ukraine's profit be split Under Ukrainian legislation, a special permit holder must obtain a certificate, which authorises the special permit holder to use a defined subsurface area. Such certificate is called "a mining allotment act". The mining allotment act is issued following the grant of the special permit and due approval of the extraction project. A special permit holder is not authorised to transfer the rights granted by the mining allotment act (in full or in part) to a third party. Unlike most European countries, there has been limited public opposition to shale gas projects (at least according to the local media). This means that one of the biggest obstacles to shale gas development is noticeably absent in the country. However, there remains significant uncertainty as to how subsoil licenses will be awarded for shale gas. At present, there is no specific legislative framework for shale gas exploration and production in the Ukraine, which instead falls within the scope of laws for conventional hydrocarbons, principally the Oil and Gas Act. To sidestep legal uncertainties in relation to shale gas E&P, the government has proposed the use of production sharing agreements (PSAs), which have historically been used alongside licenses. Even so, shale gas reserves are part of the government's future development plans. On May 20 2011, the president of Ukraine enacted a law amending the National Programme for the Development of Minerals to, among other changes, include shale gas reserves.[2] On November 27,2013 the Ukrainian government signed another production-sharing agreement with a consortium of investors led by Italian energy company Eni to develop unconventional hydrocarbons in the Black Sea.

[42] UKRAINE SHALE GAS: VOLUME I: ENVIRONMENTAL AND REGULATORY ASSESSMENT, USAID 2012

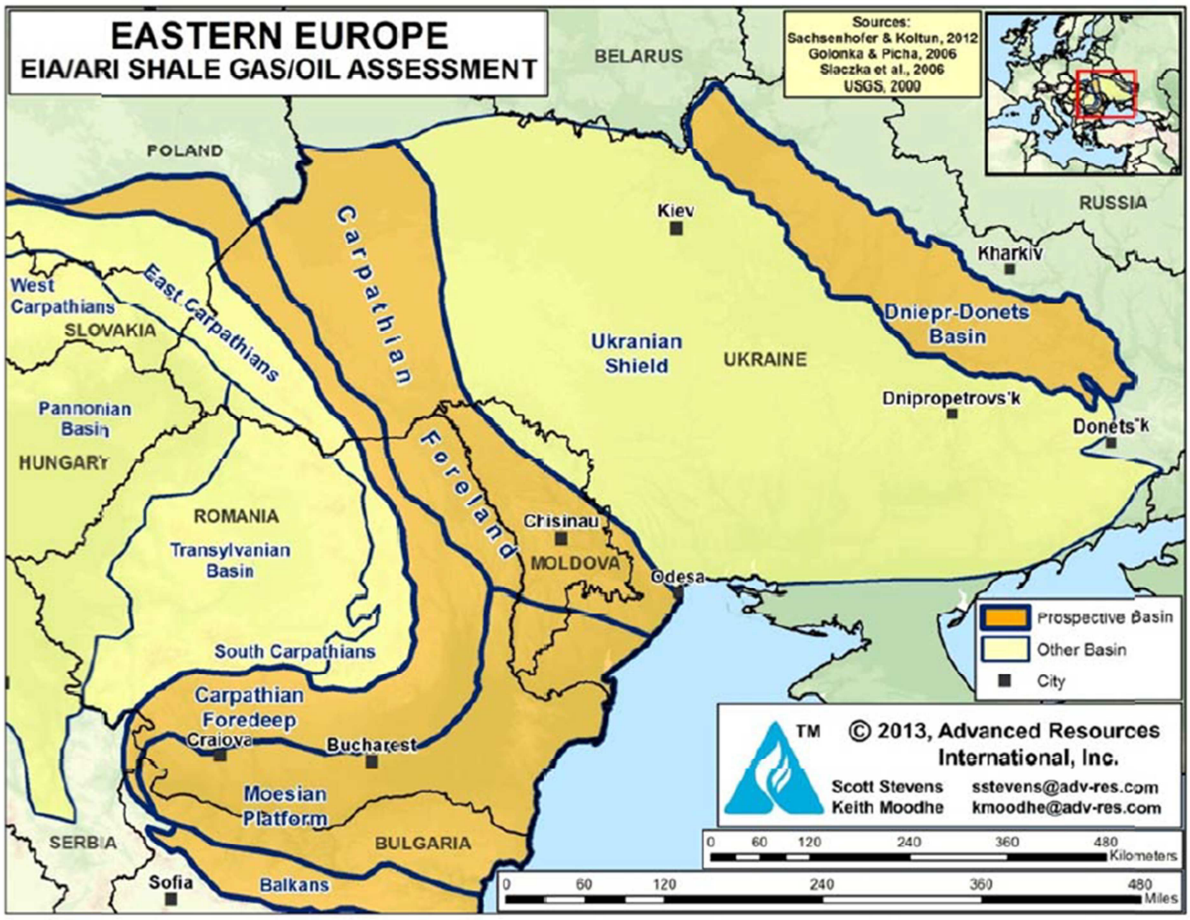


Figure 12. Shale gas in Eastern Europe

At the time of Yanukovych's ouster in February 2014, Chevron and the Ukrainian government had been negotiating an operating agreement for the shale development effort in western Ukraine, and the negotiations went forward despite Yanukovych fleeing the country. Royal Dutch Shell is also engaged in the country, having signed an agreement last in 2013 with the government of Yanukovych to explore a shale formation in eastern Ukraine, hopefully the agreement will be confirmed by the new president Prokoszenko, elected on may 25 th 2014. In disputed between Ukraine and Russia territory of Crimea, numerous oil companies including Chevron, Shell, ExxonMobil, Repsol and even Petrochina have shown interest in developing its offshore energy assets. Because Crimea's onshore and offshore fields have great extraction potantials, these companies have greatly expanded their exploration of the Black Sea off the Crimean peninsula.[43]

It is clear that all of these oil and gas companies – backed by their governments, including those of the Russian Federation and the United States – are deeply embroiled in the Ukrainian crisis, with much invested and much at stake. But with their disproportionate influence over Ukraine's future, it should be kept in mind that the number one responsibility of any corporation is to increase

[43] One of Vladimir Putin's motivations for annexing Crimea was to ensure that state company Gazprom will control Crimean offshore energy assets as well as to ensure the continued use of Crimea as host to Russia's Black Sea Fleet.

profit margins for its shareholders, not necessarily to promote the democracy or sovereignty of the countries they are operating in. This is particularly the case for Chevron and Shell, both of which have been implicated in major human rights violations in Nigeria. Chevron has been accused of recruiting and supplying Nigerian military forces involved in massacres of environmental protesters in the oil-rich Niger Delta, and Shell has faced charges of complicity in torture and other human rights abuses against the Ogoni people of southern Nigeria. With this in mind, the Ukrainian people – whether in the east of the country or the west – might want to rethink what is meant by "energy independence," and whether the future they seek can truly be met by placing their hopes in the benevolence of foreign oil and gas companies.

Recent events in Crimea have prompted thoughts of revisiting U.S. policy on exports of natural gas to Europe e.g. Speaker of the House John Boehner called in March 2014 for faster Energy Department approval of facilities to export liquefied natural gas (LNG) and Senator Lisa Murkowski (R-AK) called for lifting the ban on U.S. crude oil exports. Both senators have been urging the Obama administration to clear the way for more exports amid a natural gas boom in the U.S. The Energy Department has only approved six export licenses in recent years out of about two dozen pending.

LIQUEFIED NATURAL GAS LNG

Shale-derived natural gas can be exported from the States to Europe by means of LNG tanker and this is may attract high levels of investment. Gas is typically shipped via pipeline, but is impractical for reaching markets in Europe. LNG terminals super-chill gas to its liquid form and load it under extreme pressure into specially designed tankers for shipment overseas. Once at its destination, LNG must be re-gasified before it can be fed into pipelines for local distribution.

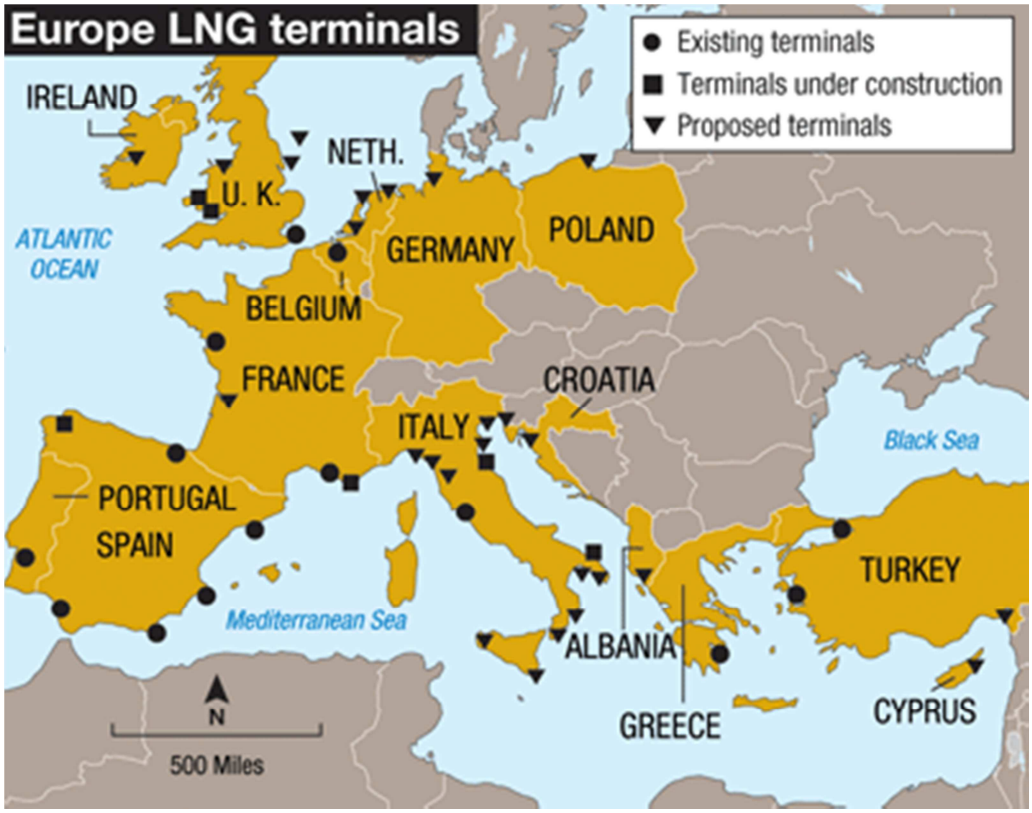


Figure 13 LNG terminals in Europe

In December 2013 the U.S. Department of Energy (hereinafter called as **DEO**) approved EOS LNG LLC's and Barca LNG LLC's applications to export LNG from a proposed floating liquefaction unit and storage tanker at the Port of Brownsville, Texas to nations with a Free Trade Agreement (FTA) with the US.[44] EPA is also seeking lifecycle environmental reviews of the currently pending LNG export proposals. In response to proposals for LNG export terminals in Maryland and Oregon, EPA Regions III and X, respectively, have sent letters to Federal Energy Regulatory Commission ("FERC") urging review of the potential cumulative impacts of implementation of all of the pending export proposals, as well as "the extent to which implementation of the proposed project, combined with implementation of other similar facilities nationally, could increase the demand for domestic natural gas extraction."

EPA does not have authority to require FERC to consider certain impacts as part of its NEPA process—these letters merely represent the Agency's view on the appropriate scope of an EIS for the proposed terminals. EPA's request for an expanded environmental review of these projects mirrors previous comments submitted by the Sierra Club in connection with the NEPA process for the Sabine Pass LNG export terminal in Louisiana.

Annual European LNG re-gasification capacity exceeds 185 bcm annually, and further 24 bcm per year is under construction, with a further 244 bcm/year proposed. This far exceeds LNG imports of just a few years back, at nearly 70 bcm of imports in 2009.16 This does not just mark new competition for Gazprom in volume terms. LNG availability, both in receiving terminals and in available cargos is essentially a form of storage, which gives it a competitive advantage over Russian gas. However, Europe meeting its energy demands via LNG is very much dependent on trade routes, as it competes with Asia for LNG imports. Although re-exports offer the US an opportunity to turn a profit by sending surplus LNG to higher-paying markets in Asia or South America, shipping constraints have made Europe the next best alternative. Additionally, Qatar is already shipping 12 million tons of LNG to the UK, 6 million tons to Italy, 3.2 million tons to France, and 4.8 million tons to Spain, as well as other European countries.17[45]The LNG share of international trade of total gas mix was 10% in 2010, and is expected to grow to 15% by 2025. LNG exports are also supposed to more than double from about 30 billion cubic feet per day in 2010 to over 70 billion cubic feet per day in 2030.22 This may even be an underestimate given technological advances such as Shell's floating LNG – the world's largest floating offshore facility for gas extraction and LNG processing. Essentially the FLNG will allow offshore gas fields to become accessible, and will include both gas extraction, and on board liquefaction, which will shrink the gas by 600x, allowing it to be shipped globally. The first facility is currently being built in South Korea, and will be deployed first 200 km off shore in Australian waters. It appears this technology is not exclusive to Shell, and other companies are also developing similar floating vessels.23[46]

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