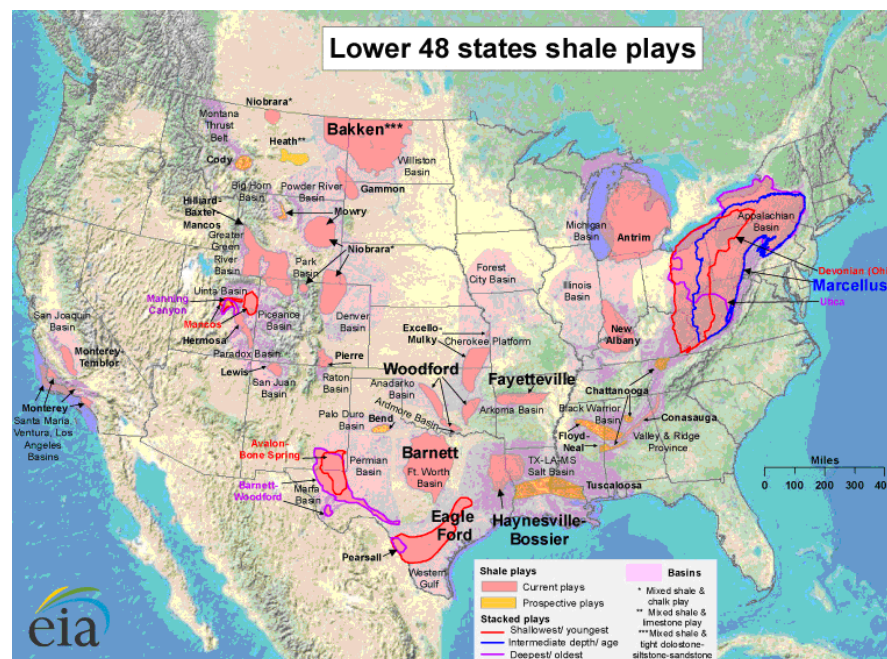


The United States has significant reserves of unconventional gas, spread across the country.

Figure 2:
Location of US natural gas reserves

which is expected to grow from 7.8 tcf in 2011 to 16.7 tcf in 2040.

Large deposits of unconventional gas are located across the US. The most significant fields including the Barnett reservoir in Texas and the Marcellus reservoir, which run across New York, Pennsylvania and most of the West Virginia. The Barnett reservoir first entered production in the late 1990s and represents one of the more established fields in the US.



Source: Energy Information Administration based on data from various published studies.

<http://www.instituteforenergyresearch.org/2011/06/30/shale-oil-may-mirror-the-shale-gas-boom>.

Shale gas has deeply altered the US gas market and energy mix, reducing gas prices, CO2 and greenhouse gas emissions, and the country's dependence on imports ... as well as generally facilitating economic recovery.

Exploiting these and other reservoirs has already led to a resources surplus and substantially lower prices. US natural gas prices are currently at a record low (close to their 1976 levels). Imports of natural gas into the US have dropped, from 16.5 % of the total gas consumed in 2007 to 11 % in 2010⁴.

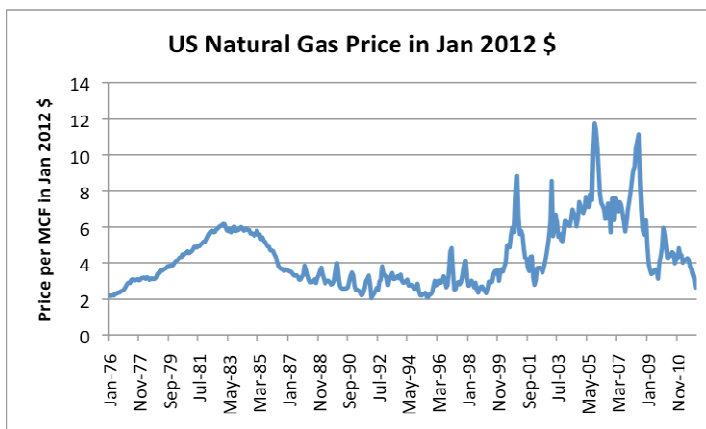
Unconventional and shale gas is also expected to enhance the US's energy security, while helping to reduce CO2 emissions and greenhouse gas pollution (electricity generated by the combustion of natural gas is generally considered to have lower emissions intensity than that generated by burning coal)⁵.

⁴ L. Dreyer and G. Stang, *The shale gas 'revolution': Challenges and implications for the EU*, European Union Institute for Security Studies, <http://www.iss.europa.eu/publications/detail/article/the-shale-gas-revolution-challenges-and-implications-for-the-eu/>.

⁵ White House, Office of the Press Secretary, 17 November 2009, [Statement on US-China shale gas resource initiative](#).

Figure 3:

US Natural Gas Price in January 2012



Source: Our Finite World based on Energy Information Administration data.

<http://ourfinitemworld.com/2012/03/23/why-us-natural-gas-prices-are-so-low-are-changes-needed>

The country's economy has also benefitted substantially from the availability of cheap energy, revitalising prospects for growth. The shale gas boom is credited with having created 600 000 jobs in 2010⁶ and contributing to a notable recovery in industrial and manufacturing activity.

Despite the many positive aspects of shale gas extraction, there are growing concerns about the scale and scope of the extraction process, as well as about its environmental impact. The estimates of the reserves released this year by the US Department of Energy (DoE) in its *Annual Energy Outlook* (mentioned above) are considerably lower than earlier estimates. Technical improvements in drilling and extraction have provided more accurate and detailed data, which now allow the Department of Energy to estimate the US's shale gas reserves of recoverable natural gas at around 482 trillion cubic feet . This represents a 42 % decline from 2011 projections, when estimates were around 827 tcf.

Even though the US continues to import millions of barrels of crude oil per day⁷, from 2005 the country's dependence on oil import has dropped from 60 % to 39 % thanks to shale gas. The United States appears well on its way to self-sufficiency in oil and gas and may overcome Saudi Arabia as the world's bigger supplier of hydrocarbons by 2020. Already, the country's increased production is having an impact on the rest of the world.

Despite the promises of shale gas, uncertainty remains about its longer-term productivity.

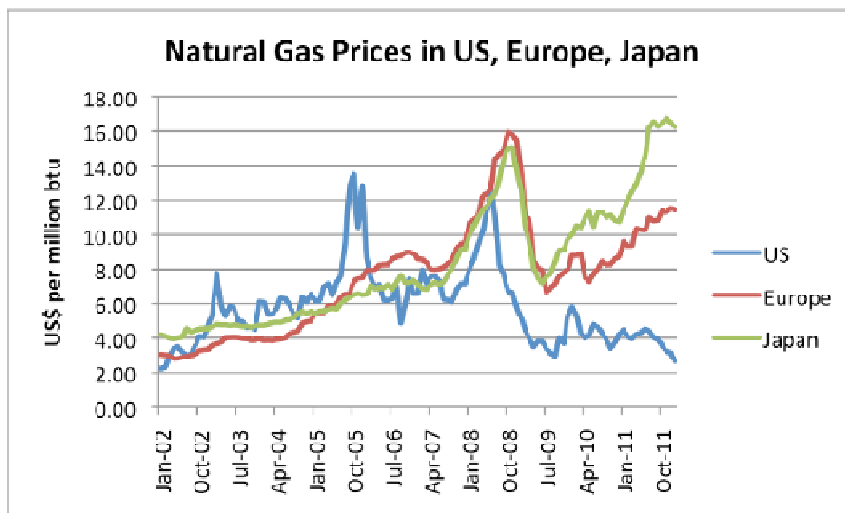
US energy self-sufficiency may potentially redefine the economics and geopolitics of energy across the globe.

⁶ IHS Global Insight, *The Economic and employment contributions of shale gas in the United States*, December 2011, <http://www.ihs.com/info/ecc/a/shale-gas-jobs-report.aspx> .

⁷ C. Ebinger and K. Massy, *Energy and Climate: From black to gold to green*, Big Bets and Black Swans - A Presidential Briefing Book, Foreign Policy at Brookings, 2013, <http://www.brookings.edu/research/papers/2013/01/energy-and-climate-black-to-gold-to-green> .

Figure 4:

Natural Gas Prices in US, Europe and Japan



Source: Our Finite World, based on World Bank Commodity Price Data.

<http://ourfinitemworld.com/2012/03/23/why-us-natural-gas-prices-are-so-low-are-changes-needed>

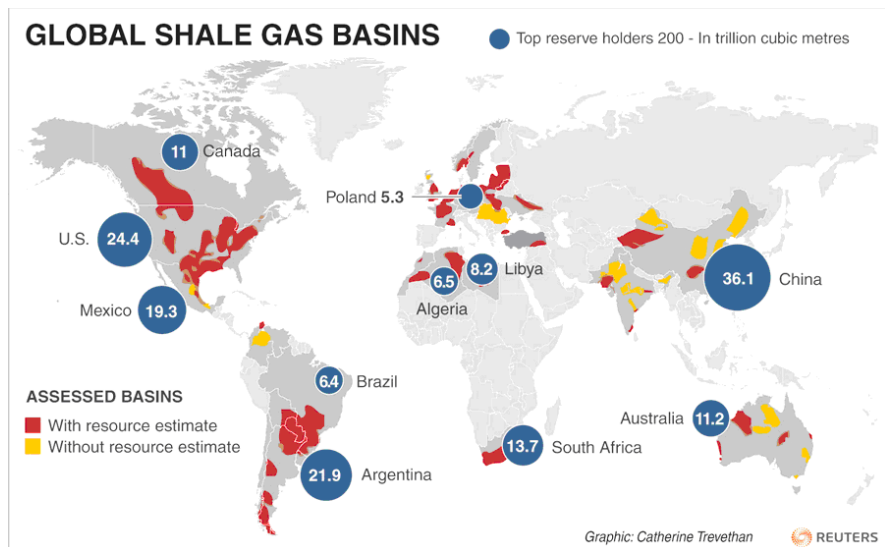
1.2. Geostrategic implications of the US shale gas boom

The shale gas 'revolution' is already having a profound impact on the US and the rest of the world.

The US's growing energy independence — largely the result of shale oil and gas — has the potential to change the global geostrategic landscape, testing the country's engagement with the world, including the Middle East and Europe. A self-sufficient US will likely have fewer strategic interests in the Middle East and other sensitive, energy-rich parts of the world, and will likely feel less vulnerable to developments beyond its borders. Yet its strategic ties with partners abroad are not all likely to dissolve. A close security and economic engagement with Australia — one of the US's most trusted allies, which has substantial natural gas reserves and potential for lowering of liquefaction costs — will continue, and may lead to greater US influence on energy issues in the Asia Pacific region.

Figure 5:

Global Shale Gas Basins



Source: US Energy Information Administration (EIA)

<http://blog.thomsonreuters.com/index.php/global-shale-gas-basins-graphic-of-the-day>

Yet the US's political, military and trade relations

US political, economic, strategic and military relations are unlikely to shift dramatically overnight. As stated by Carlos Pascual, Special Envoy

with the rest of the world are unlikely to shift overnight.

Eventually, however, the US's shale gas 'revolution' may well change have a global impact, affecting the market for liquefied natural gas and bolstering US competitiveness.

and Coordinator for International Energy Affairs for the US Department of State⁸, the gas market is increasingly a global market in which instability retains a significant impact on price. The US's strong interest in peace and security in the Middle East is therefore likely to keep the country engaged in the region.

The shale gas 'revolution' in the US has the potential to change the global gas picture, offering the country the opportunity to strengthen its economic and geopolitical position by responding to the global demand for energy, while bolstering its long-term competitive position in the global market for lower-carbon technology and addressing climate change⁹. It also seems likely that the US's excess supply of natural gas will increasingly be exported to Europe and Asia in the form of liquefied natural gas (LNG), and will affect the composition of domestic markets in those regions.

1.3. US public opinion on shale gas

The US public has expressed reservations about the extraction of shale gas, due to its environmental impact, sustainability and impact on local life.

While the rapid development of a shale gas industry has been supported politically across the aisle, US public opinion has not fully embraced the developments. Many have raised concerns about the environmental consequences and the sustainability of intensified extraction. These concerns stem from techniques involved in hydraulic fracturing, which require large amounts of water — a scarce commodity in some extraction regions — and which may contaminate groundwater with potentially hazardous chemicals. A number of people have also been concerned about the potentially negative impact on local life. The boom in extraction has affected areas unaccustomed to drilling, including various towns in Pennsylvania and around the Dallas metropolitan area in Texas. Many feel a number of environmental, social, regulatory and legal questions have not been addressed fully.

US President Barack Obama directly backed shale gas drilling during his recent State of the Union Address.

Nevertheless, US President Barack Obama directly backed shale gas drilling in his State of the Union Address of January 2013. President Obama stated that his administration is preparing to open more than 75 % of existing offshore oil and gas reserves to extraction. President Obama pointed to the need to safely develop every source of energy available to the US, referring to shale oil and gas as 'cleaner, cheaper and full of new jobs'.

Several NGOs and environmental think tanks

Despite the official position, critics say that the shale gas industry has moved too fast and lacks coherent regulation. Critics also cite potential problems from spills, leaks and contamination from the chemicals used in production. Several prominent NGOs and environmental think tanks have called for a stricter regulatory framework. Others have advocated a moratorium on all drilling activity, similar to the French ban confirmed in

⁸ *Growing US energy self-sufficiency and global consequences*, German Marshall Fund, <http://brussels.gmfus.org/multimedia/full-session-videos-2013>.

⁹ C. Ebinger and k. Massy, *Energy and Climate: From black to gold to green*, op.cit.

are launching campaigns to increase US public awareness of the impact of fracking on health.

Industry representatives argue that there is no sound evidence linking fracking technologies to water contamination.

Federal and local authorities have begun considering new regulations for the shale gas industry.

September 2012 by President François Hollande's administration. A similar prohibition has been implemented in Bulgaria. Civic bodies in the US, such as the Natural Resources Defense Council¹⁰, have launched campaigns to increase US public awareness of the health impact of living near oil and gas exploration sites and the need for a stronger federal legal framework. Members of the Pennsylvania Alliance for Clean Water¹¹ and other citizens' committees have also reported that residents in drilling areas are lobbying Congress to halt fracking in general and certain drilling projects in particular.

On the other hand, advocates of shale gas extraction argue that misconceptions about fracking are widespread and that no scientific evidence has demonstrated that the chemicals used in hydraulic fracturing contaminate water or air. In response to public disquiet over the issue, US authorities have taken initial steps towards developing a legal framework for the industry. In some states, such as New York, lawmakers are considering a moratorium on fracking, and some cities have banned fracking within their municipal limits.

President Obama's State of the Union Address¹² also called for a roadmap to be drawn up for 'responsible shale gas production.' President Obama has also expressed support for new regulations to ensure that the shale gas industry protect public interest. Industry representatives have reacted rather negatively to recent official statements hinting at a new regulatory framework, and have argued that overregulation would damage US competitiveness and energy security.

¹⁰ National Resources Defense Council, *Protecting Americans from the risks of fracking*, <http://www.nrdc.org/energy/frackingrisks.asp>.

¹¹ Pennsylvania Alliance for Clean Water, <http://pennsylvaniaallianceforcleanwaterandair.wordpress.com>.

¹² A. Rascoe and E. McAllister, *Obama backs shale gas drilling*, Reuters, <http://www.reuters.com/article/2012/01/25/us-usa-obama-speech-energy-idUSTRE80O06P20120125>.

2. Global reactions to the US shale gas 'revolution'

2.1. China

Figure 6:

Major Shale-Gas Basins in China



Source: US Energy Information Administration (EIA) <http://online.wsj.com/article/SB10001424127887323401904578156710038647662.html>.

As the US's shale gas boom changes the world's energy map, the impact on China is uncertain. The International Energy Agency's (IEA) World Energy Outlook for 2010¹³ predicts that China will continue to import 79% of its oil by 2030. Not yet a shale gas producer, China is facing domestic pressure to develop new energy sources to ensure diversity and security in its energy supplies and to meet the growing domestic demand. The Chinese government has announced its intention to increase domestic shale gas production to 2.1 tcf by 2020; today, the country's production is effectively nil. Major Chinese state-owned companies are examining the costs and benefits of developing domestic reserves. The Chinese public has not been particularly vocal on the issue, though it has in recent years become outspoken on other environmental issues, such as the level of urban pollution. If shale gas extraction advances, the Chinese public may also express an opinion.

The US Energy Information Administration evaluates China's reserves to contain 1 275 trillion cubic feet (tcf), which would make China richer in unconventional gas than the US and Canada together. Because China's environmental regulatory framework remains weak, there are currently no regulatory obstacles to exploration or extraction. That said, the mere

¹³ International Energy Agency, *World Energy Outlook 2010*, <http://www.iea.org/publications/freepublications/publication/name.27324.en.html>.

China has a strong need to develop new energy sources. A boom in domestic shale gas production could help the country to meet its growth targets and energy demands.

Despite vast unconventional gas resources, China still lacks the necessary expertise and regulatory framework to fulfil its shale gas promise.

China is likely to remain dependent on energy imports for the foreseeable future.

existence of shale gas reserves in China does not mean that it can be extracted, at least in the short-term. China's 12th five-year plan for energy development projects that about 6% of the country's energy will come from shale gas by 2020¹⁴. However, the country's recent successes in domestic extraction technology have been rather modest. Drilling technologies require technical expertise and a large volume of water — both still in short supply in China. And even if China were able to overcome these shortcomings and develop enough shale gas to meet its ambitious growth targets, the lack of a safe regulatory framework might lead to an environmental disaster and, ultimately, nationwide instability.

All things considered, China is not likely to achieve energy self-sufficiency in the foreseeable future, but will likely remain largely dependent on oil and gas imports from the Middle East and, increasingly, from Africa. This would also reinforce the US's competitive advantage in a global energy market.

2.2. Russia and the EU's Eastern Neighbourhood

The US shale gas boom will likely affect Russia's export market ... to a limited extent.

The rising importance of shale gas in the US may affect also Eastern Europe, the Caucasus region and Central Asia.

Despite large oil and

Russia will certainly be affected by the changes in the world's energy map resulting from the shale gas 'revolution' in the United States. The International Energy Agency's latest predictions suggest that by 2035 the US will surpass Russia in its production of gas, becoming the world's largest gas producer. The gas market and gas prices will be affected in Russia, as will Moscow's power over the rest of the world and its ability to lock some international clients in onerous contracts.

Yet the impact of the US shale gas boom is also likely to remain limited in Russia. Russia maintains vast conventional gas reserves and a robust transport network, which should allow the country to retain a dominant position in global and European energy markets. The high cost of transporting LNG from the US works to Russia's advantage. Moscow also has the time it needs to protect its interests, by, for example, building its own LNG export infrastructure and accessing new Asian export markets.

The growing importance of shale gas in the US may, however, affect Eastern Europe, the Caucasus region and Central Asia in the longer run. Located along global transit routes, these areas are rich in natural gas and have garnered the interest of global energy players.

Ukraine has recently discovered shale gas deposits, which may provide resources to diversify the country's gas supplies from Russia. Ukraine's shale gas reserves are estimated at 42 trillion cubic feet — Europe's third-largest — and in January 2013, Shell began exploring throughout the country. Ukraine might be able to develop its shale gas for both domestic

¹⁴ C. Yang, *China drills into Shale Gas, targeting huge reserves amid challenges*, National Geographic News, 2012, <http://news.nationalgeographic.com/news/energy/2012/08/120808-china-shale-gas>.

natural gas reserves, most of these countries lack the foreign investment and transport infrastructure necessary to become major exporters.

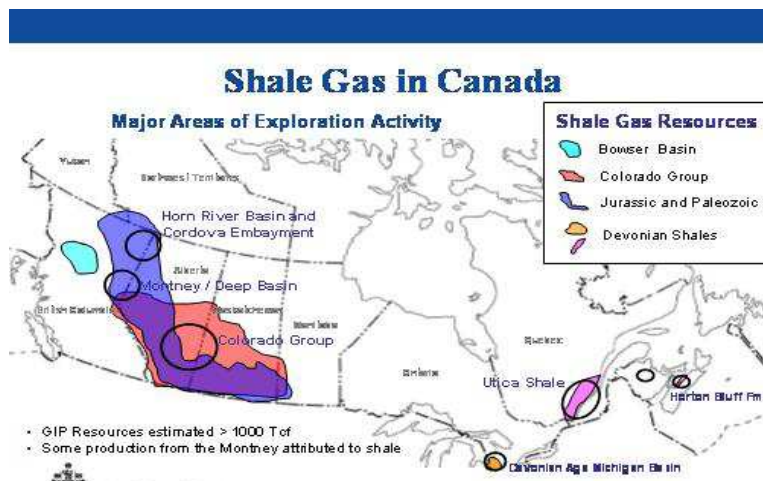
consumption and exports to Western Europe by 2020.

Azerbaijan also has huge shale gas reserves, and aims to become one of the major suppliers to the European and global gas markets. Other countries in Central Asia, including Uzbekistan and Turkmenistan, also own abundant oil and natural gas resources, but insufficient foreign investments and an inadequate transportation infrastructure prevent them from becoming major energy exporters.

2.3. Canada

Figure 7:

Shale Gas in Canada



Source: Canadian Society for Unconventional Gas.

<http://www.neb-one.gc.ca/clf-nsi/archives/rpblctn/spchsndprsnntn/2008/mtngnrthmrcndmnd/mtngnrthmrcndmnd-eng.html>

Canada's shale gas production is sharply increasing. The country remains a global exporter with an effective regulatory framework.

In recent years, several discoveries of shale gas have caused a sharp increase in the estimates of the volume of unconventional natural gas in Canada. The country owns the sixth largest reserves in the world, esteemed at 388 tcf, principally in the regions of British Columbia, Alberta and southern Ontario. Canada has dramatically increased its shale gas production and exports, thanks to strong investments, improvements in technology and research. Despite prospects for greater US energetic self-sufficiency, Canada still exports a significant amount of shale gas to the US. This is likely to continue, and Canada's shale gas extraction is rooted in an efficient and balanced legal and environmental regulatory framework. The country's regulatory bodies set strict requirements for the fracking operations, in order to prevent groundwater sources contamination.

2.4. The Middle-East and North Africa

As US shale gas production changes the world's energy map, some MENA countries are starting to invest in

Countries in the Middle East and North Africa (MENA) region have been slow to show interest in shale gas production, partly because many of them own huge reserves of conventional gas. But the growing global energy demand, driven by the population boom and industrial growth, has led some countries to review their options.

According to recent reports by the US Energy Information Administration, the region holds substantial unconventional gas resources, particularly shale gas. Libya's are apparently among the largest local reserves,

shale gas exploration.

The region is rich in unconventional gas reserves, with Libya, Algeria and Saudi Arabia holding the greatest reserves.






Yet political instability and the lack of environmental legislation may prevent extraction from taking off for years to come.

containing an estimated 290 trillion cubic feet of gas, ahead of Algeria's 231 tcf. But it is Algeria that appears to be taking the lead in exploration. The Algerian state energy company recently signed a cooperation agreement with the Italian oil and gas company ENI to develop its shale gas. In addition, Algeria has begun evaluating its natural gas liquids (the liquid components of natural gas, such as propane or butane), either in partnership with foreign companies such as Shell¹⁵ or autonomously. Saudi Arabia, Libya, Egypt and Oman have also begun evaluation their potential reserves, with those of Saudi Arabia estimated at 645 tcf by the US oilfield services company Baker Hughes.

Despite this growing interest in shale gas in the MENA region, the region's energy mix is unlikely to be transformed imminently. North Africa is currently in the midst of a difficult democratic transition, and lingering political instability may hamper potential advances in shale gas production.

Most of the MENA countries lack clear environmental legislation for the exploration of these unconventional resources.

Figure 8:
World shale gas resources

					
EUROPE					
France	0,03	1,73	98%	0,2	180
Germany	0,51	3,27	84%	6,2	8
Netherlands	2,79	1,72	(62%)	49,0	17
Norway	3,65	0,16	(2,156	72,0	83
U.K.	2,09	3,11	33%	9,0	20
Denmark	0,30	0,16	(91%)	2,1	23
Sweden	-	0,04	100%		41
Poland	0,21	0,58	64%	5,8	187
Turkey	0,03	1,24	98%	0,2	15
Ukraine	0,72	1,56	54%	39,0	42
Lithuania	-	0,10	100%		4
Others (3)	0,48	0,95	50%	2,71	19
NORTH AMERICA					
United States	20,6	22,8		272,5	862
Canada	5,63	3,01		62,0	388
Mexico	1,77	2,15		12,0	681
ASIA					
China	2,93	3,08		107,0	1,275
India	1,43	1,87		37,9	63

¹⁵ A. Maameri, *Time to look for unconventional Gas in the Middle East*, Rigzone, http://www.rigzone.com/news/oil_gas/a/125078/Time_to_Look_for_Unconventional_Gas_in_the_Middle_East.

Pakistan	1,36	1,36		29,7	51
AUSTRALIA	1,67			110,0	396
AFRICA					
South Africa	0,07	0,19	63%	-	485
Libya	0,56	0,21	(165%)	54,7	290
Tunisia	0,13	0,17	26%	2,3	18
Algeria	2,88	1,02	(183%)	159,0	231
Morocco	0,00	0,02	90%	0,1	11
Western Sahara	-	-			7
Mauritania				1,0	0
SOUTH AMERICA					
Venezuela	0,65	0,71	9%	178,9	11
Colombia	0,37	0,31	(21ù)	4,0	19
Argentina	1,46	1,52	4%	13,4	774
Brazil	0,36	0,66	45%	12,9	226
Chile	0,05	0,10	52%	3,5	64
Uruguay	-	0,00	100%		21
Paraguay	-	-			62
Bolivia	0,45	0,10	(346%)	26,5	48
TOTAL	53,1	55,0	(3%)	1,274	6,622
TOTAL WORLD	106,5	106,7	0%	6,609	

Source: Seismic Micro-Technology.

<http://southhillcreative.com/june-infographic-world-shale-gas-resources>.

3. Implications for the European Union

In some parts of the EU, expectations are high for a domestic shale gas boom, promising greater energy security, a diversity of energy sources and reduced energy dependency.

The European Commission's 'Energy Roadmap 2050' identifies

In some parts of the European Union, the US's shale gas boom is contributing to expectations for an EU shale gas 'revolution'. Developing unconventional and shale gas in the EU could lead to a greater energy security, while providing a diversity of energy sources in energy-dependent Member States, and ultimately reducing the EU's overall energy dependency.

The European Commission's 'Energy Roadmap 2050' identifies gas as a critical fuel for transforming the energy system. The report states, 'gas is expected to play an important role in the EU energy mix across all scenarios, representing 22-25 % of primary energy consumption by 2030, and between 19 and 26 % by 2050'¹⁶. Over the past few years, the EU has taken measures to improve the coherence of its energy-related activities.

In February 2011, the European Council concluded that to further enhance

¹⁶ European Commission, 2011, *Energy Roadmap 2050*, http://ec.europa.eu/energy/energy2020/roadmap/index_en.htm.

The results of this exercise, which ran from 20 December 2012 to 23 March 2013, are expected to be presented in the spring of 2013²⁶.

In conclusion, Europe's own 'shale gas and oil revolution' may be a rather distant prospect. But while shale gas is unlikely to transform the EU energy market as a whole, developments in the unconventional gas and oil industry could be significant for individual Member States, offering them considerable economic benefits, including government revenues, private sector jobs and, above all, a reduced energy dependence²⁷. The impact of shale gas on EU national energy markets may vary widely from one country to another, depending on the national energy strategy, the degree of dependence on imports, the expected growth in demand for gas, and social acceptance of such alternative supply sources.

Nevertheless, developments in the shale gas industry could be significant for individual countries, reducing their dependence on energy imports.

In this context, the EU should continue assessing its shale gas and oil potential and should ensure that administrative and monitoring resources are made available to sustainably develop this industry, while simultaneously ensuring adequate environmental safeguards. The Commission's recent green paper constitutes a step in a right direction, but more concrete proposals should follow to forge a common approach to the issue and facilitate economic benefits, while ensuring a proper regulatory framework (such as water legislation) guarantees the safety of the process for the environment and for human beings.

²⁶ European Commission, DG Environment, http://ec.europa.eu/environment/consultations/uff_en.htm.

²⁷ Ernst & Young, 2011, *Shale gas in Europe: revolution or evolution?*, <http://www.ey.com/GL/en/Newsroom/News-releases/Shale-gas-in-Europe--revolution-or-evolution>.