Euler Hermes Economic Research

Economic Insight

Shale gas: One country's meat is another country's poison?

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Executive summary

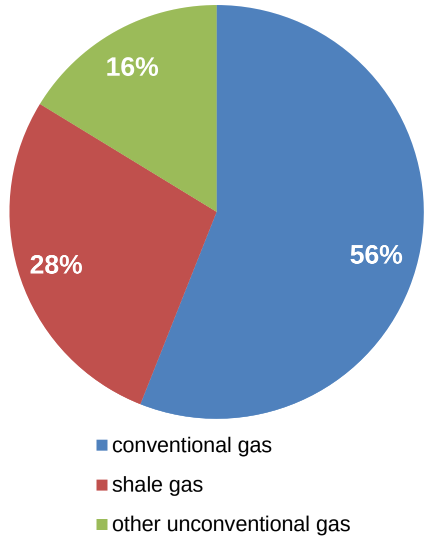
- Shale gas offers an alternative to oil in the energy consumption mix of a country and its industries such as steel, power generation, petrochemicals and transportation.
- Global reserves of shale gas (208 trillion cubic meters) are allocated in a fairest manner than reserves of conventional gas but production enjoyed a rapid take-off only in the US, boosted by its law on subsoil property.
- The take-off of US production has already reduced the energy bill of US companies ($11bn since 2010) and raised their relative competitiveness. This also means higher (relative) energy costs elsewhere, especially in Europe, as portability remains challenging.
- The risk of accelerated shale gas extraction is the possible contamination of surrounding soils.

Shale gas is an unconventional gas offering an alternative to oil consumption. It gives an extra 150 years to gas extraction thanks to reserves estimated at 208 tcm in 2012

Between 1990 and 2010, global gas reserves grew twice as fast as oil reserves. Initially, reserves were sufficient to be extracted over a period of 60 years. However, once unconventional gas reserves were taken into account, this period leapt to some 200 years of extraction. In early 2012, global gas reserves amounted to 752 trillion cubic meters (tcm). As shown by **Chart 1**, 44% of these reserves are unconventional, of which 63% is shale gas; in other words, shale gas exceeds 200 tcm and accounts for 28% of reserves of gas worldwide.

Conventional gas deposits are formed by the migration of gas molecules toward the surface, which then form vast and easily accessible reserves. By contrast, shale gas molecules are trapped in the pores of their source rock, or rock layers. Fracturing is required to subsequently extract the gas, hence its inclusion in so-called unconventional gas reserves. Hydraulic fracturing or "fracking" is the only technique that makes the extraction of shale gas possible. Currently, there is

Chart 1: Global reserves of gas (in volume, in %)



Source: International Energy Agency (IEA) no economically viable alternative technology, and this is set to remain the case at least until 2020.

Broadly speaking, the process of "fracking" involves three steps: drilling, fracturing and finally production. Drilling is complex as the average source rock depth is -1,500 meters below the surface. Once this depth is reached, bores are then drilled horizontally. Fracturing consists in cracking apart the source rock by the injection of highly pressurized liquid made up of water, sand and several chemical additives. Once fracturing has been carried out, the liquid rises to the surface and brings with it the freed-up gas. This phenomenon is better known as *flowback*.

The downstream drawback with gas compared to oil –whether or not unconventional– is its significantly higher transport cost. In addition, only 25% of the gas extracted in the world crosses a border, compared with 70% for oil flows. Coal largely remains a domestic energy, with less than 15% of quantities extracted subsequently exported.

The US is the first country to take advantage of its shale gas bonanza but is faced with four key tradeoffs

Chart 2 gives a comprehensive view of how are allocated the two kinds of gas. It appears that Eastern Europe (especially Russia) and Middle East account for 61% of conventional gas reserves worldwide. It is almost the contrary for reserves of unconventional gas for which both of them only account for 17%.

The US has been cashing in on this current situation, helped by the US law as the latter bestows on a property owner the disposal of its subsoil as well. **Chart 3** shows that the takeoff of US gas production started back in 2010. It also stems from huge improvements in the technology of "fracking".

Nevertheless, US had to get through hard decisions to become the leader in shale gas industry. Indeed, shale gas entails four trade-offs for countries wishing to extract their reserves:

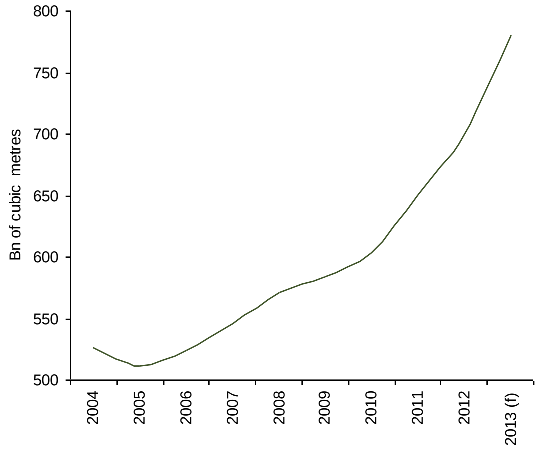
- An energy trade-off: this depends on the estimated level of a country's shale gas reserves and boils down to measuring the level of its long-term energy autonomy.
- An economic trade-off: it should be reminded that, in France for exemple, the national gas bill amounted to €15 billion in 2012 (+9.7% from 2011). Less reliance on gas produced abroad equates to lower energy imports. The resulting savings would benefit to households (heating and transportation) and companies (to run their factories). Still very much in limbo twelve years ago, the shale gas industry in the United States has created at least an estimated 600,000 new jobs at least this decade.
- A political trade-off: Western Europe is highly dependent on the trio of Russia, Qatar and Iran for its conventional gas. Given the more equal distribution of shale gas reserves throughout Europe, local shale gas production would jeopardize this captive export market. It is therefore understandable that Russia is opposed to this technology, which is booming on the other side of the Atlantic.
- An environmental trade-off: this is the most delicate

Chart 2: Global reserves of conventional and unconventional gas by geographic region

Volume in Tcm ❶at end-2011	Conventional gas		Unconventional gas (*)			**shale gas (share of the total)**
	vol.	%	vol.	%	(*) o/w shale gas	
Eastern Europe	131	31%	43	13%	28%	**7%**
Middle East	125	30%	12	4%	33%	**3%**
Asia-Pacific	35	8%	93	28%	61%	**44%**
Americas+Europe ❷	69	16%	98	30%	73%	**43%**
Africa	37	9%	37	11%	81%	**41%**
Latin America	23	5%	48	15%	69%	**47%**
TOTAL	420	100%	331	100%	63%	**28%**

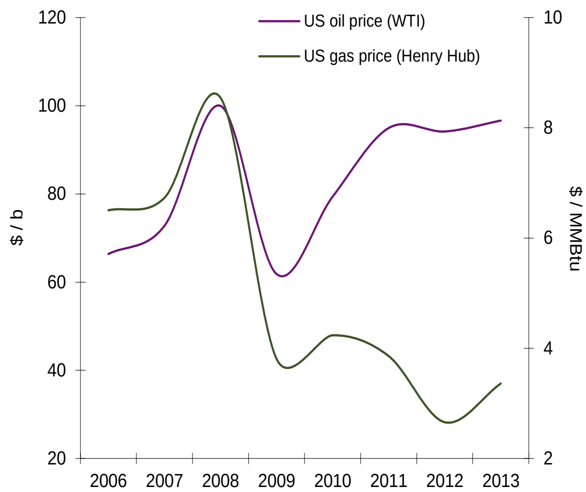
❶ Tcm ⇔ trillions of cubic meters
❷ As defined by the OECD
Source: International Energy Agency (IEA)

Chart 3: Evolution of US gas production



Sources: IEA, Euler Hermes forecasts

Chart 4: US oil price (left axis) and US gas price (right axis)



Sources: IHS Global Insight, Euler Hermes of the trade-offs. In addition to the visual pollution linked to the number of wells drilled for each concession, there is the risk of contaminating surrounding soils and ground water as a result of the discharge of many toxic substances during flowback. Moreover, a methane leakage rate in excess of 3.5% would generate a negative carbon result in which case shale gas would lose its status as a clean energy (it emits 50% less CO2 than coal and no sulfur dioxide).

The US shale gas industry is a major game-changer for American industries, giving a competitive advantage for the chemicals and primary metals industries

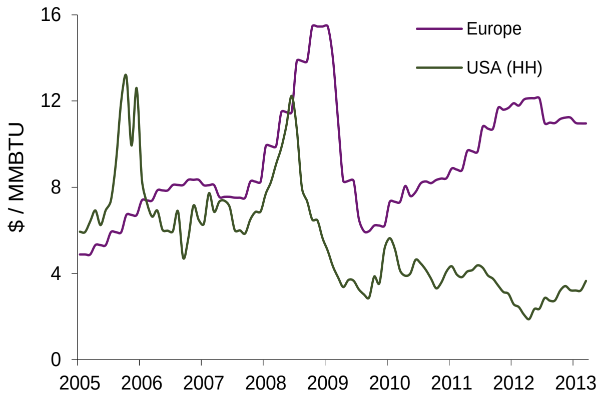
Charts 3 and 4 provide a clear illustration of the boom in the volume of US gas production since the start of the decade. It has triggered downward pressure on domestic gas prices and provided American companies with access to a cheap energy supply, especially compared to prices in Europe, as shown by **Chart 5**.

Shale gas drops the energy bill especially for the sectors requiring much energy for their factories to keep operating (**chart 6**). Likewise steel sector, chemicals (especially basic chemicals and fertilizers) is a good example of an energy-hungry sector. No wonder that US chemical firms want to keep by themselves the competitive edge of cheaper energy costs than anywhere in the world. The savings in their gas purchases make possible for US industry to raise their profit margin or help them reduce their prices in order to shore up their competition abroad. **Chart 7** shows the positive effect of the fall in the gas price on the US chemicals: improved price competitiveness has enabled companies in this sector to raise the level of their exports remarkably over the past three years.

A drop in gas price benefits not only to all large energy consumers but also to downstream industries. Industry –all sectors combined– consumes around one third of available gas supply. We estimate that the financial gains of the shale gas bonanza for US industry (power generation excl.) have made cost savings around $11bn since 2010 based on the fall of the gas consumption bill by -35% from 2010 to 2012 (despite a rebound of volume by +5%). Indeed, had the US industry paid its volume of gas consumption in 2011 and 2012 at the average price of the 2006-2010 period, its gas bill would have amounted to as much as $40bn more. And if US industry had paid its gas at the price Germany bought his at the European price between 2011 and 2012, it would have paid out around $60Bn more than it really paid out for its gas over these two years.

The impact of this divergence is particularly interesting when one looks at the ethylene market, a pivotal building block for the chemical industry. The cost of ethylene is approximately 1,200 US$/T in Europe in 2012 compared to 500 US$/T in the US. Two remarks: (i) 500 US$/T was the price in Europe… in 2005, seven years ago; and (ii) transportation cost does not help: 200-300 $/T between the two regions. With an annual consumption of ethylene at around 20mn tons in Europe, it means that the European chemical industry, downstream, has been suffering from $14bn of foregone earnings per annum. Purchasing cheaper ethylene made it possible for Westlake Chemical, a US plastics manufacturer with $4bn of revenues last year, to raise its operating margin by 12pp (+12%) in

Chart 5: Natural gas price in Europe and USA



Sources: IHS Global Insight, Euler Hermes

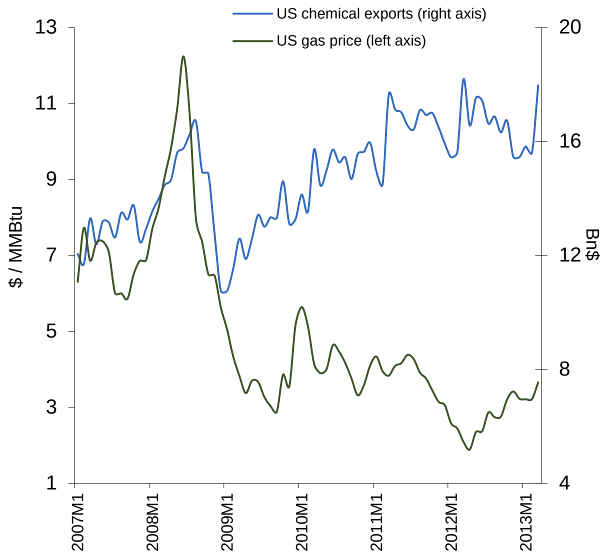
Chart 6: Top sectors benefitting from a decrease in energy prices

	Part of energy costs in sector input cost (%)	Part in U.S. manufacturing energy input costs (%)	Imports ($Bn) 2011	Exports ($Bn) 2011
Manufacturing	3%			
Nonmetallic mineral products	11%	6%	17.7	10.7
Paper products	10%	12%	21.9	25.7
Primary metals	8%	16%	103.5	76.5
Wood products	5%	2%	11.3	5.9
Chemicals 5%	22%	201.8*	197.1*	
Textile mills and textile product mills	4%	1%	24.4	12.6
Plastics and rubber products	3%	3%	40.2	29.1
Food/beverage and tobacco products	3%	18%	67.9	66.7
Apparel/leather and allied products	3%	~0%	116.4	9.0

** $108.7Bn and $149.2Bn excluding pharmaceuticals*

Sources: Bureau of Economic Analysis – International Trade Administration

Chart 7: Comparison of trends between US chemical exports and US gas price



Sources: IHS Global Insight, Euler Hermes

2012, compared to 2011, at constant sale prices.

The take-off of the US shale gas industry also implies higher energy costs elsewhere (relatively) as transportation remains an issue

The first other consequence of US shale gas is that price of coal - now replaced by shale gas in power plants- collapsed in the US. The US now exports coal heavily to other continents, especially in Europe where gas-fired combined power plants are forced to reduce production or even to stop it. And this should continue if we consider the **chart 8** showing the expected spreads in gas prices according to the geographic region where it is produced (and sold) out to 2020. While they were more or less equal across the three continents in 2005, gas prices have been diverging since this decade. The fact that the price of gas is already higher in Japan than Europe owes to the repercussions of the Fukushima disaster, which has resulted in Japan relying more heavily on gas as a source of energy.

The second consequence is that many (petro-) chemical companies –such as Dow, Shell, or Chevron– have begun to massively invest in new steam cracking capacity in the US. They want to internalize its refinement into a (much) more profitable form, namely ethane, after the extraction of the natural gas. This will contribute to accelerate the reshuffling of the cards of global gas market while a number of analysts expect the US and China, given the level of their shale gas reserves, to attain energy independence by 2030, whereas today they are still net importers (**chart 9**).

The third consequence is that shale gas debate will continue to divide the European countries. France, the Netherlands and the Czech Republic do not authorize exploration so far while Belgium and Norway do authorize exploitation and while several other countries do have already granted exploration licenses (UK, Spain, Portugal, Sweden, Denmark, Germany, Austria, Slovenia, Hungary, Romania and Greece).

The rise of gas as a predominant source of energy should nevertheless be kept in perspective. The IEA estimates that its share in the global energy market will increase from 20% in 2010 to 28% by 2025. However, this forecast also factors in considerable growth in demand for energy fuelled by vigorous economic growth in emerging countries, and distribution remains an important variable in the reconfiguration of the global gas market. Gas is not easily transportable: pipelines are costly to build and even more so to maintain intact, while marine transportation requires the gas to be liquefied prior to loading (LNG) and then regasified after unloading. Such procedures require coastal infrastructures which, existing in only small numbers, are very costly.

Chart 8: Evolution of gas prices by major geographical region (in USD/MMBTU)

In $/MMBtu	2005	2010	2020 (f)
United States	6	4	6
Europe	5	8	12
Japan	5	11	14

Sources: Euler Hermes, IEA forecasts

Chart 9: Main net exporters and importers of gas in the world (in volume terms)

In bcm* Year 2011	**Exporting** country	**Importing** country	In bcm* Year 2011
Russia	196	116	Japan
Qatar	119	70	Italy
Norway	99	68	Germany
Canada	63	55	United States
Algeria	49	47	South Korea
Indonesia	46	44	Ukraine
Total WORLD	**834**	**834**	**Total WORLD**

*bcm: billions of cubic meters

Sources: IEA, Euler Hermes

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