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ECONOTE

Société Générale
Economic studies department

US: BECOMING A LNG EXPORTER

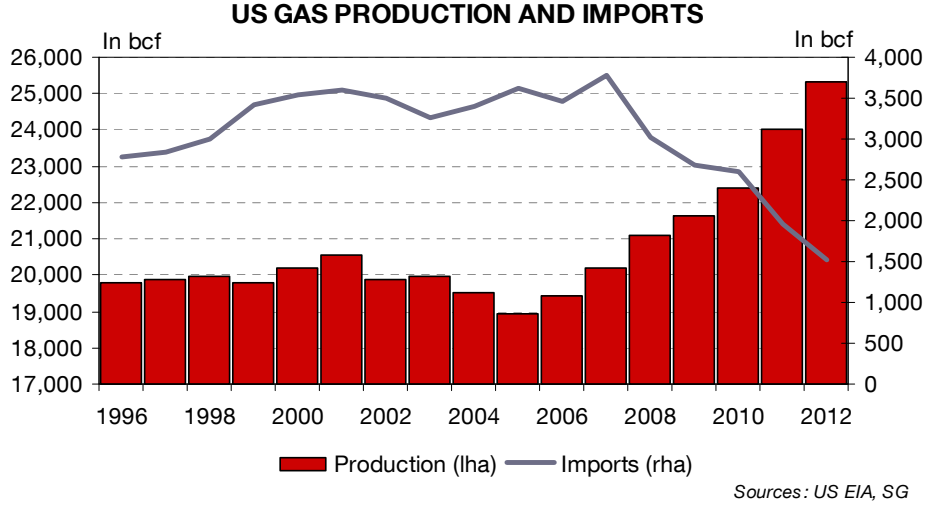
— Thanks to its gas boom, the US will start to export liquefied natural gas (LNG).

— As global gas demand is expected to grow over the next years at a rate greater than any other fossil fuel and since many LNG cargoes are sourced from countries with higher political risk, there is a strong argument for supply diversity that works to the advantage of US LNG exports.

— The possibility that the US starts to play an important role in the LNG export sector, with export contracts linked to US gas prices instead of being indexed to the price of oil, represents a major milestone and a challenge for countries like Qatar and Russia.

— That said, several obstacles could limit the magnitude of US LNG exports. First, the LNG approval process may prove long and uncertain. Second, the political debate is really a matter of who will collect the rents associated with an abundance of domestic gas resource: the domestic gas producers vs. the domestic manufacturers. Third, current market conditions do not define long-term commerciality. Higher US gas prices and lower Asian gas prices within the next few years are likely to mitigate the profitability of US LNG exports.

US GAS PRODUCTION AND IMPORTS



Sources: US EIA, SG

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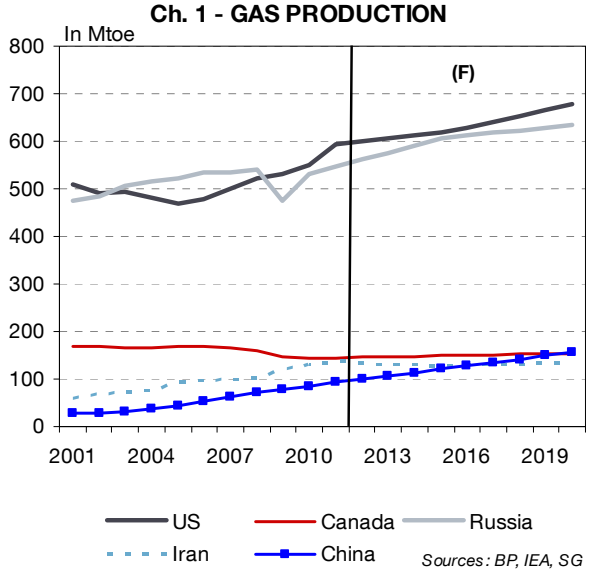
SOCIETE GENERALE

US GAS PRODUCTION IS RISING…

The exploitation of shale gas has led to a renaissance in the US gas production, reversing a decade-long decline. The US has even overtaken Russia as world's largest gas producer and should keep its first place at least until the end of this decade (Chart1).

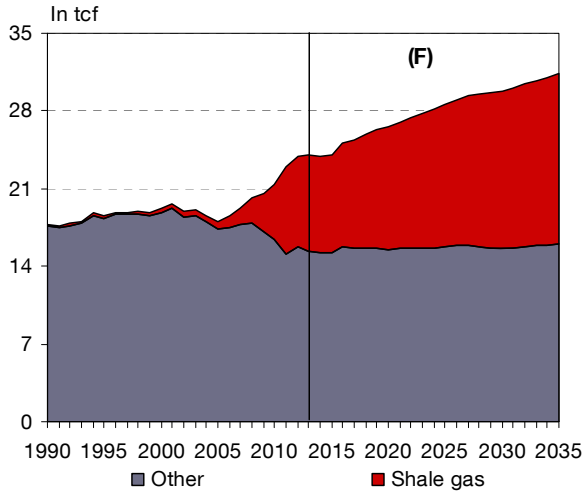
Ch. 1 - GAS PRODUCTION



Sources: BP, IEA, SG

According to the US Energy Information Administration (EIA), shale gas will become a dominant source of gas, accounting for around 50% of total supply by 2035 – vs. more than 30% in 2011 (Chart 2). Without the boom in shale gas production, total US gas production would have continued its decline as traditional gas fields become steadily depleted. That explains why in early 2000, market players were making large capital investments to facilitate the *import* to the US of liquefied natural gas (LNG).

Ch. 2 - US GAS PRODUCTION



Sources: US EIA, SG

Now, domestic production growth has been so strong that the US is considered a possible *exporter* of LNG – an unthinkable notion just a few years ago.

… BUT UNCERTAINTY REGARDING FUTURE PRODUCTION GROWTH

While US gas production has risen rapidly, continued growth will depend, among other factors, on prices and public environmental objections that have been growing.

Most researches found between USD4 and USD5/MBtu as a floor price for gas producers to be profitable. Of course unexpected events can cause short-term deviations from this, but market responses should generally push prices back toward their long-run equilibrium level.

One reason why US gas production has remained strong in spite of low prices is that drilling rigs have been moved from so-called "dry gas" wells, which produce only gas, to "wet wells" that produce a mixture of gas, oil and natural gas liquids, which are used for petrochemicals. With high prices for oil and natural gas liquids, companies have kept production high to profit from their oil and natural gas liquids output and considered gas a by-product.

Environmental groups are divided on the desirability of greater use of gas. Advocates see it as reducing emissions compared to other hydrocarbons, whereas opponents point out that natural gas still emits carbon dioxide and other pollutants and impedes the development of renewable sources of energy.

Meanwhile, hydraulic fracturing used for unconventional energy production requires a large amount of water and uses potentially harmful additives in the process. Usage of water in fracking has been linked to ground and surface water contamination.

The US Environmental Protection Agency is currently undertaking a study regarding the effects of hydraulic fracturing on drinking water resources, to be completed in 2014, while the industry has produced studies to promote the safety of hydraulic fracturing. Yet, several states have sought to limit hydraulic fracturing and Vermont has completely outlawed the process.

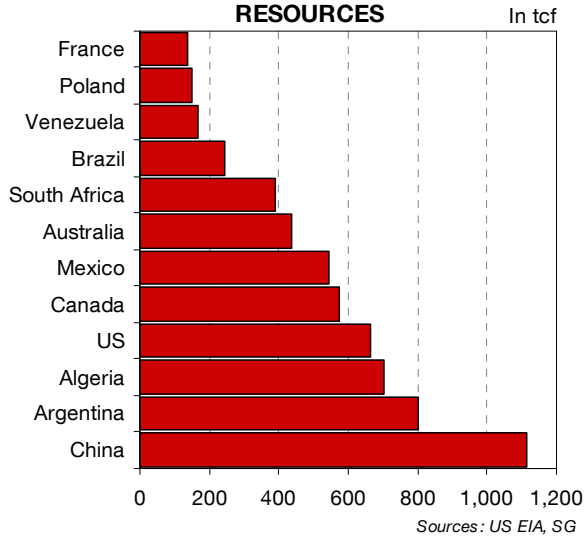
US SUCCESS IN SHALE GAS IS RATHER UNIQUE

With recent US success in boosting gas production, other countries have begun to explore similar possibilities. On June 2013, the US EIA published a study on shale gas resources worldwide, which identified large technically recoverable resources (TRR)[1] (Chart 3). This study is an update of a prior assessment of shale gas resources issued in April 2011.

[1] *Large conventional gas producing countries that were not included in the study (ex: Iran and Saudi Arabia) are likely to possess significant shale gas reserves since shale gas assets are often found underneath conventional gas fields. That being said, shale gas extraction also requires a lot of water and a water source in northern Saudi Arabia that cannot be used for drinking or agricultural purposes will be a challenge to secure.*

For countries like France, Poland and South Africa – which have very low level or no conventional gas reserves – these estimated shale gas resources are substantial relative to their current gas consumption, representing more than 100 years of reserves.

Ch. 3 - ESTIMATED SHALE GAS RESOURCES



Sources: US EIA, SG

In the wake of the 2011 study, both China and Poland commissioned their own reports into the extent of their shale resources. In both cases, the results were lower than the US EIA 2011 estimates, by 30% in the case of China, and by more than 65% in the case of Poland[2]. For the US, the 2011 estimates have been updated in June 2013 and decreased by more than 20%.

While the Chinese and Polish revisions might be explained by differing methodologies, estimates of TRR are highly uncertain particularly in emerging plays where few wells have been drilled. Initial estimates tend to vary significantly over time as new geological information is obtained through additional drilling, as long-term productivity is clarified for existing wells, and as the productivity of new wells increases with technology improvements and better management practices.

Furthermore, even though vast quantities of shale gas exist around the world, the ability of producers to extract this gas is still uncertain[3]. For now, commercial-scale shale gas production is practically non-existent outside the US and several factors argue for a worldwide gas production growth that is unlikely to occur on a similar scale than in the US.

Indeed, the US enjoys many often unique characteristics: landowners control their own mineral rights, funding is readily available, independent companies are ready to take risks in pursuit of high rewards, and there is a well-developed oil services industry to provide drilling platforms, tools and knowledge. Overall, in the near future, the US should remain in a unique position to tap its resources.

US LNG EXPORTS, BUT AT WHAT LEVEL?

US gas exports are not new. Historically, they have been primarily via pipeline to Mexico and eastern Canada. Thanks to the gas boom, companies are now considering exporting greater quantities of US gas by tanker ship to a number of other countries.

Cheniere Energy, Houston-based energy company primarily engaged in LNG-related businesses, is starting a USD 10bn project of LNG terminal at Sabine Pass, on the Texas-Louisiana border, that will have an export capacity of 18m tonnes of LNG a year and will be the first LNG export terminal in the continental US[4].

According to IHS CERA, many other projects had initiated some form of permit filing, for a total liquefaction capacity of 230m tonnes per year as of May 2013. If all the projects were approved and built, the US could become one of the world's biggest LNG producers. For comparison, Qatar, the current world leader, has a production capacity of 77m tonnes a year. However, several obstacles are likely to limit the magnitude of the US LNG exports.

REGULATION OBSTACLES

There are two main permitting tracks that US LNG projects need to cover before beginning commercial operations. First, the Department of Energy (DOE) needs to grant approval for exporting gas and LNG. Second, the Federal Energy Regulatory Commission (FERC) has to allow the sitting, construction, and operation of onshore LNG export facilities.

Obtaining export permits from DOE is virtually automatic if targeted markets are countries that have already signed free trade agreements (FTA) with the US[5]. However, applications for export to non-FTA countries are subject to more scrutiny. Yet, the largest consumption markets for LNG today are in countries with which the US does not have signed FTAs: Japan, the UK, Spain, India and China, which together accounted for almost 60% of global LNG consumption in 2011. To date, only two projects have been granted permission to export LNG to non-FTA countries, and that permission came with qualifications[6].

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[2] See Chinese Ministry of Land and Resources and Polish Geological Institute.

[3] Exxon Mobil announced in June 2012 it is no longer seeking additional exploration in Poland, after two early gas wells failed to yield commercial quantities.

[4] One LNG export terminal exists so far (Alaska), mainly destined to Japan and representing less than 1% of world LNG trade.

[5] The US has signed 16 FTAs: Australia, Bahrain, Canada, Chile, Dominican Republic, El Salvador, Guatemala, Honduras, Jordan, Mexico, Morocco, Nicaragua, Oman, Peru, Singapore, and South Korea. The recently implemented FTA with South Korea —the second largest LNG consumer— unlocked a sizeable potential market for LNG.

[6] The DOE granted Cheniere Energy and Freeport LNG conditional approval for the export of LNG to non-FTA countries, but reserved the right to revoke permission in the future if it found that these and any other LNG exports reduced the supply of gas needed to meet essential domestic needs. Furthermore, Freeport LNG must still obtain a permit from the FERC before moving ahead with construction of any facilities.

The FERC approval process generally takes longer than the DOE process because it focuses on the operational safety and environmental impact of a terminal. As part of the approval process, public opinion is sought and the projects can start construction only after receiving environmental clearances under the Clean Water Act, Coastal Zone Management Act, and Clean Air Act.

POLITICAL OBSTACLES

Besides regulation, other factors mitigate the prospects of the US becoming an important exporter of LNG. At the core of the issue is whether or not the US should export the raw material or the manufactured good. On the one hand, domestic gas producers can earn higher prices for their gas by selling to a higher priced foreign market. On the other hand, domestic manufacturers can earn higher profits by selling their final output, produced with the aid of low cost gas.

In this context, the political debate is really a matter of who collects the rents associated with an abundance of domestic gas resource.

Already, some US lawmakers have expressed concern that exporting LNG could drive up the cost of gas at home, endangering the revival in the manufacturing industries – namely petrochemical – that rely on low gas prices. In fact, the labor market in several states benefited from the energy boom experienced by the US (Table 1).

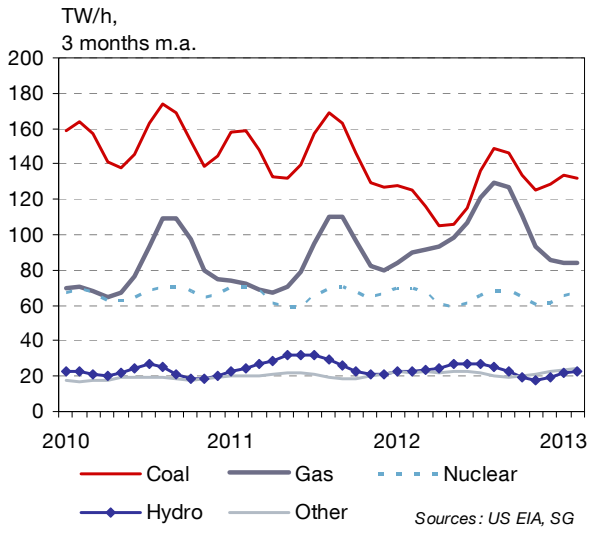
Table 1 - LABOR MARKET (March 2013)

States	Employment growth (yoy %)	Rank - crude oil production (2012)	Rank - gas production (2011)
North Dakota	4.3	2	18
Utah	4.0	11	9
Texas	3.0	1	1
Colorado	2.7	9	5
Idaho	2.7	n.a.	n.a.
California	2.1	4	13
Nevada	2.0	27	32
North Carolina	2.0	n.a.	n.a.
Montana	2.0	12	21
Georgia	1.9	n.a.	n.a.
US	1.5		

Sources: Datastream, US EIA, SG

In addition, many fear a potential increase in utility bills for consumers in the event of a too large volume of LNG exports. Indeed, the abundance of gas has encouraged the production of electricity using this fuel, mainly at the expense of coal (Chart 4).

Ch. 4 - US ELECTRICITY GENERATION

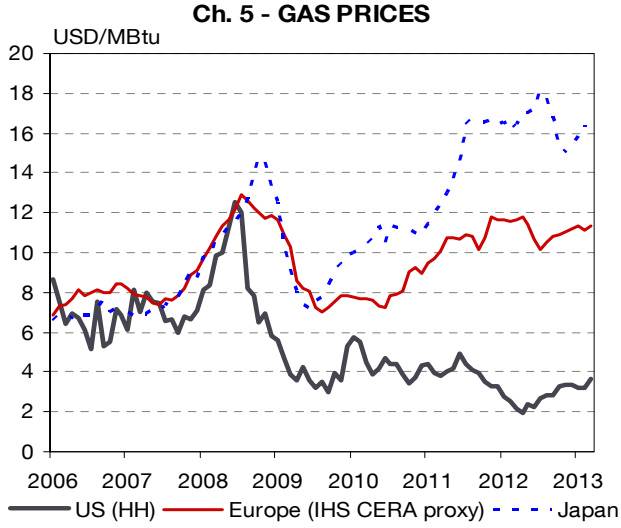


Sources: US EIA, SG

PRICE DIFFERENTIALS

Furthermore, the uncertainty regarding the future gas price differentials between the US and Asia/Europe is very high[7] (Chart 5). Yet, current market conditions do not define long-term commerciality of a trade; future market conditions do.

Ch. 5 - GAS PRICES



Sources: Datastream, IHS CERA, SG

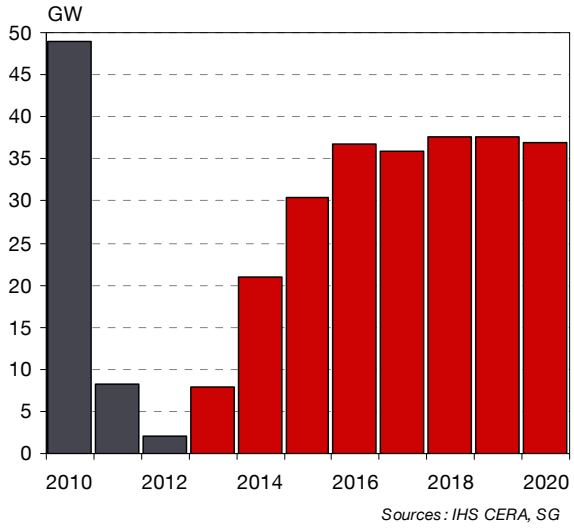
On the one hand, it is generally accepted that US gas has traded at an unsustainably low level and that sooner or later, it will converge towards the long term marginal cost of supply, which is estimated between USD4 and USD5/MBtu.

On the other hand, the elevated gas price outside the US, more specifically in Asia, is in part the result of the dramatically increased Japanese utility demand for LNG following the closure of all of Japan's nuclear

[7] *As a reminder, in 2009-2010, while energy demand slumped in Europe due to the financial crisis, a surplus of Qatari LNG has appeared in the gas market, depressing prices. In fact, Qatar has added significant capacity to supply the US, but the latter no longer needed this gas thanks to its shale gas boom.*

power generating capacity due to safety concerns after the tsunami in March 2011 (Chart 6).

Ch. 6 - JAPAN NUCLEAR POWER

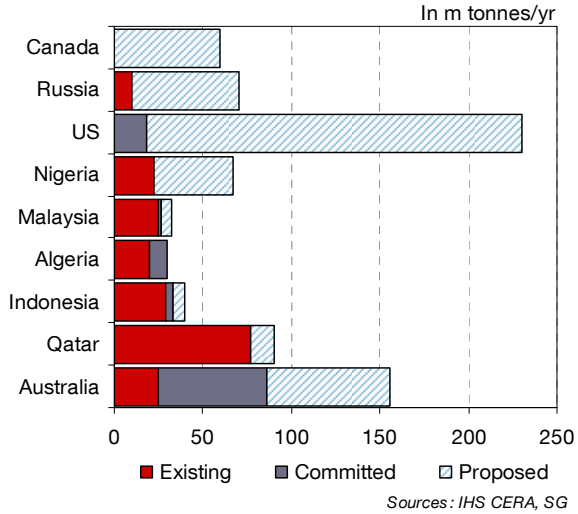


Sources : IHS CERA, SG

Yet, expected restart of nuclear energy, but also the growth of alternatives such as wind and solar, is likely to put downward pressure on actual Japanese LNG demand, although the more costly oil-fired generation is likely to be the first fossil fuel backed out of thermal generation plants.

Furthermore, relatively high prices in Asia, but also Europe, have already encouraged supply responses. In effect, there are at present a dozen LNG liquefaction projects under construction – seven of them in Australia – with a combined capacity of 80m tonnes per year. When all of them are completed, probably by 2018, they will boost global LNG export capacity by about 50% from today's level (Chart 7).

Ch. 7 - MAJOR LNG CAPACITY



Sources : IHS CERA, SG

In fact, if worldwide committed and proposed projects were to be built, global LNG capacity would reach nearly 900m tonnes per year, more than three-folds today's level – a highly unlikely outcome, but one that illustrates the global competition facing US LNG export proposals.

What's more, the development of pipeline supplies from Russia, Central Asia, and South Asia to China will displace the need for LNG towards that country, freeing those supplies for consumers in South Korea and Japan.

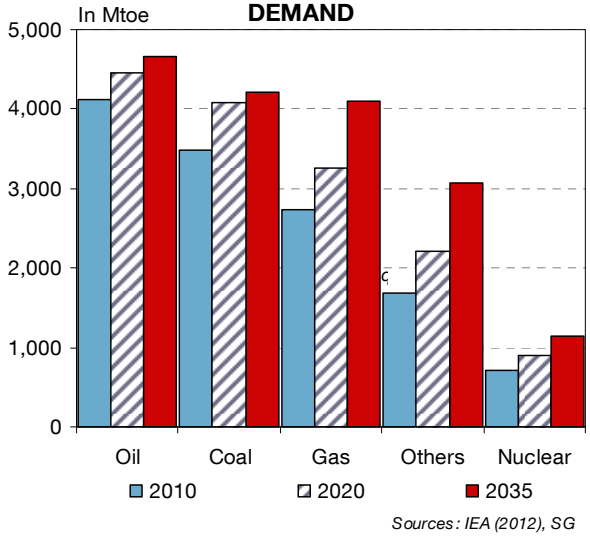
Thus, these factors go into the direction of reducing the gap between the observed gas prices between different markets, which should limit the prospects for US LNG exports[8].

US LNG-PROMOTING FACTORS

That being said, the Middle East is a large producer of gas, but also a large consumer. Its gas production growth is slowing, and it is expected that most of the future increase in production would go toward meeting incremental domestic demand — especially in Qatar and Saudi Arabia — and not toward generating additional exports.

More broadly, global gas demand is expected to grow over the next years at a rate greater than any other fossil fuel (chart 8). The power sector should account for 40% of incremental gas demand to 2035.

Ch. 8 - WORLD PRIMARY ENERGY DEMAND



Sources : IEA (2012), SG

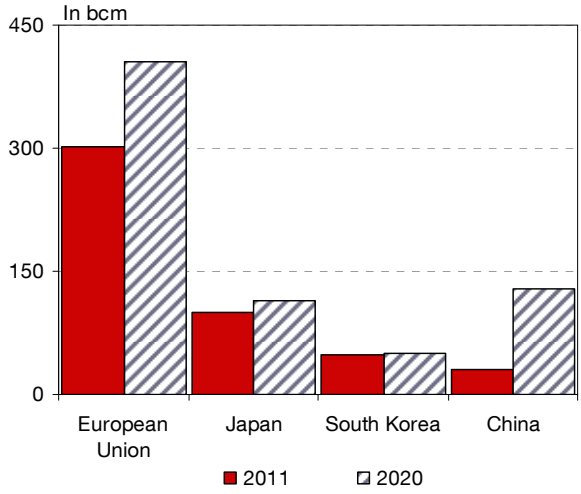
Yet, the prospect of gas-for-oil substitution in transportation could have a far-reaching impact on gas demand. There were an estimated 15 millions natural gas vehicles (NGV) on the roads in 2011, mainly in Iran, Pakistan, Argentina, Brazil and India, and the potential exists for much faster growth in the global NGV gas use. Indeed, high oil prices and worries about pollution have stimulated interest in using gas as a road transport fuel.

In that context of growing demand, international trade in gas is set to continue to expand. Among the importers, it is projected that Europe's needs will

[8] *The total delivered cost of US Gulf Coast LNG exports is estimated to range from US 8 to USD10.50/MMBtu, depending on the destination. At these levels, US LNG could be landed in Asia at a cost well below the oil-linked price of LNG that currently prevails in Asia. Conversely, the landed cost in Europe would be at best only marginally profitable at expected market prices.*

increase more than 30% by 2020. But a larger share of global trade is set to be drawn towards Asia (chart 9). For example, the increase of demand from China is expected to equal to nearly 40% of the total expansion in international trade.

Ch. 9 - MAJOR GAS IMPORTERS



Sources : IEA (2012), SG

Lastly, political risk is another matter. Many LNG cargoes are sourced from countries with higher political risk than potential LNG supplies from the US. There is a strong argument for supply diversity that works to the advantage of US LNG exports, and several importing countries are expressing tangible interest in US LNG exports by virtue of participation in the proposed export projects[9].

WORLDWIDE IMPLICATIONS

Overall, it is estimated that around 5% of US gas production would go to LNG exports by 2020, two-thirds of which is expected to go to markets in Asia. Worldwide gas prices are expected to converge, although they are likely to remain somewhat separated since US LNG exports are likely to be insufficient to either raise US prices to global levels or lower global prices to US levels.

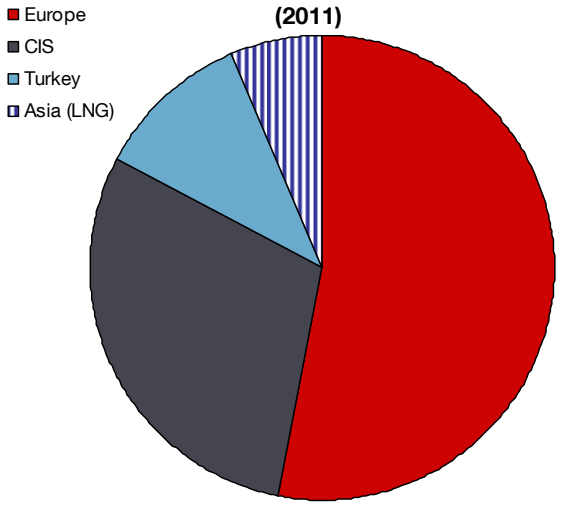
Still, it is difficult to exaggerate the significance of this shift and its consequences for the business model of the big gas producers like Russia, but also Qatar which today represents one third of global LNG exports.

Companies and countries supplying LNG could face increasing pressure from their customers to review their contracts and soften the price indexation of oil (for more on the formation of gas prices, see Box 1).

Indeed, for decades, LNG has been widely sold under contracts covering a period of 20 years, adjusted for most of the price of oil. The emergence of the US as a potential exporter of LNG, with the possibility of negotiating contracts now indexed to (low) US prices, is therefore a major development.

With regard to Russia, some of its customers, such as Poland, are exploring unconventional deposits that could allow them to reduce their dependence on Russian imports (Chart 10). In addition, China has such reserves of shale gas that it could revise down its long-standing project to massively import Russian gas via a new Siberian pipeline.

Ch. 10 - RUSSIA GAS EXPORTS (2011)



Sources : BP, SG

We must underline that Russia is highly dependent on energy prices. In round numbers, oil and gas together account for about 30% of Russian GDP. As an unprecedented price gap has opened up between cheap gas and expensive oil, a strong incentive to displace oil in the transportation sector has emerged and could even lead to lower oil prices.

Yet, surging oil revenues over the last decade have translated into an eightfold increase in government spending. Accordingly, Russia's breakeven price – the price at which government spending matches revenues – has rocketed from just USD34p/b in 2007 to more than USD115p/b in 2012. This therefore shows some fragility of Russia regarding the implications of US energy boom[10].

CONCLUSION

All things considered, the incoming surge in US unconventional gas production is a positive development not only for the US, but also for the global economy. By bolstering and diversifying sources of supply, it will loosen the global energy constraint and thus improve the world growth/inflation trade-off.

However, the benefits will not be evenly distributed across the world and new risks could appear. In that regard, large producers such as Russia and Qatar, the future looks a lot less certain than it did a decade ago.

[9] For example, Gas Natural Fenosa (Spain), KOGAS (S. Korea), and Gail (India) all have offtake agreements with Cheniere Energy.

[10] See « US Energy Independence », EcoNote No 17.

BOX 1 – DIFFERENT PRICING MECHANISMS FOR GAS

Since 2006, the International Gas Union (IGU) undertakes an ongoing study on wholesale gas pricing mechanisms. Looking at global pricing developments, it identified different mechanisms:

— gas-to-gas competition (GGC), which implies that gas prices are based on supply/demand balances (prevails mostly in North America, the United Kingdom and some parts of Continental Europe);

— regulation ([1] cost of service, [2] social and political, whereby gas prices are decided on an ad-hoc basis, and [3] below cost (*i.e.* subsidised gas prices));

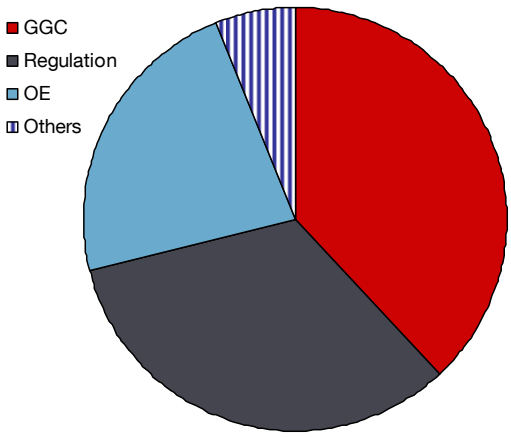
— oil escalation (OE) (also called oil indexation), which is usually a legacy of long-term import contracts with an oil linkage (prevails mostly in Europe, Japan, Korea, Chinese Taipei);

— bilateral mechanisms reflecting bilateral agreements between two countries, usually agreed directly between heads of states (prevails mostly in the Former Soviet Union, but such contracts tend to disappear in favour of OE);

— no price (*i.e.* where gas is given for free, as in Turkmenistan).

The last report, covering up to 2010, was released in June 2012. The most widely used pricing mechanisms are GGC, OE and the three types of regulated prices. The report also shows LNG imports tend to be dominated by OE (70%) vs. GGC (30%). The quasi absence of GGC in Asian markets – with a weight of only 5% – is mostly due to the absence of an Asian spot price, and largely reflects LNG trades.

GLOBAL WHOLESALE GAS PRICE FORMATION (2010)



Sources : IGU, IEA, SG

Creating a market for gas in Europe is a challenge due to its long-distance pipeline system characterized as dysfunctional by energy specialists. Indeed, the patchwork of state-owned pipeline monopolies bears no resemblance to US system of open access to interstate gas transport and its decentralised investment, which allowed it to adjust rapidly to the shale gas boom.

Natural gas: Proved reserves Trillion cubic meters	at end 1991	at end 2001	at end 2011	Share of total	Reserve / Production ratio
US	4,7	5,2	8,5	4,1%	13,0
Canada	2,7	1,7	2,0	1,0%	12,4
Mexico	2,0	0,8	0,4	0,2%	6,7
Total North America	**9,5**	**7,7**	**10,8**	**5,2%**	**12,5**
Argentina	0,6	0,8	0,3	0,2%	8,8
Bolivia	0,1	0,8	0,3	0,1%	18,3
Brazil	0,1	0,2	0,5	0,2%	27,1
Peru	0,3	0,2	0,4	0,2%	31,1
Trinidad & Tobago	0,2	0,6	0,4	0,2%	9,9
Venezuela	3,6	4,2	5,5	2,7%	*
Total S. & Cent. America	**5,3**	**7,0**	**7,6**	**3,6%**	**45,2**
Azerbaijan	n/a	1,2	1,3	0,6%	85,8
Kazakhstan	n/a	1,8	1,9	0,9%	97,6
Netherlands	1,8	1,5	1,1	0,5%	17,2
Norway	1,3	2,2	2,1	1,0%	20,4
Poland	0,2	0,1	0,1	0,1%	28,3
Romania	0,5	0,3	0,1	0,1%	9,9
Russian Federation	n/a	42,4	44,6	21,4%	73,5
Turkmenistan	n/a	2,6	24,3	11,7%	*
Ukraine	n/a	1,0	0,9	0,4%	51,3
United Kingdom	0,5	1,1	0,2	0,1%	4,5
Uzbekistan	n/a	1,7	1,6	0,8%	28,1
Total Europe & Eurasia	**54,9**	**56,8**	**78,7**	**37,8%**	**75,9**
Bahrain	0,2	0,1	0,3	0,2%	26,8
Iran	19,8	26,1	33,1	15,9%	*
Iraq	3,1	3,1	3,6	1,7%	*
Kuwait	1,5	1,6	1,8	0,9%	*
Oman	0,1	0,9	0,9	0,5%	35,8
Qatar	6,4	25,8	25,0	12,0%	*
Saudi Arabia	5,2	6,5	8,2	3,9%	82,1
Syria	0,2	0,2	0,3	0,1%	34,3
United Arab Emirates	5,8	6,1	6,1	2,9%	*
Total Middle East	**42,7**	**70,9**	**80,0**	**38,4%**	*****
Algeria	3,6	4,5	4,5	2,2%	57,7
Egypt	0,4	1,6	2,2	1,1%	35,7
Libya	1,3	1,3	1,5	0,7%	*
Nigeria	3,4	4,6	5,1	2,5%	*
Total Africa	**9,5**	**13,1**	**14,5**	**7,0%**	**71,7**
Australia	0,9	2,7	3,8	1,8%	83,6
China	1,0	1,4	3,1	1,5%	29,8
India	0,7	0,8	1,2	0,6%	26,9
Indonesia	1,8	2,6	3,0	1,4%	39,2
Malaysia	1,7	2,5	2,4	1,2%	39,4
Pakistan	0,8	0,7	0,8	0,4%	19,9
Vietnam	^	0,2	0,6	0,3%	72,3
Total Asia Pacific	**9,3**	**13,1**	**16,8**	**8,0%**	**35,0**
Total World	**131,2**	**168,5**	**208,4**	**100,0%**	**63,6**
of which: OECD	15,2	16,1	18,7	9,0%	16,0
Non-OECD	116,1	152,5	189,7	91,0%	90,0
European Union	3,8	3,6	1,8	0,9%	11,8
Former Soviet Union	49,8	50,9	74,7	35,8%	96,3

* More than 100 years
n/a: not available

Sources: BP, SG

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