

ECONOTE

Société Générale
Economic studies department

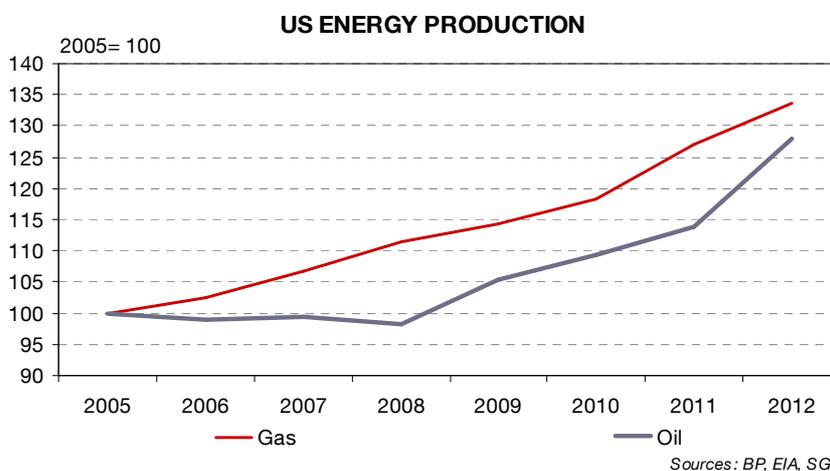
US ENERGY INDEPENDENCE

— US oil and gas production has been rising significantly over the last few years, mainly from unconventional sources. By 2020, not only is the US expected to remain the first gas producer, ahead of Russia, it is also expected to become the first oil producer, ahead of Saudi Arabia.

— Excluding Canadian and Mexican imports, the US is expected to import no more than 10% of its consumption by 2020. With lower energy imports, but also with an industrial renaissance that could produce an increase in exports and substitute imports for locally produced goods, the US current account deficit is likely to shrink over the coming years. That being said, the improvement will only be gradual.

— As the US is moving toward greater oil independence, China is becoming ever more dependent on oil imports. A net exporter in the 1990's, China's dependence toward the Middle East is expected to grow. As a result, China is settling in for a long-term economic and political presence in that region. This is likely to accelerate the switch in direction of Middle-East oil exports towards Asia-Pacific markets and away the Atlantic basin.

— Europe will face two major challenges. First, its manufacturing sector is likely to suffer an additional cost-handicap relative to US competitors. Second, as for its energy dependency, Europe will become more isolated and correspondingly more vulnerable if the energy map is redesigned along two inter-regional axes: an intra-American axis and a Middle East-Asia axis. This might excessively reinforce its reliance upon energy imports from Russia.



COLLARD Marc-Antoine
+33 1 57 29 62 28
marc-antoine.collard@socgen.com

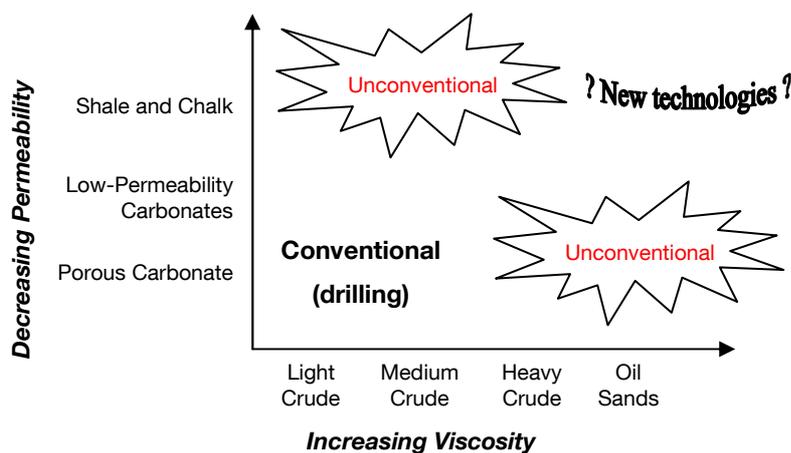
Abbreviation

Mtoe	million tonnes of oil equivalent
tcf	trillion cubic feet
p/b	per barrel
b/d	barrels per day
k b/d	thousand barrels per day
m b/d	million barrels per day
Mbtu	million British thermal units

BOX 1 – WHEN IS IT CALLED UNCONVENTIONAL?

The "unconventional" gas designation is a generic term that covers three types of natural gas resources: shale gas, tight gas and coal bed methane. It is the combination of two existing techniques, horizontal drilling and hydraulic stimulation, which allowed the development of the production of unconventional gas. For its part, the "unconventional" oil refers to the oil produced or extracted using techniques other than the traditional method of oil wells. In the case of oil, the term began to be applied to the Canadian oil sands and the Orinoco Belt in Venezuela.

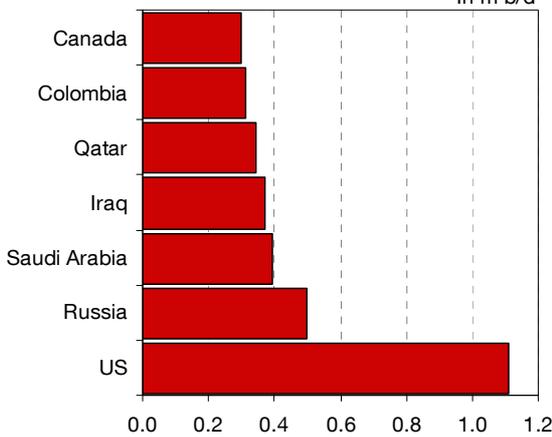
Another way to think about conventional and unconventional—on the oil side—is to think of a continuum of increasingly difficult (higher viscosity) oils on one axis and increasingly difficult rocks (decreasing permeability) on the other (see Figure below). Various technologies are applied to different combinations of rock and fluid, and typically the ones considered unconventional are at the far end of one axis or the other. For gas, there would only be one axis, involving the rock.



US OIL PRODUCTION IS RISING...

After falling for almost 30 years, US oil production has been on the rise since 2008, mostly due to the production of unconventional oil (see Box 1). As a result, the US saw the world's biggest increase in production in 2011 compared to 2008 levels¹.

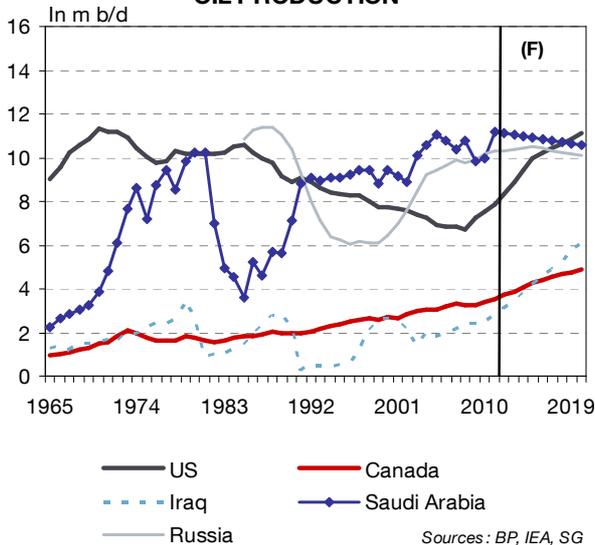
OIL PRODUCTION VARIATION 2008-2011
In m b/d



Sources: BP, SG

By 2020, it is estimated that the US production could even overtake Saudi Arabia's, with more than 11m b/d produced. For the same period, Canadian oil production is expected to grow by 50% to almost 5m b/d. Thus, by the end of this decade, the US and Canadian oil production could reach 16m b/d².

OIL PRODUCTION
In m b/d



Sources: BP, IEA, SG

¹ The highest production growth is occurring in the Bakken area, which is mainly in the North Dakota state. According to IHS CERA, North Dakota production increased from 100k b/d in 2005 to 700k b/d in early 2012. It is now the second largest oil-producing state, behind only Texas.

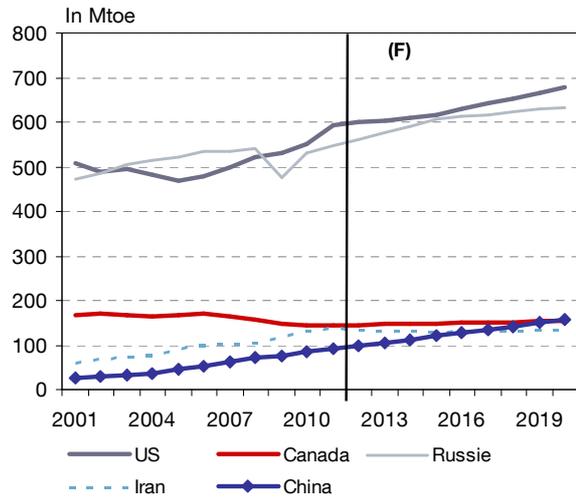
² World Energy Outlook (2012), International Energy Agency (IEA)

What's more, Canada has the world's third largest oil reserves, behind only Venezuela and Saudi Arabia.

... AND SO IS ITS GAS PRODUCTION

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.

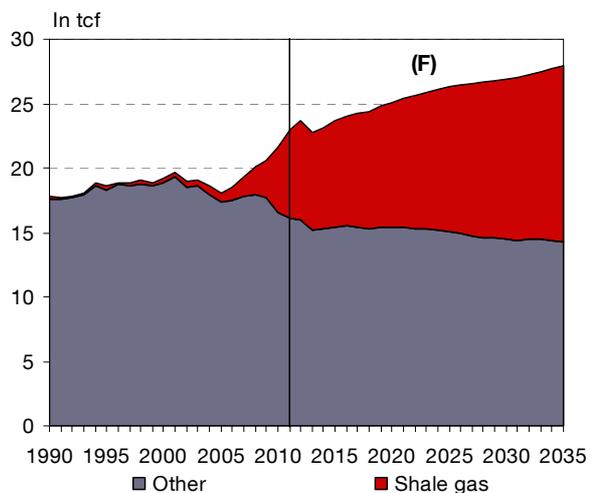
GAS PRODUCTION
In Mtoe



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 around 30% in 2011. 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).

US GAS PRODUCTION
In tcf



Sources: US EIA, SG

Now, domestic gas production growth has been so strong that the US is considered a possible *exporter* of LNG – an unthinkable notion just a few years ago³.

CHALLENGES REGARDING FURTHER GROWTH

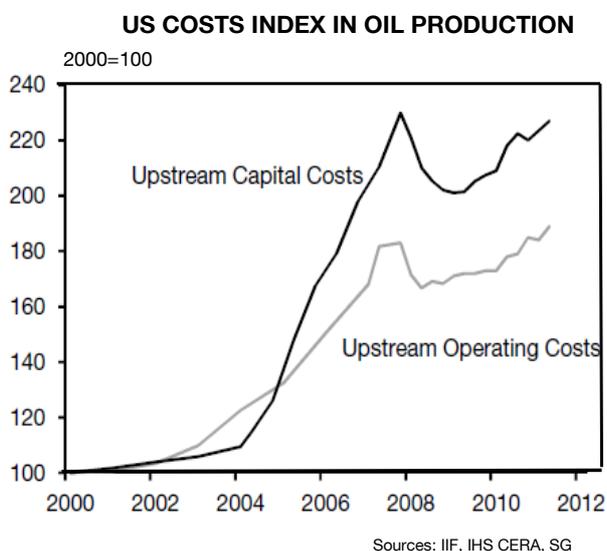
While US oil and gas production have risen rapidly, continued growth will mainly depend on 3 factors: [1] prices, [2] the construction of additional transportation infrastructure, and [3] public environmental concerns.

PRICES

The oil industry has for a century and a half been a boom and bust business. If the North American success is followed by global energy boom, prices could fall much lower.

For the unconventional oil production to be profitable, various sources give estimates ranging from USD 50 to USD 80 p/b, depending on a number of factors including access to cost-efficient technology, the characteristics of the production site and physical access to markets.

These estimates have been revised higher as costs are on the rise, due to increasing demand for inputs such as labour and services, rigs, and other physical equipment. That being said, costs indices, which had surged at annual rates of almost 10% during boom years 2002-08, have decelerated to low single digits since then.



We must underline the fact that there are two countervailing forces emanating from Organization of the Petroleum Exporting Countries (OPEC). On the one hand, oil ministers in the Middle East are increasingly aware that they need oil prices to be much higher than a few years ago as they have announced large-scale financial packages aimed at reducing social tensions⁴.

³ See "US: Evaluating gas exports potential", EcoNote No. 18 to be published in May 2013.

⁴ In late 2011, Saudi Arabia's Oil Minister indicated that his government was comfortable with a crude oil price of USD 100 p/b, up from USD 70-80 p/b previously.

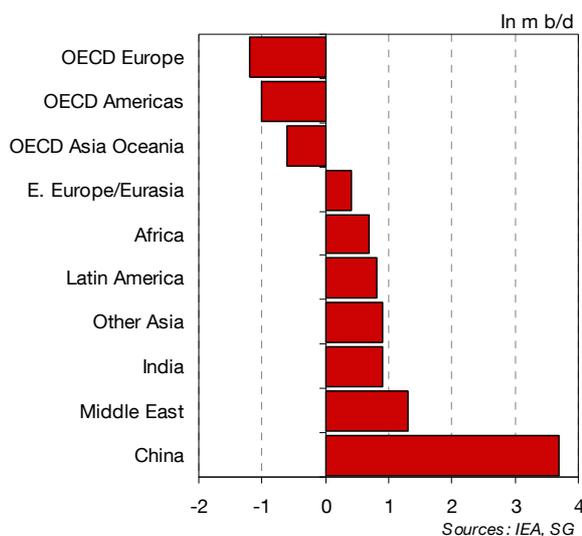
Thus, OPEC defending a floor price of no less than USD 80 p/b mitigates the risk of a freefall in oil prices.

On the other hand, elevated prices are risky for two main reasons: it jeopardizes economic growth, and more importantly for longer term, it encourages new energy discoveries and put the cartel's hegemony at risk. Furthermore, the expected renaissance of the Iraq's oil sector is a major source of increase in OPEC oil production. Iraq is already the world's third-largest oil exporter and its oil production could more than double to reach 6.1m b/d by 2020 as it recovers from three decades punctuated by conflict and instability.

Moreover, even though outside North America, production of unconventional oil is unlikely to make a large contribution to global oil supply before 2020, there is clearly some upside potential⁵.

This upside oil supply potential occurs in a context where measures to promote more efficient oil use and switching to other fuels, together with reduced subsidies in some major consuming countries and increased taxes on oil products, will help to offset underlying growth in demand for transportation, especially in non-OECD countries. What's more, the demand growth forecast relies heavily on one country – China – which adds to the demand uncertainties.

OIL DEMAND GROWTH 2011-2020



In sum, potential slower demand growth and faster supply growth could weigh on oil prices and result in the slow down of US oil sector developments.

For its part, most researches found USD 4/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.

⁵ In its latest World Energy Outlook, the IEA stated the Neuquén basin in Argentina shows promise, while the extension of the Eagle Ford shale into Mexico is also a focus of attention; China could grow a light tight oil industry, in parallel with its efforts on shale gas; and Russia is thought to have significant resources, in particular in the Bazhenov shale in Western Siberia, which are under study.

INFRASTRUCTURES

Despite the rise in the production potential for unconventional oil, take away infrastructure to the Gulf Coast refineries remains problematic. To address this issue, over 2m b/d in pipeline capacity is expected to come online prior to 2015, but that still will not be sufficient to accommodate planned production increases. US oil infrastructure remains relatively disconnected even within the continental US, with California, the Midcontinent and the East Coast operating almost as separate markets, as there is no East-West pipeline to connect the regions.

In addition to inland oil movement problems, the US also faces issues with waterborne movements. The US bans domestic oil exports for national oil security reasons (except in specific cases). As for intra-US shipping by water, legacy political interference through the Jones Act prevents, for example, Gulf of Mexico oil products moving easily to the East Coast⁶.

Contrary to oil, the US gas pipeline network is a highly integrated transmission and distribution grid that can transport gas to and from nearly any location in the country. However, as gas production is expected to grow rapidly, this will challenge the gas network.

ENVIRONNEMENTAL OBJECTIONS

In addition to infrastructure and price concerns, environmental objections have been growing. 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.

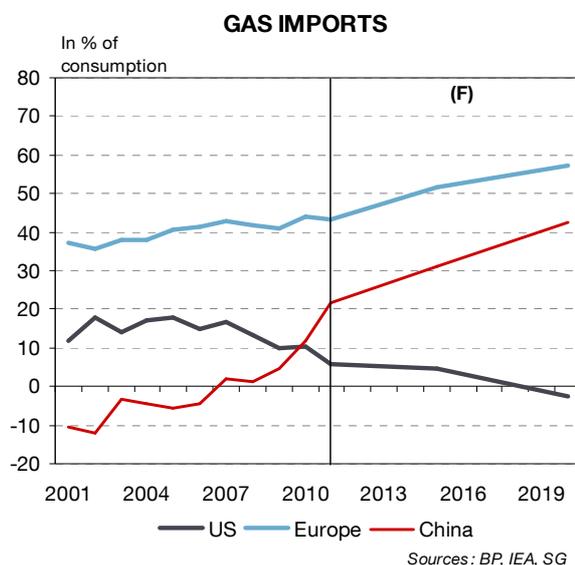
US MACROECONOMIC IMPLICATIONS: MANUFACTURING REVIVAL AND LOWER CURRENT ACCOUNT DEFICIT

In 2011, the US and the euro zone both spent more than 2% of GDP on imports of crude oil and other petroleum products, Japan more than 3% of GDP and the rest of Asia in excess of 3.5% of GDP. The US energy boom could lead to some divergence in trade balances between the US, Europe and Asia.

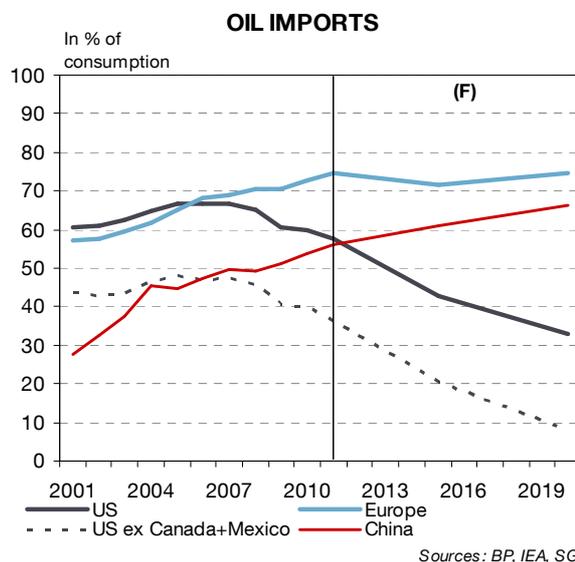
LOWER IMPORTS OF ENERGY...

The surge in US gas production has translated in the fall of gas imports. As mentioned, the US is even considered a possible exporter of LNG. That contrasts

with the fortunes of Europe, which now imports over 40% of its gas with Russia maintaining its position as the main supplier. As for China, it has shifted from being an exporter to being an importer in the past decade. In both cases, the dependence on imported gas is expected to increase in the next years.



On the oil side, US imports have been decreasing since 2005. What's more, excluding Canadian and Mexican imports, the US is expected to import no more than 10% of its consumption by the end of this decade. If proven right, this trend bears geopolitical implications that we will discuss in the next section.

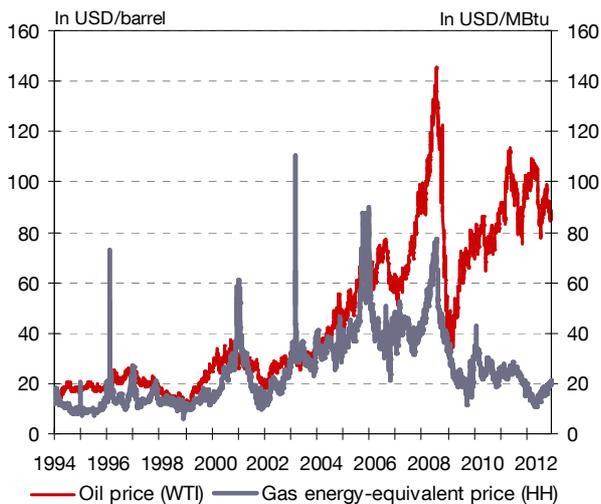


The jump in its oil production is not the sole factor behind the expected decrease in US oil imports. In effect, low gas prices – and the energy price differentials that it brought⁷ – are likely to encourage the move to natural gas-driven cars and trucks.

⁶ The Jones Act mandates that any intra-US shipping by water be done using vessels under US flag, built in the US, and manned primarily by US crews, which greatly increases the costs of shipping.

⁷ A simple rule of thumb is called the Energy Content Rule, which is to compare the Btu of a barrel of oil (5.825 MBtu) and an MBtu of gas. At the moment, for the same amount of energy, gas is four times cheaper than oil.

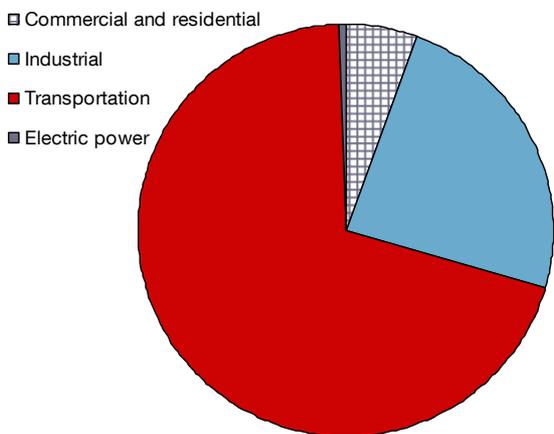
ENERGY PRICES



Sources: Datastream, SG

We must stress that the transportation sector represents almost 70% of the total US petroleum consumption, which shows the magnitude of the potential decrease in US oil imports. Substitution for gas should happen first where central fuelling infrastructure is available – for example buses and municipal garbage trucks. Still, given the elaborate infrastructure devoted to petroleum, substitution to gas on a broad base is unlikely to happen quickly⁸.

US PETROLEUM CONSUMPTION BY SECTORS IN 2011



Sources: US EIA, SG

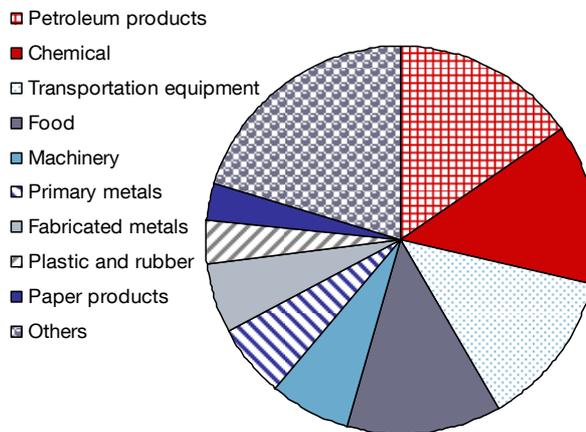
The residential and commercial sector is also experiencing a change, where heating oil as a traditional fuel for home heating, particularly in the Northeast, is being replaced by gas as long as infrastructure is available, thus lowering the US petroleum demand.

⁸According to most recent US EIA data, there were less than 100,000 passengers natural gas vehicles, compared to roughly 240m conventional passengers vehicles.

... AND HIGHER US EXPORTS...

Thanks to the gas boom, the US looks to be the lowest gas cost country in the world, with the possible exception of Qatar. That spells investment opportunities in energy intensive industries.

US MANUFACTURING SHIPMENTS



Sources: US Census, SG

The chemical industry relies on energy derived from gas not only to heat and power its facilities, but also as a raw material. In the US, this industry – which is the second largest manufacturing industry in terms of shipments – is among the first beneficiary of low gas prices and has seen a revival and restart of idled units⁹.

According to the American Chemistry Council, the shale gas boom would lead to a 25% increase in US petrochemicals capacity and USD 32.9bn in additional chemical industry output and create more than 17,000 jobs directly in the chemical industry. In addition to direct effects, indirect and induced effects from these added outputs would lead to an additional USD 50.6bn gain elsewhere in the economy¹⁰.

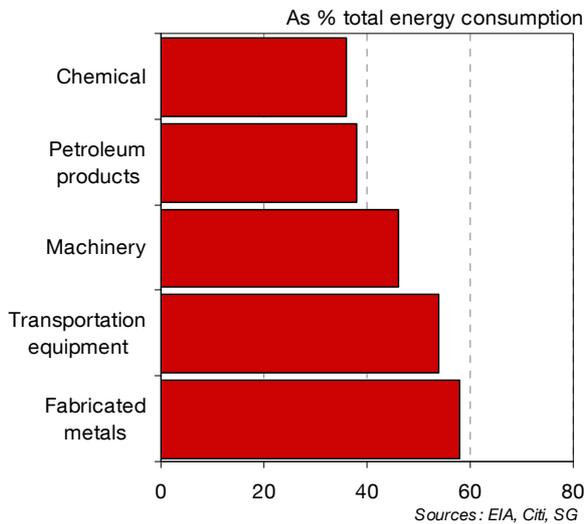
What's more, it is estimated that around 85% of US ethane production comes from gas, vs only 30% in Europe and Asia where it is produced mainly from oil. As a result, the US companies who produce ethane from gas will benefit from the lower prices compared to their international competitors who rely on oil or on more expensive gas not produced in the US. Since gas is also a key input for ammonia and nitrogen, US fertilizer companies will too become more competitive due to lower prices.

⁹ Shell Oil announced in March 2012 that it will build a "multibillion dollar" petrochemical plant in Pennsylvania that will employ 10,000 people during construction. On July 2012, Dow Chemical announced plans for new "world-class" propylene plant in Texas. Both projects are located to take advantage of shale gas that will be the primary feedstock for the plants.

¹⁰ See Shale Gas and New Petrochemicals Investment: Benefits for the Economy, Jobs, and US Manufacturing, American Chemistry Council, 2011

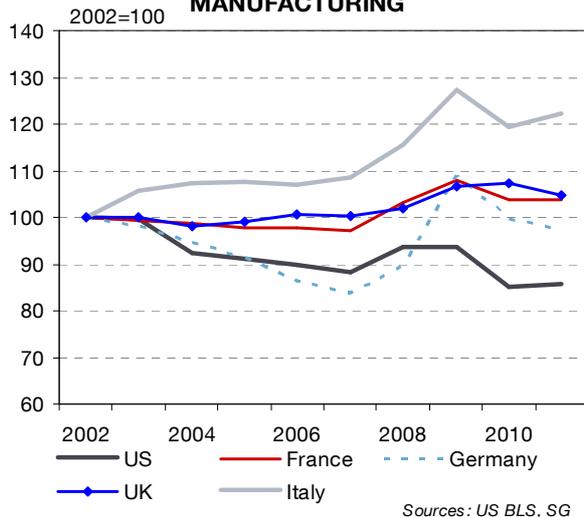
Other industries would also benefit from the US energy boom. For example, machinery and fabricated metals are seeing an increase in shipments as these industries supply the oil and gas companies, for example with pipes and drilling equipments. Furthermore, around 50% of their energy consumption comes from gas, so not only are they improving their revenues, they also benefit from lower energy costs.

GAS CONSUMPTION



Overall, in comparison with Europe, today's gas price differential of around USD 7/MBtu corresponds to a reduction in production costs for US industries of USD 120bn per year¹¹. This adds to the competitiveness of US manufacturing sector that was already bolstered by decreasing unit labour costs in comparison to Europe.

UNIT LABOUR COST MANUFACTURING



Thus, an industrial renaissance built on energy renaissance could produce an increase in exports and substitute imports for locally produced goods.

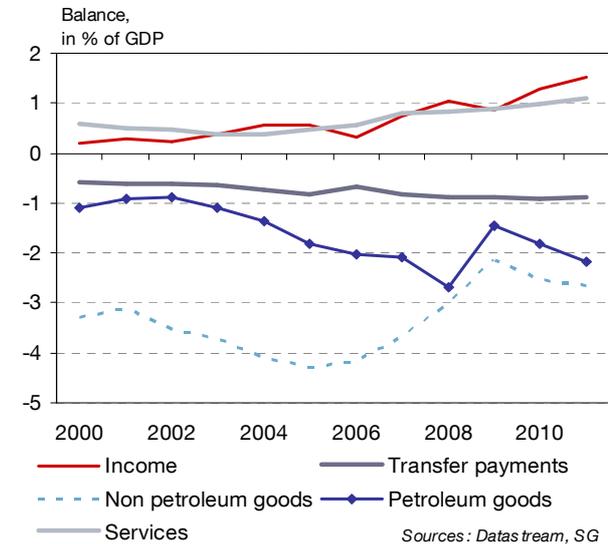
¹¹ US gas consumption by industries is around 3bn of barrels of oil equivalent, which represents around 17,5 MBtu.

Moreover, as the US energy imports within North America are increasing at the expense of the Middle East producers, economic growth will benefit. Indeed, a dollar spent buying more oil from Canada is more likely to end up back in the US than a dollar spent buying Iraqi or Saudi oil.

... BUT DON'T EXPECT DRASTIC CHANGES IN THE US CURRENT ACCOUNT DEFICIT

As a reminder, a nation's current account is the sum of its balances of goods and services, investment income, such as interest and dividends, and net transfer payments, such as foreign aid. In the US, the positive investment income and services balances are counterbalanced by its negative balances on goods and transfer payments. Since the non petroleum trade deficit is unlikely to shrink quickly, a drastic reduction in the US current account faces limits.

US CURRENT ACCOUNT

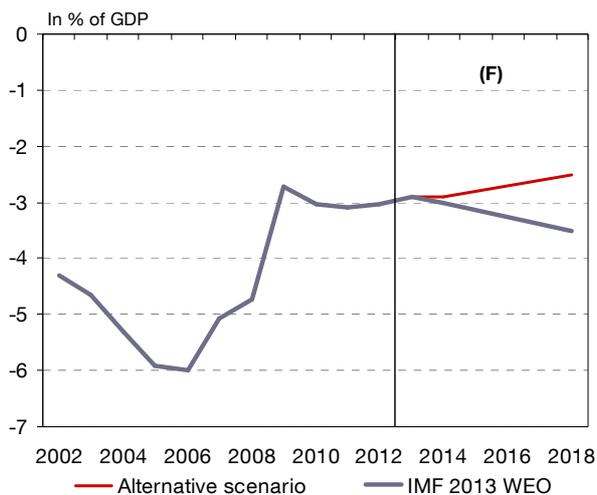


Indeed, with US growth currently more resilient than in many other regions, strong domestic demand is likely to lead to slow improvement in the non-oil trade deficit. In addition, US import elasticity to domestic demand growth is thought to be higher than US export elasticity with respect to foreign demand.

Yet, with lower energy imports and stronger exports of goods and services, the US current account deficit is likely to shrink over the coming years¹², thus diverging from the actual consensus of a widening current account deficit.

¹² We forecast the petroleum goods deficit will be cut almost in half and that the non petroleum goods deficit will marginally improve. We basically kept the other components constant.

US CURRENT ACCOUNT



Sources: IMF, SG

GEOPOLITICAL IMPLICATIONS

Overall, North America will reduce substantially its reliance on oil imports thanks to the rapid growth of oil production and also the decline in oil demand¹³.

Dependence on Middle East oil has shaped American foreign, national-security and defence policies for most of the last half century¹⁴. The shift away from Middle Eastern oil means closer ties with Canada, which is emerging as the top US energy ally. That being said, the region will remain important to US foreign policy partly because of the region's continuing influence on global oil markets and because the US have a fundamental interest that those markets are stable¹⁵.

Furthermore, most future US new oil production will consist of light-sweet oil. This phenomenon represents a considerable challenge for the US refineries in the Gulf of Mexico Coast. Most of them have reached a high level of complexity over the years through massive investments to increase their ability to process heavy-sour oil, the majority of the US oil imports. Correspondingly, the likelihood of the US continuing importing oil because of refinery constraints is elevated.

Still, as the US is moving toward greater oil independence, China is becoming ever more dependent on oil imports and could overtake the US as the largest oil importer in the world. A net exporter in the 1990's, China now gets about half its oil from the Gulf countries and its dependence toward this region is

¹³ Not only because of expected oil/gas substitution, but also because of more efficient car engines and growing supply of renewable fuel.

¹⁴ Active participation of the US in the process of Israeli-Palestinian peace, alignments with the monarchies of the Gulf States, military intervention in Iraq after its invasion of Kuwait, establishing and maintaining a military presence in the region.

¹⁵ On a more political front, the presence of the US in the region is also to be expected due to its ties with Israel.

expected to grow. As a result, China is settling in for a long-term economic and political presence in a region.

Interestingly, China may not share the US commitment to regime stability in the region. Either it believes that it cannot make a material difference in the stability of these regimes or that US efforts in that regard are and will be sufficient to safeguard China's interests.

As for Europe, decreasing oil production over the last decade was much more rapid than the decrease in demand, which has resulted in an increased reliance on Russia and its satellites (Kazakhstan) and, to a certain extent, the Middle East.

CONCLUSION

All things considered, the incoming surge in US unconventional gas and oil 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. Europe will face two major challenges. First, its manufacturing sector is likely to suffer an additional cost-handicap relative to US competitors. Second, as for its energy dependency, Europe will become more isolated and correspondingly more vulnerable if the energy map is redesigned along two inter-regional axes: an intra-American axis and a Middle East-Asia axis. This might excessively reinforce its reliance upon energy imports from Russia.

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ECONOMIC STUDIES DEPARTMENT CONTACTS

Olivier Garnier

Group Chief Economist
+33 1 42 14 88 16
olivier.garnier@socgen.com

Olivier de Boysson

Deputy & Emerging Markets Chief
Economist
+33 1 42 14 41 46
olivier.de-boysson@socgen.com

Marie-Hélène Duprat

Senior Advisor to the Chief Economist
+33 1 42 14 16 04
marie-helene.duprat@socgen.com

Ariel Emirian

Country Risk Analysis / CIS Countries
+33 1 42 13 08 49
ariel.emirian@socgen.com

Clémentine Gallès

Macro-Financial Studies & United
States
+33 1 57 29 57 75
clementine.galles@socgen.com

Benoît Heitz

Global Economic Forecasting & Euro
zone and Europe
+33 1 58 98 74 26
benoit.heitz@socgen.com

Constance Boubliil

Central & South-eastern Europe
+33 1 42 13 08 29
constance.boubliil@socgen.com

Marc-Antoine Collard

Gulf States, Latin America,
Commodities
+33 1 57 29 62 28
marc-antoine.collard@socgen.com

Marc Friso

Euro zone, Northern Europe & Sub-
Saharan Africa
+33 1 42 14 74 49
marc.friso@socgen.com

Régis Galland

Middle East, North Africa &
Central Asia
+33 1 58 98 72 37
regis.galland@socgen.com

Audrey Gasteuil-Rougier

OECD ex. Euro zone & Macro-Financial
Studies
+33 1 57 29 52 26
audrey.gasteuil@socgen.com

Sopanha Sa

Asia
+33 1 58 98 76 31
sopanha.sa@socgen.com

Isabelle Ait El Hocine

Assistant
+33 1 42 14 55 56
isabelle.ait-el-hocine@socgen.com

Valérie Toscas

Assistant
+33 1 42 13 18 88
valerie.toscas@socgen.com

Sigrid Millereux-Beziaud

Information specialist
+33 1 42 14 46 45
sigrid.millereux-beziaud@socgen.com

Tiphaine Cappe de Baillon

Statistic studies & Publishing
+33 1 42 14 00 25
tiphaine.cappe-de-baillon@socgen.com

Société Générale | Risk division

Economic studies department | 75886 PARIS CEDEX 18

<http://www.societegenerale.com/en/Our-businesses/economic-studies>

Tel: +33 1 42 14 55 56 — Tel: +33 1 42 13 18 88 – Fax: +33 1 42 14 83 29

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