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Liquefied natural gas and North American shale gas: Room for both?

Let's take a look at the drivers affecting these commodities

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In the early 2000s, substantial concerns about impending natural gas shortages and price spikes drove a boom in the planning and construction of facilities to import and regasify liquefied natural gas (LNG) in the US. As more unconventional natural gas production from shale deposits proliferates, North American natural gas prices stagnate, and crude oil linked to LNG prices in Asia continue to far exceed US natural gas prices, the industry is anxiously anticipating the impacts of these ongoing developments on the North American natural gas market. This includes whether LNG import trends will reverse and whether domestic shale production will result in greater energy independence. Some have even begun to ask whether US-produced shale gas could find a home in Asia, where gas consumption is expected to increase dramatically in the coming decades.

The article will examine the current and future state of LNG imports to the US, along with the growing competition that imported LNG faces from growing production of domestic natural gas from unconventional sources. It will also question whether the current trend toward the underutilization of US LNG storage and regasification facilities could one day serve as a launching pad for domestically produced natural gas to reach consumers across the globe. Although technically possible, it is likely that political pressures in the US would present nearly insurmountable hurdles to the export of domestically produced gas. Additionally, as shale deposits are discovered all over the globe, growing economies like China may rely on their own production of shale gas rather than imports of US-produced shale gas.

LNG boom and bust. Since the 1990s, natural gas demand has risen throughout the US. This is especially true in the electric power sector, where utilities and other electricity suppliers increasingly turn to gas-fired power generation to meet ever-tightening environmental regulations. As a result, demand for natural gas began to significantly outstrip domestically produced supplies.

This, coupled with a decline in conventional domestic natural gas production, resulted in a steady rise in natural gas prices throughout the decade, peaking in June 2008. According to the US Energy Information Administration, prices reached $12.69 per MMBtu on the Henry Hub spot market.

At roughly the same time, global liquefaction capacity also was developing at a rapid pace. Today, a number of countries produce and export LNG, including Qatar, United Arab Emirates, Algeria, Nigeria, Indonesia, Australia, Malaysia, Oman, Trinidad and Tobago, Egypt, Yemen, Norway and Russia.

In the US, LNG came to be viewed, therefore, as a key supply source to offset near and long-term demand for natural gas. As a result, the US federal government took steps to encourage the development of LNG infrastructure, leading to a significant increase in developing LNG storage and regasification capacity.

Specifically, the Federal Energy Regulatory Commission (FERC) implemented a number of key measures to drive investment in new LNG regasification terminals. These steps included significantly streamlining the process for reviewing and approving new natural gas pipelines and exempting LNG terminals from open access and regulated rate requirements. These measures were designed to eliminate much of the uncertainty affecting new LNG terminal development.

That effort, combined with the decline in domestic drilling and higher US natural gas prices, provided the economic and regulatory stimulus needed to drive the construction of multiple new LNG marine terminal facilities, as well as needed natural gas pipeline expansions to deliver the regasified LNG to consuming markets.

In the late 1990s, there were only four LNG import terminals in the US. Today, there are nine, including Hackberry, Louisiana; Cove Point, Maryland; Elba Island, Georgia; Everett, Massachusetts; Lake Charles, Louisiana; Sabine, Louisiana; Freeport, Texas; and three offshore facilities, one in the Gulf of Mexico and

two offshore Massachusetts. In addition, two other facilities, Gulf LNG and Golden Pass LNG, are currently under construction. Several other import terminals are seeking, or have received, authorization from federal authorities. Finally, in Kenai, Alaska, there is an LNG export facility that has been operating since the late 1960s, which produces LNG sourced from Cook Inlet gas, and exports LNG to Asian markets.

Changing natural gas markets. Due in part, however, to the global recession, natural gas prices in the US stabilized or declined toward the end of this decade, causing a decrease in the amount of LNG imported to the US (Fig. 1). This was particularly in light of competing Asian and European demand and higher prices. Now, most regasification terminals in the US are operating below 50% utilization. In fact, in February 2010, the US imported the equivalent of 42.7 bcf of natural gas in the form of LNG. As shown in Fig. 2, this is a considerable decline from January imports. Only five of the nine LNG terminals had any imports of LNG in February. Statistics also bear out the noticeable decline in LNG imports over the last couple of years (May 10, "US LNG Import Comparison").

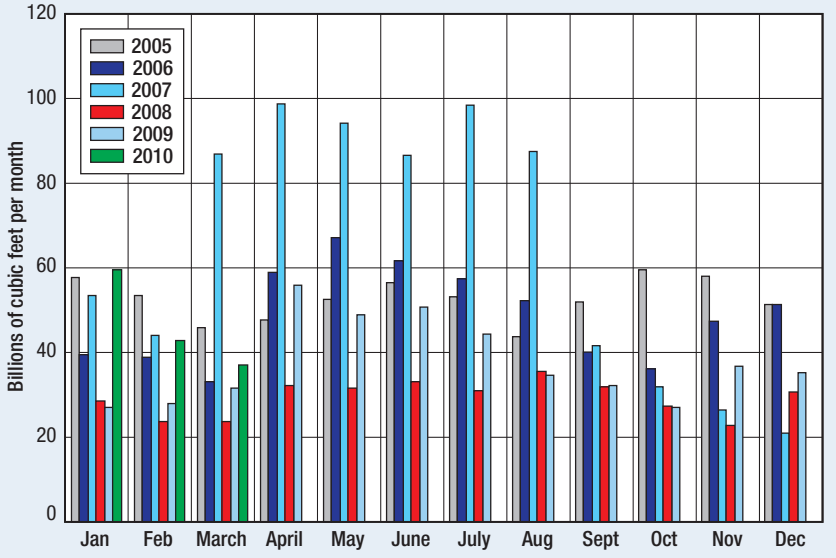
While economic opportunities for LNG imports into the US declined significantly, problems with upstream liquefaction terminals in other parts of the world have slowed LNG production. Notably, operational and technical problems in Norway, Yemen, Qatar and Russia delayed start dates of major liquefaction trains.

In 2008, a global commodity bubble pulled energy prices to unprecedented levels, peaking just before July 4. When capital began flowing out of commodity markets, prices began falling and continued doing so as economies around the world plunged into recession.

In 2009, natural gas prices started relatively low and moved lower still. Mild weather, the effects of the recession, record storage inventories filling record storage capacity and supply abundance pushed prices to levels not seen since 2002. Late in the year, with the onset of winter, gas prices moved back up to their early-2009 levels.

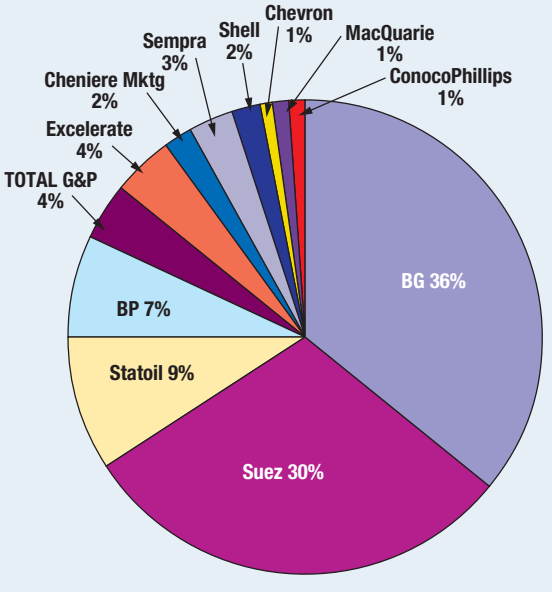
Interestingly, gas demand was relatively steady between 2008 and 2009, as a 5.5% increase in demand for gas for electric generation offset declines in the residential, commercial and industrial sectors.

Shale gas developments. At the same time, an increase in production of "unconventional" sources, including natural gas produced from shale deposits, has resulted in imported LNG having a new source of domestic competition in the US. While shale gas production in the US has impacted North American LNG imports and most analysts predict that this will continue to do so both in the short- and long-terms, the jury is still out with regards to the extent of that impact. Assuming that certain environmental challenges can be managed, many gas industry experts believe that domestic shale gas exploration and production has the potential to remake the natural gas industry not only in North America, but globally as well.



Source: Pan Eurasian Enterprises North American Terminal Survey (NATS); Data: Department of Energy, Office of Fossil Energy

FIG. 1 US LNG Import Comparison 2005–2010.



Share of US imports by importer for 12 months rolling

Volumes by importer (bcf)		
	February	12 mos
BG	8.9	180.2
Suez	13.8	151.8
Statoil	5.9	43.9
BP	2.8	34.7
Cheniere Mktg		12.0
Excelerate	3.9	19.1
TOTAL G&P	7.4	22.4
Shell		8.3
Sempra		13.9
ConocoPhillips		2.8
MacQuarie		3.0
Chevron		7.2
Totals	42.7	499.4

Volumes by importer (bcf)		
	January	12 mos
BG	11.3	177.2
Suez	14.0	154.1
Statoil	8.8	44.0
BP	6.0	31.9
Cheniere Mktg		12.0
Excelerate	10.0	15.2
TOTAL G&P	5.1	14.9
Shell		8.3
Sempra	4.2	13.9
ConocoPhillips		2.8
MacQuarie		3.0
Chevron		7.2
Totals	59.5	484.5

Source: Pan Eurasian Enterprises North American Terminal Survey (NATS); Data: Department of Energy, Office of Fossil Energy

FIG. 2 Importers of LNG into the US.

There are a number of drivers behind the increased production of shale gas. For example, significant advancements in drilling technologies, particularly hydraulic fracturing, have substantially reduced the cost of accessing and capturing shale gas. This, in turn, has led to improvements in the exploration and discovery of major shale deposits, including shale plays like the Marcellus in the Northeast, the Haynesville in Louisiana, the Barnett in Texas, and the Fayetteville in Arkansas. More recently, new plays in Appalachia, Northern Louisiana, British Columbia, South Texas and elsewhere have been announced.

These discoveries have resulted in a major reassessment of the country's natural gas reserves. In its April 2009 report, "Modern Shale Gas Development in the US: A Primer," the US Department of Energy (DOE) stated that US natural gas production rates for 2007, roughly 19.3 Tcf, could provide enough natural gas to supply the US for the next 90 years. Some analysts think this is a conservative assessment in light of the advancements in production technologies.

The Potential Gas Committee, an independent group that develops assessments of gas resources, raised its estimate to over 2 quadrillion ft^3, pegging the gas supply at almost 100 years at current consumption levels. The large increase, the committee said, is due almost entirely to improvements in the ability to produce gas from shale. As a result, the DOE reports that shale gas production is expected to increase from a 2007 US total of 1.4 Tcf to 4.8 Tcf in 2020. The DOE also states that shale gas production potential of 3 Tcf to 4 Tcf per year may be sustainable for decades. Thus, the shale resource base is expected to contribute mightily to future natural gas production in the US.

Shale gas development is also the beneficiary of government policies that support energy independence. In fact, the driving forces behind recent legislative and regulatory efforts related to energy, including the economy and national security, actually have recast the debate on energy. The focus of this policy shift has been almost exclusively inward, causing elected officials to craft proposals that develop and utilize predominantly US-based energy resources, including renewable energy and, in many cases, domestically produced shale gas.

At his company's most recent shareholder's meeting, Chesapeake Energy's Chairman and CEO Aubrey McClendon went so far as to suggest that employing a greater amount of natural gas would help the US stop indirectly funding nations that are "declared enemies," while also benefiting the environment.

Finally, shale gas is viewed as a "greener" alternative to coal and oil, since its carbon emissions are 50% lower than modern coal-fired power plants. As the US increases its renewable energy resources, many proponents of increased natural gas usage also cite the need for more stable baseload fuel when the sun does not shine and the wind is not blowing to provide supplementary power to the grid. This trend is already playing out across the country as electric utilities, which are responsible for more than 40% of the nation's greenhouse gas emissions, continue to choose more environmentally benign natural gas turbine generators over coal and other power-generation technologies.

Even Texas oil tycoon T. Boone Pickens, a recent proponent of wind energy, is now touting a plan to convert truck fleets to run on domestically produced natural gas. Testifying before a congressional committee in April 2010, in support of pending legislation that would provide major incentives for the conversion of truck fleets from gasoline to natural gas, Pickens stated, "[T]he only way we can solve the OPEC oil threat is by replacing their expensive, dirty fuel with cleaner, cheaper, American natural gas."

North American game changer?

With so much going for it, many in the industry view shale gas production as a "game changer" that will significantly—some say negatively—impact future LNG imports. However, shale gas faces substantial environmental hurdles, chief among them its impact on water supplies.

In response to a congressional request, the US Environmental Protection Agency (EPA) recently announced that it would spend $1.9 million to conduct a transparent, peer-reviewed study to answer questions about the potential impact of hydraulic fracturing on human health and the environment. This study is expected to address potential groundwater and air pollution concerns.

Much of the focus will be on the hydraulic fracturing process that requires large amounts of water, in some cases, up to three million gallons for a single well, to create a circulating mud that cools the drill bit and carries the shale rock cuttings out of the borehole. After drilling, the shale formation is stimulated by hydraulic fracturing.

According to a recent report on the Marcellus shale formation by the US Geological Survey (USGS), regional and local water management agencies are concerned about how such large volumes of water will be obtained, as well as the potential consequences for the local water supplies. Under drought conditions, or in locations with already stressed water supplies, securing millions of gallons for a shale gas well could be problematic. Moreover, drillers could be faced with significant transportation costs if the water has to be trucked in from substantial distances.

The USGS says that water recovery and disposal are also issues. For gas to flow out of the shale, nearly all the water injected into the well must be recovered and disposed of. In addition to dealing with large bulk volumes of liquid waste, contaminants in the water may complicate its treatment. In addition, fracturing fluids often are treated with proprietary chemicals—the makeup of which is closely guarded—to increase the viscosity to a gel-like consistency that enables the transport of a proppant, usually sand, into the fracture to keep it open. The fluids' viscosity breaks down quickly after hydraulic fracturing is completed, so it's removed easily from the ground.

Since the water is in close contact with the rock formation, it may contain a variety of materials, including brines and heavy metals. When combined with fracturing fluids, these additives may further complicate long-term wastewater treatment, making it more difficult and more expensive.

Unsurprisingly, the US Congress is making efforts to get involved as well. The Energy Policy Act of 2005 (EPAct) amended the Safe Drinking Water Act (SDWA) to change the definition of "underground injection" to exclude "the underground injection of fluids or propping agents (other than diesel fuels) pursuant to hydraulic fracturing operations." Thus, the amendment exempted hydraulic fracturing from federal law and gave jurisdiction and authority over hydraulic fracturing operations to the states.

However, bills have been introduced in the House and Senate to repeal this exemption and place the regulatory jurisdiction in the hands of the federal government. The House bill is sponsored by Colorado Democrat Diana DeGette, and the Senate companion legislation is sponsored by Democratic Senator Bob Casey from Pennsylvania. While the future of both bills is uncertain, there is an increasing awareness

of the environmental concerns associated with shale gas development and a growing number of elected officials are expressing an interest in ensuring that their constituents have adequate assurances.

State regulation. In addition to the EPA study, regulatory efforts directed at shale gas exploration and production are underway at the state level as well. In the Barnett shale play in Texas, the Texas state and county agencies monitor the volumes of water used during the drilling process. A consortium of Barnett Shale drilling companies have developed best practices for water conservation, with an eye toward keeping the pace of drilling and production within the bounds of sustainable water use. Similar steps are being discussed in Marcellus Shale production areas, though they have not been fully implemented yet.

In New York, the state's Department of Environmental Conservation requires a review of each drilling application for environmental compliance before any drilling can transpire. The review involves pre-screening the proposed well location to identify any environmental sensitivities; reviewing the proposed well design to ensure that its well casing and cement protects fresh-water aquifers; on site inspections of the actual drilling operations; and enforcement of strict restoration rules when drilling is completed. On top of this, the DEC has effectively issued a moratorium on all new gas drilling in the New York City and Syracuse watersheds, effectively putting a temporary halt to Marcellus shale drilling in New York pending the development of new regulations.

In Pennsylvania, elected state officials have been struggling with what actions to take in response to the increase in drilling operations. Many elected officials recognize the major benefits that will accrue locally and state-wide from production of large volumes of shale gas, particularly in light of the current economic recession and the strapped budgets of state and local governments. Moreover, a number of the gas producers are locally based companies that have histories in the region and employ local citizens. Nonetheless, with increasing complaints from constituents, elected officials are often caught in the middle of two competing objectives. For example, Democratic gubernatorial candidate Joe Hoeffel has proposed a moratorium on new permits for shale gas projects. From a regulatory perspective, the Pennsylvania Department of Environmental Protection has proposed regulations that would, among other things, increase the number of well inspectors at the DEP by more than 50%.

Need for additional pipeline infrastructure. In the Marcellus Shale region, the existing interstate pipeline grid is already constrained and largely inadequate to transport the projected gas flows that will be produced in the next few years. As a result, significant pipeline expansion is needed to accommodate these new supplies.

A number of expansions have been announced in the last year. Texas Eastern Transmission, a major long-haul pipeline that carries gas from Texas all the way to New York City, has announced a binding agreement with two major Marcellus producers and a major New York City utility to expand its pipeline and bring Marcellus supplies to New York consumers. When completed, this project will mark the first expansion of a major interstate natural gas pipeline into New York City in more than 40 years. Other major interstate pipelines, like Tennessee Gas and National Fuel Gas Supply, also have announced significant expansions.

Gas composition concerns. Finally, all natural gas is not created equal. Depending on the natural gas source, the gas composition can vary greatly. While this is not a new issue for the US gas industry—the industry has been engaged in regulatory proceedings and court cases for over five years as a result of the different composition of increased LNG imports—the increasing sources of unconventional gas and the proximity to the consuming markets have raised new issues in the ongoing discussions.

Shale gas plays with higher levels of ethanes and heavy hydrocarbons, for example, can have a major impact on the need for liquids removal. However, excessive ethanes in the Marcellus region where no beneficial use for them currently exists, presents additional hurdles for shale gas developers to overcome. Similarly, the presence of non-hydrocarbons like CO_2 can require gas processing to remove the impurities.

The impact of gas composition on pipeline infrastructure may be magnified by the large gas volume production coming from the shale deposits. For example, some industry analysts speculate that the large volumes of gas in the Marcellus Shale could substantially replace the flow of more traditional Gulf of Mexico-based supplies to the Northeast markets.

What is clear is that utilities and other end users in the market areas are happy about the prospect of increased domestic production close to the consuming markets, but need to ensure that their facilities are equipped to handle changing gas compositions. Ultimately, these issues will likely be worked out on a pipeline-by-pipeline basis before FERC.

Will LNG import facilities become export facilities? In spite of the recent shale gas developments, global energy analysts predict that LNG will continue to play an important role in the US energy portfolio, especially over the next four or five years. The US offers far more natural gas storage capacity than other markets in the Atlantic Basin, particularly those in Europe. Because liquefaction facilities cannot easily shut in production, they must continuously produce LNG for export. The US market is likely to serve as the "market of last resort" for LNG that cannot be sold in higher-priced spot markets like Europe or Asia. However, once shale production has ramped up, imports to the US are expected to steadily decline. This prediction has left LNG terminal operators wondering how to recapture the value of these multi million-dollar storage and regasification facilities.

Recognizing the shifting dynamics of the North American natural gas markets, in the last 18 months, two US LNG import terminals have altered the operation and management at their storage and regasification terminals, seeking and obtaining authorization from FERC to "re-export" previously imported LNG in-tank supplies. The two terminals are the Freeport LNG terminal in Freeport, Texas, and Sabine Pass LNG terminal in Sabine Pass, Louisiana. With this authority, importers can bring LNG into the US, store it for a period of time, and then re-export it to other countries depending on global demand and pricing.

In its application to FERC and the DOE, (the latter has authority over the import and export of the natural gas commodity) the applicants stated that their proposals would allow customers to purchase LNG at current world market prices. This would be done with the intention of exporting the LNG for redelivery to a foreign market at a later date, in the event that US market prices are lower than world market prices. The applicants also asserted that stored LNG would be readily available

for US consumption if US prices were to rise to a level where the domestic sale of regasified LNG becomes economically feasible. It argued that the public interest would be served by the proposal because a continuous supply of LNG would ensure the facility remains in operation even when US market prices are low, and would help ensure that LNG supply is present in the US when needed. One significant question that remains is that, if and when global LNG prices and demand rise, could these terminals be employed to liquefy domestically produced shale gas for delivery of LNG to foreign markets? Though technically feasible, the possibility, at least at this point, appears doubtful. The export of LNG sourced from domestically produced natural gas requires a comprehensive regulatory review process by the DOE. To date, only the Kenai LNG export facility in Alaska has been granted such authority.

Such authorization, while possible, seems unlikely as any request to export domestically produced natural gas likely would trigger substantial political scrutiny in light of the perception surrounding the export of domestic energy sources. Elected officials likely would be forced to challenge such exports, particularly because of the laws, regulations and policies noted above that expressly exist to encourage additional natural gas usage in light of its reduced environmental footprint. Despite the growing domestic natural gas supplies as a result of the discovery of these new shale plays, any entity seeking such authorization likely would need to employ a robust stakeholder engagement plan with elected officials and regulators in order to secure such authorization.

On June 4, 2010, Cheniere announced that it will seek authorization from FERC to construct liquefaction trains at Sabine Pass and operate the terminal as a fully bidirectional import and export facility. Cheniere's press release did not reference the required DOE export authorization process.*

Assuming such authorization would be possible, there are also questions about whether demand for US shale gas would be present in Europe or Asia. According to a number of studies, shale deposits exist worldwide. In fact, deposits in Europe and China could rival some of the US deposits. Assuming shale gas can be produced in an environmentally sensitive manner, US shale gas would likely face stiff competition from shale gas produced elsewhere in the world.

Summary. Ultimately, shale gas' dominance in the US will depend on the successful resolution of myriad issues, including the ability of producers to manage the environmental concerns surrounding water quality and use, and the expense associated with increasing regulation, as well as the development of adequate pipeline infrastructure to move the gas to consumers. Whether this dominance will be felt globally will largely be dependent on the political climate in the US.

At least for the foreseeable future, US energy policy will likely not favor the export of domestically produced natural gas. The US government will maintain a protectionist posture with respect to one of the nation's most abundant natural resources, unless we establish a strong renewable portfolio and become less dependent on foreign-sourced oil.

Moreover, as more shale gas is produced from international deposits as predicted, global demand for US-produced shale gas could be minimal. Thus in the future, the role for US storage and regasification terminal capacity may be limited to providing a home for LNG imported on the spot market and for the occasional re-exporting of LNG when prices in Europe or Asia attract supplies. **HP**

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*Following publication of this article, Sabine Pass Liquefaction, LLC submitted an application to DOE requesting authority to export up to 16 million tons of LNG per year for a 30-year term to countries that have a free trade agreement in effect with the United States. In its application, Sabine Pass noted that it will file a separate application with DOE in the near term for authorization to export LNG to those countries that do not have a free trade agreement with the US and to which the export of LNG by vessel is not prohibited by US law or policy.

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