U.S. Natural Gas (LNG) Exports: Opportunities and Challenges

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INTRODUCTION

The rapid expansion of natural gas production in the United States in the latter half of the first decade of the 21st Century created an environment where production was expanding much faster than consumption, which laid the foundation to pursue opportunities to export natural gas particularly to the Asia Pacific region where gas prices have been traditionally significantly higher than elsewhere in the world. However, opportunities arise and fade in the energy world, and this truism hold for exports in the form of LNG, too.

SOME CLARIFICATIONS

Let's begin with some clarification and correction of media discussions. First, what is LNG? LNG is not a separate and distinct commodity with a market of its own. LNG is simply the transportation phase of natural gas that is going to be moved from point A to point B where no pipeline connection exists. More recently it is also used as a storage medium for natural gas to be used for various transportation options. However, in actual use the fuel is always in its gaseous form. So, natural gas (mostly methane) is transformed into its liquid phase by dropping its temperature to -161 C (-260 F), which reduces the physical space required to hold the gas by a factor of 600. It is loaded into a storage mechanism, including LNG tankers for overseas shipping, and it is then re-gasified for use as a fuel or input to petrochemical processes. LNG competes directly against natural gas and is priced just like natural gas, i.e., according to heat content, for example $ per million Btu (MMBtu) or gigajoule (GJ) or therm, etc. The natural gas that has been shipped in the LNG form also competes against other alternative fuels on exactly the same basis as natural gas that is brought to market via pipelines.

For U.S. exports of natural gas in the form of LNG, we frequently see statements that we are exporting shale gas. We are exporting natural gas sourced from the national (indeed, international grid that interconnects with Canada and Mexico) natural gas pipeline grid, which is a mixture of natural gas from all production sources in the U.S. Indeed, one can imagine that the primary source of natural gas that is the input to Cheniere's operations at Sabine Pass is most likely from offshore Gulf of Mexico. It is true that the technological developments of combining hydraulic fracturing with horizontal drilling led to a production surplus of a magnitude that can support both domestic and export demands. But we are still at a stage where so-called conventional natural gas production exceeds that of the unconventional. Moreover, even the unconventional is comprised of more than just shale sourced gas; it also includes coal seam gas.

THE OPPORTUNITIES AND CHALLENGES

So now onto the opportunities and challenges faced by current and prospective U.S. exporters of natural gas. One additional clarification is necessary. The March 2016 shipment of natural gas from the Cheniere Energy Sabine Pass facilities to Brazil was not the first export of natural gas from the U.S. in the form of LNG. The first occurred in 1959 carried in the Methane Pioneer from the U.S. to Great Britain. Moreover, commercial export of natural gas via LNG tankers commenced in 1969 from Nikiski, Alaska to originate the LNG trade in Asia with shipments still flowing to Japan.[1]

The expansion of U.S. natural gas production that began with force around 2005 suggested to many that there was significant commercial opportunity available for exports. The growth in production drove prices below $2.00 per MMBtu at a time when natural gas delivered into Asia was going for $15.00 per MMBtu or more. That potential margin appeared to provide a window of opportunity so large that one could expect to easily drive an LNG tanker through and come away with wads of cash.[2] Eventually, the delivered prices in Asia pushed up to around $19.00 per MMBtu while the U.S. prices remained in the $2.00 - $5.00 range.

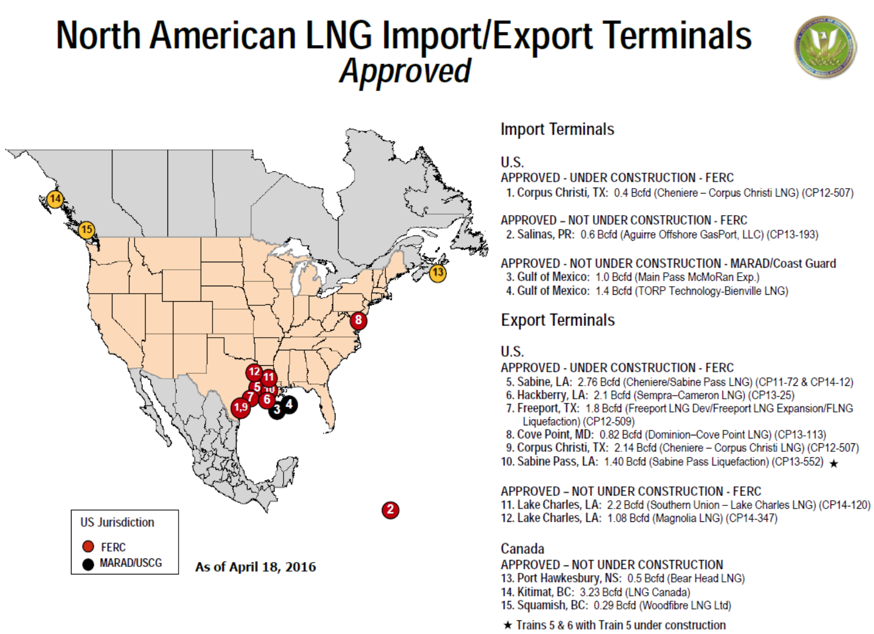
The export potential brought a rush of applications to export natural gas, which would also require constructing natural gas liquefaction facilities where none previously existed. However, one characteristic of the U.S. market structure that facilitated this move was the existence of several LNG regasification terminals along the U.S. Gulf and East Coasts. Some of these facilities date back to the 1970s, but they contained a significant share of the capital requirements for an LNG export operation. They were already connected to the pipeline grid, they had dock facilities built to handle LNG tankers, and they had LNG storage facilities. While not insignificant, this meant that to enter the natural gas export trade these facilities needed to only construct liquefaction trains. This meant that relative to other proposed, or even under construction, projects around the world, the U.S. projects (at least the earliest ones proposed) had a significant capital expenditure advantage over virtually all greenfield projects and even some brownfield projects.

LNG Export Projects
DOE application as of March 18, 2016
59 line items, occasionally with numerous line items for a single company
59 applications for FTA approvals; of which 3 are vacated or withdrawn
49 applications for Non-FTA approvals
48 FTA approvals
18 Non-FTA approvals
48.053 Bcf/d approved
Subset with FERC approval
11.02 Bcf/d approved and under construction
3.28 Bcf/d approved but not under construction

Table 1 – LNG Project Application Summary

In rapid succession, LNG export projects were proposed and began the export license application process, which requires approvals from both the DOE and FERC. Table 1 provides a summary of proposed projects, the DOE approved export capacities, and the subset of FERC approved projects. A detailed list of the DOE applications may be found at http://energy.gov/fe/downloads/summary-lng-export-applications-lower-48-states. Figure 1 shows locations of both FERC-approved LNG export and regasification projects.

Under current market conditions, and even under earlier more favorable conditions, many of the proposed projects are quite unlikely to be developed. One way to think about the reasoning behind these applications is to see them as representing options on future development should market conditions warrant. Effectively, it comes down to not being able to enter the game without a ticket, and the required ticket for entry to this game is an approved project.



Source: http://www.ferc.gov/industries/gas/indus-act/lng.asp.

Figure 1

The opportunity window began to close with the decline in crude oil prices in 2014, initiated by the growth in production in the U.S. from shales and exacerbated by the OPEC decision in December of that year to not reduce production. The price of natural gas in Asia has been closely linked to the price of crude oil since the inception of the trade in 1969 with the natural gas flowing via LNG tankers from Nikiski to Japan. Nearly all long-term contracts for natural gas transported as LNG in Asia have price contractually tied to crude oil. The most common benchmark is the Japanese Customs Cleared average price, referred to as JCC and colloquially as Japanese Crude Cocktail. So, as crude oil prices declined so did the prices for natural gas delivered into Asia. As of March 2016, the average spot delivered price into Japan was below $7.00 per MMBtu.[3] For Europe, natural gas prices have also fallen substantially, as they too have been closely related to oil prices. The current futures price for June 2016 for the UK's National Balancing Point is equivalent to $4.12 per MMBtu, and the Continental price is very similar. Now with shipping costs included the margins that a U.S. exporter can realize may still be double digit, but unfortunately these digits may have a decimal point in front of them rather than behind.

Table 2 provides a view of estimated costs of delivering natural gas from the U.S. Gulf Coast to Asia and Europe, and a comparison with those from Australia to Asia. It shows that for Asia the route of commercial viability is via the Panama Canal, and that route is not open until the canal expansion project is completed; this has been stated recently to be June, 2016, but there have been several delays previously. The table is comprised of three panels, with the differences based on a range of LNG tanker day rates.

The LNG tanker day rates are currently relatively low, being in the low $30,000 range. Within the past five or so years the rate has exceeded $130,000 per day, and these rates vary according to their own market dynamics. The shipping cost estimates are based on an LNG tanker with 160,000 cubic meters of capacity, which translates to approximately 3,000,000 MMBtu of deliverable natural gas. Tankers have to be paid for in both directions, and the calculations account for a day for loading and a day for unloading. If these operations take longer or harbors are congested and additional demurrage time occurs, these costs will increase. The costs also account for fuel at $35 per nautical mile. Included in these calculations for shipments transiting the Panama Canal are the proposed tolls that will add approximately $0.20 per MMBtu.[4]

A – Low day rate

LNG Carrier shipping cost comparison between XXX and YYY
160,000 m^3 tanker => ~ 3,000,000 MMBtu
Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

Port-to-Port		Appr. Distance nautical miles	Fuel	18 knots Days	18 knots Hours	Day rate $ 33,000 18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 874,500	$ 0.40
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 2,409,000	$ 1.17
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 1,408,000	$ 0.88
Dampier	Tokyo	3762	$ 263,319	8	12	$ 561,000	$ 0.27

B – Medium day rate

LNG Carrier shipping cost comparison between XXX and YYY
160,000 m^3 tanker => ~ 3,000,000 MMBtu
Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

Port-to-Port		Appr. Distance nautical miles	Fuel	18 knots Days	18 knots Hours	Day rate $ 70,000 18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 1,855,000	$ 0.73
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 5,110,000	$ 2.06
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 2,986,667	$ 1.40
Dampier	Tokyo	3762	$ 263,319	8	12	$ 1,190,000	$ 0.48

C – High day rate

LNG Carrier shipping cost comparison between XXX and YYY
160,000 m^3 tanker => ~ 3,000,000 MMBtu
Accounts for round trip, includes 2 additional days for loading and unloading, $35/nm fuel cost, and $0.20/MMBtu for Panama

Port-to-Port		Appr. Distance nautical miles	Fuel	18 knots Days	18 knots Hours	Day rate $ 130,000 18 knots	Cost/MMBtu
Sabine	Zeebrugge	4861	$ 340,248	13	6	$ 3,445,000	$ 1.26
	Tokyo (S.Afr.)	15825	$ 1,107,755	36	12	$ 9,490,000	$ 3.52
	Tokyo (Panama)	9149	$ 640,440	21	8	$ 5,546,667	$ 2.25
Dampier	Tokyo	3762	$ 263,319	8	12	$ 2,210,000	$ 0.82

Author calculations; distance and travel time taken from www.sea-distances.org

Table 2 – LNG Shipping Cost Estimates (A, B, and C)

In panel A, the low day-rate environment ($33,000 per day), shipping from Sabine Pass to Tokyo via the Panama Canal (which as noted above is not yet open for LNG tanker traffic) will cost $0.88 per MMBtu. If instead the route around South Africa were taken the shipping cost will be $1.17 per MMBtu. For prospective exports to Europe, the shipping cost to Zeebrugge, Belgium is $0.40. In panel C, we see that the shipping costs rise significantly to $2.25, $3.52, and $1.26 per MMBtu for Panama, South Africa, and Zeebrugge, respectively. So even if we focus on just the Panama Canal route for exports to Asia, we see that shipping costs can range from $0.88 to $2.25 per MMBtu, based on the range of LNG tanker day rates that have been experienced in the relatively recent past.

But how will these shipping costs affect the competitiveness of U.S. natural gas aimed to be exported to Asia or Europe? The most widely discussed arrangements for exports of U.S. natural gas are those associated with Cheniere Energy. Cheniere has approved projects at Sabine Pass and Corpus Christi, where they have 4.16 Bcf/d and 2.14 Bcf/d of liquefaction capacity under construction, respectively. And initial commissioning volumes have been produced and shipped from Sabine Pass.

The pricing mechanism that is in place for these projects is represented in Table 3. The system is effectively cost-plus, whereby Cheniere purchases natural gas from the national pipeline grid and charges the Henry Hub price plus 15%. It then transports via pipeline to its facilities and processes it into LNG by lowering the temperature as described above. Cheniere has entered into a number of agreements to cost this step in the process, as can be seen in the table. The lowest cost is $2.25 per MMBtu for 3.5 million tonnes per annum (mtpa) for BG rising to $3.00 per MMBtu for several buyers totaling 12.75 mtpa at the Sabine Pass facility. For Corpus Christi the liquefaction cost is $3.50 per MMBtu for all buyers.[5]

Project	Buyer	Contractual Quantity (mmtpa)	Liquefaction Costs (US$/mmBtu)	HH price	HH + 15%	FOB Price
Sabine Pass	BG	3.50	2.25	2.15	2.4725	4.72
Sabine Pass	GNF	3.50	2.49	2.15	2.4725	4.96
Sabine Pass	BG	2.00	3.00	2.15	2.4725	5.47
Sabine Pass	GAIL	3.50	3.00	2.15	2.4725	5.47
Sabine Pass	KOGAS	3.50	3.00	2.15	2.4725	5.47
Sabine Pass	TOTAL	2.00	3.00	2.15	2.4725	5.47
Sabine Pass	Centrica	1.75	3.00	2.15	2.4725	5.47
Corpus Christi	PERTAMINA	0.76	3.50	2.15	2.4725	5.97
Corpus Christi	Endesa	1.50	3.50	2.15	2.4725	5.97
Corpus Christi	Endesa	0.75	3.50	2.15	2.4725	5.97
Corpus Christi	Enel	1.11	3.50	2.15	2.4725	5.97
Corpus Christi	Enel	1.11	3.50	2.15	2.4725	5.97
Corpus Christi	Iberdrola	0.80	3.50	2.15	2.4725	5.97
Corpus Christi	GNF	1.52	3.50	2.15	2.4725	5.97
Corpus Christi	Woodside	0.85	3.50	2.15	2.4725	5.97
Corpus Christi	EDF	0.77	3.50	2.15	2.4725	5.97
Corpus Christi	PERTAMINA	0.76	3.50	2.15	2.4725	5.97
Corpus Christi	EDP	0.77	3.50	2.15	2.4725	5.97

Contractual quantities and liquefaction costs provided by FGE; calculations by the author.

Table 3 – Cheniere "formula"

Table 3 shows what the price of the gas to Cheniere's buyers, once liquefied, would be given the pricing mechanism and a price of natural gas at Henry Hub of $2.15 per MMBtu. The costs to the buyers range from a low of $4.72 to $5.47 for natural gas processed at Sabine Pass, and $5.97 for gas processed at Corpus Christi.

To examine the economic viability of exports into Asia or Europe the shipping costs must be added. For example, under the terms of the BG contract and the current low day rate environment, exports to Tokyo may be delivered for a cost of $5.60 per MMBtu, if it can be shipped via Panama or $5.89 per MMBtu around South Africa. If we examine the high day rate environment the costs rise to $6.97 via Panama and $8.24 per MMBtu via South Africa. To Europe, for the low day rate the cost would be $5.12 per MMBtu, and for the high day rate is would be $5.98 Per MMBtu.

It was noted above that natural gas prices for LNG-based imports into Asia have fallen below $7.00 MMBtu. Table 4 shows the prices of spot-LNG deliveries into Japan spanning the period from March 2014 to preliminary numbers for March 2016. On an arrival basis, they have fallen from $18.30 per MMBtu in April 2014 to $6.80 per MMBtu for March 2016; quite a narrowing of the window of profitable opportunity.[6]

Japan - Spot-LNG prices (USD/MMBtu)				
Year	Month		Contract-based	Arrival-based
2014	3	Detailed	18.3	-
	4	Detailed	16.0	18.3
	5	Detailed	14.8	16.3
	6	Detailed	13.8	15.0
	7	Detailed	11.8	13.8
	8	Detailed	11.4	12.5
	9	Detailed	13.2	11.3
	10	Detailed	15.3	12.4
	11	Detailed	14.4	14.3
	12	Detailed	11.6	15.1
2015	1	Detailed	10.2	13.9
	2	Detailed	7.6	10.7
	3	Detailed	8.0	7.6
	4	Detailed	7.6	7.9
	5	Detailed	×	×
	6	Detailed	7.6	7.6
	7	Detailed	7.9	×
	8	Detailed	8.1	7.7
	9	Detailed	7.4	7.7
	10	Detailed	7.6	7.9
	11	Detailed	7.4	7.5
	12	Detailed	7.4	7.5
2016	1	Detailed	7.1	7.9
	2	Detailed	6.5	6.9
	3	Preliminary	×	6.8
x - indicates that there were not two or more reporters.				
Source: METI				

Table 4 – Japanese LNG Prices

So with current market conditions, both in the U.S. and the two primary export target regions, BG has the potential to realize a margin of $1.20 per MMBtu if it can transit the Panama Canal, and $0.91 per MMBtu via South Africa if the LNG tanker day rates remain as low as $33,000 per day. Indeed, if Panama is viable BG may realize a positive margin up to a day rate of about $118,000; around South Africa the day rate will need to be below $70,000. However, under current conditions exports to Europe are not commercially viable since the cost of the gas as it will be loaded into the LNG tanker is higher than the competing gas available in the region, even before accounting for shipping costs. For those buyers at Sabine Pass who have agreed to pay a price that includes the $3.00 per MMBtu liquefaction cost, even Panama cannot provide them with a positive margin if the day rate exceeds $65,000; Corpus Christi buyers are obviously worse off.

But what does the future hold for U.S. exports of natural gas? Table 5 shows projections of regional imbalances for natural gas according BP's 2016 Outlook to 2035. It is important to note that Russia is included within the Europe & Eurasia region and Australia is included within the Asia Pacific region as defined by BP. This is relevant because that means, for example, that the shortfalls projected for the Asia Pacific region are after accounting for Australia's production. So, while Australia will become the largest exporter of natural gas in the form of LNG by 2018, there will continue to be a need for more natural gas imports into the region. Not all of the shortfall will be supplied from the sea via LNG tankers, but the projections suggest that there will be need in the region to import from other regions, including North America. The key question will be at what price.

North America (United States, Canada, and Mexico) is projected to have significant surplus natural gas production over consumption throughout the period to 2035. Indeed, from 2030 onward the North American surplus is projected to exceed that of even the Middle East or Africa. So, the physical opportunity appears to be there well into the future, but will the economic opportunity be realized? The projection for North America for 2020 is equivalent to 9.5 Bcf/d. As shown in the FERC map above there are 11.02 Bcf/d of capacity currently approved and under construction. If, as with many large complex capital intensive projects like an LNG facility, these projects are completed and operate near 90% capacity factor, there is a very near match; assuming Canada does not bring on any of its proposed projects.

Regional imbalance (production minus consumption) - mtpa											
	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035
North America	4.06	(18.16)	(21.80)	(23.33)	(20.33)	(0.02)	1.50	72.11	73.76	139.82	138.77
S & C America	0.23	0.39	4.52	12.27	10.77	3.63	1.33	(5.52)	(11.99)	(22.04)	(29.93)
Europe & Eurasia	(9.14)	(27.84)	(37.52)	(51.40)	(73.52)	(5.34)	(22.28)	(18.43)	4.44	(0.07)	(10.91)
Middle East	5.34	5.19	15.27	30.78	68.72	100.26	93.42	91.06	89.52	85.43	88.25
Africa	21.50	27.89	53.01	67.71	78.32	60.91	55.48	53.13	45.52	60.03	92.59
Asia Pacific	(1.43)	(1.72)	(13.92)	(25.65)	(56.69)	(108.79)	(106.85)	(127.34)	(213.33)	(260.66)	(287.49)
Total Natural Gas Imbalance	20.56	(14.25)	(0.43)	10.39	7.27	50.64	22.59	65.01	(12.08)	2.51	(8.73)

Source: BP Outlook 2016; author calculations. To convert to Bcf/d multiply by 48 and divide by 365. For example, the 2020 shortfall for Asia Pacific is equivalent to 16.7 Bcf/d.

Table 5 – Projected Regional Natural Gas Imbalances

CONCLUSION

The opportunity for the United States to become a major player in the international trade of natural gas, shipped in the form of LNG, arose very abruptly as a result of the massive increase in domestic natural gas production due to the technological advances brought on by combining horizontal drilling and hydraulic fracturing. In a rapidly evolving energy world, with prices declining significantly around the world, the economic opportunity afforded by technological advance has nonetheless shrunk to the point that only modest volumes of natural gas can currently be expected to be exported profitably, except perhaps where pre-existing take-or-pay contracts may save the day. And while a significant imbalance in production and consumption in the Asia Pacific suggests export opportunities over the next 20 years, the dynamics of the U.S. domestic natural gas market, the Asia Pacific natural gas market, and LNG tanker market will play significant roles in determining the degree to which U.S. natural gas exports may be able to expand much beyond the current capacity approved.

Footnotes

[1] ConocoPhillips recently received approval to extend its export license through 2018.

[2] This is clearly a mixed and mashed metaphor, but it seems pretty representative of the mood and attitude in the U.S. natural gas industry at the time.

[3] Similarly, an estimate of the JCC-linked price for natural gas, given a JCC price of $37, will also be under $7.00 per MMBtu.

[4] The approved tolls for LNG tankers involve three stages of pricing based on capacity, plus a discount for return transit under ballast if the return is within 60 days. The roundtrip, with discount, for the 160,000 cm tanker is $635,500. By comparison, the round trip tolls through the Suez Canal would be about $324,000, but the extra transit days (one-way 33 days and 15 hours compared to 21 days and 8 hours for Panama) would add $811,250 to the Suez route relative to Panama at the day rate of $33,000. It also turns out that due to the tolls for the Suez that it will tend to be less costly to travel around South Africa than to transit the canal.

[5] Cheniere Energy explicitly eschews the term tolling related to these liquefaction charges, because they will own the gas moving their facilities, and ownership only changes hands at dock-side. This differs from some of the other projects whereby the gas to be liquefied is sourced by the customer and the LNG facility operator never takes ownership of the gas and is simply providing a service by transforming someone else's natural gas to the liquid state.

[6] An April 29, 2016 article in Reuters ("GLOBAL LNG-Prices rise on oil, European gas hub levels") notes that LNG prices for June 2016 delivery into Asia are reported at below $5.00 per MMBtu, which will place even more pressure on potential margins even with the completion of the Panama Canal expansion.