SPECIAL REPORT

TD Economics

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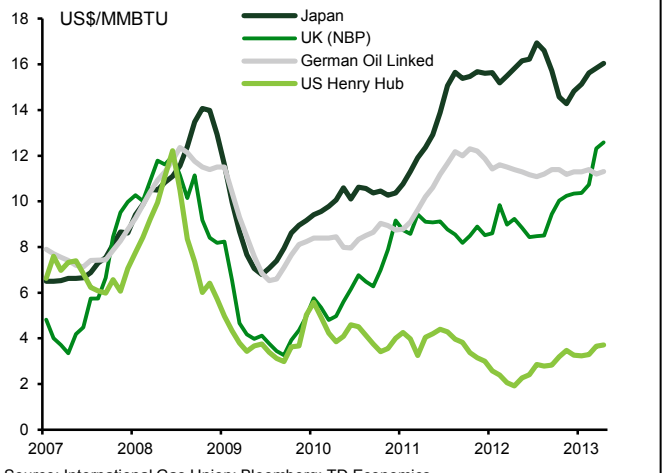
LIQUEFIED NATURAL GAS: THE NEXT LEG OF CANADA'S ENERGY BOOM?

Highlights

- Ample supply, attractive spreads and an increasingly promising global demand outlook have made exporting liquefied natural gas attractive to North American resource producers. This is particularly true for producers in Western Canada, whose traditional markets have been eroded due to the expansion of shale gas production in the United States.
- Canada's proximity to high priced markets, hospitable regulatory environment, and political support for resource development make it an ideal candidate for developing liquefied natural gas export capacity.
- Exporting liquefied natural gas presents a tremendous opportunity for the Canadian economy. It is expected to create jobs, generate tax revenues and foster growth in multiple provinces and industries throughout Canada.
- Economic activity associated with developing most of the proposed liquefied natural gas projects in British Columbia is estimated to generate $4-$11 billion annually in provincial tax and royalty revenue over a 20 year span.
- Despite multiple years of planning, proposals and negotiations, resource developers have yet to break ground on Canadian liquefied natural gas facilities. Looking ahead, shifts in the exchange rate, cost inflation, new alternative supply sources, regulatory and construction approval processes and changes in demand from Asian markets are the major factors that can potentially make-or-break Canadian liquefied natural gas exports.

Higher prices abroad and an increasingly promising global demand outlook for natural gas have garnered a considerable amount of attention from North American resource producers, who are interested in tapping into foreign markets, via liquefied natural gas (LNG) exports. This is especially true in Canada, where ample supply, a well developed natural gas industry and proximity to high-priced foreign markets provide advantages for resource developers that are not available in other countries. B.C. is particularly well positioned to reap economic rewards from LNG development, but benefits would also span across various regions and industries. Multiple resource producers have entered into consortia and proposed potential projects to export Canadian natural gas into the global marketplace. However, despite years of planning, proposals and negotiations, no final investment decisions have been made, in part due to uncertainty surrounding the future of underlying market fundamentals. These uncertain-

CHART 1 - REGIONAL NATURAL GAS PRICES



Source: International Gas Union; Bloomberg; TD Economics.

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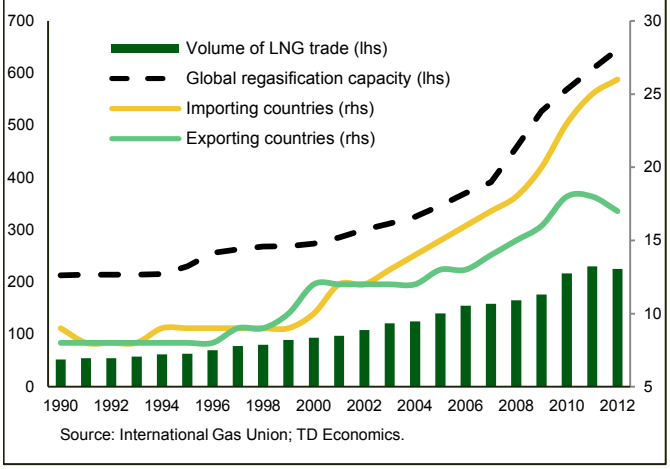
ties are underscored by the recent deal between China and Russia, where China will buy natural gas via pipeline from Eastern Siberia, reducing, but not eliminating its projected demand for LNG.

A market in change

The shale gas boom was a "game changer" for the North American natural gas market. Technological improvements made it economical to tap into shale formations, resulting in a 30% jump of U.S. natural gas production from 2006-2012. The influx of supply drove down the price of natural gas in the continental market, and reduced U.S. dependence on Canadian gas imports. Consequently, Canadian gas production fell by 18% over the same period. Following a bit of a rough patch for gas producers, the bitter cold of this past winter jolted the gas market back to life by bolstering demand and driving up prices. But, as discussed in the TD Economics report "Finally Some Good News for Canadian Natural Gas Producers?", the spike in the price and production of natural gas is expected to be short-lived.

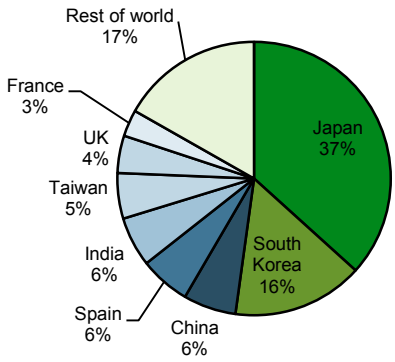
Traditionally, North American natural gas is transported via pipeline and is largely landlocked to the continent, which means a single global market for natural gas has yet to develop. Instead, global natural gas is concentrated into several regional markets, each with their own unique dynamics. The abundant supply and low prices currently in the North American market are not characteristic of natural gas markets elsewhere in the world. In regions like Germany and Asia Pacific, gas prices are typically tied to the price of substitute fuels, such as oil. Relative to North American natural gas markets where prices are based on market

CHART 2 - LNG TRADE VOLUMES



Source: International Gas Union; TD Economics.

CHART 3 - LNG IMPORT DISPOSITION (2012 % SHARE OF TOTAL IMPORTS)



Source: International Gas Union; TD Econoimcs.

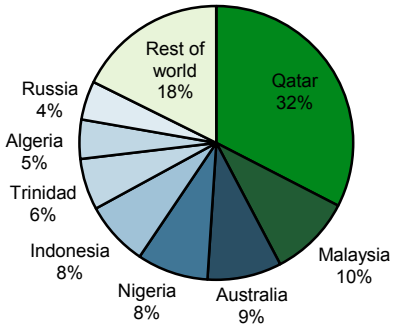
"hubs", oil-linked markets tend to pay a much higher price for natural gas – note the Japanese market price being four times greater than the North American (Henry Hub) price (see Chart 1). The price spread between markets presents arbitrage opportunities that have garnered a considerable amount of attention from North American gas producers, who are looking at breaking into foreign markets.

Enter liquefied natural gas

Liquefied natural gas (LNG) is the key to bridging the gap between the North American natural gas market and the rest of the world. LNG is natural gas that is cooled and converted to a liquid through a process known as liquefaction. Once in its liquid form, LNG can be easily transported over long distances in specially designed ocean tankers. Upon reaching its destination, LNG is converted back into a gas and used for general consumption. Liquefied natural gas is of particular interest to Canadian producers, as the vast reserves in Western Canada could be easily transported to high priced Asian markets through exports from the west coast.

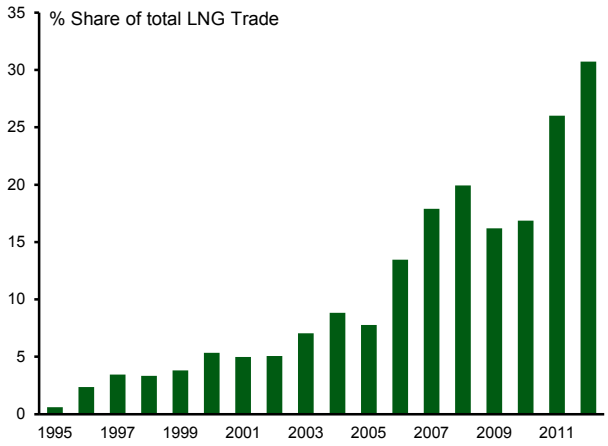
Liquefied natural gas trade is an established and growing market (see Chart 2). Countries that lack domestic production of natural gas – such as Japan and South Korea, who together compose over 50% of global LNG demand (see Chart 3) – use LNG to meet all of their natural gas needs. Other countries, such as China and India, use LNG as a means of filling excess demand beyond domestic and continental supply. Qatar, Malaysia and Australia are the major exporters of LNG, supplying over half of global demand, while a handful of other countries supply the remainder (see Chart 4). In 2012, LNG accounted for just over 30% of total

CHART 4 - LNG EXPORT DISPOSITION (2012 % SHARE OF TOTAL EXPORTS)



Source: International Gas Union; TD Econoimcs.

CHART 6 - SPOT AND SHORT-TERM LNG TRADE



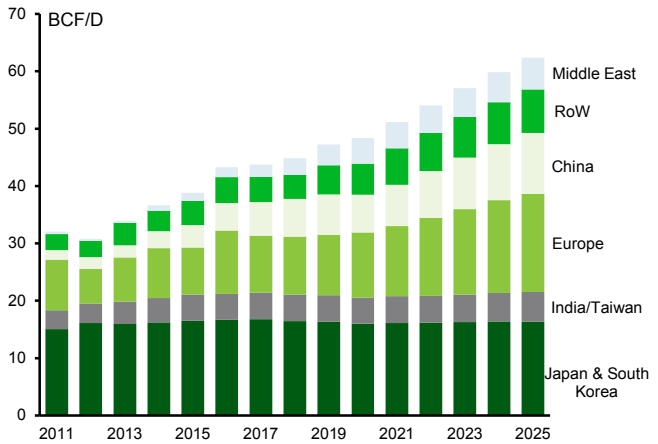
Source: International Gas Union; TD Economics.

natural gas trade. Going forward, LNG demand is poised to grow by almost 6% per year from 2013-2025 (see Chart 5) and is expected to surpass existing liquefaction capacity.

Traditionally, LNG has been traded through long-term arrangements between buyers and sellers. As noted, in some Asian and European markets, these prices are tied to the price of oil. Asian markets typically pay the highest prices, with countries like Japan and South Korea paying more than countries, such as China and India, due to the lack of domestic production or access to a pipeline network. Relying on imports as a sole means of supply means occasionally purchasing gas on the spot market to meet sudden changes in demand. Spot market transactions make up a minority share of LNG trade. Growth in liquefaction capacity the past decade has increased supply flexibility and allowed for more complex trade arrangements. As a result, short term spot trade has increased substantially, from 5% of total LNG trade in 2000, to 31% in 2012 (see Chart 6), and reflects the increasing maturity of the LNG market.

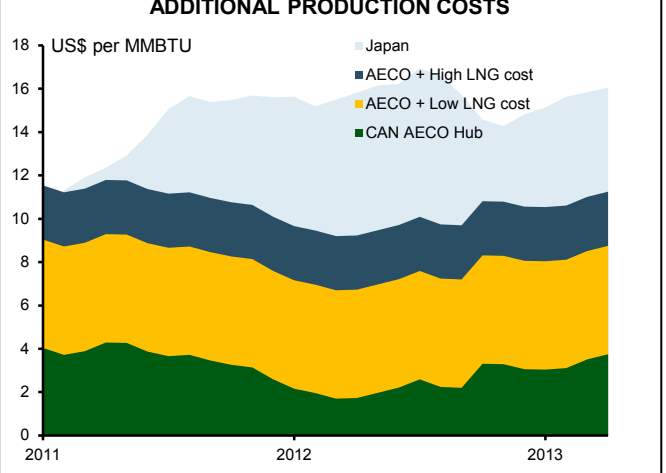
Developing capacity for LNG export is extremely capital intensive. The average 5 million tonne (MT) North American project can cost upwards of US$7 billion (US$2 billion upstream, US$3.5 billion for liquefaction facilities and US$1 billion in transportation). In places like British Columbia, the additional operating costs needed to produce LNG are estimated to add US$5 – US$7.5 per MMBtu of production. In order for LNG exports to remain attractive to resource producers, the price spread between markets must be large enough to cover the additional cost of production, while still remaining profitable. Chart 7 puts these costs and spreads

CHART 5 - WORLD LNG DEMAND FORECAST



Source: Canadian Energy Research Institute; TD Economics.

CHART 7 - PRICE SPREAD INCLUDING ADDITIONAL PRODUCTION COSTS



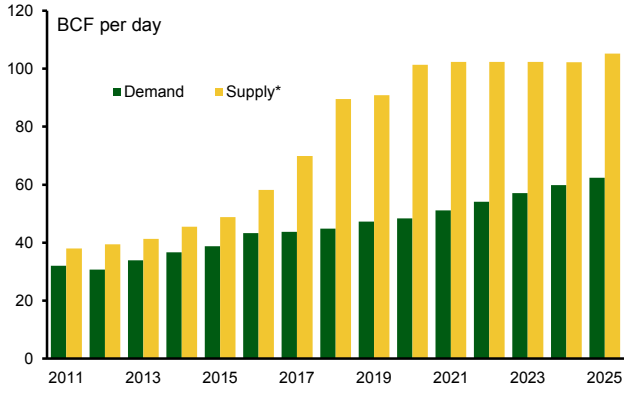
Source: International Gas Union; Bloomberg; TD Economics.

into perspective. The light blue area of the chart indicates that, over recent years, the spread between markets is wide enough for LNG to remain attractive to Canadian resource producers, even at the top end of the cost range.

However, the recent long-term supply deal inked between China and Russian shows that these high oil-linked price contracts are increasingly unlikely. It is speculated that the contracted price is around $10-12/MMBtu, well below the current pricing in the Japanese market. Other deals signed with some LNG projects on the U.S. Gulf Coast used a pricing formula based on the Henry Hub gas price plus costs. Clearly with so much LNG supply capacity set to come on stream, Asian buyers have more power to bargain for lower prices in LNG contracts, lowering the potential prices Canadian producers would receive, and could squeeze the economics of certain LNG projects.

Canada isn't the only country to recognize potential in the global LNG market. The attractive spreads and the growing demand for LNG has caught the attention of resource producers around the world. Multiple countries are competing to tap into the high prices in Asia-Pacific markets. Current exporters, such as Australia, are rapidly increasing gasification capacity (from 23 million tonnes per annum (MTPA) in 2012, with an additional 62 MTPA currently under construction), while several new players – like Canada, the United States and Mexico – are considering developing their own export capacity. For these newcomers, time is of the essence.

CHART 8 - LNG DEMAND AND SUPPLY CAPACITY FORECAST



*Includes facilities that are speculative, proposed, under construction and operational. Realistically, not all speculative and proposed projects will be built

Source: Canadian Energy Research Institute; TD Economics.

There is a finite amount of demand in the highest priced markets, and exporters are sure to compete fiercely for a share. The longer new producers wait to develop capacity, the less likely they are to supply a portion of high priced markets. Planned and proposed export capacity is set to expand rapidly over the next couple of decades – although, only a portion of these proposed projects will realistically be built (see Chart 8). Despite the time sensitivity, resource producers in Canada are still carefully mulling over their decisions to enter the market place, as they must be sure to offset the immense capital expenditure needed to export LNG. Two LNG projects are slated to make final investment

TABLE 1 - Proposed Canadian liquified natural gas projects

Company	Location	Proposed capacity (BCF/yr)	Term Length (years)	Application Status
KM LNG Operating General Partnership	British Columbia	468	20	Approved
BC LNG Export Co-operative LLC	British Columbia	85	20	Approved
LNG Canada Development Inc.	British Columbia	1180	25	Approved
Pacific NorthWest LNG Ltd.	British Columbia	1001	25	Approved
WCC LNG Ltd.	Kitimat/Prince Rupert, B.C.	1461	25	Approved
Prince Rupert LNG Exports Limited	Ridley Island, B.C.	1062	25	Approved
Woodfibre LNG Export Pte. Ltd.	Squamish, B.C.	105	25	Approved
Repsol/Irving Canaport	Saint John, N.B.	438	n/a	Under review
Triton LNG Limited Partnership	Kitimat/Prince Rupert, B.C.	115	25	Under review
Pieridae Energy Ltd.	Goldboro, Nova Scotia	511	20	Under review
Aurora Liquefied Natural Gas Ltd.	Prince Rupert B.C.	1140	25	Under review
Kitsault Energy Ltd.	Kitsault, B.C.	960	25	Under review
Oregon LNG Marketing Company LLC	Kingsgate/Huntington, B.C.	473	25	Under review
Canada Stewart Energy Group Ltd.	Stewart, B.C.	1475	25	Under review

Source: National Energy Board; TD Economics.

decisions by the end of this year.

Each LNG project has its own economics, in part due to which natural gas producing region would feed the terminal. Certain natural gas "plays" are higher cost than others, and some projects have more pipeline infrastructure already in place. These features will play a role in which Canadian projects get built. Assessing the merits of each project is outside of the scope of this report.

The Canadian advantage

There are currently three ways natural gas destined to be exported as LNG is proposed to leave Canada. The first is liquefaction and shipping to Asian markets from British Columbia. Second would be liquefaction and export from Atlantic Canada to Europe or other countries along the Atlantic. The final option would be a southbound pipeline from Western Canada to Oregon, where the gas would be liquefied and exported to Asia. The National Energy Board, Canada's federal energy regulator, has approved eight export license applications, ranging in 20-25 year durations, and has an additional six applications currently under review (see Table 1). Receiving approval from the NEB does not guarantee a project will be built. Realistically, we expect that only a portion of these projects will be developed. The B.C. government currently expects at least one liquefaction terminal near Kitimat to be built towards 2018, with two additional projects to come online by the end of 2020. There is also the possibility of two or more proposed liquefaction terminals being combined in order to reduce development costs. The anticipated start dates for most Canadian LNG projects is near the end of the decade, with Canadian capacity coming online in the early parts of 2020.

The LNG market presents a tremendous opportunity for the Canadian economy, which would create benefits for industry and Canadians at large. Building the infrastructure required to export natural gas will create a significant amount of jobs, both temporary in construction, and permanent in operations and technology. Building the majority of LNG projects with NEB approval in British Columbia, would generate anywhere between $4 billion - $11 billion ($2012) annually in tax/royalty revenue from all aspects of the business (upstream exploration, production, transportation etc.) over the 25 year construction and operating period.[1] The range depends on the capacity that is ultimately completed, from a base of 82 MTPA to a high of 120 MTPA completed by 2020. These capacity estimates are likely on the ambitious side.)

The benefits generated by the Canadian LNG industry are expected extend beyond western Canada – LNG is poised to generate significant federal and provincial tax revenues, promote Canadian exports in the international market, as well as drive other sectors of the economy in other provinces. For example, LNG development would create large opportunities for the Canadian manufacturing and financial services sectors, among others. The LNG industry would also help improve Canadian terms of trade by diversifying Canada's trade portfolio to include a larger portion of Asia Pacific and Europe, while also offsetting some of the losses of the reduced natural gas trade with U.S. markets. LNG development may also present opportunities for aboriginal communities. Where mutually beneficial agreements can be reached, LNG development may create employment, royalties and community investment from resource developers.

From the perspective to resource producers, developing LNG facilities in Canada has some distinct advantages:

Location

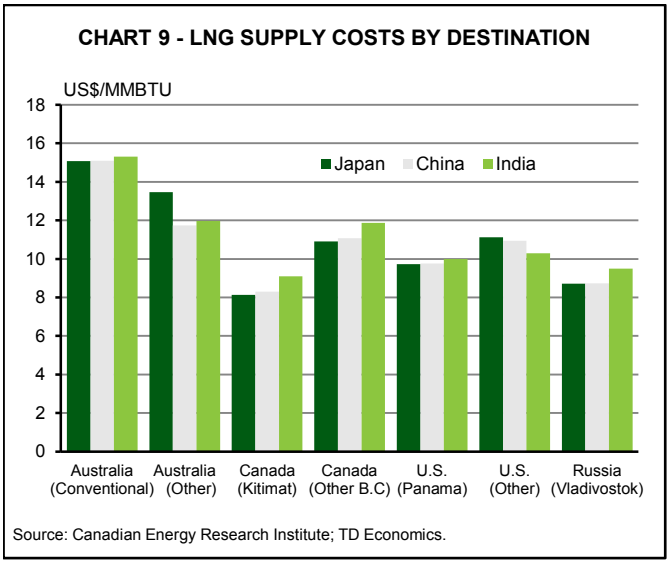
- Western Canadian LNG is closer to major Asian markets, relative to most of its current and potential competitors (see Table 2 for an example of shipping distance to Japan). Shorter shipping distances are attractive to buyers, as they imply a greater flexibility of supply and lower transportation costs, which can make Canadian prices more competitive, while still offsetting high construction costs undertaken by resource developers. The breakeven price of Canadian LNG is competitive when compared to alternatives (see Chart 9).
- On the eastern seaboard, Canada has access to the United Kingdom and other European countries, which

Table 2 - Shipping distance to Tokyo port

Origin	Nautical miles	Duration* (days)
Western Australia	3,300 - 3,600	7 - 8
Eastern Australia	4,000 - 4,300	9
West Coast, Canada	4,000 - 5,000	9 - 11
Western Russia	5,000 - 6,000	11 - 13
Oregon, U.S.	6,000 - 7,000	13 - 15
Qatar	6,000 - 7,000	13 - 15
East Africa	6,500 - 7,000	14 - 15
U.S. Gulf Coast (via Panama Canal)	9000	19
West Africa	11,000 - 11,500	24 - 25
U.S. Gulf Coast (via Suez Canal)	14,520	31

*Duration based on a 19.5 knot shipping time

Source: ITG Investment Research, Centre for Global Energy Studies, Financial Post, Google Earth, TD Economics.



may prove to be large markets for Canadian resources, especially if the ongoing geopolitical tension with Russia leads to Western Europe wanting to diversify away from Russian gas. Although, it is worth noting that due to long construction times, it can take several years from the start of construction until the first shipment of LNG, which casts some doubt on Canada's potential role of supplying European demand. A significant amount of long-term contracts would likely have to be arranged ahead of time before construction takes place.

Supply

- The North American shale gas revolution has left Canada with an abundant supply of relatively low-cost natural gas. Simply put, abundant reserves imply a low risk stable supply for importers, barring any unforeseen exogenous shocks.

Labour market

- Canada has a well-developed resource industry in place, which for resource producers, means there is a pool of skills and expertise to draw upon for the construction and operation of LNG facilities. However, competition for skilled labour could tighten the market and create a challenge for resource producers, as we point out in the following section.

Hospitable political and regulatory framework

- Canada is already a large resource producer and exporter, with a regulatory structure in place that facilitates resource extraction and export licenses. There is also broad based political support for resource development. The B.C. government has expressed its commitment to supporting LNG development in the province, and has released a preliminary tax structure for LNG production. The B.C. government is currently working with resource producers to finalize a tax scheme that would facilitate LNG exports in the province.

Table 3 - Compairson of generic U.S and Canadian LNG projects

	Gulf Coast Brownfield	B.C. (old tax rate)	B.C. (new tax rate)*	Oregon
Capital Intensity ($/MTA)	650	1300	1300	1300
Facility Toll ($/Mcf)	3	5	5	4
Income Tax Rate (%)	43%	25%	26.5%; 32%	43%
Capex ($million)	7800	7800	7800	7800
Pre-Tax NPV ($million)	14644	10114	9935	7860
After Tax NPV ($million)	8213	7517	6740	4091

*Assumes a provincal tax rate of 26.5% pre payout and 32% post payout

Source: ITG Investment Research; Financial Post; TD Economics.

Resource developers also face some challenges when it comes to developing LNG capacity in Canada:

Greenfield facilities

- Canada's west coast requires brand new (greenfield) infrastructure in order to export LNG. This infrastructure is very capital intensive and it can take years before developers see a return. This comes at a time when natural gas producers are under pressure from stakeholders to be more disciplined about capital expenditures. Existing infrastructure (brownfield) can be retooled for export much faster than new facilities can be built. In the U.S. brownfield infrastructure along the Gulf of Mexico is about half as capital intensive as Canadian greenfield infrastructure (see Table 3).

Cost inflation

- Just because Canada has an ample pool of skilled labour to draw upon now, does not mean it will in the future. If multiple producers do decide to follow through on their LNG projects, there could be a competition for skilled labour, which would drive up the cost of labour and the overall cost of projects. A similar scenario is currently

underway in Australia, where rapid development and labour competition has inflated capital costs. Given the already capital intensive nature of Canadian projects, cost inflation could severely impact the economic viability of sites. Cognizant of this risk, four of the top producers have recently announced they will collaborate on labour strategies through the B.C. LNG Developers Alliance, which could help mitigate these challenges.

First mover advantage

- The current amount of global proposed LNG liquefaction capacity is set to outpace demand. As each new project is built, the construction of proposed projects becomes more unlikely, as excess market capacity will result in lower prices, which may not be able to offset the capital expenditure needed to build capacity. While LNG importers may see value in diversifying their supply, it may not be enough to recover costs. This same principal also applies within countries, as issues with competition for labour (cost inflation) and excess capacity can lower the probability of proposed projects being economically feasible.

Social License

- Land dispute conflicts with local and First Nation communities can significantly delay projects. First Nation communities generally support LNG development, due to the lower environmental risks (relative to oil) in the event of a pipeline failure. Some communities have even successfully reached revenue sharing agreements with resource producers.
- An additional issue would be the environmental risks associated with shale gas fracking, which are not well understood. Some European countries are adverse to gas extracted via fracking procedures, with France issuing an outright ban on shale gas fracking. It's possible that resistance to these techniques will soften, as friction with Russia may lead to European countries to seek out alternative suppliers of natural gas. On the other hand, any major environmental accident with fracking could lead to a reduction in government support for fracking activities.

Looking ahead – future threats

Despite the advantages of developing LNG capacity in Canada, resource developers have yet to make the final commitment and break ground on LNG facilities. Each project has a different set of considerations to take into account, with certain projects drawing their natural gas supply from relatively higher cost producing areas, but uncertainty in some of the core fundamentals of the market may have contributed to the hold up. Perhaps a disproportionate amount of attention has been focused on the proposed tax structure B.C. LNG producers would face.[2] These tax structures are critically important, however, they're not likely to be the deal-breakers in terms of projects receiving final investment decisions. Apart from the challenges to LNG development in Canada, there are several "deal-breaker" issues which could knock LNG development off course. These major factors reside in the underlying fundamentals of the market:

Exchange rates

LNG infrastructure is very capital intensive, and the majority of equipment used in its construction is manufactured offshore and priced in U.S. dollars. Even a moderate depreciation in the Loonie can substantially increase capital costs. Conversely, labour is paid for in Canadian dollars – meaning an increase in capital costs may be offset by lower labour costs. The overall impact on a project depends on the mix of labour and capital costs.

Securing long-term contracts

In order to recoup construction costs, Canadian producers will need to secure long-term contracts with high priced Asian markets. While some producers have already secured preliminary long-term contracts, other producers may have difficulty. The future of Japan, the highest priced market, is uncertain. Japan has yet to make a final decision of whether or not it will fully restore its nuclear capacity interrupted by 2011 earthquake, or if it will continue to rely on natural gas. Returning to nuclear energy would truncate a serious portion of demand from the highest valued market. Moreover, Asian buyers are increasingly pushing for Henry Hub based prices, and as more liquefaction capacity comes online, there will be an increased flexibility of supply which would encourage short term spot market trade, while discouraging long term oil-linked contracts.

Recently, China has signed a deal with Russia to import 3.6 Bcf per day of natural gas via pipeline from Eastern Siberia. While gas is not expected to flow for four to six years, that capacity amounts to over 80% of China's total natural gas imports in 2012. The reality that with the stroke of a pen the equivalent of 10% of estimated 2014 LNG demand can be taken off the table demonstrates just how

much uncertainty there is about global demand for LNG going forward.

Volatility

Market volatility is another major concern for both producers and consumers of LNG. For consumers, natural gas is an attractive fuel because it is cheap, clean burning and abundant in supply. Sharp changes in prices or supply can drive foreign markets away from gas toward cheaper, more secure fuel sources. Natural gas is an inherently volatile commodity, and something like an exceptionally cold winter or hot summer, could push foreign markets towards a fuel with a more stable market. For producers, this uncertainty is a large deterrent, given the immense capital costs and long time-horizons associated with developing infrastructure.

Bottom Line

The ample supply of natural gas unlocked by the shale revolution in North America, along with high prices in the Asia Pacific market have made potential Canadian liquefied natural gas exports an especially attractive opportunity. Canada's ample supply of gas, proximity to high priced markets, hospitable regulatory environment and political support for resource development make it an ideal candidate for developing LNG capacity. Resource producers are still weighing the benefits of developing this capacity against the significant capital costs and risks associated with future market uncertainty. While no final investment decisions have been made yet, two projects are expected to make a final decision by the end of this year. The ultimate shape of Canada's LNG future remains a question mark. While many issues factor into to these decisions, the real deal breakers to LNG development in Canada concern shifts in the exchange rate, cost recovery and uncertainty over future demand. Market conditions permitting, developing LNG capacity in Canada would generate a significant amount of economic benefits which would span multiple provinces and economic sectors of the country.

End Notes

1. Ernst & Young (February 2013). "Potential Revenues to BC Government from the Potential Liquefied Natural Gas Development in BC"
2. The B.C. government has proposed a two-tiered tax rate which increased once initial capital costs are recovered.