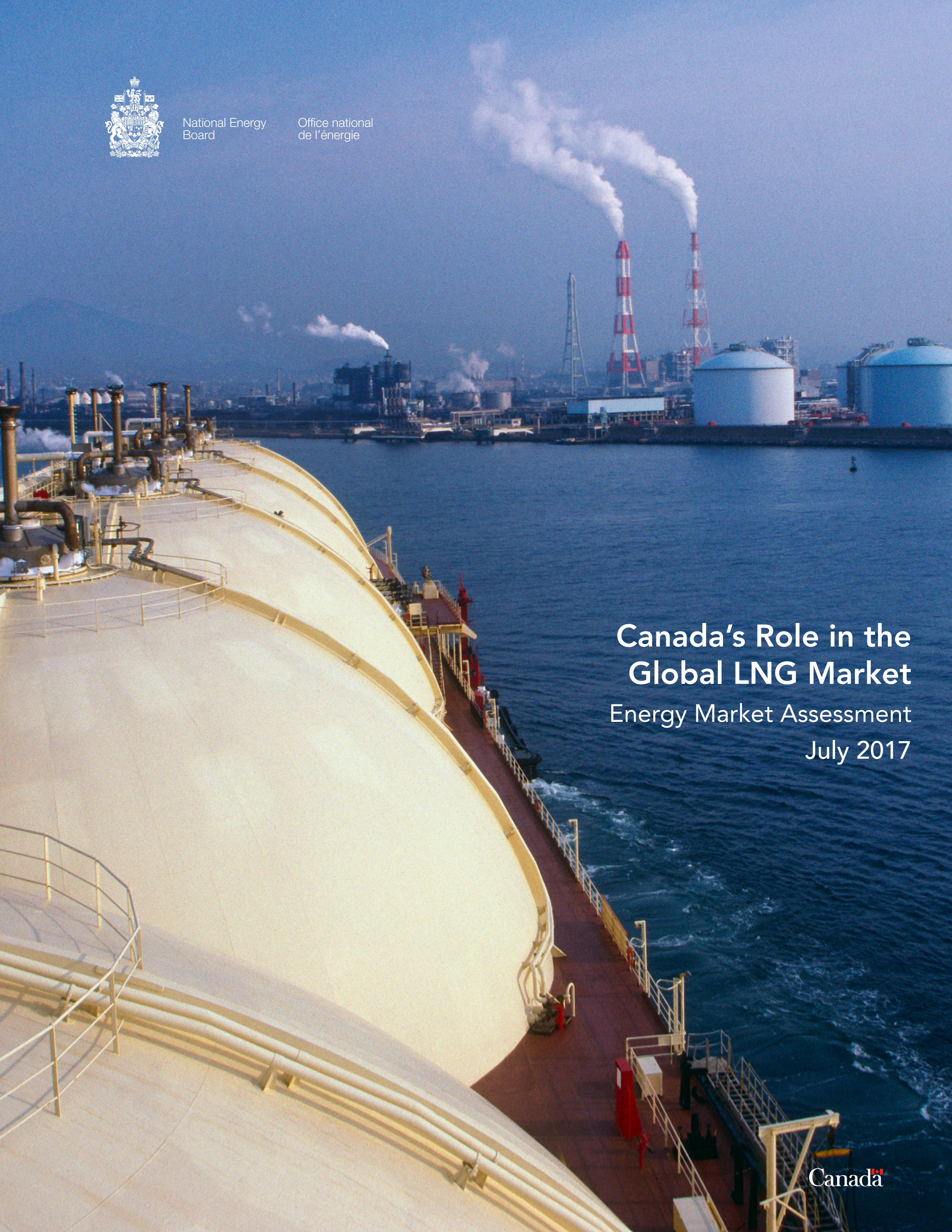
National Energy Board
Office national de l'énergie



Canada's Role in the Global LNG Market

Energy Market Assessment

July 2017

Canada

Canada's Role in the Global LNG Market –
Energy Market Assessment

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Le rôle du Canada dans le marché mondial du GNL –
Évaluation du marché de l'énergie.

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Ce rapport est publié séparément dans les deux langues officielles. On peut obtenir cette publication sur supports multiples, sur demande.

About the NEB

The National Energy Board (NEB or Board) is an independent national energy regulator. Its role is to regulate, among other things, the construction, operation and abandonment of pipelines that cross provincial or international borders, international power lines and designated interprovincial power lines, imports of natural gas and exports of crude oil, natural gas liquids, natural gas, refined petroleum products, and electricity, and oil and gas exploration and production activities in certain areas. The NEB is also charged with providing timely, accurate and objective information and advice on energy matters.

The NEB's strategic outcome states: The regulation of pipelines, power lines, energy development and energy trade contributes to the safety of Canadians, the protection of the environment and efficient energy infrastructure and markets, while respecting the rights and interests of those affected by NEB decisions and recommendations.

The Board's main responsibilities include regulating:

- the construction, operation, and abandonment of pipelines that cross international borders or provincial/territorial boundaries;
- associated pipeline tolls and tariffs;
- the construction and operation of international power lines and designated interprovincial power lines;
- imports of natural gas and exports of crude oil, natural gas, natural gas liquids, refined petroleum products, and electricity; and
- oil and gas exploration and production activities in specified northern and offshore areas.

About this Report

The Board monitors energy markets and assesses Canadian energy requirements and trends to support its regulatory responsibilities. This report, *Canada's Role in the Global LNG Market*, is part of a portfolio of publications on energy supply, demand, and infrastructure that the NEB publishes regularly as part of its ongoing market monitoring.

Contributors to this report include: Colette Craig (project manager), Kinsey Nickerson, and Jennifer Petrie.

Questions or comments? Please e-mail energy-energie@neb-one.gc.ca.

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Executive Summary

Canada has an abundance of natural gas and produces far more natural gas than it needs to meet domestic demand. Traditionally, the United States (U.S.) has been the primary export market for excess Canadian gas, but growing shale gas production in the U.S. has reduced this demand.

Consequently, Canadian (and U.S.) producers have been seeking overseas markets for their natural gas in the form of liquefied natural gas (LNG) exports. Price differentials between North American gas and global LNG have also been large enough to justify the facility development and long-range transportation costs related to LNG trade, although these differentials have been decreasing.

There have been a number of LNG projects proposed in Canada on the West and East Coasts. According to the province of B.C., a reported $20 billion has been spent on the LNG industry in British Columbia (B.C.). Despite this, Canada has yet to emerge as a significant participant in global LNG markets. There are no LNG export projects currently under construction in Canada, and only one of the smaller projects has decided to move ahead.

No proposed projects on the U.S. West Coast are currently under construction and there may still be an opportunity for Canadian west coast projects to take the lead in this region. However, the U.S. is an active player in global LNG markets with multiple LNG export terminals operating and under construction in the Gulf of Mexico.

Global LNG trade is increasing. The strongest LNG demand growth is in Asia, while most near to medium-term increases in global supply will come from capacity already under construction in Australia and the U.S. However, changing LNG market dynamics, including lower prices and fierce competition, have led to considerable uncertainty among all LNG projects.

Canada is a late entrant to global LNG markets and the next several years will be critical to the development of the Canadian LNG industry. Canadian projects have certain advantages, including abundant and relatively low cost natural gas supplies. In addition, west coast Canadian LNG projects have a shorter shipping distance to Asian markets compared to U.S. gulf coast facilities, and east coast Canadian projects have a shorter shipping distance to Europe.

Disadvantages facing Canadian projects include high costs to develop projects in remote locations with limited infrastructure, and, where the construction of new pipelines is required to supply the necessary gas. With LNG prices falling in recent years, the margins needed to justify this type of capital-intensive development have eroded. Increased competition has also made it difficult for Canadian projects to sign long-term supply contracts.

Introduction

Supply Chain

The LNG supply chain spans natural gas production, liquefaction, shipping, regasification, and delivery to the end user (Figure 1). There are two types of LNG terminals needed: liquefaction terminals, which liquefy and export LNG, and regasification terminals, which import and convert LNG back to natural gas.

Most liquefaction terminals receive natural gas by pipeline from a gas producing field. Before liquefaction, the gas is cleaned of impurities that may freeze, become corrosive, or interfere with the liquefaction process. A typical liquefaction plant consists of one or more independent processing units, called trains, which compress and liquefy the gas.

After the liquefaction process, the LNG is loaded onto specially designed cryogenic sea vessels (LNG carriers) or road tankers for transport. Upon arrival at the regasification terminal, the LNG can be stored or sent directly to a regasification plant. Once regasified, this natural gas is transported by pipeline for distribution or placed in temporary storage (Figure 1). Later, the natural gas is used for various purposes, including electricity generation, industrial power, and residential heating.

What is LNG?

Liquefied natural gas (LNG) is natural gas that has been converted into a liquid state by cooling it to a temperature of minus 162°C.

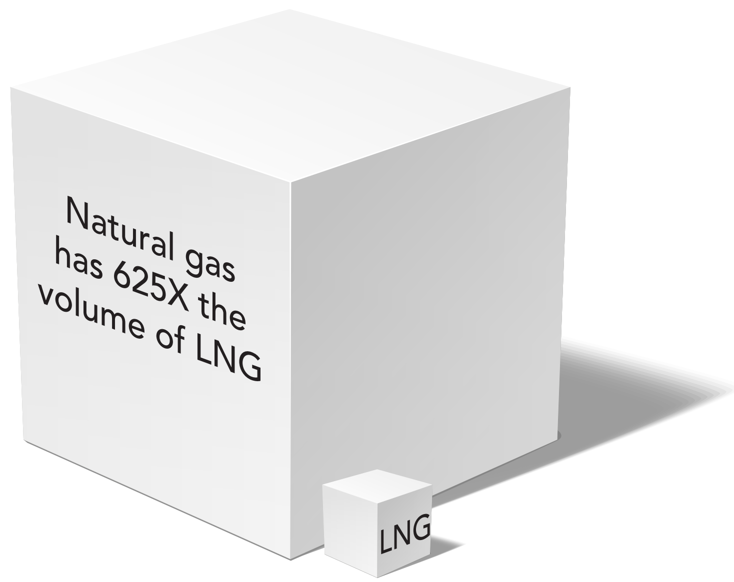
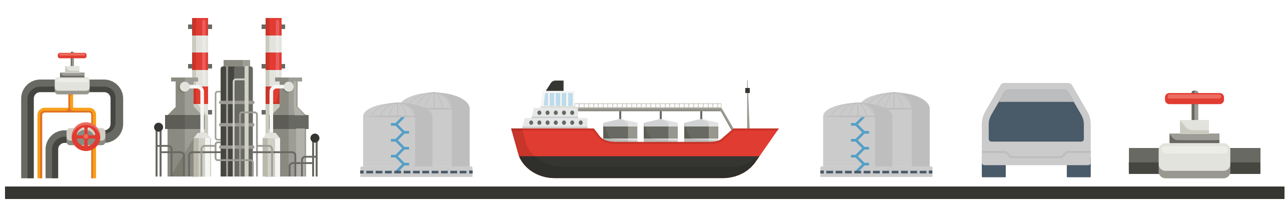


FIGURE 1

LNG Supply Chain

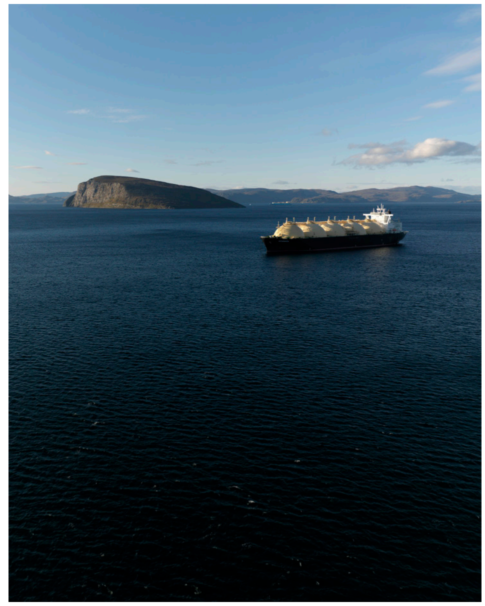


Source:
Natural Resources Canada – Natural Gas Division

Why LNG?

Liquefying natural gas allows for efficient transportation when pipelines are not available or logistically feasible. LNG supplements domestic production and diversifies sources of energy supply in major consuming regions that would otherwise have limited access to natural gas or other energy sources.

Natural gas emits less CO_2 and less particulate matter when burned and contains less sulphur than coal and crude oil products. Relative to natural gas that has never been liquefied, LNG has a greater environmental impact because throughout the LNG supply chain additional energy is consumed to liquefy, transport, and regasify the natural gas. However, LNG still has a lower environmental impact than burning coal, diesel, or fuel oil.



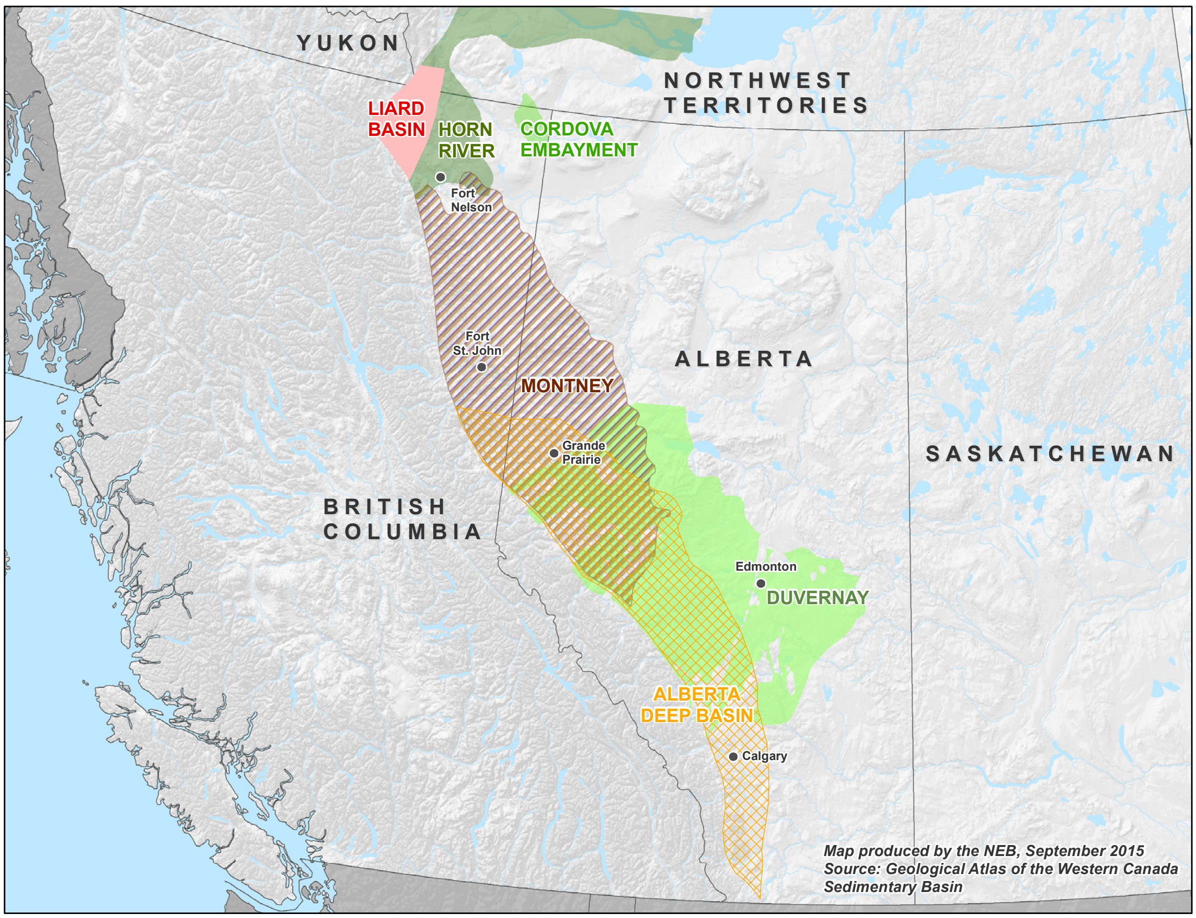
Canada’s LNG Landscape

Current State of North America’s Natural Gas Industry

Canada’s natural gas resources are abundant. The total remaining natural gas resource size is [30.8 trillion cubic metres ($10^{12}m^3$) or 1 087 trillion cubic feet (Tcf)](), with 72% coming from tight and [shale gas]() formations in Alberta and British Columbia. The Montney formation (Figure 2) accounts for 36% of Canada’s total remaining natural gas resources.

FIGURE 2

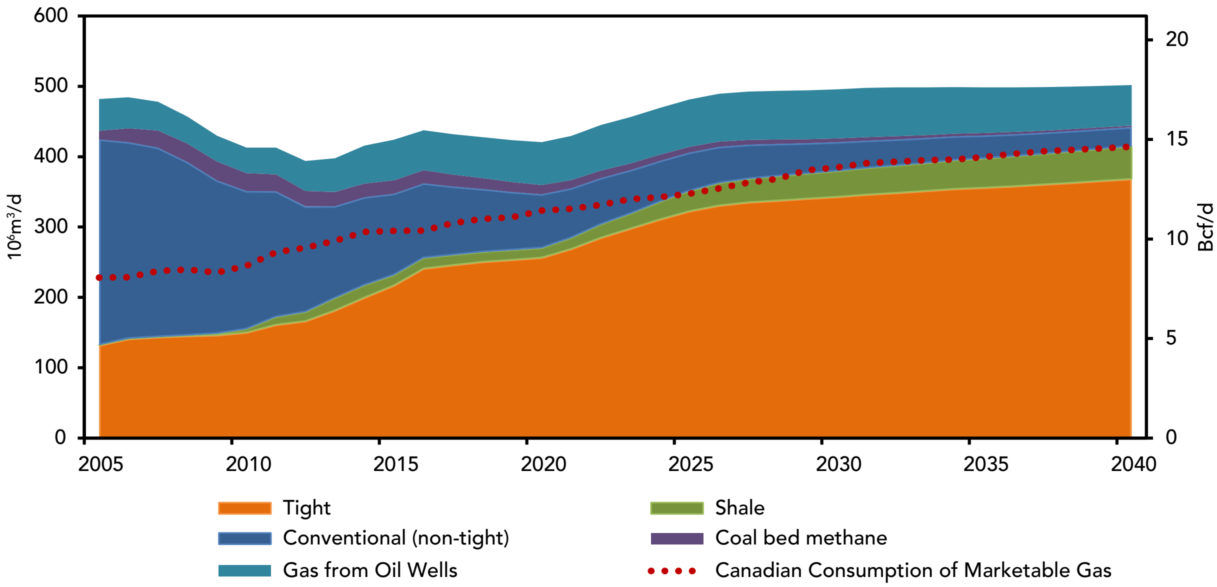
Canada’s Prolific Shale and Tight Gas Resources



Source:
[Canada’s Energy Future 2016: Energy Supply and Demand Projections to 2040]()

FIGURE 3

Canada's Marketable Natural Gas Production and Consumption



Source:
Canada's Energy Future 2016: Update - Energy Supply and Demand Projections to 2040[1]

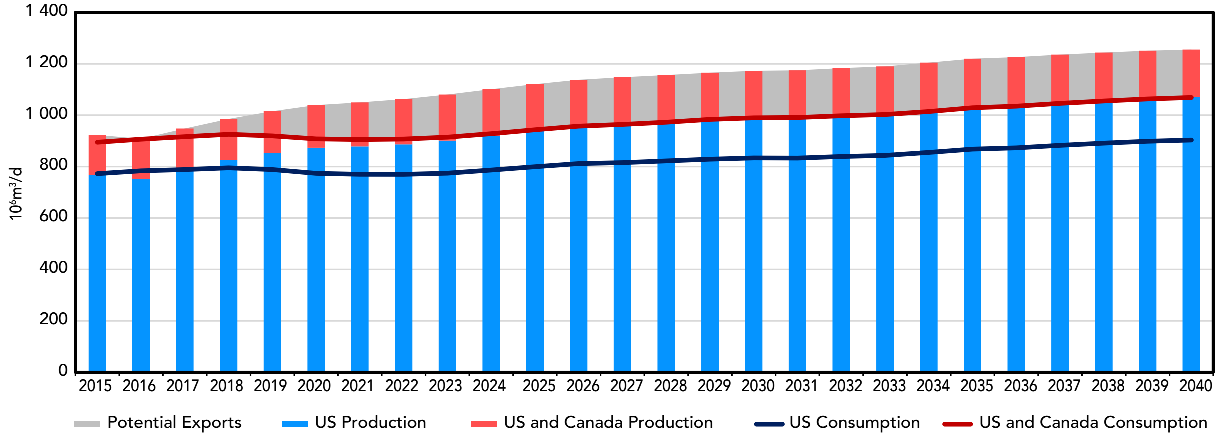
Technological advances in horizontal drilling and hydraulic fracturing have led to the development of tight and shale resources. Previously uneconomic to develop, tight and shale resources are now more than half of current production and the main areas of future growth for Canadian natural gas supply (Figure 3). The NEB projects that production in Canada will increase by 18% by 2040.

The same technologies have resulted in the development of U.S. shale resources, which are even larger than Canada's. The U.S. Energy Information Administration (EIA) projects natural gas production to increase 40% in the U.S. by 2040. As shown in Figure 4, Canada and the U.S. have ample supply available for export.

1 The NEB's Reference Case assumes that LNG exports from the B.C. Coast start in 2021 and increase by 14 million cubic metres per day ($10^6m^3/d$) (0.5 Bcf/d) per year to reach 71 $10^6m^3/d$ (2.5 Bcf/d) by 2025. In the Reference Case, the onset of these exports reverses the declining trend in overall Canadian gas production, with production reaching 489 $10^6m^3/d$ (17.3 Bcf/d) by 2026.

FIGURE 4

Canada and U.S. Natural Gas Production and Consumption

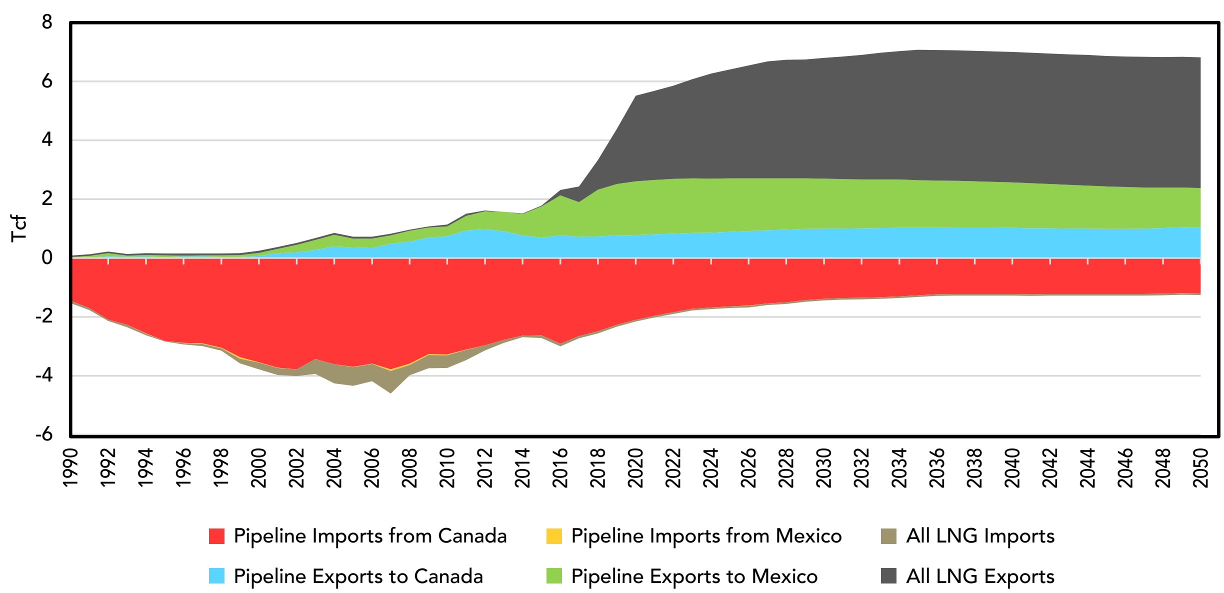


Source:
Canada's Energy Future 2016: Update - Energy Supply and Demand Projections to 2040, EIA (Annual Energy Outlook 2017)

Canada has always been a net natural gas exporter, with nearly all exports going via pipeline to the U.S. However, in recent years U.S. demand for Canadian gas has decreased due to increases in U.S. production. Historically the U.S. has been a net importer of natural gas but is set to become a net exporter in 2017/2018. As shown in Figure 5, natural gas exports from the U.S. are set to triple in the next three years; LNG exports are projected to surpass pipeline exports.

FIGURE 5

U.S. Natural Gas Trade



Source:
EIA (U.S. Natural Gas Exports and Re-Exports by Country, U.S. Natural Gas Imports by Country)

Current State of Canada's LNG Industry

Canada has one existing large-scale LNG regasification (import) terminal, the Canaport LNG facility in New Brunswick, which began operating in 2009 and has a capacity of 34 10^6 m^3/d (1.2 Bcf/d)[2]. Canaport LNG receives offshore supply from regions such as the North Sea and the Caribbean, and helps supply the natural gas needs of Atlantic Canada and the U.S. Northeast via the Emera Brunswick Pipeline. Due to changing natural gas market dynamics in North America, Canaport LNGs owners, Repsol and Irving Oil, initially proposed to convert the LNG import facility into an LNG export facility and received a 25 year export licence from the NEB. However, the project's proponents announced that the project is currently on hold.

FIGURE 6

Canaport LNG Facility

Source:
Canaport LNG

While Canada is not yet involved in large-scale global LNG export trade, Canada's LNG industry dates back decades. It is comprised primarily of small-scale liquefaction and regasification facilities that serve local markets. LNG is used to smooth or peak shave[3] fluctuating demand on natural gas pipeline systems by liquefying and storing gas in specialized storage tanks when demand is low, and then regasifying and supplying gas when demand is high. LNG plants such as FortisBC's Tilbury Facility and Gaz Metro's LSR Montreal plant currently serve as peak shaving facilities in addition to selling LNG to industrial customers, and both are expanding their capacity.

In remote areas with no gas pipeline infrastructure, LNG is transported by tanker truck to serve industrial customers operating heavy drilling and mining machinery, to power gas-fired electrical generating stations, and to serve as heating fuel in rural communities. LNG is also used in Canada to fuel ferries and ships.

2 The Canaport LNG facility accounts for nearly all of Canada's LNG import volumes, with the small remainder brought in by truck.

3 Peak shaving refers to storing excess energy in periods of lower demand and distributing the energy to customers in sudden higher demand periods, such as extreme cold or hot weather.

Proposed Canadian LNG Projects

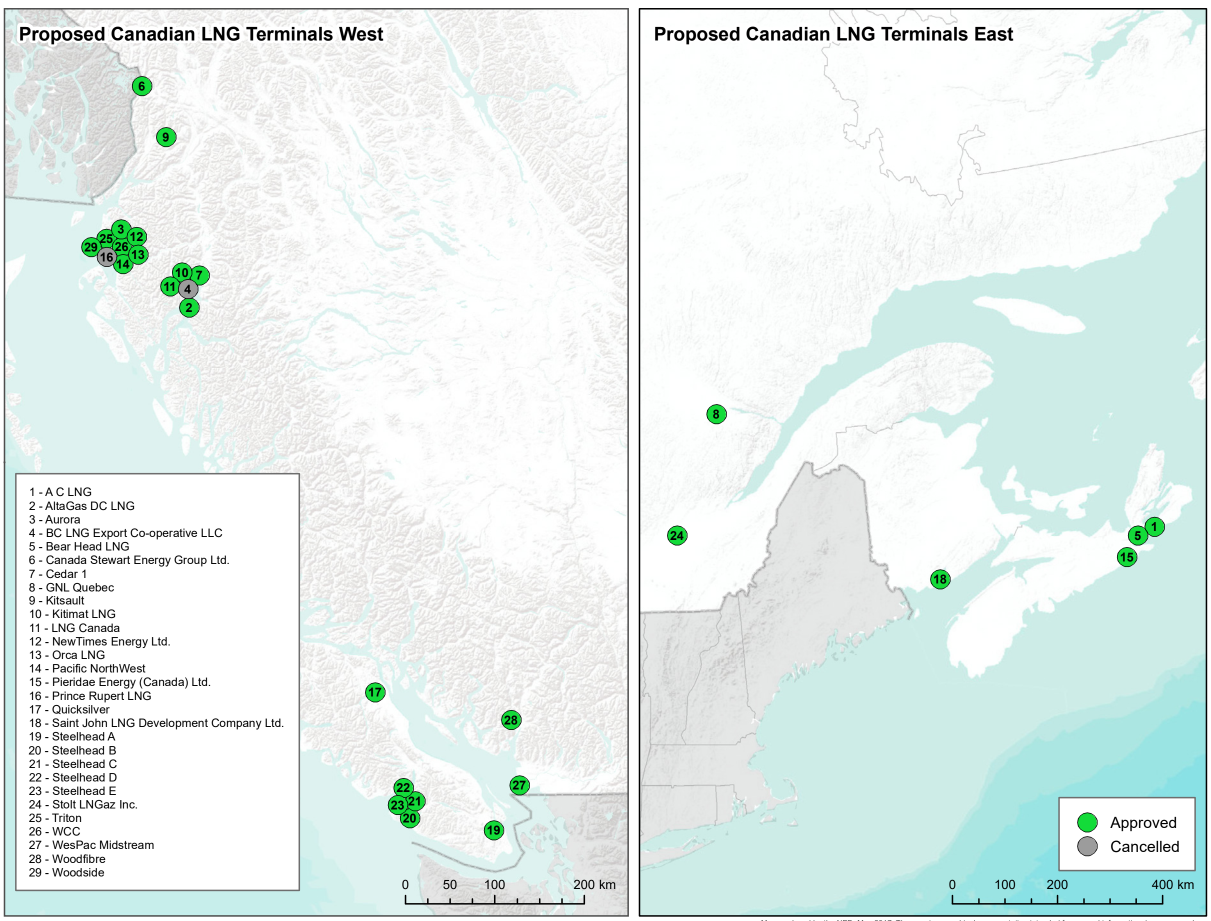
Under the *National Energy Board Act* (NEB Act), the Board must authorize all exports and imports of natural gas from Canada, including LNG. Proposed LNG projects must also receive regulatory and environmental approvals from other federal and/or provincial regulators. The final investment decision for each LNG project lies with the project proponents' management, and is usually based on a combination of market and regulatory factors.

Since 2010, the Board has received 43 LNG export licence applications, 35 of which were approved. There are 24 distinct projects, with 18 projects based along the B.C. Coast and the remaining projects located in the Maritimes and Quebec. Figure 7 shows the geographical location of the proposed facilities associated with the approved licences.

These applications were largely for the export of LNG from western Canada to Asian markets, although there were also applications to ship gas from eastern Canada to the Atlantic basin (Europe/Latin America) and Indian markets. Four east coast projects have also been granted import licences to accommodate the movement of gas across the border from the U.S. The projects range in size from 2.3 10^3 m^3/d (0.08 Bcf/d) to 130.2 10^6 m^3/d (4.6 Bcf/d). See Appendix 1 for a list of all licences approved by the Board.

FIGURE 7

Canadian LNG Export Licences Approved for Proposed Projects



Source:
NEB

There are more proposed LNG projects on the West Coast than on the East Coast. This is because there is significant gas supply in northeast B.C. and Alberta and many of the largest LNG project proponents are also gas producers in western Canada aiming to maximize the value of their producing assets by seeking alternate markets.

Secondly, the West Coast is a shorter distance to the primary target market of Asia. Consistent with this, many proposed Canadian LNG projects have investors from countries such as Japan, Korea, China, and India. Some of these Asian proponents have already entered into long-term contracts with their project partners to buy a portion of the Canadian-produced LNG. These long-term contracts are important to the viability and financing of larger Canadian LNG projects, as these would be costly greenfield[4] developments.

A small number of projects[5] on Canada's west coast have received regulatory approvals but most are waiting for market conditions and project economics to improve before reaching a final investment decision (see Appendix 1). In Quebec, one project received regulatory approvals to proceed but has not moved forward. On the East Coast, one project received regulatory approvals from all levels of government, but project proponents are working to secure gas supply before proceeding.

The competitive nature of global LNG markets means that not all proposed LNG projects are likely to be built. To date, none of the LNG export facilities associated with NEB export/import licence approvals have reached the construction stage, although dozens of LNG projects are at various stages of planning. Only one of these projects, Woodfibre LNG has reached a final investment decision. Woodfibre LNG is being built on a repurposed site (formerly a pulp mill) near Squamish B.C. It is one of the smaller volume NEB export licence holders, with a 40-year licence to export up to 2.1 million metric tonnes per annum (MMtpa) (0.3 Bcf/d) of LNG.

4 Greenfield projects are developed on land that was not previously used for similar or other industrial purposes, and generally lacks existing infrastructure.

5 Pacific Northwest, Kitimat LNG, LNG Canada, and Woodfibre LNG

The U.S. LNG Industry

In years prior to the large-scale production of shale and tight gas resources, companies in the U.S. invested in the construction of LNG import terminals, anticipating a need to import natural gas to meet future demand (see Appendix 2). With increased domestic natural gas production, most of these facilities have been under-utilized, decommissioned, or are being converted (or considered for conversion) into export liquefaction capacity.

Existing U.S. import facilities such as Cove Point LNG, Freeport LNG, Corpus Christi LNG, and Sabine Pass LNG are being re-purposed from regasification terminals to liquefaction terminals. The conversion helps reduce the high costs associated with building greenfield facilities (such as many of those proposed in Canada), and is a major factor in the global competition for capital to develop LNG projects.

The U.S. has the only two existing LNG export terminals in North America with one currently in operation. The Sabine Pass terminal has a current capacity of around 33.9 10^6 m^3/d (1.2 Bcf/d) and was the first project to add liquefaction capacity to its existing regasification terminal, with commercial operations beginning in May 2016. Kenai LNG, located in Alaska is currently up for sale and has not exported since 2015.

TABLE 1

Liquefaction Capacity in Canada and the U.S.

	United States		Canada	
	Projects	Capacity (Bcf/d)	Projects	Capacity (Bcf/d)
Existing	2	1.4	-	-
Under Construction	5	7	-	-
Proposed	33	40	29	55
Cancelled	11	11	2	4

Source:
EIA, FERC, NEB, IHS Market

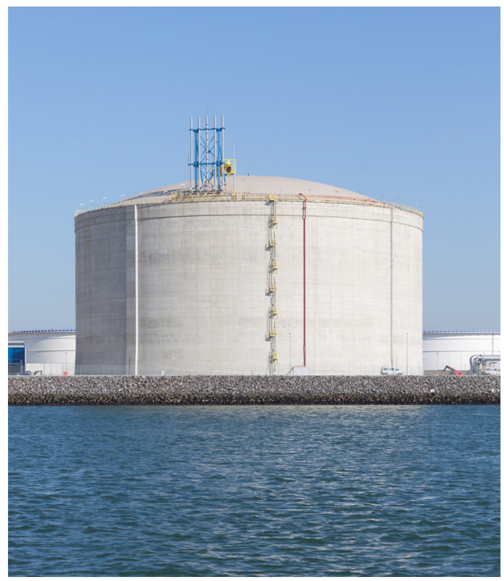
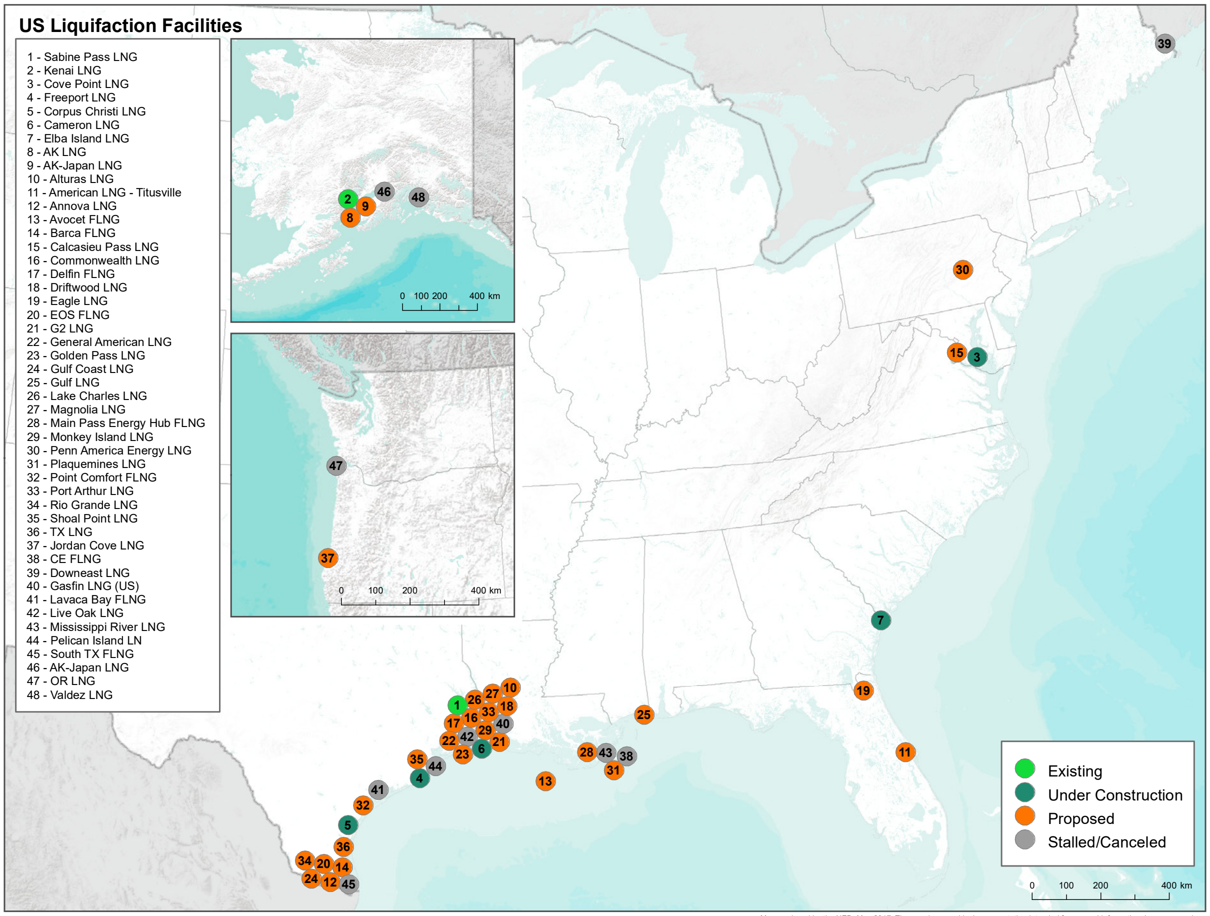


FIGURE 8

U.S. LNG Export/Liquefaction Projects



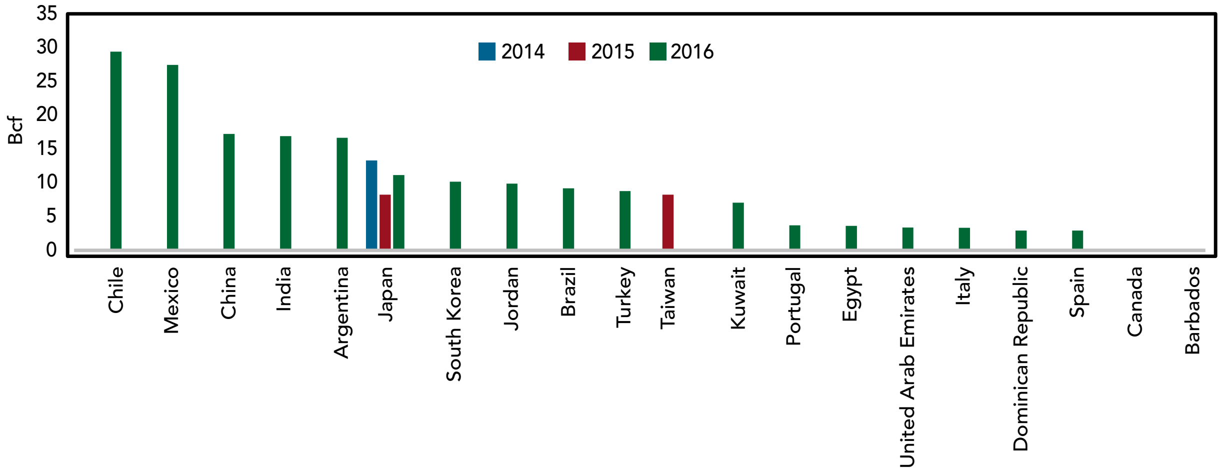
Source:
NEB

Implications of U.S. LNG Development for Canada

Sabine Pass is currently exporting to many of the markets which Canadian projects are hoping to access. In 2016, 32% of U.S. LNG exports (all from Sabine Pass) went to South America, 30% to Asia, 15% to Mexico, 11% to the Middle East, and 10% to Europe.

FIGURE 9

U.S. LNG Export Destinations



Source:
EIA

Most of the proposed projects in the U.S. are located along the Gulf of Mexico. However, the Jordan Cove project is located along the U.S. West Coast and would compete with Canadian west coast projects with respect to proximity to Asian markets.

The U.S. has contracts to export LNG to many countries, but nearly 70% of U.S. capacity is not dedicated to a specific location. This reflects the challenge LNG exporters face in securing long-term contracts, as buyers are diversifying their supply away from single LNG projects and single regions. If they become operational, Canadian LNG projects are likely to face similar contracting challenges.

A recent deal between the U.S. and China, whereby U.S. LNG developers could target Chinese buyers directly, could support project financing and lead to Chinese investment in liquefaction and upstream development in the U.S.

The Global LNG Landscape

Table 2 shows the countries that have the largest liquefaction/export capacity and largest regasification/import capacity in 2016.

TABLE 2

Leading Countries in the Global LNG Trade

LNG Liquefaction Capacity by Country (Mmtpa)		*LNG Regasification Capacity by Country (Mmtpa)*	
Qatar	77	Japan	198
Australia	61	United States	132
Malaysia	29	South Korea	99
Algeria	25	Spain	49
Nigeria	22	China	49
Indonesia	21	United Kingdom	35
Trinidad	15	India	27
Russia	11	France	20
Oman	11	Mexico	17
Egypt	7	Taiwan	13
Other	47	Other	131

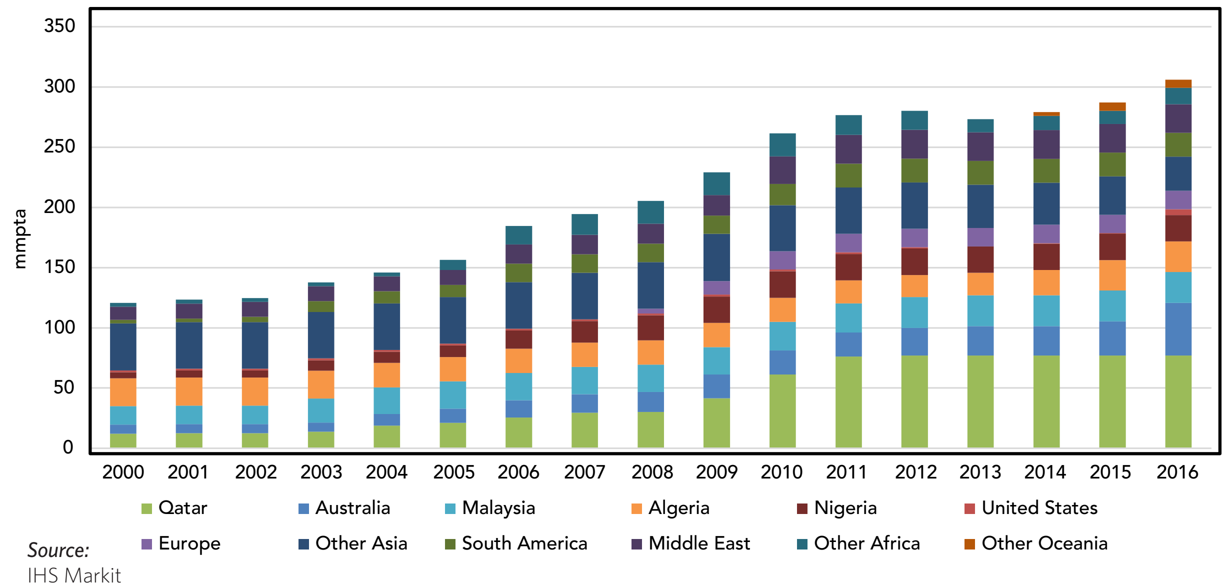
Source:
NEB, IHS Markit, IGU, GIIGNL

Global LNG Supply

Global LNG liquefaction capacity is currently about 300 MMtpa (40.0 Bcf/d). The majority of current liquefaction capacity is in Qatar, Australia, Southeast Asia, North Africa, and Russia.

FIGURE 10

Global Liquefaction Capacity



Source: IHS Markit

Currently, the world's largest operating LNG liquefaction facility, with a capacity of about 22 MMtpa (3 Bcf/d), is the Bontang facility in Indonesia. Other large facilities include the North West Shelf in Australia, Bethioua in Algeria, Qatar Gas 2, Rasgas II, and RL 3 in Qatar, and Sakhalin 2 in Russia. Qatar has the largest total capacity in the world, at over 77 MMtpa (10.3 Bcf/d), and Australia is second with over 61 MMtpa (8 Bcf/d).

Four new projects adding over 25 MMtpa (3.3 Bcf/d) of combined capacity began operations in 2016, including three in Australia (GLNG, Australia Pacific, and Gorgon LNG) and Sabine Pass in the U.S. The majority of the near to medium-term increases in supply will come from capacity already under construction in Australia and the U.S., which combined account for 75% of capacity under construction worldwide. This will secure Australia and the U.S., along with Qatar, as the world's largest LNG exporters in the next decade.

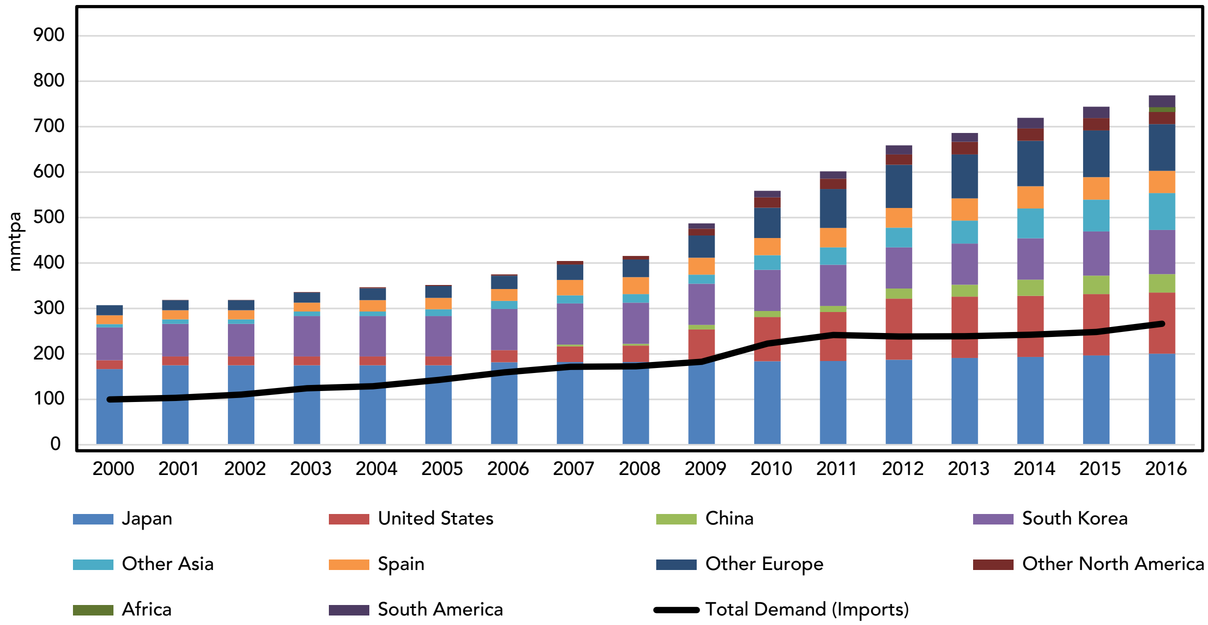
In the NEB's *Canada's Energy Future 2016: Update - Energy Supply and Demand Projections to 2040*, Canadian LNG exports from the B.C. Coast are assumed to start in 2021 and increase by 14 10^6 m^3/d (0.5 Bcf/d) per year to reach 71 106 m^3/d (2.5 Bcf/d) by 2025. Based on this assumption, Canada would be a relatively small contributor to global LNG supply over the next decade, contributing approximately 11.24 MMtpa (2.5 Bcf/d).

Global LNG Demand

Current global regasification capacity is approximately 770 MMtpa (102.7 Bcf/d) and is spread across more than 170 facilities (Figure 11). Most of these facilities are located in Asian countries, such as Japan, South Korea, Taiwan, China, and India, followed by the U.S. and western Europe.

FIGURE 11

Global Regasification Capacity



Source:
IHS Markit

LNG regasification capacity has been under-utilized, with global utilization rates of 35-40% over the past decade. Actual imports of LNG were about 270 MMtpa (36.0 Bcf/d) in 2016 versus 770 MMtpa (102.7 Bcf/d) of existing regasification capacity.

Regasification utilization is low for a variety of reasons. Some facilities were built in regions where expected gas demand growth did not materialize, where domestic gas supply growth far exceeded expectations, and/or where new pipeline capacity has now been added. The U.S. is an example where many regasification facilities were built on the East Coast in anticipation of gas supply shortages in a high demand region, but shale gas developments in the U.S. Northeast have since more than met demand.

Global LNG Pricing

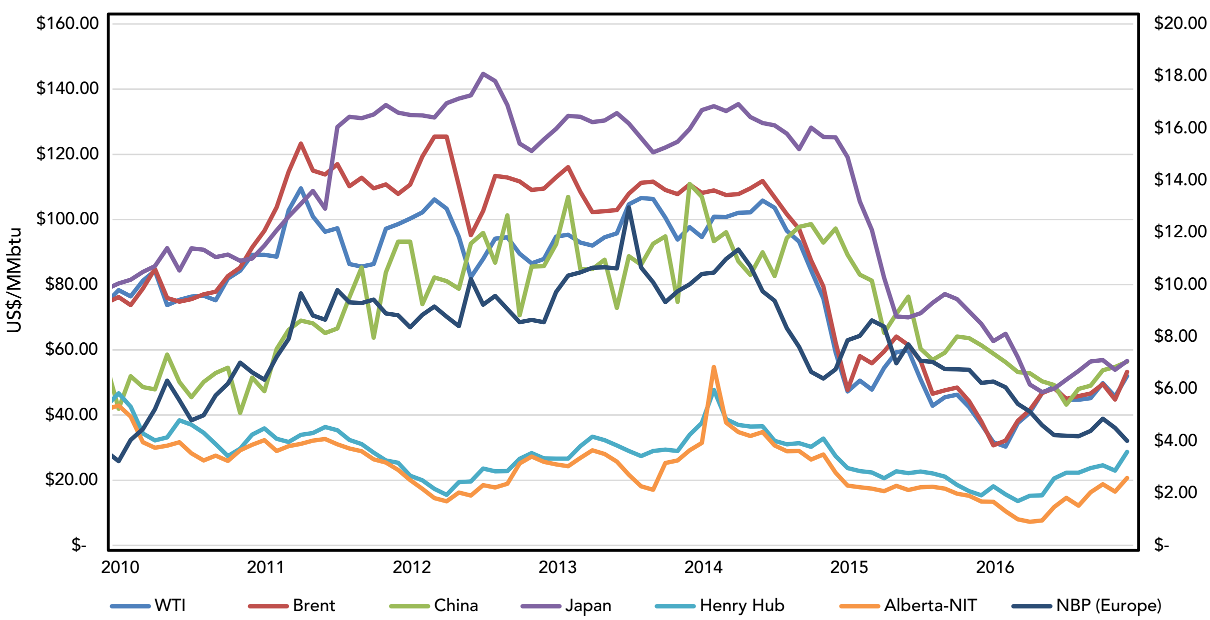
Although LNG trade has become global, there is no standard global LNG pricing system[6]. Currently, some LNG contract prices are linked to global oil index prices like Brent. Other contracts are linked to regional natural gas index prices like Henry Hub plus a fixed fee for liquefaction and additional costs. Futures exchanges, such as the Intercontinental Exchange (ICE), now list LNG pricing products, but trading volumes are not significant yet.

Historically, the majority of LNG contract prices have been linked to oil prices and contracted to a fixed destination for long terms (15-20 years). This has been the standard contract structure for major Asian LNG purchasers. More recently, given the volatile price environment for both gas and oil, contracts are becoming shorter as sellers are less willing to accept long-term contracts at current prices and buyers are less willing to lock in above today's market prices. Also, LNG buyers are increasingly able to negotiate flexible contract terms, including different routes, shipping practices, and export and delivery points compared to traditional purchase agreements.

LNG prices vary by region. Figure 12 shows crude oil prices rising between 2010 and 2014 relative to North American natural gas prices. Since most LNG contracts outside of North America are oil-linked, Asian LNG prices and European gas prices were also rising and were significantly higher than North American natural gas prices. It was during this period that many North American companies, particularly natural gas producers, started considering building major LNG liquefaction facilities. Additionally, many Asian importing countries started making significant investments in North American gas projects that would eventually supply the LNG facilities.

FIGURE 12

Global Historical LNG Prices and the WTI Oil Price



Source:
NEB, NGX, NYMEX, IHS Markit, Various Asian customs import websites

6 With the recent startup of major LNG facilities in the U.S., there is potential that the U.S. Gulf Coast may become a global pricing hub in the future.

As global oil prices dropped in late 2014, so did Asian LNG prices (to a lesser extent, so did European gas prices). As an example, the weighted-average Japanese import price dropped more than $6 per million British thermal units (MMBtu) throughout 2015, or 43%. The LNG price drop was due to the direct impact of lower oil prices on oil-linked contracts coupled with decreased LNG demand and increased global energy supply options.

Current global pricing conditions and, ultimately, the inability to secure higher priced long-term contracts have resulted in the delay and cancellation of many proposed LNG projects and expansions, particularly in North America and Australia. In addition, liquefaction projects that are already in operation with uncontracted capacity are looking for alternate LNG markets outside of Asia.

Global LNG Trends

A growing trend in global LNG is the use of Floating Storage Regasification Units (FSRUs). These are popular in emerging markets such as Lithuania, Pakistan, and the Middle East (Jordan, Israel, Kuwait, and UAE). They are also being used extensively in South America.

For example, all of Brazil and all of Argentina's regasification capacity is provided by FSRUs. Globally, 21 of the 170 existing regasification projects are floating facilities (totalling 78 MMtpa or 10.4 Bcf/d). FSRUs are generally a lower cost option than land-based LNG facilities, and are faster to bring into operation.

LNG is also being used as transportation fuel in the trucking and marine shipping industries. The International Maritime Organization (IMO)'s upcoming requirement effective in 2020 will require barges, tankers, and other ships to use only low sulfur fuel (<0.5%). Therefore, LNG demand could increase due to the retrofitting or building of new LNG-fueled ships.

Looking Ahead for Canada's LNG Industry

While many LNG export licences have been granted in Canada, not all of the projects will go ahead. Canada is a late entrant into a global LNG export market that is becoming increasingly competitive as more facilities are built around the world. The following is a summary of Canada's competitive advantages and disadvantages in the world LNG market.

Advantages

- Canadian west coast projects have a proximity advantage to prolific gas supply from shale and tight gas resources in western Canada (such as the Montney, Deep Basin, and Horn River plays), which represent over 50% of Canada's current production.
- The most competitive of these gas plays supply relatively low cost production, which helps improve the economics of LNG trade from Canada versus some international LNG projects with higher cost gas supply (e.g. offshore deep water gas basins).
- Canadian west coast projects are closer to prime Asian markets than existing U.S. facilities in the Gulf Coast/East Coast region by about 5 000 nautical miles and do not require passage through the Panama Canal[7]. This proximity to Asia is a key advantage over U.S. Gulf Coast-based LNG project offerings. Canada is also about 1 000 nautical miles closer to Asia than significant west African liquefaction players like Nigeria.
- Canadian east coast projects are closer to European import markets than the U.S. Gulf Coast (by 2 000 nautical miles) and other leading international LNG exporters such as Australia, Qatar, and Malaysia.
- LNG facility tax incentives in Canada provide a significant financial advantage.

Challenges

- Historically low global natural gas prices and ample supply in key natural gas markets make it challenging for Canadian LNG projects to secure long-term contracts. The current market environment is trending towards short-term or spot price-based transactions that generally make it more difficult to finance multi-billion dollar investments in new LNG facilities.
- Most proposed Canadian LNG projects would rely on inland supply sources in northeast B.C. and Alberta. This would require major new long haul pipelines or expansions of existing systems to transport natural gas to coastal liquefaction facilities – a major additional project expense and that also requires regulatory approvals. In contrast, many other global LNG supply regions, including Australia, use offshore gas as their major supply source.
- Canadian LNG projects would generally be greenfield sites and incur higher costs than U.S. projects built on existing LNG import terminal sites.
- There are growing public concerns over competing uses for land and marine resources, local impacts from hydraulic fracturing, pipeline routing, safety, and GHG emissions, among other issues. As a result, the regulatory environment continues to evolve and could impact future LNG project-related approvals.
- Australia and other Asia-Pacific LNG supply regions such as Malaysia and Indonesia are closer to the prime Asian market.[8] These competing regions have significant shipping time and cost advantages over Canadian projects.

7 The Panama Canal expansion, completed in 2016, nearly doubled its capacity. An LNG tanker using the Panama Canal rather than sailing around South America can shorten its voyage time by up to 11 days. A pass through the Panama Canal comes with a cost of $2-$2.50 per cubic metre (or .06-.07 MMbtu) of LNG. For example a recent shipment from Sabine Pass of 160 000 m^3 of LNG paid tolls of $355 000 for its trip through the canal.

8 For example, Bintulu, Malaysia to Tokyo, Japan is approximately 3 000 Nautical Miles (NM) and western Australia to Tokyo, Japan is approximately 3 600 NM. From Canada's west coast to Japan is approximately 4 200 NM.

- Competition is increasing; some U.S. LNG export facilities have already begun operations while many others are progressing to a final investment decision and will be in full operation before most Canadian projects. Other fiscally stable regions such as Australia also have many operating facilities.

Uncertainties

- Canada has the opportunity to become an LNG exporter before U.S. west coast projects. At this point, no U.S. west coast project has reached a final investment decision.
- Future global natural gas and LNG contracting and pricing is an area of uncertainty that will dramatically impact global LNG project economics.
- The role of natural gas in addressing global climate change concerns is uncertain in the coming decade(s). Natural gas and LNG demand may strengthen as economies become less reliant on more carbon-intensive fossil fuels such as oil and coal. Alternatively, natural gas and LNG demand could decline if renewable and/or nuclear energy sources become more prevalent at the expense of all fossil fuels.
- Many global LNG projects under development are competing for available labour, expertise, and materials and could face inflated development costs. Canadian project proponents are concerned about cost over-runs observed in other global projects.

Appendices

Appendix 1: Canada's NEB LNG Export Licences

Export Licence Holder	Project Proponents	Export Point(s)	Licence Term	Licence Issued	Volume w/ tolerance (Bcf/d)	Export Licence
A C LNG Inc.	H-Energy (India)	Middle Melford (NS)	25 years	5/27/2016	2.07	GL-328
AltaGas DCLNG General Partner Inc., on behalf of AltaGas DCLNG Lease Limited Partnership	AltaGas	Kitimat (BC)	25 years	5/27/2016	1.00	GL-332
Aurora Liquefied Natural Gas Ltd.	Nexen (CNOOC), INPEX, JGC Exploration	Prince Rupert (BC)	25 years	10/24/2014	3.57	GL-307
Bear Head LNG Corporation	Liquefied Natural Gas Limited (Australian Company)	Point Tupper (NS)	25 years	5/26/2016	1.88	GL-315
Canada Stewart Energy Group Ltd.	Northwest World Energy Services Ltd., Great United Petroleum Holding Co.	Stewart (BC)	25 years	5/27/2016	4.60	GL-331
Cedar 1 LNG Export Ltd.	Cedar LNG Export Development Ltd.	Kitimat (BC)	25 years	05/27/2016	0.83	GL-327
GNL Québec Inc.	Ruby River Capital LLC (Freestone International LLC, Breyer Capital LLC)	Saguenay (QC)	25 years	5/26/2016	1.79	GL-317
Jordan Cove LNG L.P.	Veresen	Kingsgate and Huntingdon (BC)	25 years	7/24/2015	1.78	GL-305
Kitsault Energy Ltd.	Kitsault Energy	Kitsault (BC)	20 years	5/27/2016	3.11	GL-334
KM LNG Operating General Partnership (Kitimat LNG Project)	Chevron, Woodside (Apache sold to Woodside) (Kitimat LNG Project)	Kitimat (BC)	20 years	11/14/2011	1.41	GL-298
LNG Canada Development Inc.	Shell, Mitsubishi, Korea Gas, PetroChina	Kitimat (BC)	40 years	5/27/2016	3.68	GL-330
NewTimes Energy Ltd.	NewTimes Energy Ltd.	Prince Rupert (BC)	25 years	5/27/2016	1.85	GL-333
Orca LNG Ltd.	Orca LNG	Prince Rupert (BC)	25 years	5/26/2016	3.68	GL-312
Oregon LNG Marketing Company LLC	Oregon LNG (Leucadia, others)	Kingsgate and Huntingdon (BC)	25 years	7/24/2015	1.49	GL-308
Pacific NorthWest LNG Ltd. as general partner of the Pacific NorthWest LNG Limited Partnership	Petronas, Sinopec, Japex, Indian Oil Corp., Petroleum Brunei	Lelu Island (BC)	40 years	12/21/2016	3.35	GL-337
Pieridae Energy (Canada) Ltd.	Pieridae Energy	Goldboro (NS)	20 years	5/26/2016	1.61	GL-313
Quicksilver Resources Canada Inc. (Transfer to Rockyview Resources Inc.)	Quicksilver Resources Inc. (Transfer to Rockyview Resources Inc.)	Campbell River (BC)	25 years	5/26/2016	3.03	GL-311
Saint John LNG Development Company Ltd.	Repsol	Saint John (NB)	25 years	5/27/2016	0.79	GL-318

Export Licence Holder	Project Proponents	Export Point(s)	Licence Term	Licence Issued	Volume w/ tolerance (Bcf/d)	Export Licence
Steelhead LNG (A) Inc.	Steelhead LNG Limited Partnership	Mill Bay (BC)	25 years	5/26/2016	0.98	GL-320
Steelhead LNG (B) Inc.	Steelhead LNG Limited Partnership	Sarita Bay (BC)	25 years	5/26/2016	0.98	GL-321
Steelhead LNG (C) Inc.	Steelhead LNG Limited Partnership	Sarita Bay (BC)	25 years	5/26/2016	0.98	GL-322
Steelhead LNG (D) Inc.	Steelhead LNG Limited Partnership	Sarita Bay (BC)	25 years	5/26/2016	0.98	GL-323
Steelhead LNG (E) Inc.	Steelhead LNG Limited Partnership	Sarita Bay (BC)	25 years	5/26/2016	0.98	GL-324
Stolt LNGaz Inc.	Company registered in QC; partners will be Stolt-Nielsen Gas, SunLNG and LNGaz.	Bécancour (QC)	25 years	5/27/2016	0.08	GL-325
Triton LNG Limited Partnership	AltaGas, Idemitsu	Kitimat or Prince Rupert (BC)	25 years	10/24/2014	0.36	GL-306
WCC LNG Ltd.	ExxonMobil, Imperial Oil	Kitimat or Prince Rupert (BC)	40 years	10/26/2016	4.60	GL-335
WesPac Midstream-Vancouver LLC	WesPac LLC (Highstar Capital LP, Primoris Services Corp.)	Delta (BC)	25 years	5/26/2016	0.46	GL-310
Woodfibre LNG Export Pte. Ltd.	Pacific Oil and Gas Ltd.	Squamish (BC)	40 years	6/9/2017	0.32	GL-340[9]
Woodside Energy Holdings Pty Ltd.	Woodside Energy Ltd.	Prince Rupert (BC)	25 years	5/12/2015	3.22	GL-309
Total Approved Bcf/d	**Total Approved Bcf/d**				**55.46**	

CANCELLED PROJECT(S):	CANCELLED PROJECT(S):					
BC LNG Export Co-operative LLC	LNG Partners LLC, Haisla Nation, Golar	Kitimat (BC)	20 years	4/12/2012	0.25	GL-299; revoked on 5 March 2015 (BC LNG dissolved)
Prince Rupert LNG Exports Limited (revocation in process)	BG Group	Ridley Island (BC)	25 years	3/31/2014	3.34	GL-301
Total Cancelled Bcf/d	**Total Cancelled Bcf/d**				**3.59**	

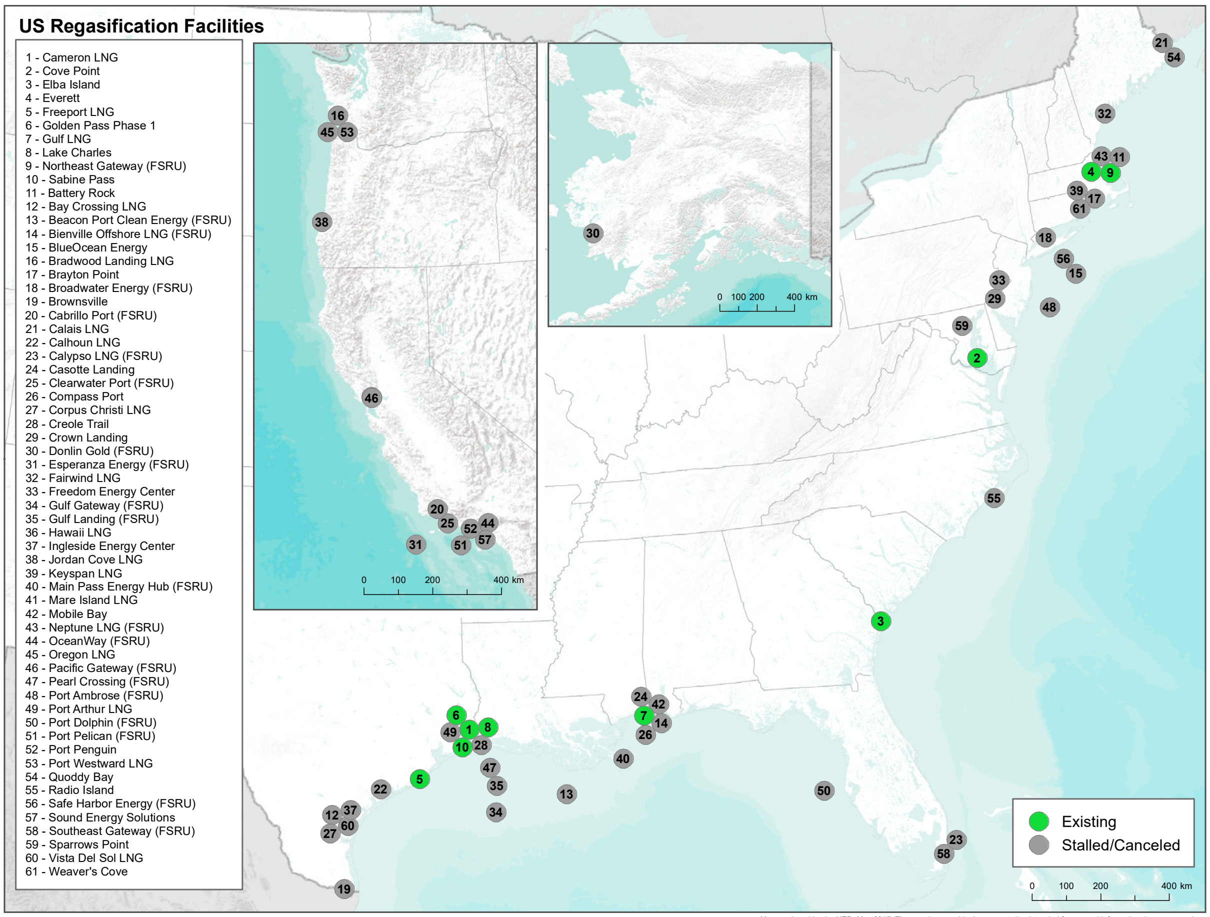
9 Revocation has not been issued.

Appendix 2: U.S. Regasification Projects

In the years prior to the large-scale accessibility of shale and tight gas resources, the U.S. invested in the construction of LNG import terminals, anticipating a need to import foreign natural gas to meet future demand. However, in the wake of this growth in shale development, the U.S. decommissioned, stalled, or canceled many import terminal projects.

FIGURE A2.1

U.S. Regasification Projects



Source:
NEB