LNG: Economic & Environmental Benefits for Vessels

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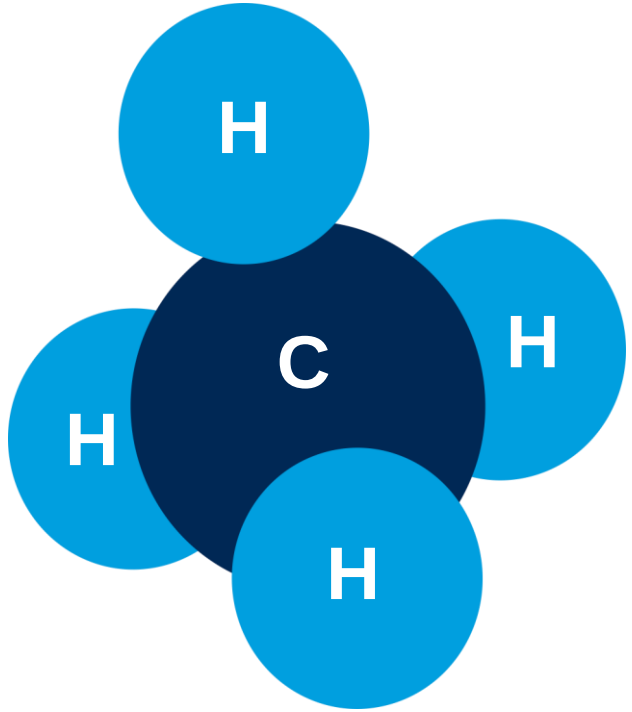
Our Energies in Many Territories

Liquefied Natural Gas (LNG)

- **Natural gas changes to a liquid state when chilled to - 162° C (- 260° F);**
- It takes up to 600 times less space in its liquid state;
- **Heavier** than air until -100° C (- 212 °C);
- About **half as dense as diesel** in its liquid state (430 kg/m^3);
- Colourless, odourless and **without odorant** (mercaptan would crystallize). Methane sensors must be used;
- Natural gas is **not toxic** and is **non-corrosive**

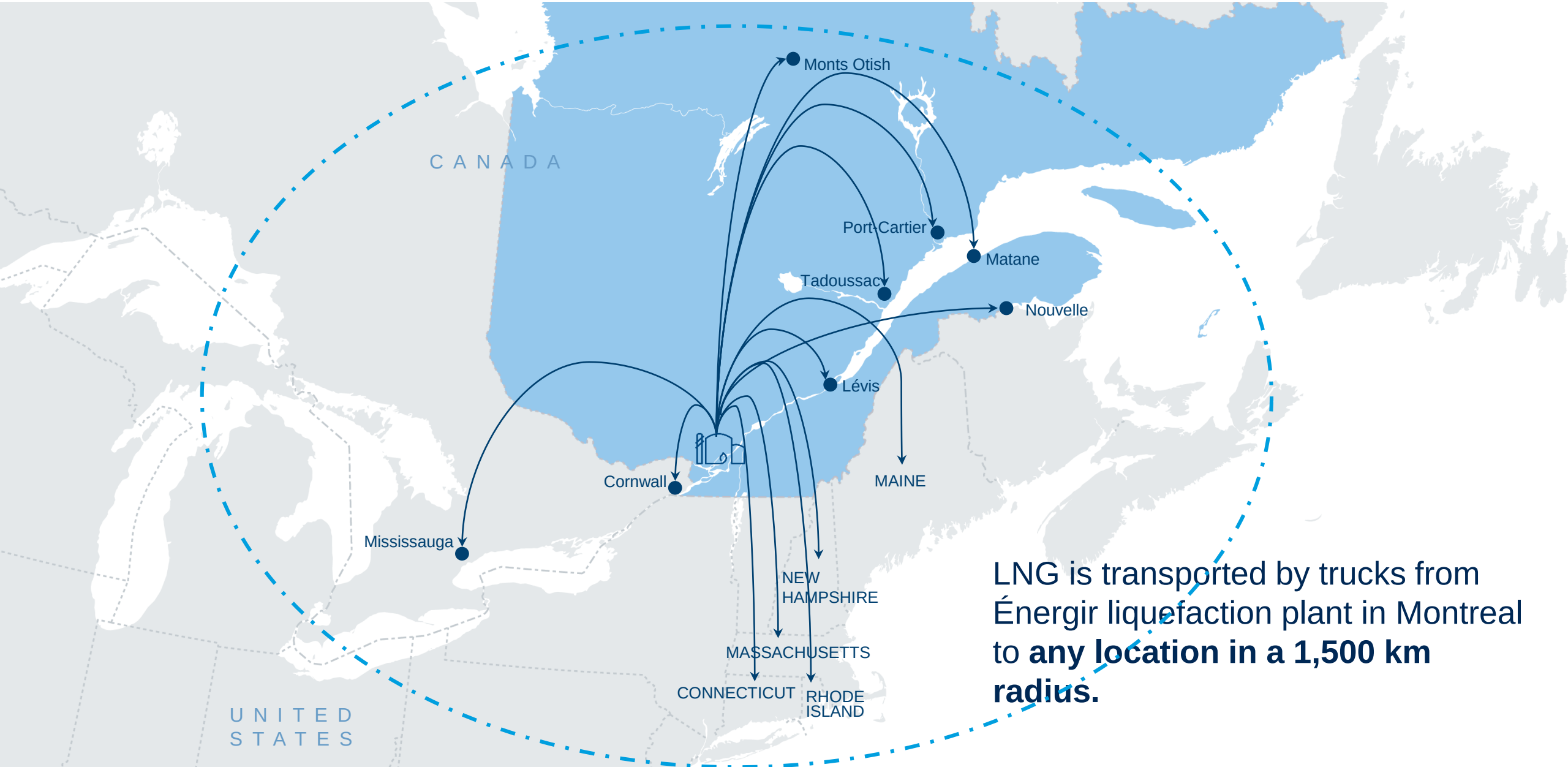


LNG Production in Montreal

Énergir has its own liquefaction, storage and regasification (LSR) plant based in Montréal

- **Volume:**
  The plant's liquefaction capacity is 10,5 Bcf per year ~ 270 000 tons of diesel equivalent
- **Production capacity:**
  2 liquefaction units
  (3,5 Bcf / 1969 and 7 Bcf / 2017)
- **Daily production capacity**:
  600 tons of LNG ~ 740 tons of diesel equivalent
- **Storage capacity:**
  2 storage tanks of 1 Bcf each ~ total of 50 000 tons of diesel equivalent

LNG Delivered by Energir



LNG is transported by trucks from Énergir liquefaction plant in Montreal to **any location in a 1,500 km radius.**

Two LNG-ready Harbours in Québec

LNG supply as a marine fuel is **available:**

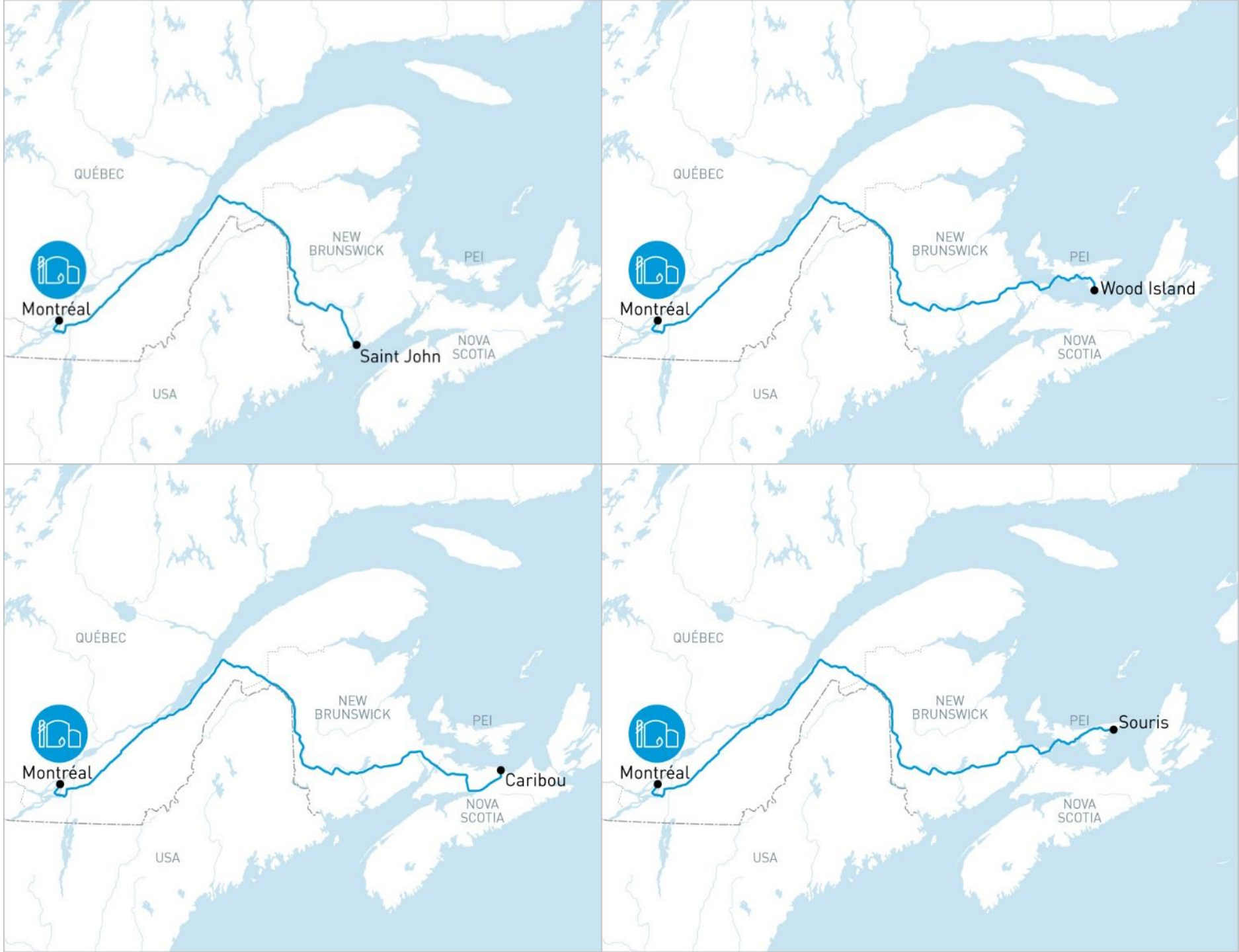
In the **Port of Montréal** since May 2017; and

In the **Port of Quebec** since July 2018.

Supply solution **available to all ship owners** whose fleets pass through these harbours.

more than 60 bunkering operations up to date

A robust LNG supply chain for all Eastern Canada



Two different types of operations

Case 1

Ferry

Example: STQ

Characteristics

- Stable energy needs
- Routes are established and arrivals at the bunkering dock are frequent
- Bunkering locations and available time at the dock are known in advance

Possibility of continuous delivery of LNG

Case 2

Bulk carrier

Example: Groupe Desgagnés

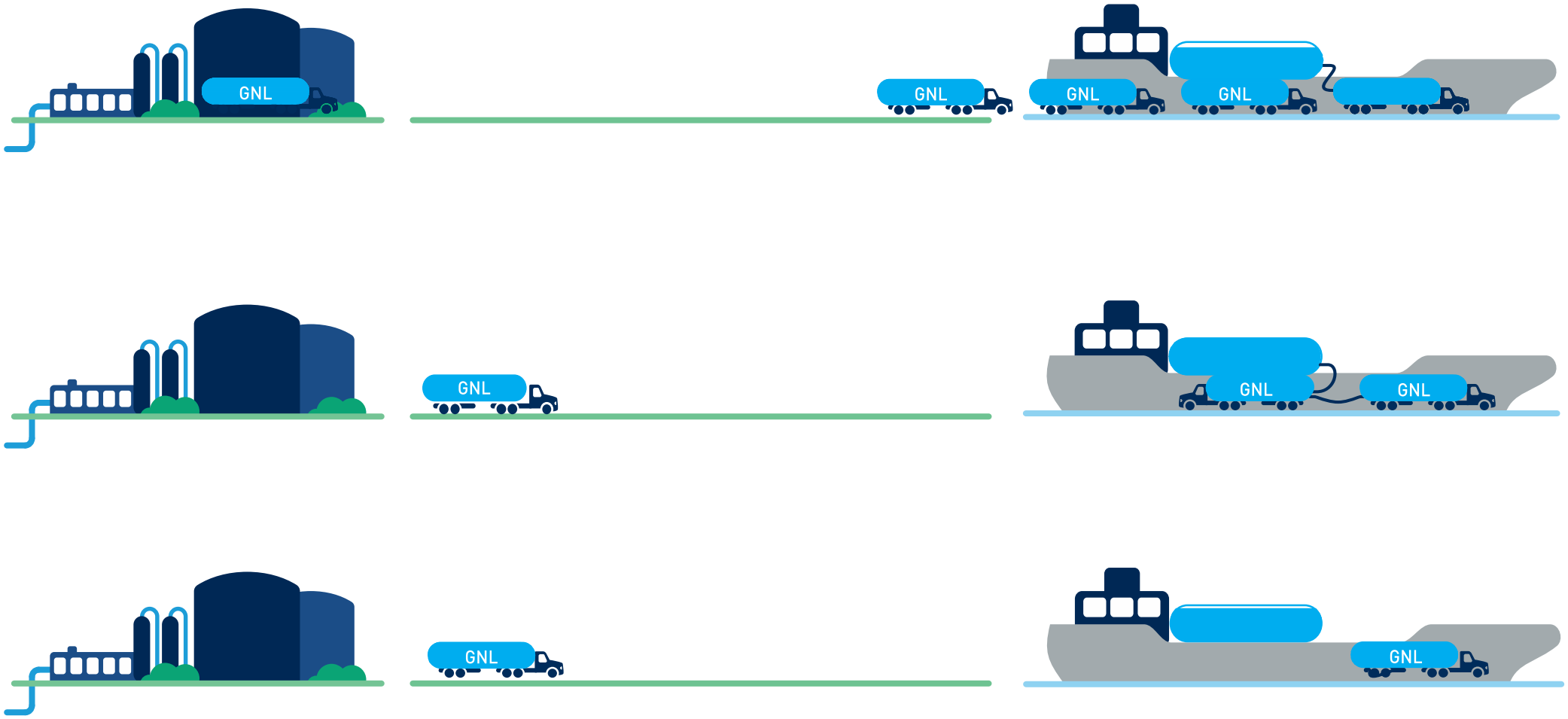
Characteristics

- Energy needs depend on the commercial activity
- Routes are variable and arrival dates at the bunkering dock fluctuate greatly
- Bunkering locations and available time at the dock are variable

Need for LNG is periodic and for large quantities

LNG Bunkering Solutions for all Ship-owners

Truck-to-ship (40m³/h)



LNG Bunkering Solutions for all Ship-owners

Truck-to-ship

Truck-to-truck-to-ship (80m³/h)

LNG Bunkering Solutions for all Ship-owners

Truck-to-ship

Truck-to-truck-to-ship

Truck-to-manifold-to-ship (300m³/h)

LNG – Environmental benefits

- **reductions of GHG by 10 – 20 %** with a potential for up to 25% compared with conventional oil-based fuels*
- **zero SOx** and virtually **zero particulate matter**
- **90% fewer NOx emissions**

* https://sea-lng.org/lng-as-a-marine-fuel/emissions/

LNG – Environmental benefits

LNG is an excellent solution to help the marine industry meet **current and future environmental regulations**

North American's natural gas industry delivers affordable and reliable natural gas

Abundant resource : natural gas resources of Canada is about 1,230 trillion cubic feet, a 300-year supply based on current technology and consumption levels.

Strong production: 10 years advances in horizontal drilling and multi-stage hydraulic fracturing = **continuing low prices** due to regional oversupply.

Natural gas prices - forecasts

(CAN$/GJ)

	Henry Hub	Dawn	Empress
2019 (Q4)	3,16	3,10	2,37
2020	3,11	3,05	2,22
2021	3,10	3,02	2,10
2022	3,15	3,06	2,06
2023	3,24	3,19	2,10

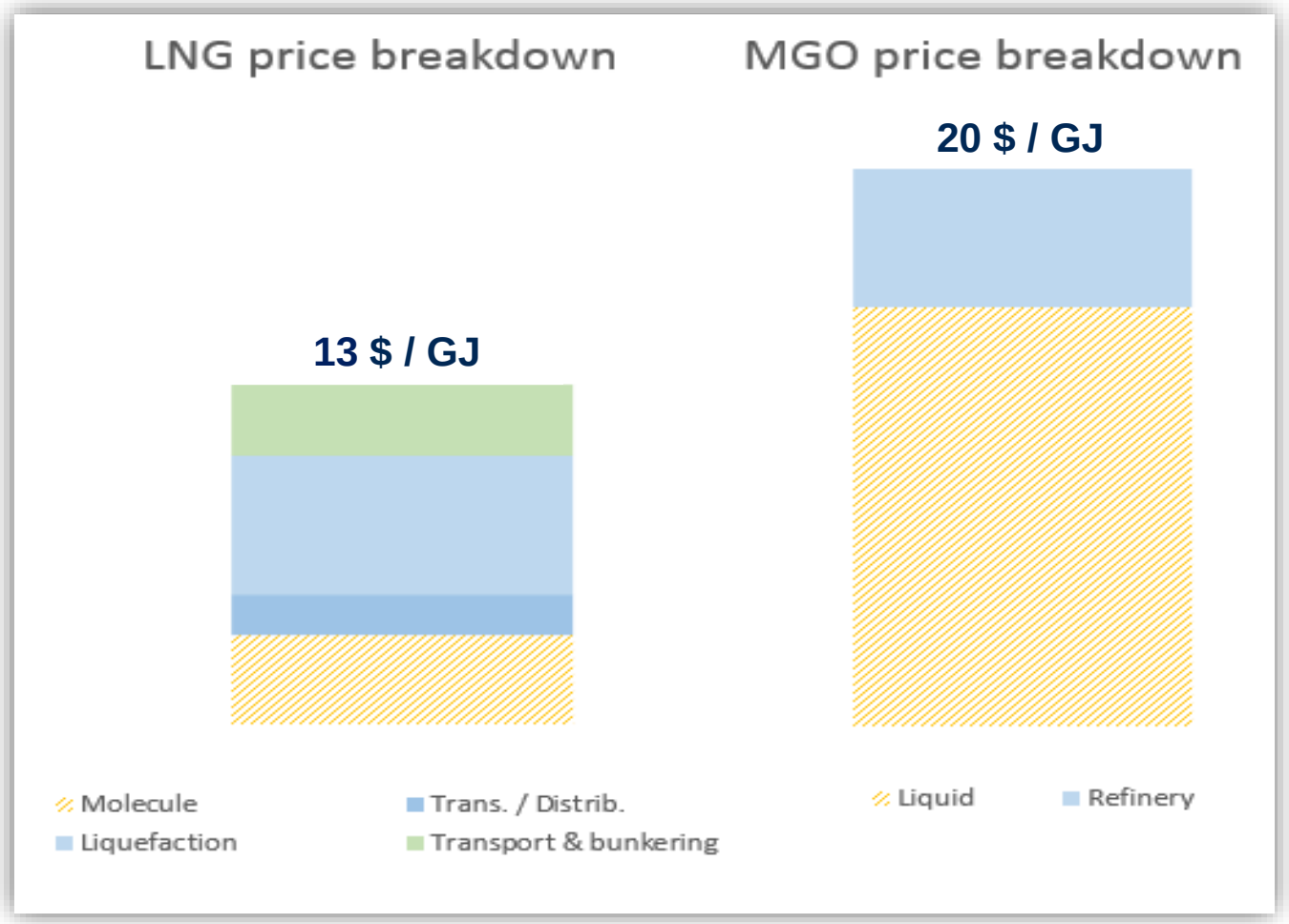
source : TD Securities, september 5th 2019

Markets trends at the main natural gas hubs in North America are all showing that **commodity prices will keep on being low** for the coming years.

LNG, the Most Predictable & Stable Marine Fuel

LNG is now a **more cost-effective** fuel than marine diesel or fuel oil for shipowners whose fleets operate on the St. Lawrence River, the Great Lakes or the East Coast of Canada.

Less than 30% of the LNG price is **subject to market variation** when 75% of diesel and heavy fuel prices depends on it



Available technology in Eastern Canada to comply with regulations

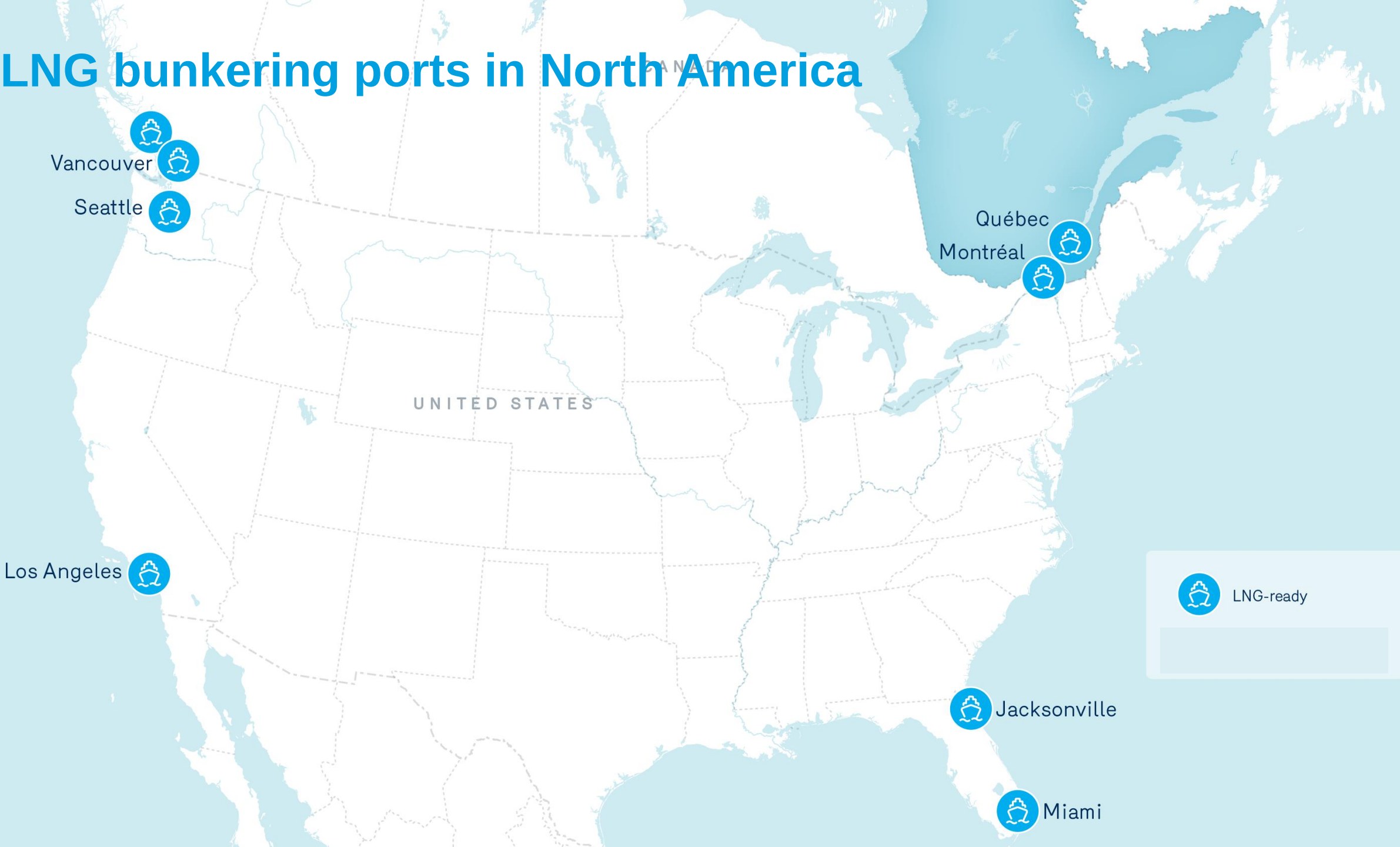
*	Low-sulfur marine diesel vessel with selective catalytic reduction (SCR) system	Fuel-oil vessel with scrubber and selective catalytic reduction (SCR) system	LNG-fuelled vessel	LPG-fuelled vessel	Methanol-fuelled vessel
	High price of fuel	Low price of fuel	Low price of fuel	Moderate price of fuel	High price of fuel
	Additional costs for operating the SCR system	Additional costs for operating the SCR system and scrubber	Additional costs for LNG equipment	Potential additional costs for SCR system	Additional costs for methanol equipment
	Availability of fuel and infrastructure ++	Availability of fuel and infrastructure ++	Availability of fuel and infrastructure +	Availability of fuel and infrastructure +	Availability of fuel and infrastructure --
	High CO2 emissions	High CO2 emissions	Lower CO2 emissions	Lower CO2 emissions	Lower CO2 emissions
	Available	**Available**	**Available**	**Not Available**	**Not Available**

LNG is one of the **best transitional energies** for achieving IMO objectives:

- Generates lower emissions than other fossil-based and alternative energies
- Is immediately accessible
- Is economical

* Summarized information is from the following report: DNV_GL_Complete-Alt-Fuels_guidance_paper_2018-05

LNG bunkering ports in North America

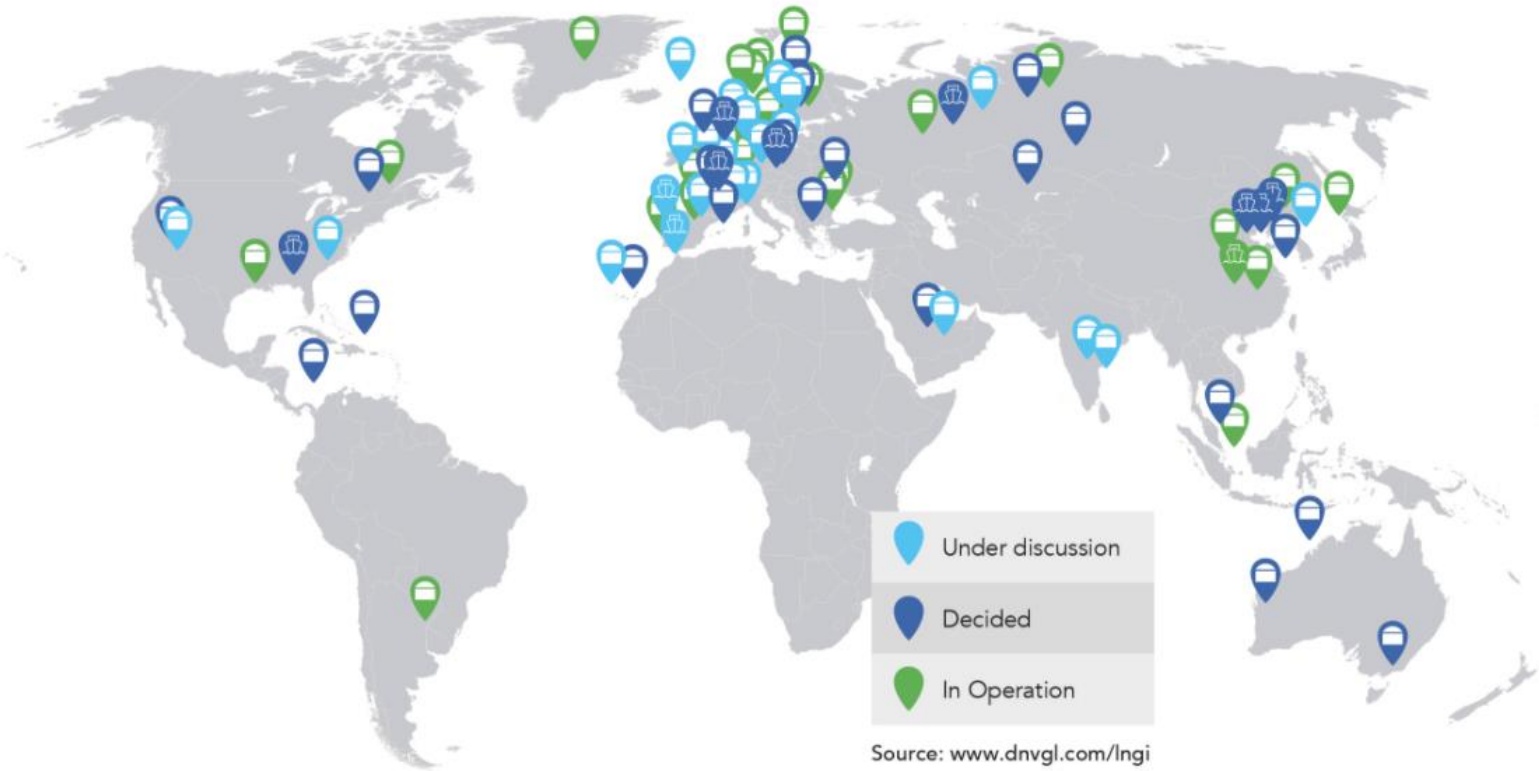


LNG bunkering options are expanding on a global scale

60 supply locations worldwide and as many facilities decided or under discussion

143 vessels burning LNG & a confirmed order book of **139 vessels***:

- 43 LNG ferries in operation (North America 8)
- 25 other on order (North America 2)



* Alternative Fuels Insight platform, DNV GL January 2019

Questions?

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