



IMO 2020 Global Fuel Standards Update

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IMO 2020 OPTIONS

The IMO 2020 requires ship owners to decide whether to:

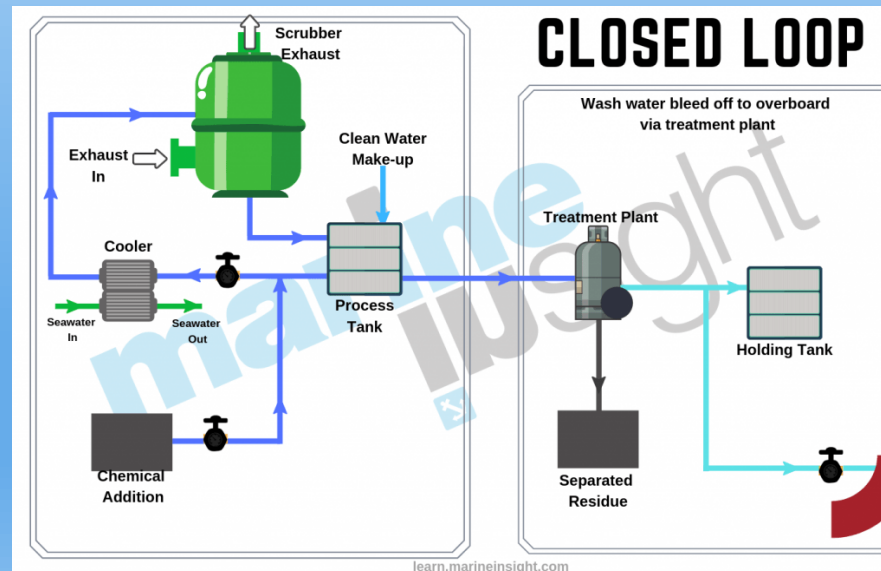
- Continue using high sulfur fuel oil and add scrubbers/exhaust gas cleaning systems
- Switch to low sulfur fuel options i.e. distillates or MGO
- Switch to LNG - Tighter emissions standards are acting as a tailwind for LNG-fueled vessels.

COMPLIANCE OPTIONS

LNG	SCRUBBERS + HFO	MGO
<ul style="list-style-type: none"> ❖ Low OPEX ❖ Meets NOX, Particulate and Tier III Engine Requirements 	<ul style="list-style-type: none"> ❖ Low CAPEX ❖ Easier Transition 	<ul style="list-style-type: none"> ❖ Zero CAPEX ❖ Easiest Transition
<ul style="list-style-type: none"> ❖ Infrastructure ❖ High CAPEX ❖ Increased Containment 	<ul style="list-style-type: none"> ❖ Technical Challenges ❖ HFO Scarcity ❖ Effluent for Closed Systems 	<ul style="list-style-type: none"> ❖ Tier II Compliance Issues ❖ Fuel Availability ❖ High OPEX (\$\$)

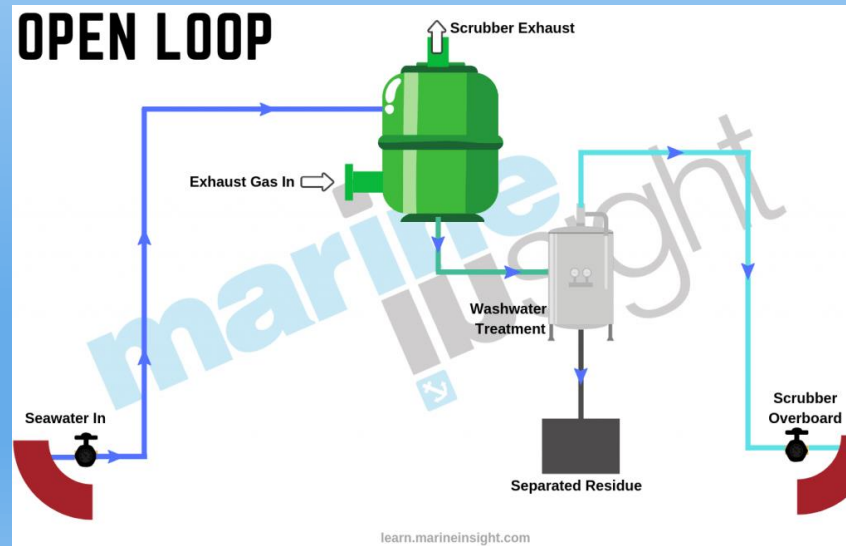
CLOSED LOOP SCRUBBER SYSTEM

Uses fresh water treated with a chemical (usually sodium hydroxide) instead of seawater as the scrubbing media. The SOX from the exhaust gas stream is converted into sodium sulphate. Before being re-circulated for use, the wash water from a closed loop scrubber system is passed through a process tank where it is cleaned.



OPEN LOOP SCRUBBER SYSTEM

This system uses seawater as the scrubbing and neutralizing medium, no other chemicals are required for desulfurization of gasses. The exhaust stream from the engine or boiler passes into the scrubber and is treated with only alkaline seawater only. The volume of this seawater depends upon the size of the engine and its power output.



IMPLEMENTATION ISSUES EARLY ON

'It's the Wild West': Greek shipping executives say IMO 2020 start is worse than it appears

Fuel switchover troubles are brewing just beneath the surface, industry bosses tell conference in Greece

27 January 2020 13:29 GMT *UPDATED 27 January 2020 13:29 GMT*
By [Herry Papachristou](#) in Athens

MANY
PORTS HAVE
BANNED
OPEN LOOP
SCRUBBER
EFFLUENT

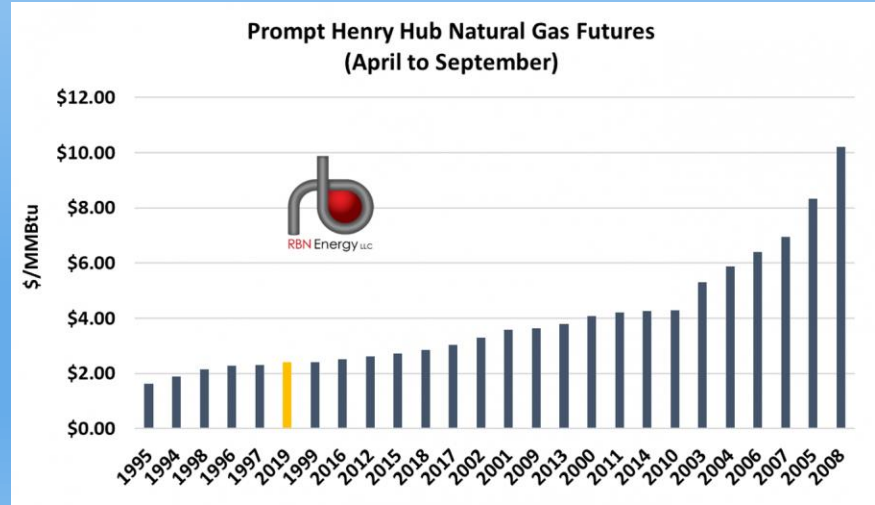
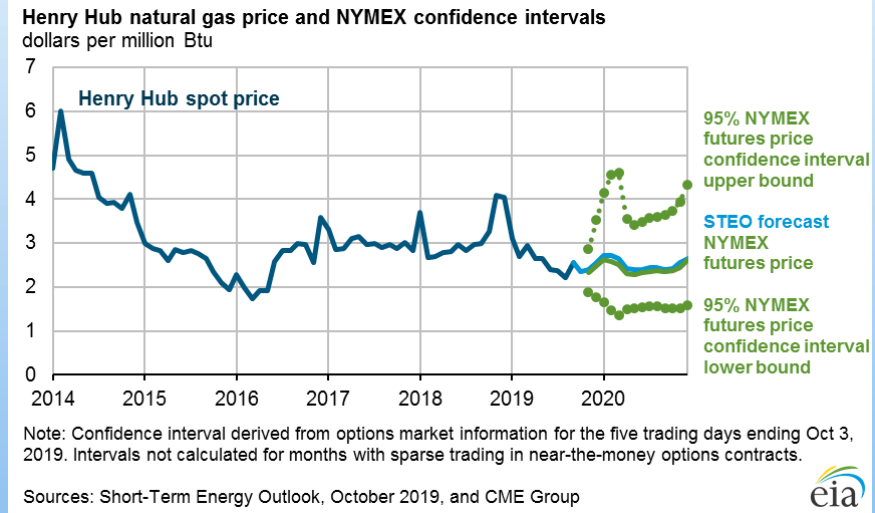


Existing and upcoming areas in which the discharge of wash water is banned

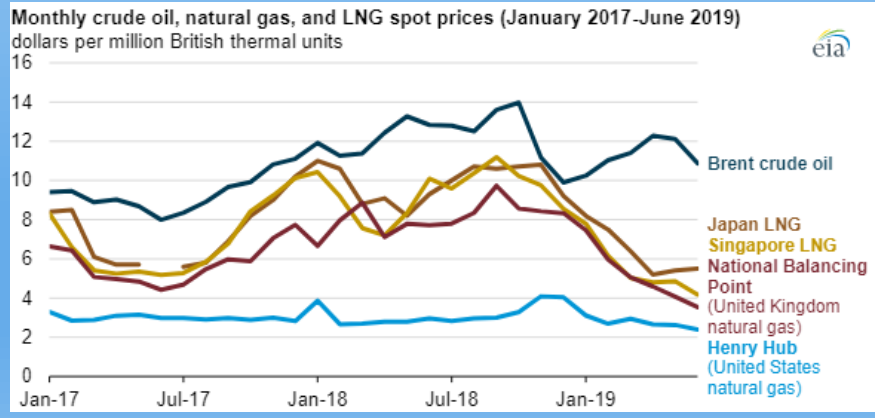
Source: International Chamber of Shipping

The Cost of LNG Supply in the US is Very Competitive...

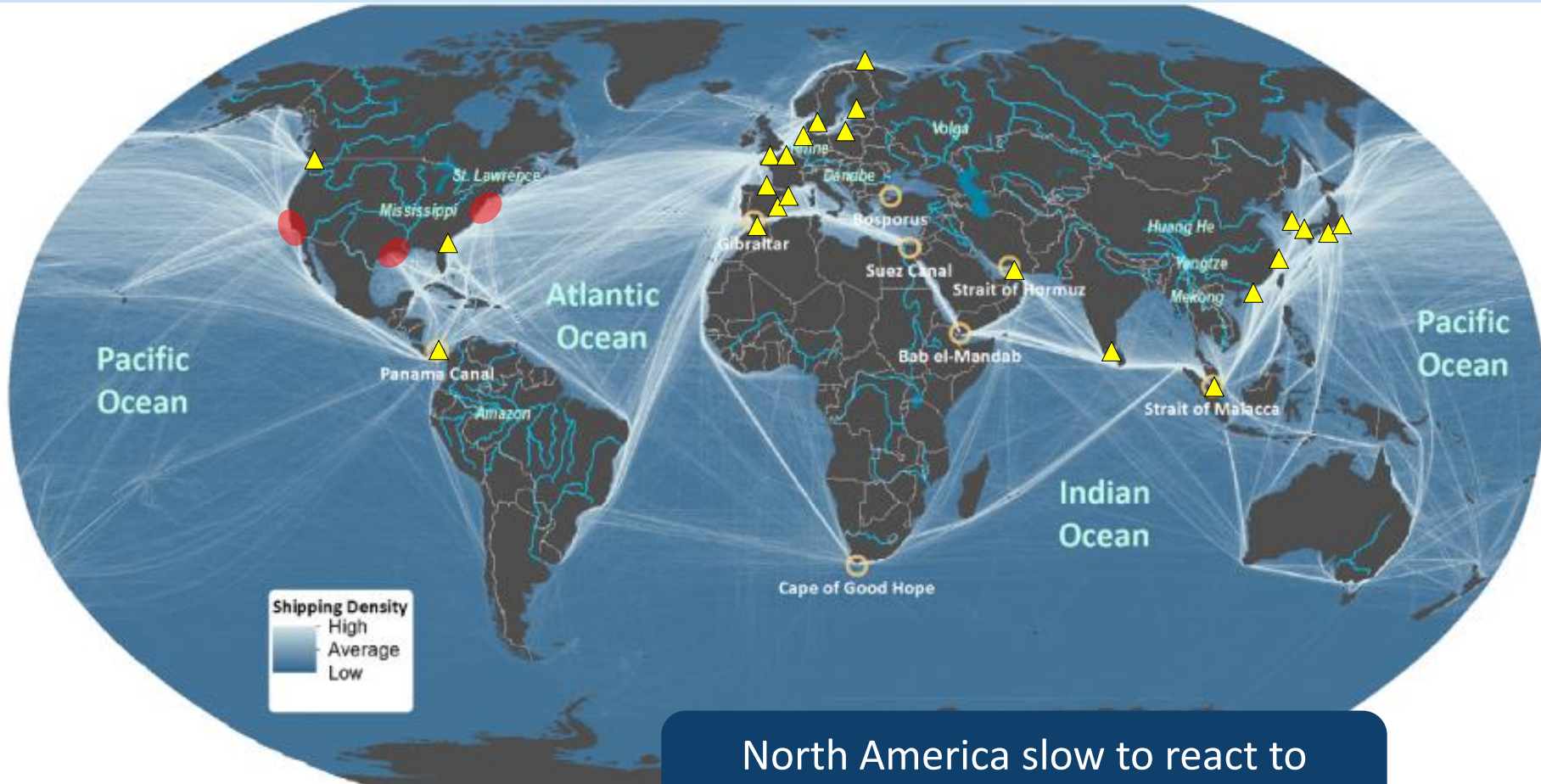
- Increased natural gas production in the U.S. has put significant downward pressure on natural gas pricing, pushing prices to the lowest levels in 20 years
- April to September Henry Hub natural gas futures averaged \$2.41/MMBtu
- U.S. LNG export market is also dependent on international LNG market pricing and crude oil pricing, which impacts mid- to small-scale LNG cost



Source: RBN Energy, October 2019



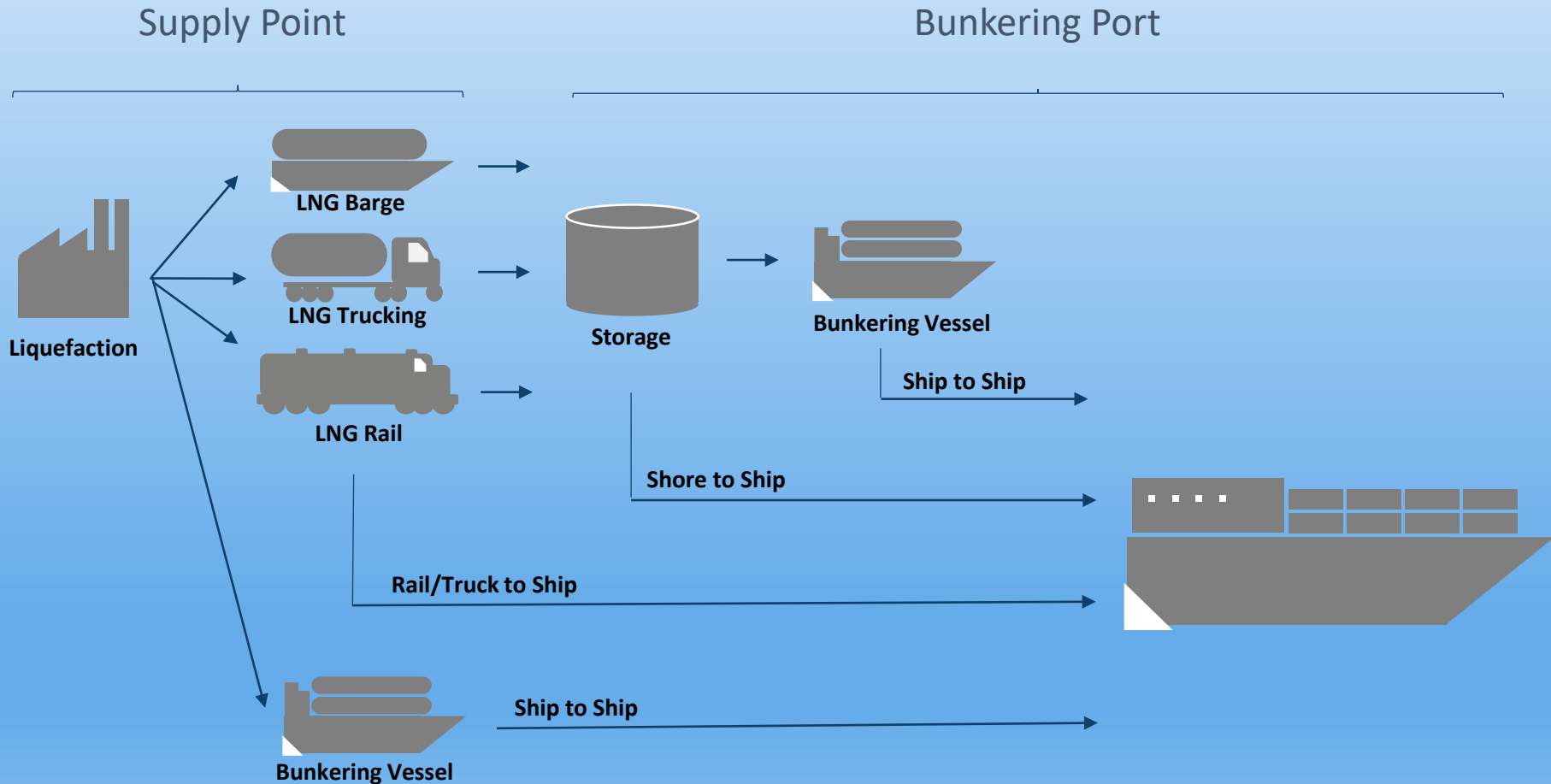
Marine Intensity vs LNG Supply



North America slow to react to changing global marine fuel market.

- ▲ LNG Bunkering Supply Point
- Open U.S. Markets

LNG BUNKERING - MULTIPLE SUPPLY PATHS AVAILABLE



STS is Primary Method of Fuel Supply in USEC



Current Methods of Supply

- Almost all bunkering on the USEC is done via ship-to-ship transfer (“STS”)
- Vane Brothers dominates the USEC bunker supply market, providing STS bunkering in 7 locations from New York to Jacksonville
- Global operates bunkering facilities in Portland, Boston, Providence, Philadelphia and Baltimore delivering by barge, tank truck or to a dockside facility
- Port Canaveral has land-based storage facilities with bunkering services via pipeline, truck delivery and barge to the cruise terminal, tanker berth and cargo piers
- One of the project deliverables was to evaluate LNG barge navigation constraints. In discussion with harbor pilots in the targeted ports the feedback we received was that it is too soon to assess constraints until the fleet expands and there is more experience with these types of movements

Snapshot of Current / On Order LNG-Fueled Fleet in the USEC through 2023



Vessel Type	Operator	Vessel Size	# LNG Tanks	Tank Capacity	Total LNG Capacity
Cruise Ship	Royal Caribbean	200,000 GT	Two	2200 CBM	4400 CBM
Cruise Ship	Carnival	180,000 GT	Three	1100 CBM	3600 CBM
Cruise Ship	Disney Cruise Lines	144,000 GT	Two	1050 CBM	2100 CBM
Containership	TOTE Maritime	36,750 GT	Two	902 CBM	1804 CBM
Container/RoRo	Crowley Maritime	26,410 DWT	Three	600-720 CBM	2100 CBM
Asphalt Tanker	Desgagnes Group	15,000 DWT	Two	300 CBM	600 CBM

Accommodating these volumes will require an LNG barge or LNG supply on the waterfront, as truck fueling would be time and cost-prohibitive

Complicated Logistics to Deliver LNG to a Vessel



Clean Jacksonville 1st US Flag LNG bunker barge launched August 2018



Q-LNG 4000 LNG barge launched Oct 2019

- **By Barge:** Almost all bunkering on the USEC is done via ship-to-ship transfer (“STS”), requiring the use of barges. Recently built US-Flag LNG bunkering barges include the *Clean Jacksonville* and *Q-LNG 4000*
- **By Rail:** Restricted to ISO-containers, currently in limited volumes & restricted to special approvals (Florida, Alaska).
Trump Administration seeking to move LNG by rail in approved (DOT 113) tank cars by mid-2020, which would still require the construction of a fleet of LNG tank cars
- **By Truck:** MC338 Tank Trailer or ISO-Containers
- **By Pipeline:** Most economical mode of transport if pipeline capacity is available, and infrastructure needs to be developed for “last-mile” delivery.



ISO Container: ~5k-11k gallons (20' vs. 40')



MC-338 Truck Cargo Tank Capacity: ~11k gallons



DOT 113 Rail Tank Car Capacity: 15k-30k gallons

IMO GHG REDUCTION TARGETS

- 2030 - At least a 40% reduction in carbon intensity by 2030 and pursuing efforts towards a 70% reduction by 2050, both compared to 2008 levels.
- 2050 - Reduce them by at least 50% by 2050 compared to 2008 levels while pursuing efforts towards phasing them out consistent with the Paris Agreement temperature goals.



SEA\LNG AND SGMF (GHG) EMISSIONS LIFECYCLE RESEARCH STUDY

- SEA\LNG and SGMF commissioned a Well-to-Wake (WtW) Greenhouse Gas (GHG) Emissions Lifecycle Research Study on the use of LNG as a marine fuel.
- This study was conducted by independent consultants and reviewed by a panel of academic experts.
- It is considered the most accurate study of the life cycle GHG emissions and local pollutants from LNG as a marine fuel compared with current and post-2020 conventional marine fuels because of its WtW parameters



IMO 2030 AND 2050 STRATEGY

- Supporting the development and update of national action plans;
- Encouraging ports to facilitate GHG reductions from shipping;
- Initiating and coordinating R&D activities by establishing an International Maritime Research Board (IMRB);
- Pursuing zero-carbon or fossil-free fuels for the shipping sector and developing robust lifecycle GHG/carbon intensity guidelines for alternative fuels;
- Undertaking additional GHG emission studies to inform policy decisions and to estimate Marginal Abatement Cost Curves for each measure (if appropriate)
- Encouraging technical cooperation and capacity-building activities, as appropriate.



About Eagle LNG

Our vision is to create a safe, economic and cleaner energy future through leadership and key partnerships in clean fueling solutions.

 POWER 	 MARINE 	 RAIL 
<p>Supplying fuel in ISOs for off-grid power generation in Puerto Rico/Alaska/Yukon.</p> <p>FERC-regulated LNG export facility in Jacksonville to supply fuel for Caribbean island gas-fired generation</p>	<p>Fuel two LNG powered Jones Act ConRo ships in Jacksonville-Puerto Rico service</p> <p>Maxville LNG Facility and Talleyrand Fuel Station in service Q1 2018</p>	<p>Key vendor and technical advisor on LNG locomotive engine pilot programs for CN Railway in Western Canada and BNSF on Chicago-Barstow mainline service</p>



The Energy & Minerals Group (EMG) is a private investment firm with over \$15 billion under management

Eagle LNG's Florida Projects



Eagle's facilities in Florida are strategically located near abundant gas supply, interstate pipelines, transportation hubs and a community wanting to use LNG to improve air quality.



MAXVILLE LNG FACILITY

In-Service Q1 2018

TALLEYRAND STATION

In-Service Q2 2018

JACKSONVILLE LNG FACILITY

FERC-approved; EPC awarded

Maxville LNG – LNG for Bunkering



MAXVILLE LIQUEFACTION FACILITY

In service: Q1 2018

Initial Liquefaction: 87,000 GPD (330 m³/d)

Max Liquefaction: 200,000 GPD (760 m³/d)

Storage Size: 1,000,000 Gallons (3,800 m³)

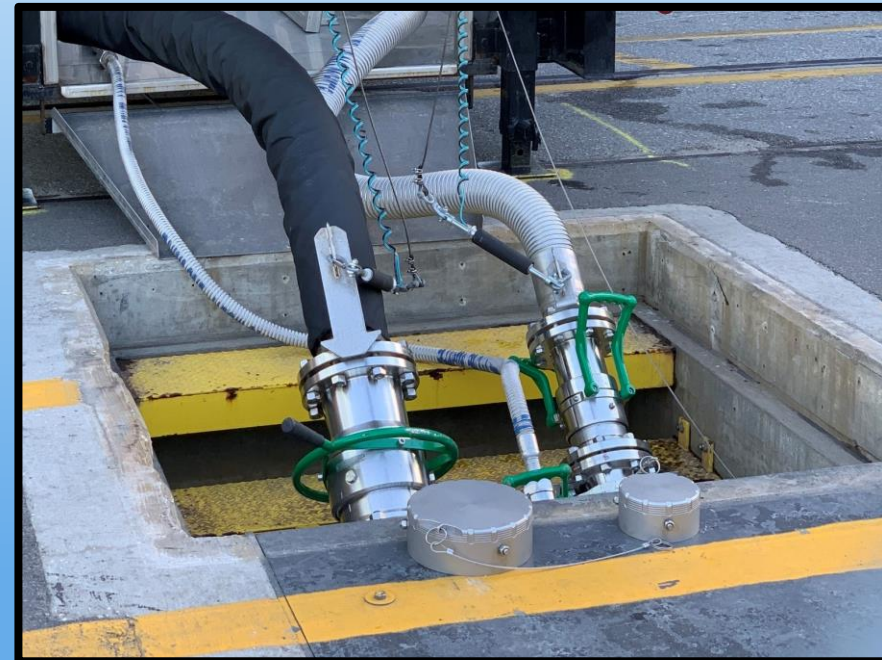
100 construction jobs and 8 full-time positions (plant and depot)

Talleyrand LNG Bunker Station



- In service: Q2-2018
- Innovative design for small 2-acre footprint
- 24-months from kick-off to first bunkering
- Storage: 528,000 LNG gallons (2 x 1,000m³ tanks)
- Load Out Rate: 2,400 gpm (540m³/hr)
- Below-grade bunkering lines
- Refill by trailer delivery (56 loads)

Talleyrand – Shore-to-Ship Bunkering



Jacksonville LNG – Island Power Generation



JACKSONVILLE LNG FACILITY – FERC-Approved; Matrix/Chart selected

Liquefaction: 550,000 GPD/train, 1,650,000 GPD (6,245 m³/d) at full production

Storage Size: 12,000,000 Gallons (45,420 m³)

Thank you for having me AAPA!

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