



AAPA 2019

VIRGINIA

REVOLUTIONIZING AMERICA'S FIRST PORT



LNG in the Maritime Industry

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Chief Operating Officer, SEA\LNG



THE INDUSTRY ADVOCATE

Working across the value chain



ENVIRONMENT

LNG is the most environmentally-friendly, readily available, fuel for shipping today

- thinkstep study on the use of **LNG** as marine fuel shows **GHG benefits of up to 21% compared with current oil-based** marine fuels over the entire life cycle from Well-to-Wake
- On a **Tank-to-Wake basis**, the combustion process for **LNG** as a marine fuel shows **GHG benefits of up to 28%** compared with current oil-based marine fuels.
- **LNG** provides a **significant advantage in terms of improving air quality** when compared to other conventional fuels which is **particularly important in ports and coastal areas**

INFRASTRUCTURE

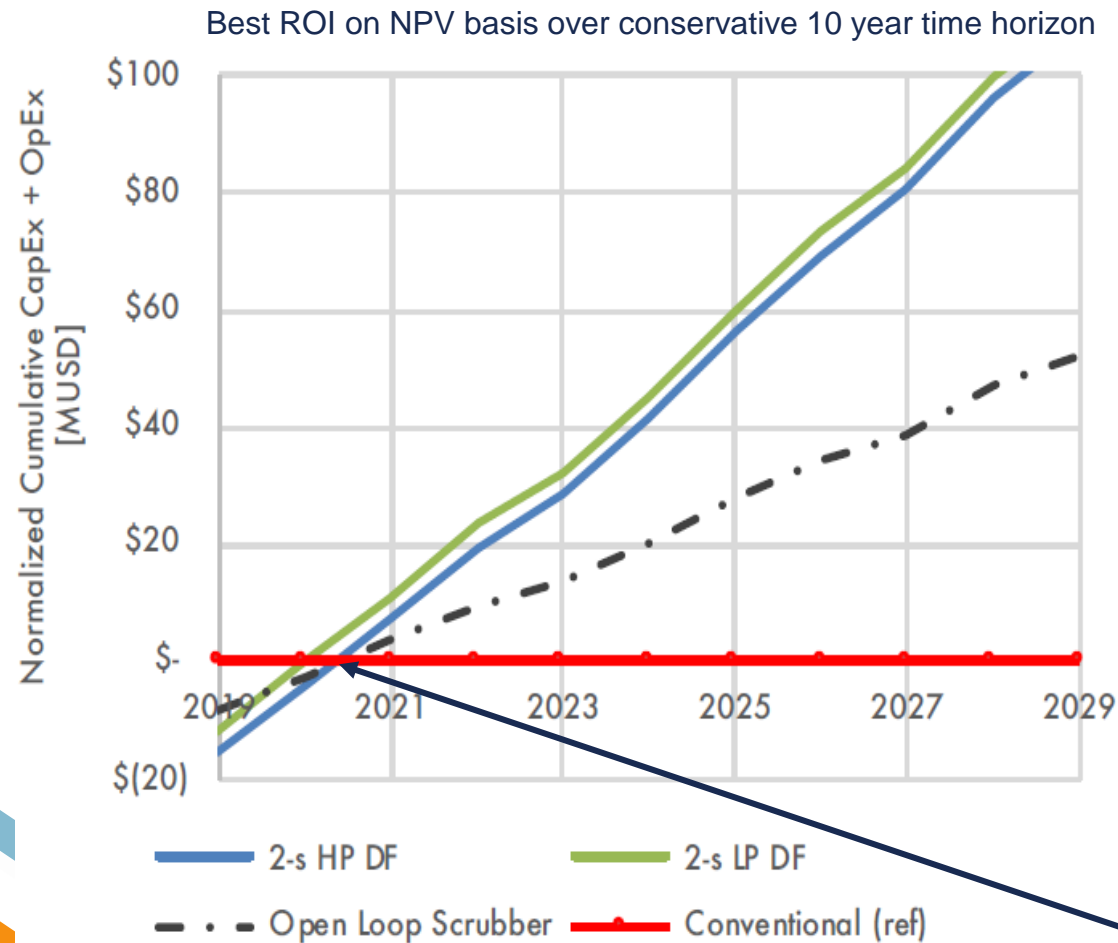
Bulk infrastructure already exists – “Last Mile” investments happening



- Plentiful and growing LNG supply
- Bulk LNG infrastructure exists and is in the right places
- ‘Last mile’ investments are happening (globally)
- LNG bunkering available or planned top 10 bunkering locations
- Bunker vessels – 9 in operation and many more on order

ECONOMICS

Compelling investment case as most financially effective long-term compliance with IMO 2020



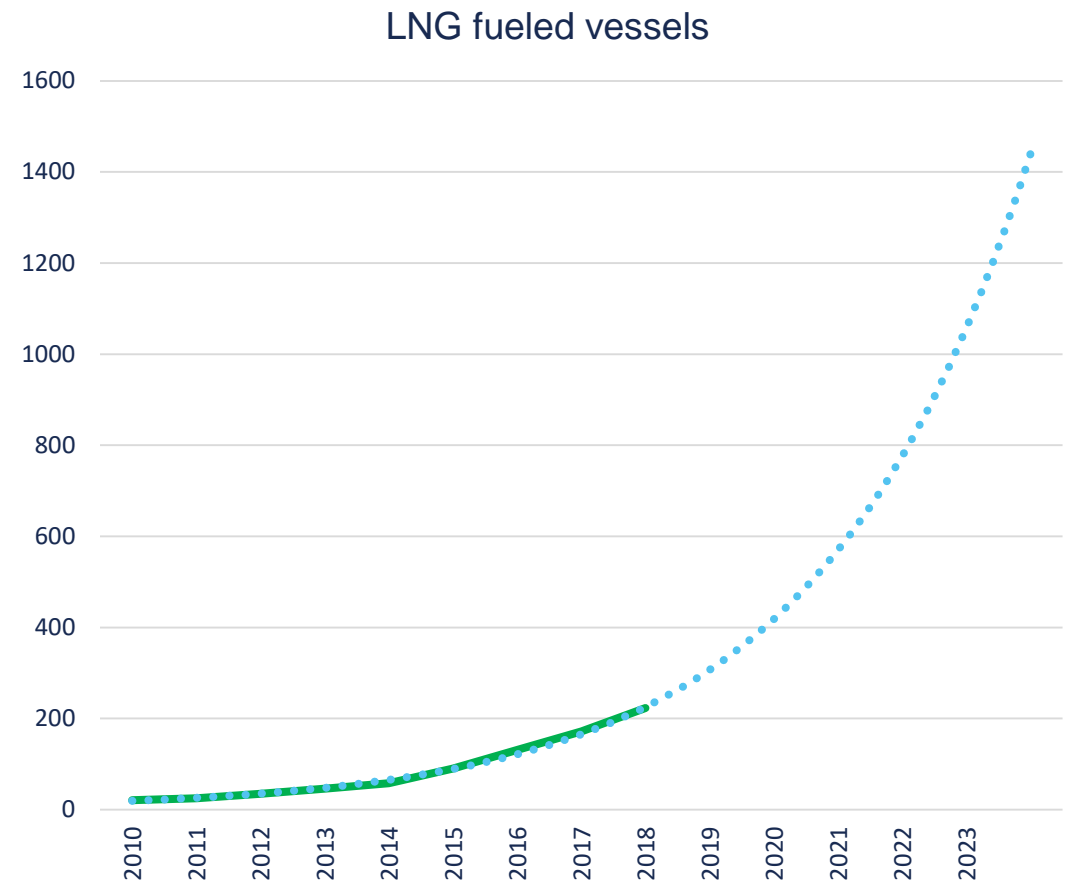
- Diminishing CAPEX hurdle
- Competitive energy costs
- Cost of LNG is stable
- Modelled investment case for 14K TEU newbuild container vessel
- Asia - US West Coast trade route
- Compared LNG DF with HFO + scrubber and LSFO engine options (CAPEX & OPEX costs modelled)
- Variety of fuel price and operating scenarios
- Weighted Average Cost of Capital of 8% over 10 year investment horizon period

Fast pay-back period – under 2 years

USE OF LNG AS A MARINE FUEL IS ACCELERATING

Investment case is increasingly recognized

- Number of LNG fueled ships growing strongly:
 - 170 in operation
 - 184 on order
 - 20% - 40% annual growth since 2010
- Advancing across a range of vessel types
- Move from short-sea to deep-sea shipping space

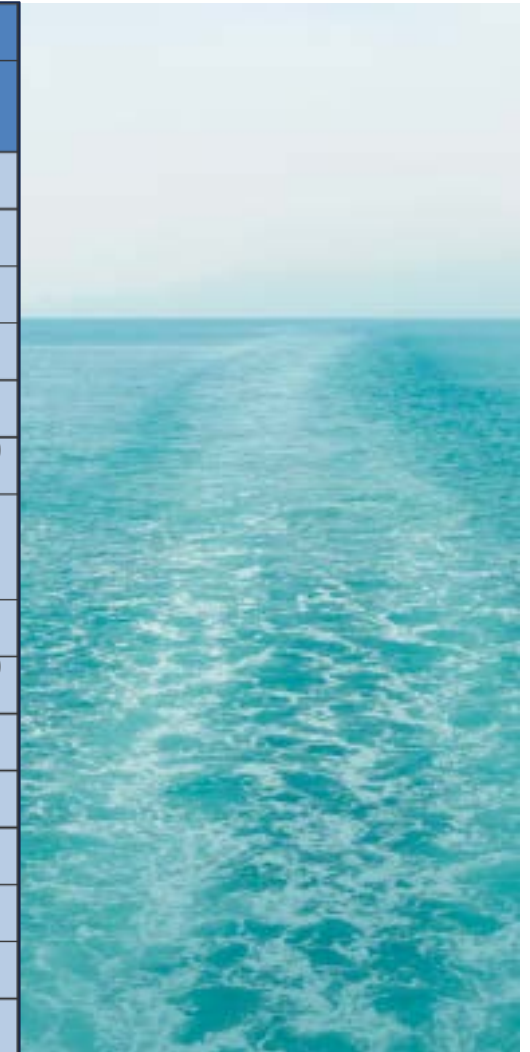


Source: DNV GL LNGi, January 2019

LNG is the ONLY viable Alternative Fuel today

Results of the Sep 19 study by DNV GL into Alternative Marine Fuels

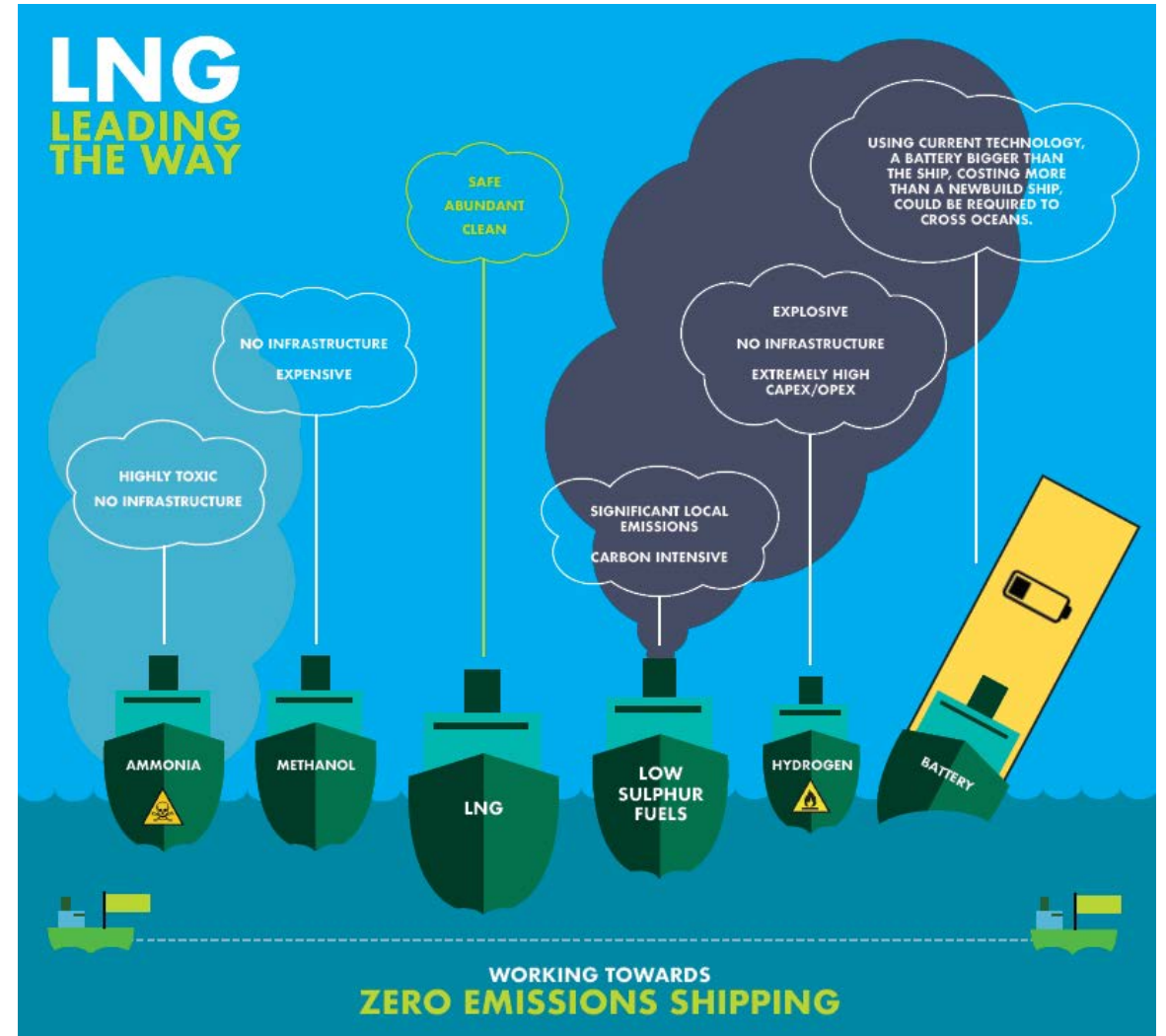
Energy source	Fossil (without CCS)					Bio	Renewable ⁽³⁾			
	Fuel	HFO + scrubber	Low sulphur fuels	LNG	Methanol	LPG	HVO [Advanced biodiesel]	Ammonia	Hydrogen	Fully-electric
High priority parameters										
• Energy density		●	●	●	●	●	●	●	●	●
• Technological maturity		●	●	●	●	●	●	●	●	●
• Local emissions		●	●	●	●	●	●	●	●	●
• GHG emissions		●	●	● ⁽²⁾	●	●	●	●	●	●
• Energy cost		●	●	●	●	●	●	●	●	● ⁽⁴⁾
• Capital cost	Converter	●	●	●	●	●	●	●	●	●
	Storage	●	●	●	●	●	●	●	●	●
• Bunkering availability		●	●	●	●	●	●	●	●	●
<i>Commercial readiness⁽¹⁾</i>		●	●	●	●	●	●	●	●	● ⁽⁵⁾
Other key parameters										
• Flammability		●	●	●	●	●	●	●	●	●
• Toxicity		●	●	●	●	●	●	●	●	●
• Regulations and guidelines		●	●	●	●	●	●	●	●	●
• Global production capacity and locations		●	●	●	●	●	●	●	●	●



WAITING IS NOT AN OPTION

LNG engine technology is:

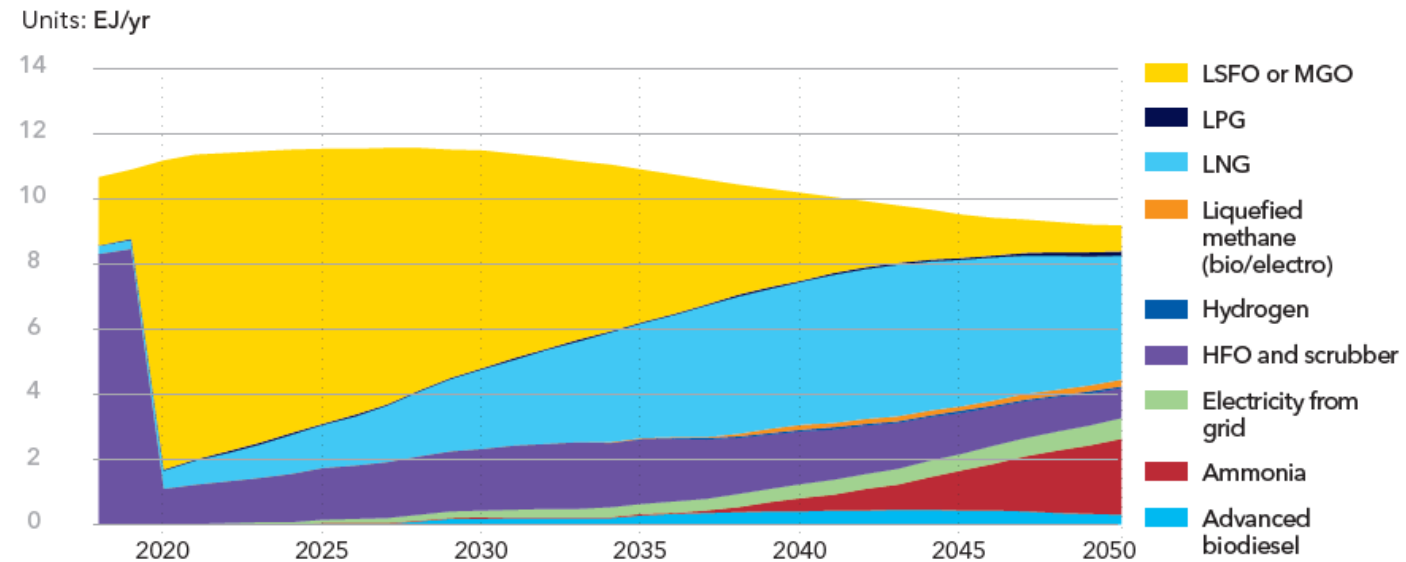
- safe, with millions operating hours experience
- mature, used as a marine fuel for over 50 years
- commercially viable, readily available
- scalable, bunkering available at major ports
- fully compliant with ECAs around the world
- no ocean contamination from marine fuel spill accident
- eliminates SOx pollution preserving human health
- reduces NOx emissions by 95%, Particulate Matter emissions by nearly 99%
- cuts GHG emissions by up to 21% on well-to-wake basis, 28% on a tank-to-wake basis
- zero-emissions potential through bio and synthetic sources of LNG



ENERGY USE AND PROJECTED FUEL MIX 2018-2050

For the simulated IMO ambitions pathway with main focus on design requirements

- DNV GL forecast, Sep 19
- Recognition of LNG as main marine fuel
- Fuel oil usage peaking shortly
- 20 years before first zero-carbon fuel (Ammonia) becomes widespread
- Little use of hydrogen forecast



LSFO, low-sulphur fuel oil; MGO, marine gas oil; LPG, liquefied petroleum gas;
LNG, liquefied natural gas; HFO, heavy fuel oil;
Advanced biodiesel, produced by advanced processes from non-food feedstocks

©DNV GL 2019





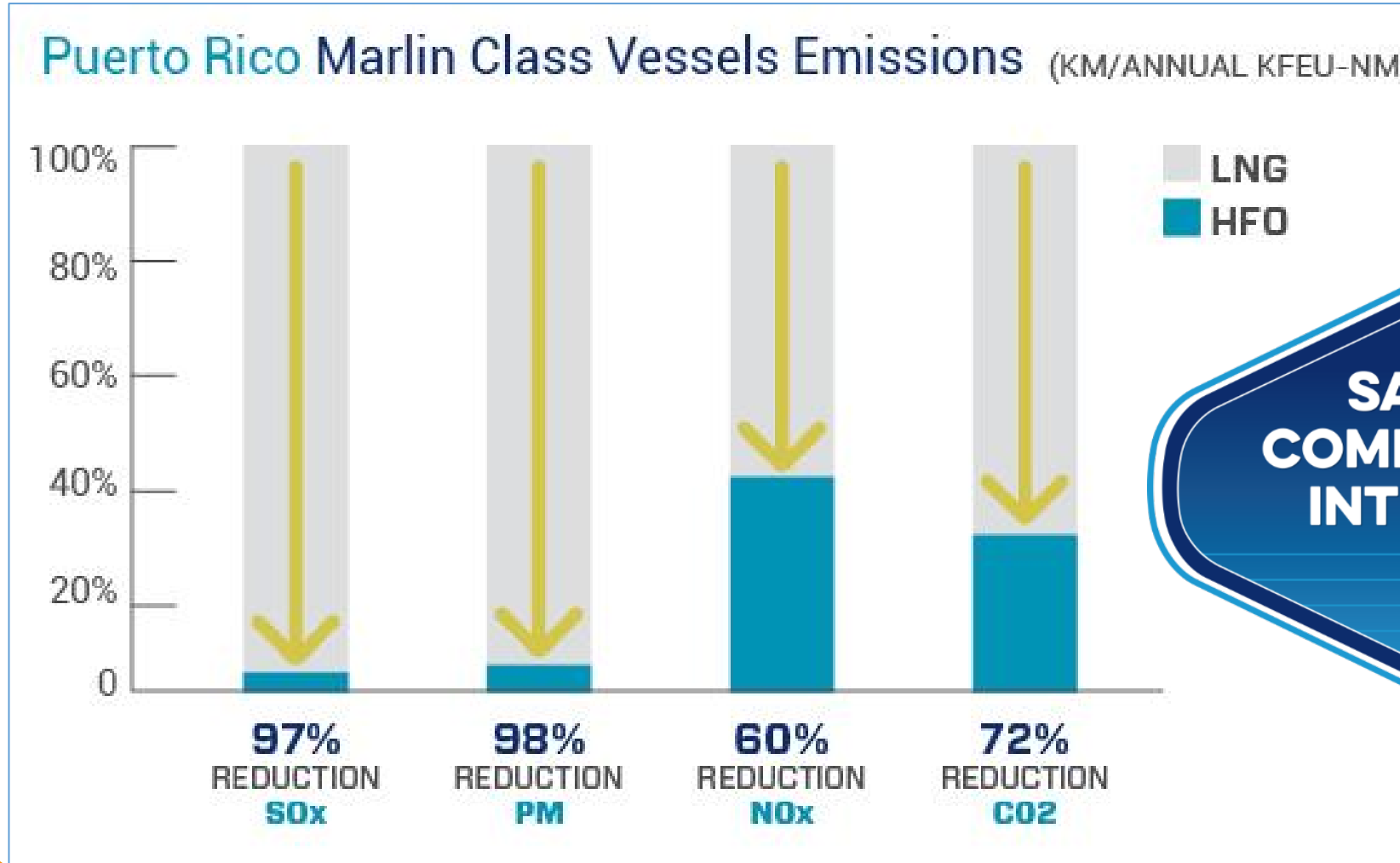
TOTE: Achieving our Vision – LNG as Marine Fuel

Tim Nolan, President and CEO, TOTE Inc.



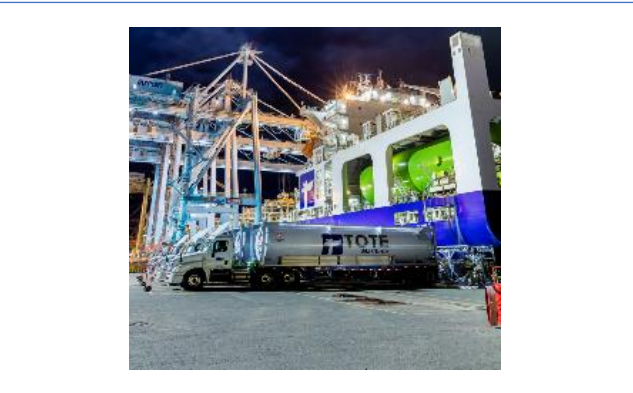


Driving Advancement in the Use of Alternative Fuels



TOTE'S LNG Projects

**Marlin Class Ships:
Jacksonville** **LNG Bunker Barge:
Jacksonville** **Orca Class Ships:
Tacoma**



How we started: Operations in JAX

- 250,000 LNG gallons from trucks in 10 hours while simultaneously discharging and loading container cargo
- Since February 2016, over 44.3MM gallons (168,000 m³) safely transferred using skid.
- Applied Cryogenic Technologies (ACT) developed skid
- Pivotal LNG supplies LNG from Macon, Georgia



Clean Jax TOTAL Fuel Bunkered Service = 43,000 m³ (11.3MM US GAL)

- Connections made in under 25 minutes
- 1,000 m³ LNG transferred in under 4 hours



JAX LNG Terminal

- LNG liquefaction plant and marine berth situated on 37 acre industrial water front property on the St. Johns River
- Serve TOTE Maritime Puerto Rico and other marine customers situated in the Jacksonville area
- Initial tankage of 2,000,000 gallons (7,570m³) with plans for expansion
- Actively targeting other markets including power, trucking and rail

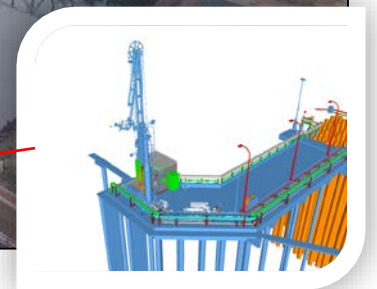




Q1-2021 – Conversion complete and operating on LNG



Tacoma Onsite Liquefaction Capability - Direct Delivery



Location of on dock marine loading arm.



LNG Supply Infrastructure Development

Jacksonville Case Study – JAX LNG

Tim Hermann

President, Pivotal LNG



Southern Company

We provide clean, safe, reliable and affordable energy



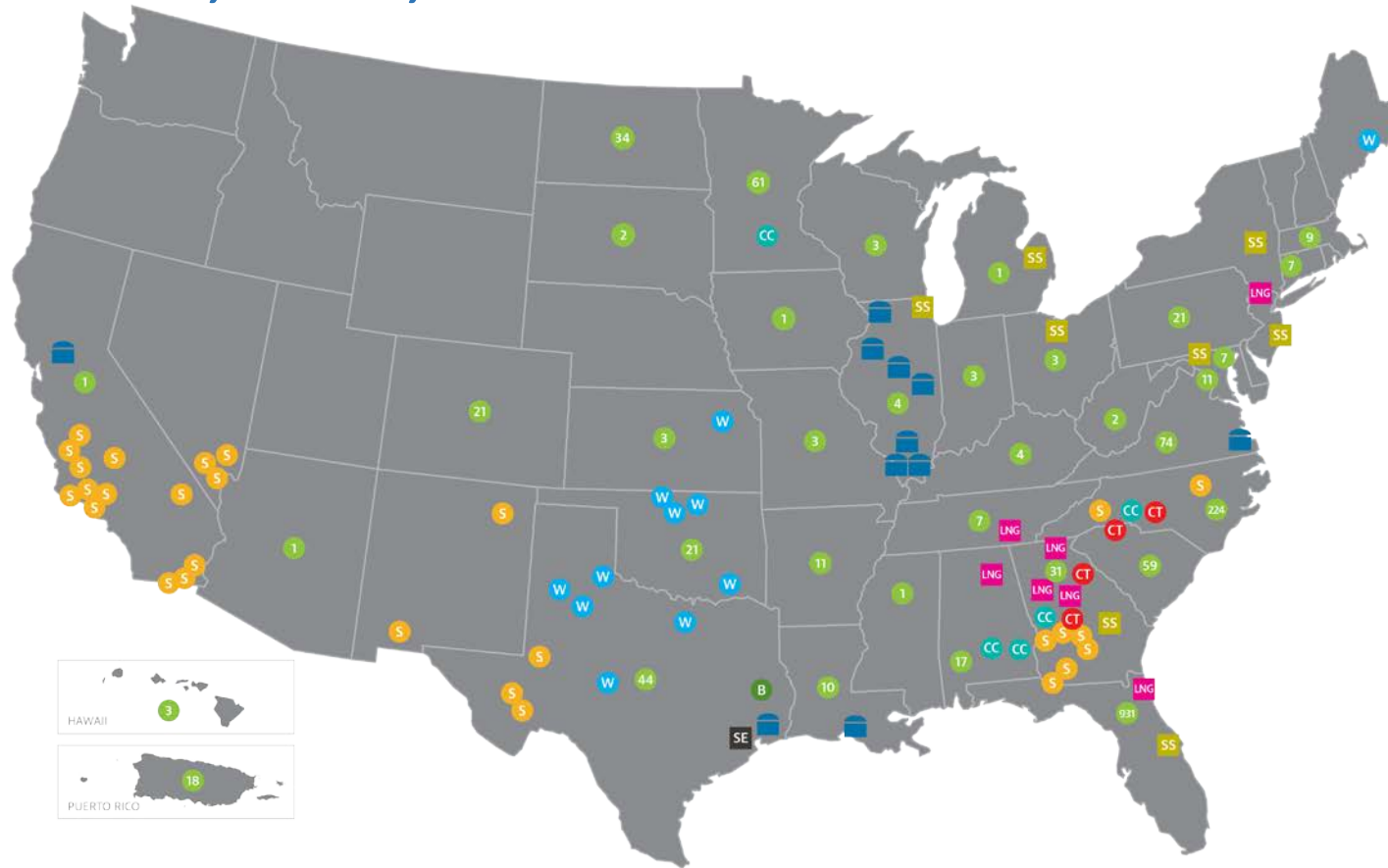
Service territories

- Electric
- Gas



Gas pipelines

- Southern Natural Gas
- Southern Company Gas
- Pipeline projects



Southern Power

- CC Combined-cycle facility¹
- CT Peaking facility
- B Biomass facility
- S Solar facility
- W Wind facility

Southern Company Gas

- LNG LNG facilities
- SE Sequent Energy Management
- SS SouthStar
- Natural gas storage

PowerSecure

- # Owned and managed sites per state

Capabilities in
50 States

7
Electric & Natural
Gas Utilities

9 Million
Customers

Approximately
29,000
Employees

Approximately
44,000 MW
of Generating Capacity

¹In November 2018, Southern Power agreed to sell its combined-cycle facility in Mankato, Minnesota.

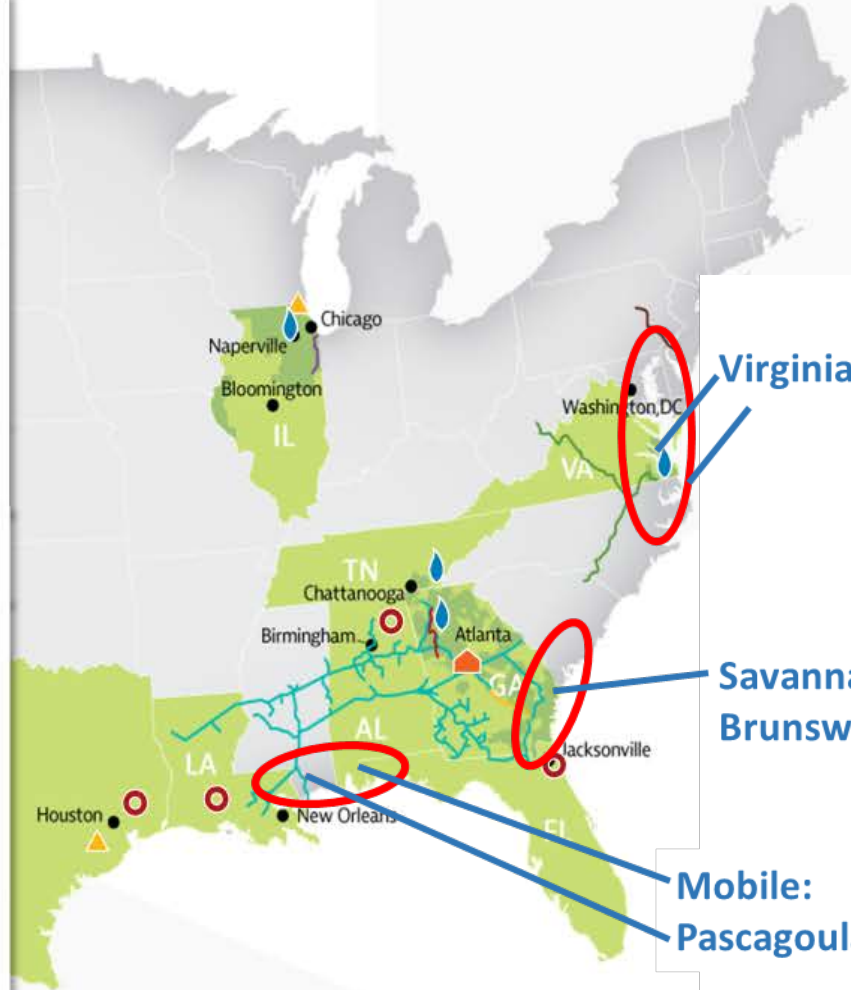
Southern Company Gas Overview



Southern Company Gas

Atlanta-based natural gas services company and subsidiary of Southern Company.

- ★ **Corporate Headquarters**
-  **GAS Distribution Operations**
 - Atlanta Gas Light
 - Chattanooga Gas
 - Nicor Gas
 - Virginia Natural Gas
-  **GAS Marketing Services**
 - SouthStar Energy Services
-  **GAS Wholesale Services**
 - Sequent Energy Management
- GAS Pipeline Investments**
 - Operational Pipelines**
 -  Southern Natural Gas
 -  Dalton
 -  Horizon
 -  Magnolia
 - Pipelines in Development**
 -  Atlantic Coast
 -  PennEast
-  **GAS Other**
 - Central Valley Gas Storage
 - Golden Triangle Storage
 - Jefferson Island Storage & Hub
 - Pivotal LNG



Virginia:  Virginia Natural Gas

Savannah:  Georgia Power
Brunswick:  Atlanta Gas


Mobile:  Alabama Power
Pascagoula:  Mississippi Power

Southern Company Gas Business Segments



DISTRIBUTION OPERATIONS

-  Nicor Gas
-  Atlanta Gas Light
-  Virginia Natural Gas
-  Chattanooga Gas

MARKETING SERVICES

-  **SouthStar Energy Services**
-  **Georgia Natural Gas**
-  **Grand Rapids Energy**
-  **Maryland Energy**
-  **Ohio Natural Gas**
-  **Illinois Energy**
-  **Illinois Energy Solutions**
-  **Florida Natural Gas**
-  **Virginia Retail Energy**







WHOLESALE SERVICES

-  Sequent Energy Management
-  Nicor Enerchange

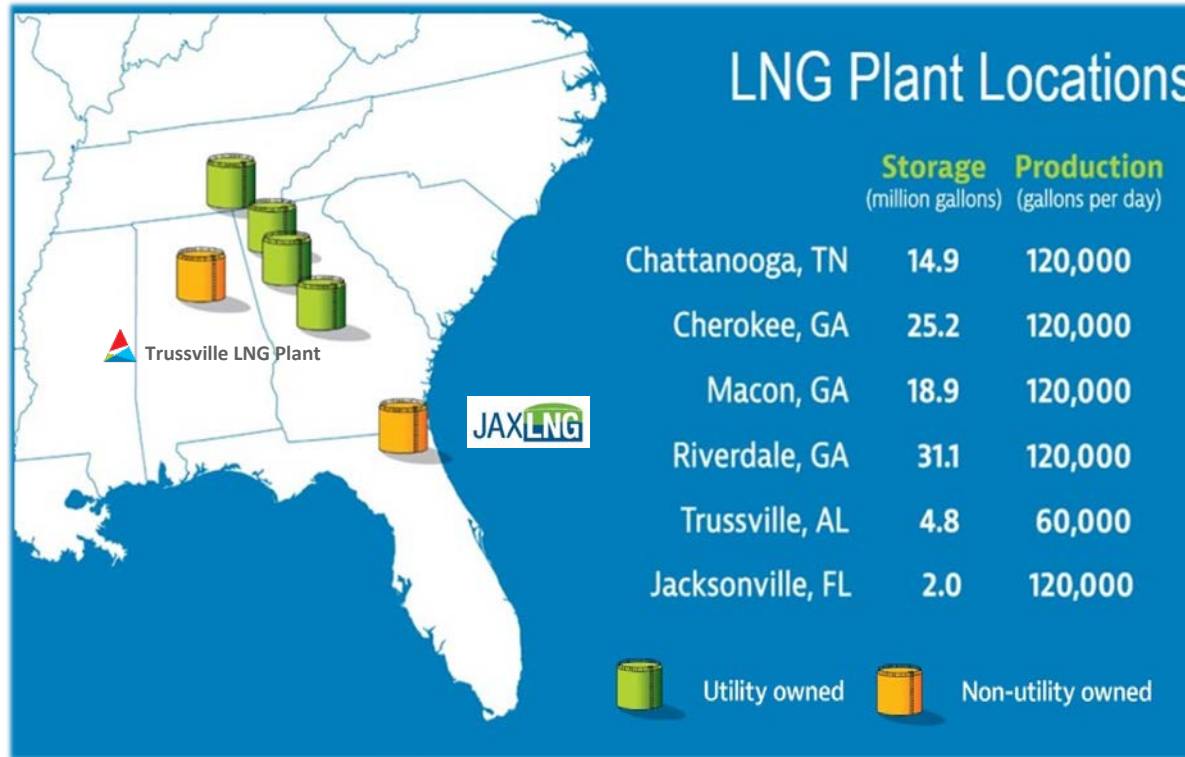
PIPELINE INVESTMENTS

-  Southern Natural Gas Company, L.L.C.
a Kinder Morgan company
-  PennEast
-  Atlantic Coast Pipeline
- Transco Dalton Expansion
- Horizon
- Magnolia

STORAGE & FUELS

-  Central Valley Gas Storage
-  Golden Triangle Storage
-  Jefferson Island Storage & Hub
-  Pivotal LNG
-  Trussville LNG Plant
-  JAX LNG

Southern Company Gas – Corporate LNG Fleet



LNG Markets We Serve



Trucking Fleets



Rail



Industrial



Maritime



Space

Pivotal LNG Markets Through Two Business Entities



- Wholly owned subsidiary of Southern Company Gas formed in 2010
- Owns and operates the Trussville LNG plant near Birmingham, AL, and six 10,000 gallon tankers
- Over 50 years of corporate experience operating LNG facilities safely
- Over 150 years corporate experience delivering reliable energy to customers in service territories throughout the USA, including many ports
- Industry leading brand name in the SE United States



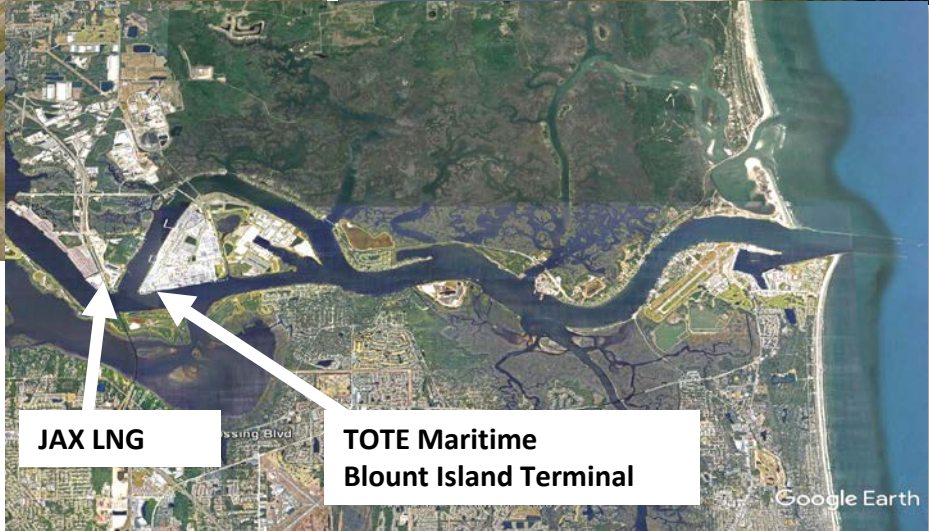
- 50/50 partnership between Pivotal LNG and Northstar Midstream, a subsidiary of OakTree Capital Partners and Clean Marine Fuels
- Completed the construction of the JAX LNG facility in the port of Jacksonville, FL; in service September 2018
- First facility in the USA to deliver LNG into a bunkering vessel
- Plant capacity expandable 5x
- Plant operated by Pivotal LNG and Southern Company Gas

Trussville LNG Plant

- Located east of Birmingham, AL
- Storage tank: 4.9 million gallons
(18,500 m³)
- Production: 60,000 gallons per day
225 m³/d
- Two truck loading scales
- Three truck loading racks
- Fully staffed for 24/7 operations



Jacksonville LNG Plant



Jacksonville LNG Plant – Then and Now



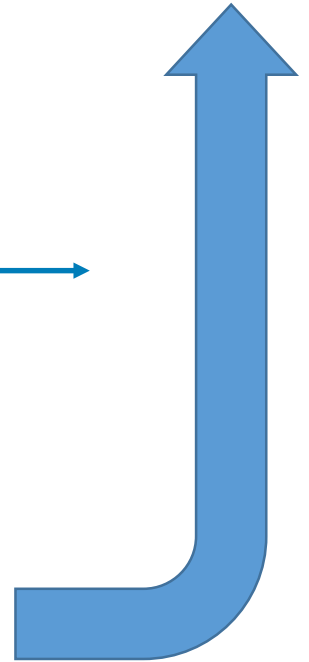
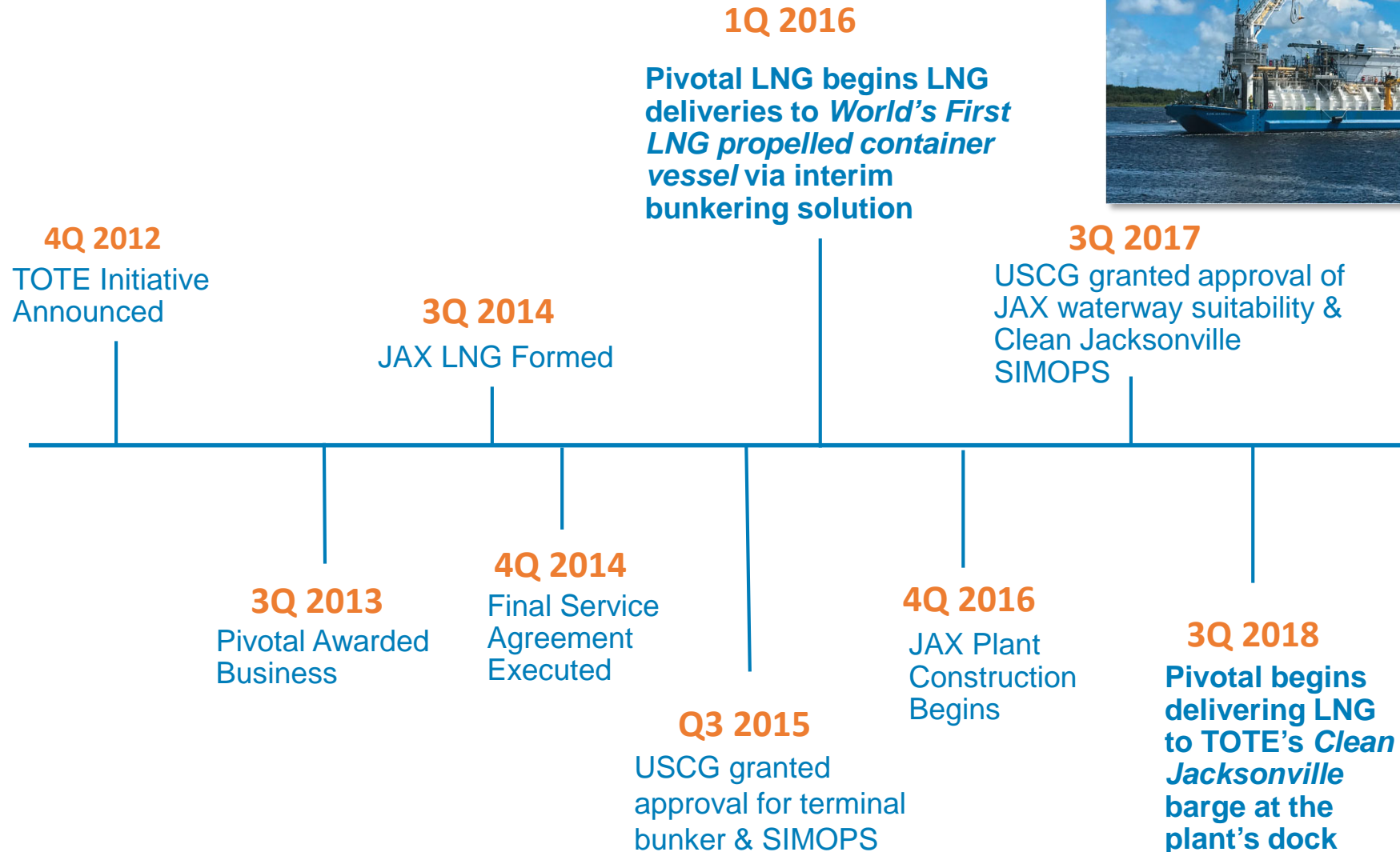
Redevelopment of an abandoned gypsum / sheetrock plant

Jacksonville LNG Plant – In Service Sept 2018



- Initial liquefaction capacity – 120,000 gpd (450 m³/d)
- On-site LNG storage – 2.0 million gallons (7,500 m³)
- Expandable to 5x (600,000 gpd / 4.0 million gallons storage)
- 38 acre brownfield site at Dames Point in Jacksonville
- Dock with marine loading arms
- Two truck loading/unloading racks with scales
- Firm natural gas supply and transportation to plant
- 10 MW on-site generation powers all plant equipment
- Facility manned 24 x 7 x 365
- Control systems integrated with seven other Southern Company plants

JAX LNG – Development Timeline



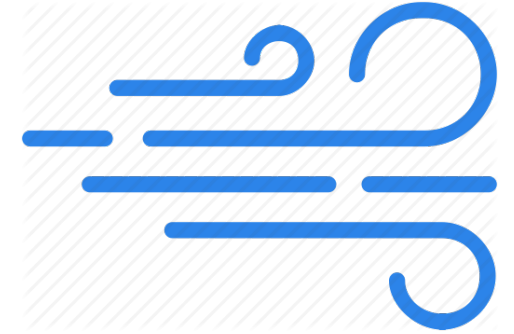
LNG Deliveries – Terminal Solution

Interim LNG bunkering solution built by TOTE and operated by Pivotal LNG

No safety incidents or spills



JAX LNG Plant – Tailwinds



- We are working with a focused and dedicated customer
- Tremendous collaboration with USCG and First Responders
 - Rigorous and thorough; committed to best practices
- Progressive and supportive Port Authority
- Pragmatic community and political culture in Jacksonville appreciated the project's environmental and economic benefits
- Brownfield site reduced permitting lead time
- Pivotal LNG's Trussville plant offered a firm supply source years before a new plant could be built in Jacksonville
- IMO decision to implement emissions cap in 2020

JAX LNG Plant – Headwinds



- Experience can work against you in a bidding environment
- Balancing long term vision for dock with design and construction schedule
- Compact site had to accommodate vapor dispersion and thermal radiation zones
- Vapor dispersion modeling techniques are time consuming and are challenged to keep up with the faster pace of small scale plant development
- Uncertain quality and price of commercial power available to site
- PHMSA's approach to overseeing small scale LNG plants is evolving

Key Elements of an LNG Supply Project

- **Defined customer demand**
 - What to build? Where? Configurations? Size/Scale?
- **Feasible Site**
 - Size / buffer zones
 - Environmental impacts (history, wetlands)
 - Access to natural gas supply system ***with available capacity***
 - Proximity to navigable waterway and available gas supply
- **Supportive / collaborative stakeholder groups**
 - Regulatory Agencies, First Responders, Port Authorities, etc.
- **Educated and pragmatic public and political environment**
- **Reliable and experienced LNG supplier that will follow through**

LNG Facilities and Buffer Zones

(aka Vapor Dispersion and Thermal Exclusion Zones)

- **NFPA 59A Dictates Methods for Determining Required Buffer Zones based on spill and fire scenario modeling**
- **Different configurations have different models to satisfy**
 - If connected to a PHMSA-regulated pipeline, 2001 vintage of NFPA 59A applies, resulting in larger buffer zones
 - If only configured for marine, truck and/or rail loading, different model requirements are required, which generally decrease required buffer distances (“marine loading facility”)
 - *Engineers often focus on the tank, but vapor dispersion at the loading flange is often the limiting factor, affecting transfer rates and pressures*
- **Tank without liquefaction can be installed on a much smaller site**
 - Primarily due to reduced buffer zone requirements dictated by code
- **Three port configurations based on availability of land and gas supply**
 - Liquefaction, Tank and Bunkering; Tank and Bunkering; Bunkering Only

JAX LNG – Lessons Learned

- **It all starts with the customer**
 - LNG initiatives in Jacksonville began when TOTE led the way
- **Customer / supplier / public stakeholder collaboration is key**
 - Working together to solve unique challenges related to lack of standardization as industry evolves
- **Different ports will have different solutions**
 - Availability of a feasible site
 - Gas supply availability
 - Public and political environment
- **Many informal partnerships worked together to drive success at JAX**

LNG Partners Needed For Success

The image features a central collage of logos for various partners and organizations. Two large white boxes are overlaid on the collage, highlighting specific logos:

- Top Box:** Contains the logo for **Pivotal LNG**, which consists of a stylized sailboat icon (red, white, and blue) followed by the text "Pivotal LNG".
- Bottom Box:** Contains the logo for **JAX LNG**, which features the letters "JAX" in blue and "LNG" in white with a green and blue background.

Other logos visible in the collage include:

- TOTE Maritime**
- UPS**
- FEC**
- JAXPORT JACKSONVILLE PORT AUTHORITY**
- HDR**
- Carib Energy LLC**
- Jack B. Kelley, Inc. since 1946**
- REVLNG**
- SOUTHSTAR Energy Services**
- JAX LNG** (bottom left)
- United States Coast Guard**
- Propeller Club of the**
- CROWLEY**
- Sequent Energy Management**
- JEA**
- Westport**
- NORTHSTAR MIDSTREAM**
- PowerSecure**
- SEA LNG**
- COSMODYNE**
- POLARIS NEW ENERGY**
- JAXUSA PARTNERSHIP**
- FOSS**
- PORT EVERGLADES**





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