



# Marine LNG Markets & Use of LNG as a Fuel

**Kurt Larsen**  
Director, Global Gas Solutions

Irvine, California  
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# Overview

- LNG Market
- LNG as a Fuel
- Regulatory Update
- ABS Technology Projects
- Global Gas Solutions Organization



# LNG Market



# The ERA of GAS

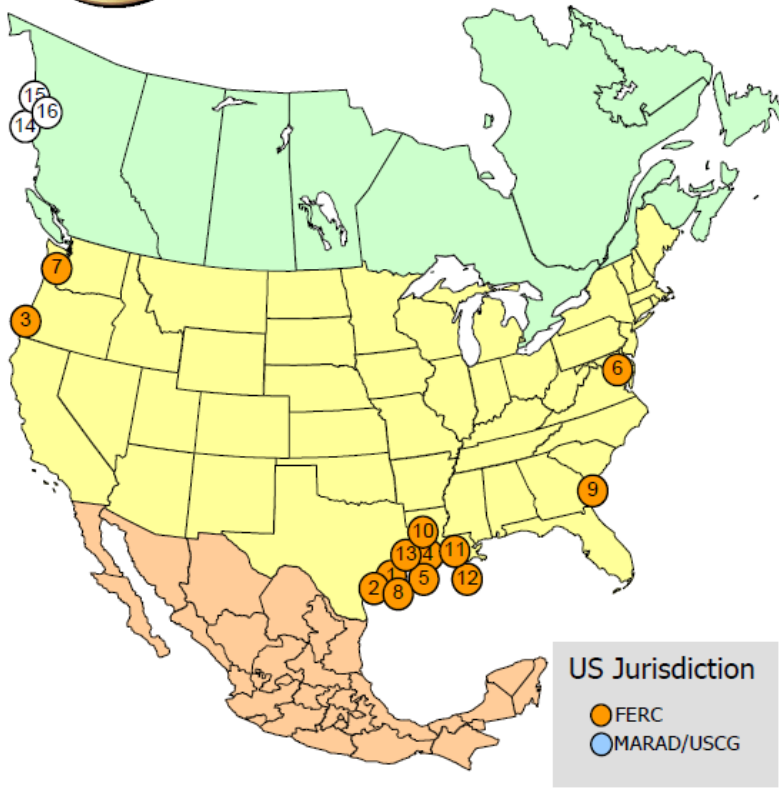
- 3 key main growth areas
  - LNG trade
    - US exports, growing worldwide supply (Australia/East Africa)
    - Development of new markets
    - Emergence of FSRU and floating LNG projects
    - Development of small scale LNG
  - Gas as Fuel
    - High activity in North America due to low gas price
    - Increased level of interest worldwide. LNG ready concepts.
    - LNG, but also other low flash point fuels (LPG, Methanol, ...)
    - LNG bunkering (bunkering vessels)
  - LPG trade
    - Growing market (following increased LNG production)
    - Increasing number of new ship orders

# FERC Approval Status



## North American LNG Export Terminals *Proposed*

7 Projects have been approved for export to non-FTA Countries



### Export Terminal PROPOSED TO FERC

1. **Freeport, TX:** 1.8 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction) (CP12-509)
2. **Corpus Christi, TX:** 2.1 Bcfd (Cheniere – Corpus Christi LNG) (CP12-507)
3. **Coos Bay, OR:** 0.9 Bcfd (Jordan Cove Energy Project) (CP13-483)
4. **Lake Charles, LA:** 2.2 Bcfd (Southern Union - Trunkline LNG) (CP14-120)
5. **Hackberry, LA:** 1.7 Bcfd (Sempra – Cameron LNG) (CP13-25)
6. **Cove Point, MD:** 0.82 Bcfd (Dominion – Cove Point LNG) (CP13-113)
7. **Astoria, OR:** 1.25 Bcfd (Oregon LNG) (CP09-6)
8. **Lavaca Bay, TX:** 1.38 Bcfd (Excelerate Liquefaction) (CP14-71 & 72)
9. **Elba Island, GA:** 0.35 Bcfd (Southern LNG Company) (CP14-103)
10. **Sabine Pass, LA:** 1.40 Bcfd (Sabine Pass Liquefaction) (CP13-552)
11. **Lake Charles, LA:** 1.07 Bcfd (Magnolia LNG) (PF13-9)
12. **Plaquemines Parish, LA:** 1.07 Bcfd (CE FLNG) (PF13-11)
13. **Sabine Pass, TX:** 2.1 Bcfd (ExxonMobil – Golden Pass) (PF13-14)

### PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

14. **Kitimat, BC:** 1.28 Bcfd (Apache Canada Ltd.)
15. **Douglas Island, BC:** 0.23 Bcfd (BC LNG Export Cooperative)
16. **Kitimat, BC:** 3.23 Bcfd (LNG Canada)

As of March 26, 2014

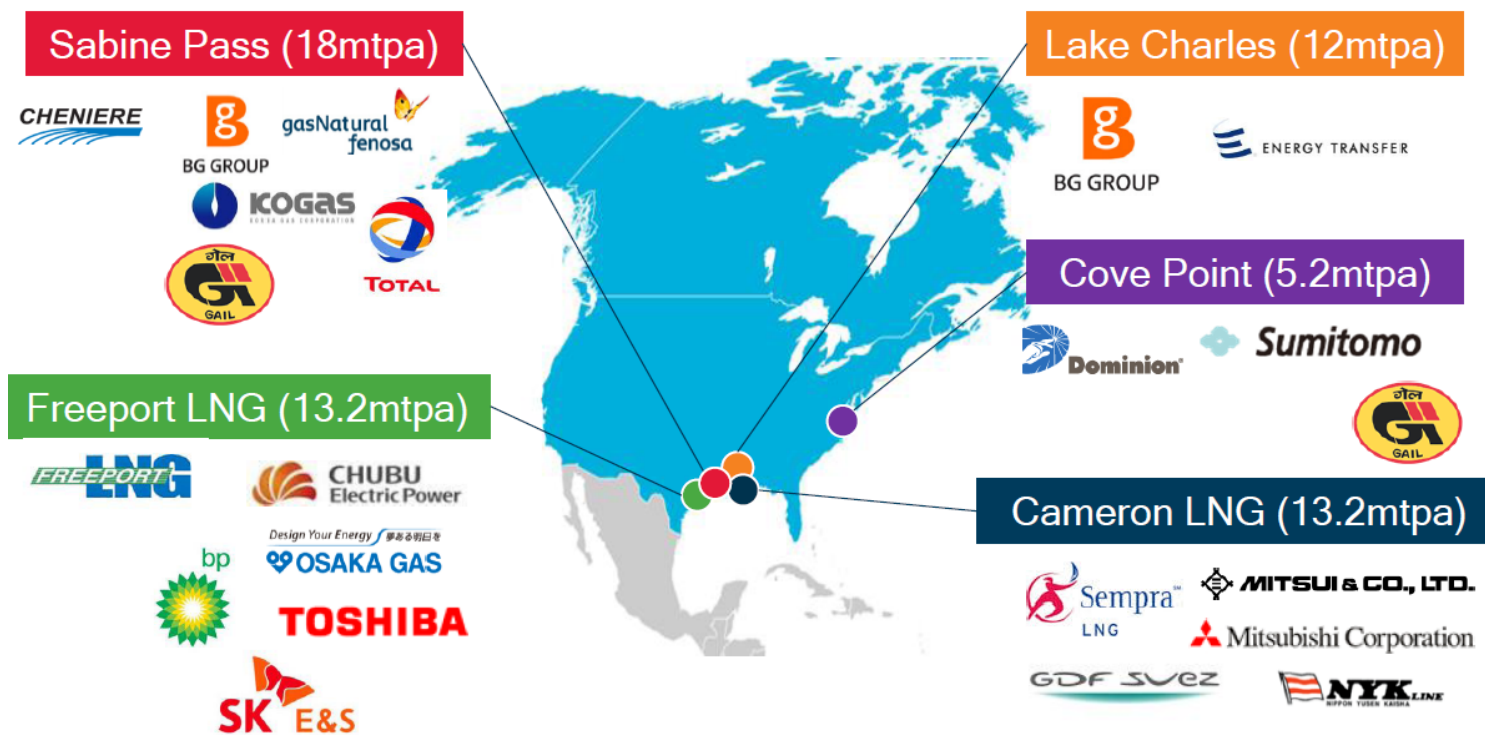
\* Filed Certificate Application

*Office of Energy Projects*

# USA LNG Export



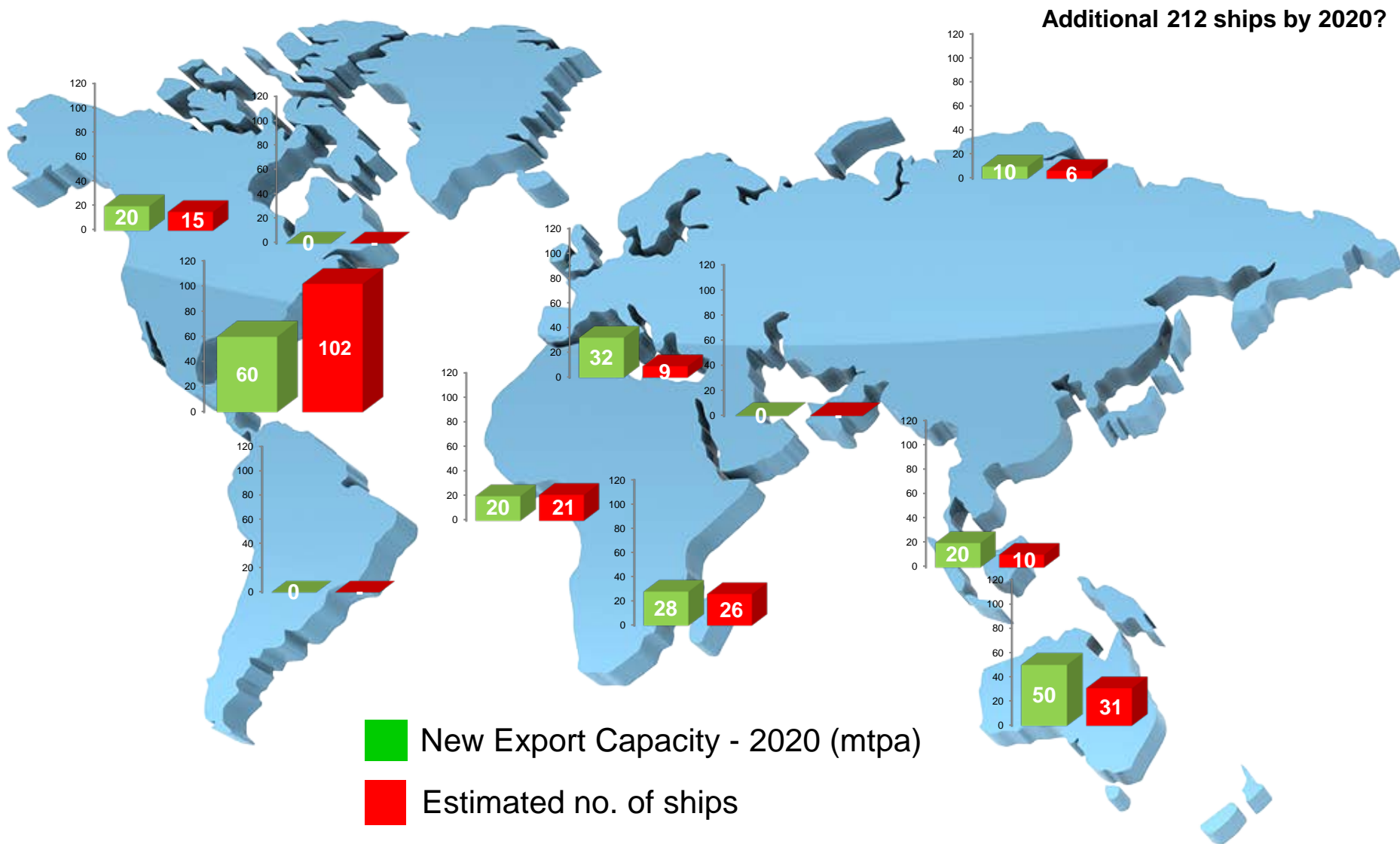
## Participants in Selected Projects



4th Annual North American LNG Exports, 11-12 December, 2013

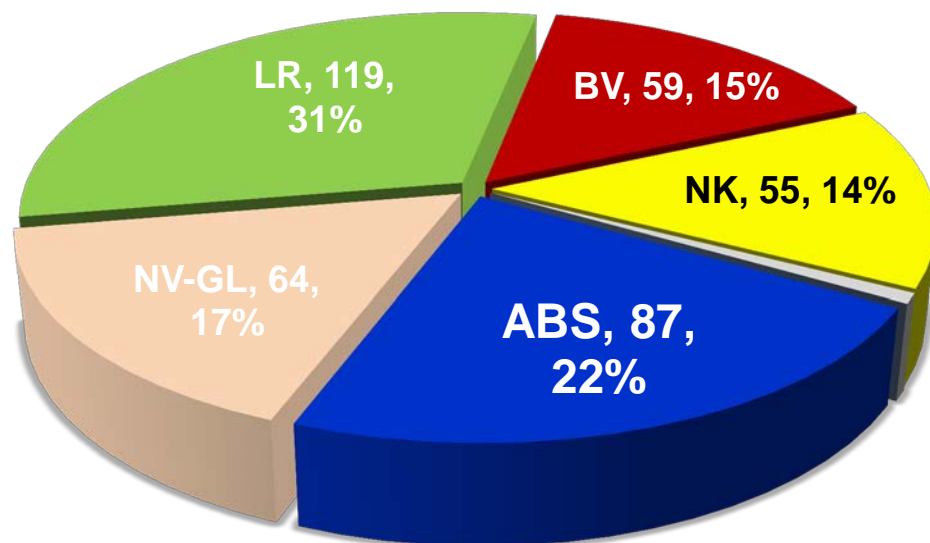
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# Additional LNG Shipping Required



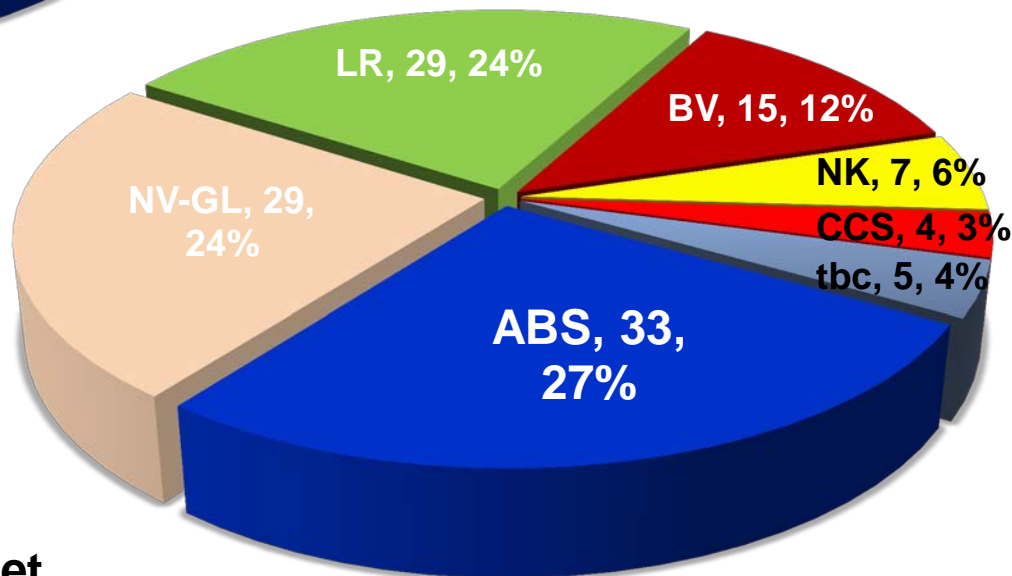
# LNG Carrier Fleet & Orderbook

Status January 2014



Existing Fleet 387 Ships

**Orderbook: 122 ships  
(including 11 FSRUs  
& 8 small LNGCs)**

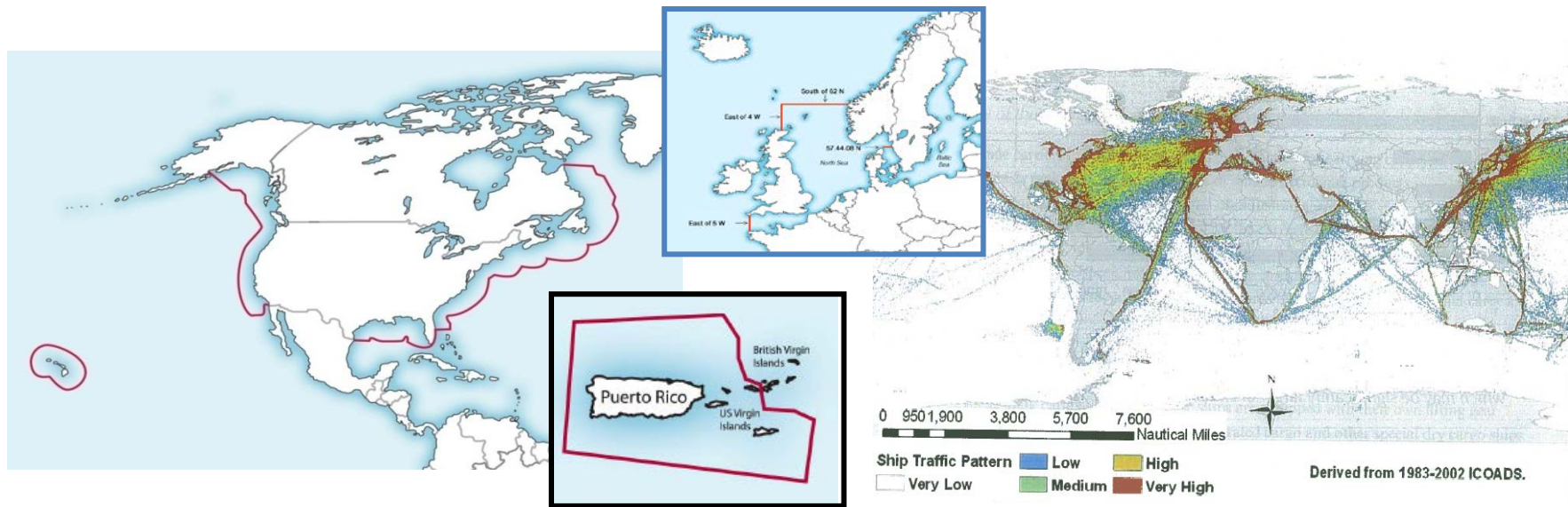
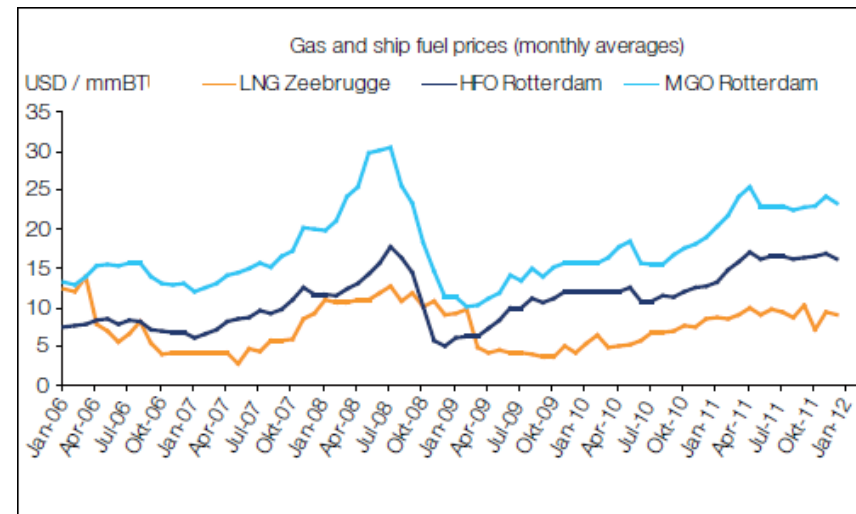


Orderbook is >30% of existing fleet



# LNG as a Fuel: Background & Key Drivers

- Emissions regulations
  - SO<sub>x</sub>, NO<sub>x</sub>, PM and CO<sub>2</sub>
- Economics – high price of oil
  - Oil price uncertainty
  - Low sulfur fuel availability
  - Abundance of shale gas



# Why Use LNG as Fuel?

- Governing factors for selection of future fuel and power plants
  - MARPOL 0.1% sulfur fuel in ECA (from **1 Jan. 2015**)
  - EU Sulfur Directive
  - CARB Ocean-going Vessel Regulations
  - MARPOL Tier III level NO<sub>x</sub> emission (from **1 Jan. 2016/2019/2021!!!!**)
  - EPA Tier 3 and Tier 4 (2014 and 2016)
  - Lowest possible EEDI (MARPOL energy efficiency requirement)
  - MARPOL 0.5% sulfur fuel global limit (from **1 Jan. 2020**, subject to review in 2018)
  - Life cycle operating costs
- Options
  - Distillate fuel
  - HFO power plants with SO<sub>x</sub> scrubber
  - Advanced engine technologies (NO<sub>x</sub>)
  - Aftertreatment systems (NO<sub>x</sub>, PM)
  - LNG fueled propulsion and auxiliary systems



# Gas Fueled Ship Projects in the USA

- Harvey Gulf International Marine
- First dual fuel new construction in the US
- 6 vessels – First delivery 2nd Half of 2014



# LNG as a Marine Fuel

- Totem Ocean Trailer Express (TOTE)
- First dual fuel containerships – worldwide
- New construction containerships at NASSCO
- Conversion of Orca Class trailer vessels



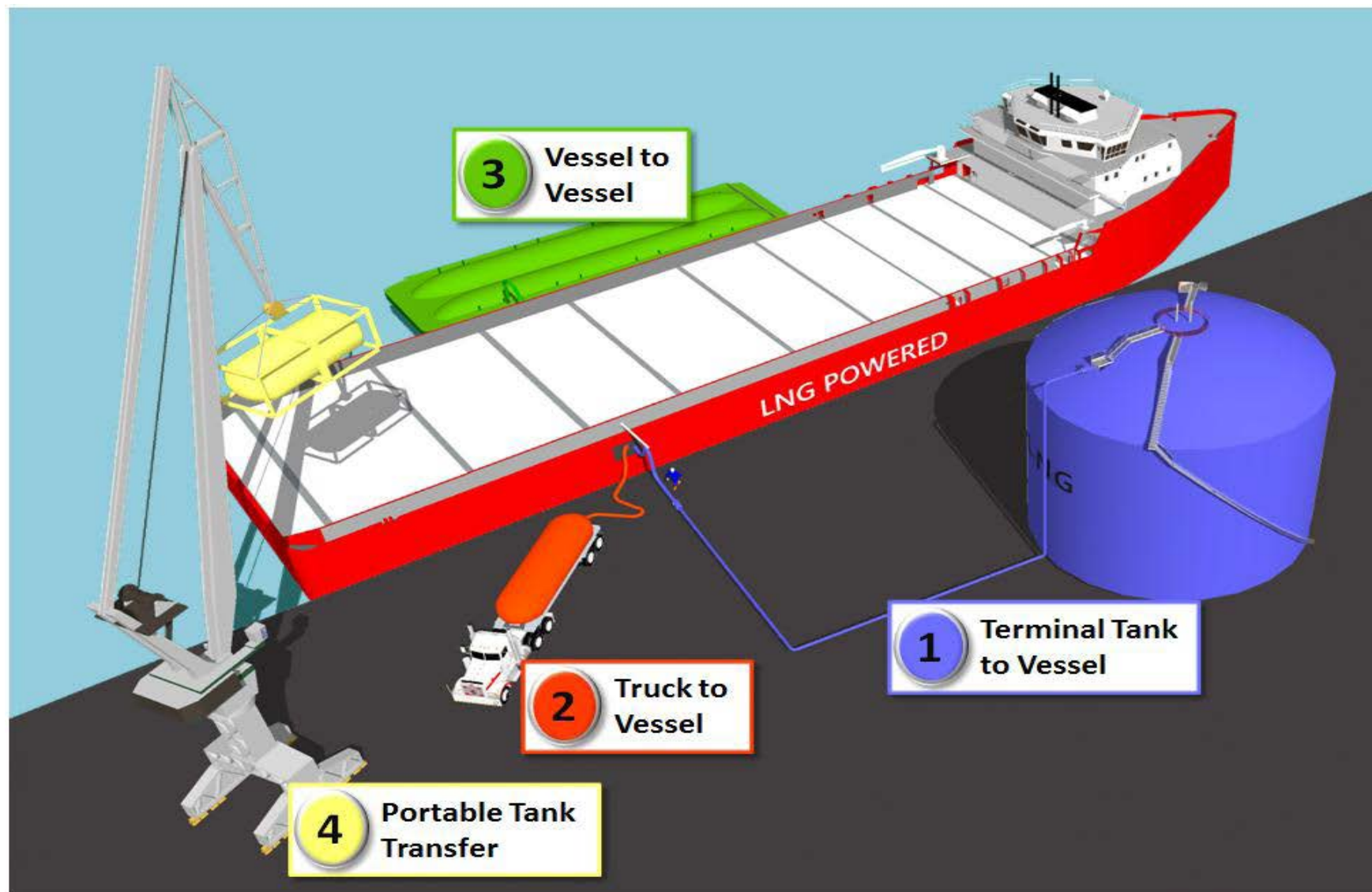
# Current Gas Fueled Ship Projects in USA

- Six new construction OSVs for Harvey Gulf International Marine being built at Trinity Offshore, Gulfport, MS
- Two new construction 3,100 TEU Containerships for Totem Ocean Trailer Express (TOTE), Inc. being built by NASSCO, San Diego, CA
- Conversion of the two ORCA class Trailer Vessels for TOTE, Inc.
- Washington State Ferries – Issaquah Class Ferry conversion program
- Austen Class Staten Island Passenger Ferry conversion pilot program
- Interlake Steamship Co. Laker Conversion project
- Horizon Lines, Inc. Containership Re-powering project
- Two new construction 2,400 TEU Ro-Ro (ConRo) vessels for Crowley Maritime Corp. being built at VT Halter in Pascagoula, MS

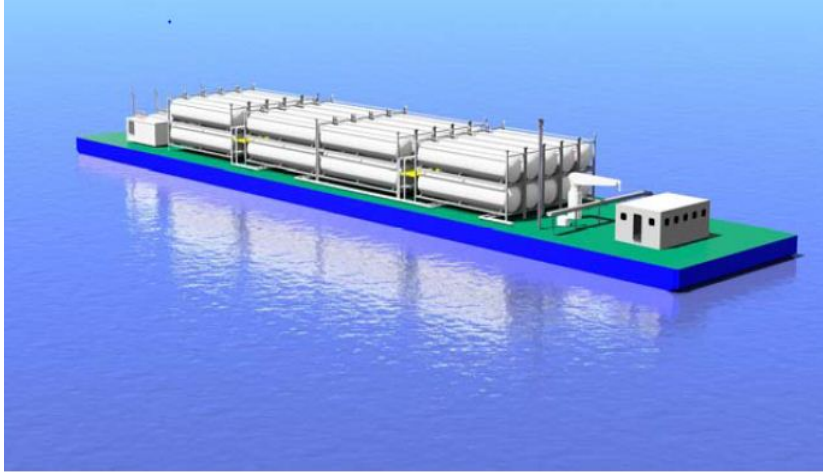
# Current LNG-ready Ship Projects in USA

- Four new construction LNG-ready Product Carriers for American Petroleum Tankers being built by NASSCO
- Four new construction LNG-ready Product Carriers for Crowley Maritime Corp. being built by Aker Philadelphia
- Three new construction LNG-ready Product Carriers for Seabulk Tankers, Inc. being built by NASSCO
- Two new construction LNG-ready 3,600 TEU Containerships for Matson Navigation being built by Aker Philadelphia

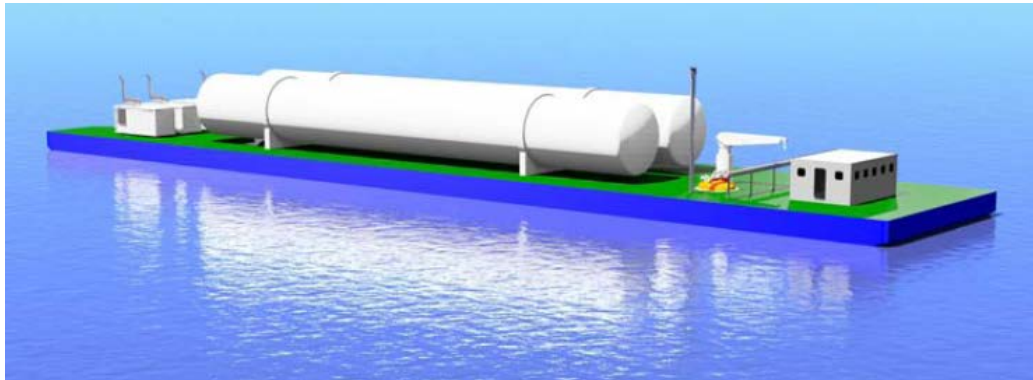
# Bunkering Scenarios



# LNG Bunkering Barge Concepts



Use of interchangeable ISO Tank Containers with permanently installed common manifold and piping systems.

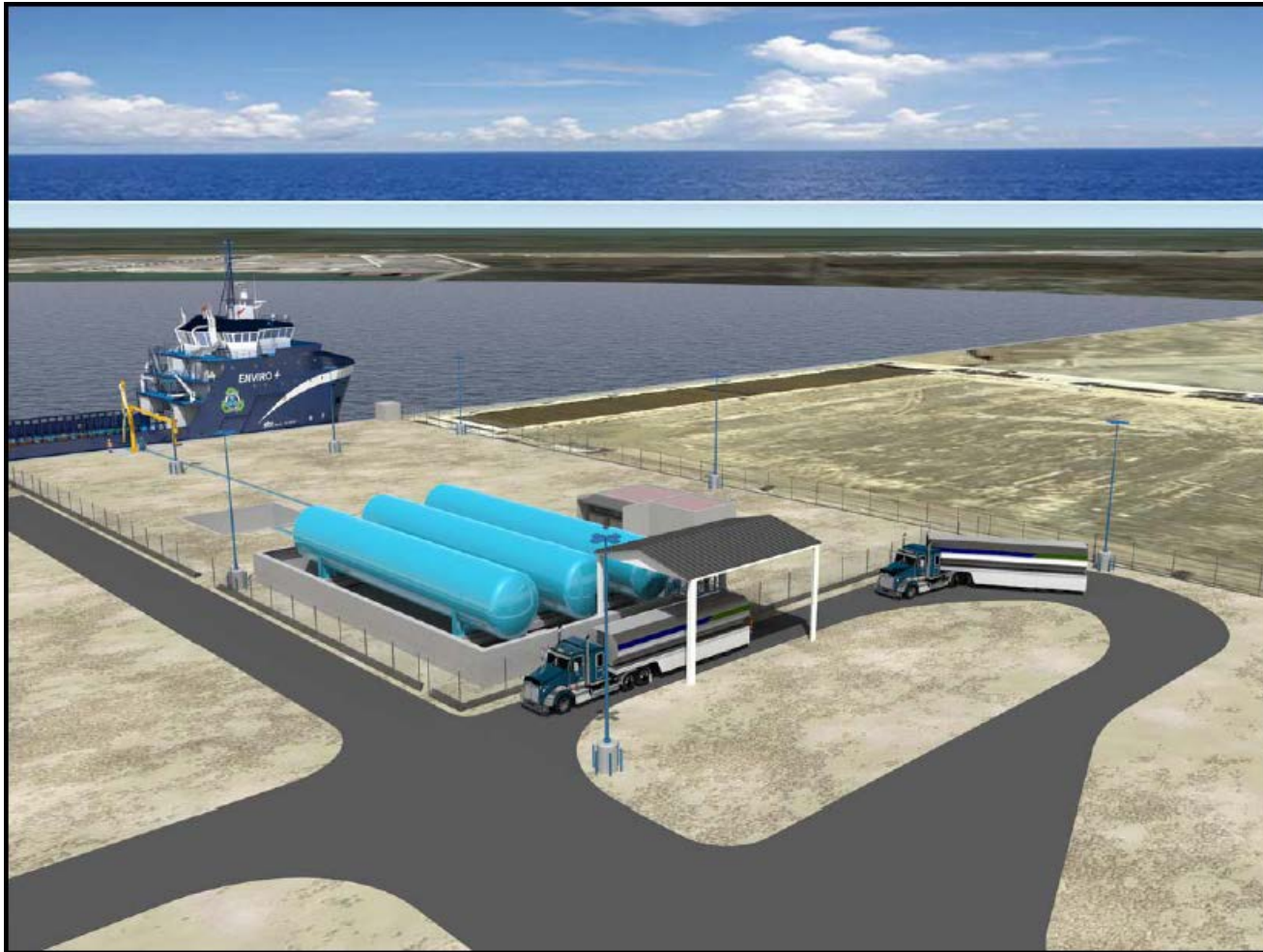


Permanently installed Type C vacuum insulated tanks and piping systems.



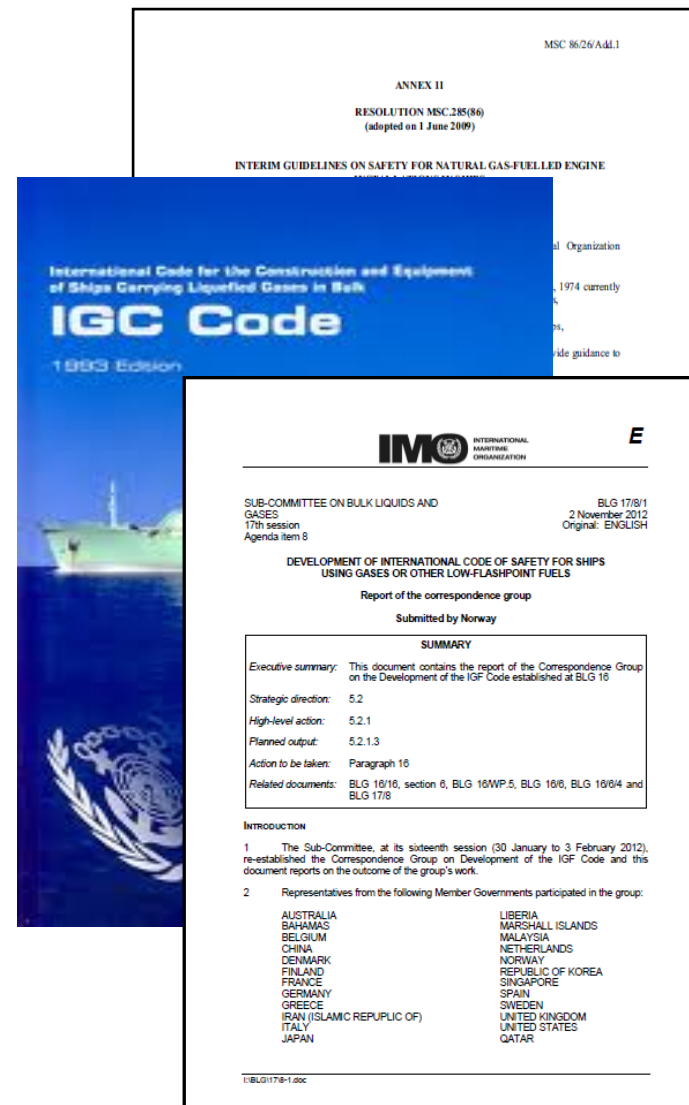
# LNG Bunkering Facility in Port Fourchon

- Harvey Gulf building first LNG Bunkering facility in US



# Regulations for Gas Fueled Ships

- IMO Interim Guidelines on Safety for Natural Gas-Fueled Engine Installations in Ships (IMO Res. MSC.285(86)) (non-mandatory) Class Societies' existing Guidelines make general reference to Interim Guidelines.
- IMO International Code for Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code) – Expected 2016
- International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)
- Additional requirements may be imposed by flag Administrations



# Industry Groups as Responses to LNG Fuel

- SIGTTO LNG Fuel Safety Advisory Group
- Intertanko (ISTEC)
- International Council of Combustion Engines (CIMAC)
- **Society for Gas as a Marine Fuel newly established (SGMF)**
- LNG as Fuel Advisory Council (US)



# USCG Guidance: Bunkering Operations

- USCG has DRAFT Transfer Operations Policy letter (CG-OES Policy Letter No. 01-14), "Guidelines for Liquefied Natural Gas Fuel Transfer Operations and Training of Personnel on Vessels Using Natural Gas as Fuel"
- USCG has DRAFT Bunkering Policy letter (CG-OES Policy Letter No. 02-14), "Guidance Related to Vessels and Waterfront Facilities Conducting Liquefied Natural Gas (LNG) Marine Fuel Transfer (Bunkering) Operations"
- Above DRAFT policies were subject to public comment until 10 March 2014
- The USCG is developing a policy letter for LNG Tank Barges
- ALL DRAFT POLICIES ARE SUBJECT TO CHANGE

# ABS Technology Gas Projects

- ABS Report on LNG Bunkering Regulations
- Steel Barge Rule Update
- Bunkering Procedures – Best Practices
- Floating Offshore Liquefied Gas Terminals Guide
  - Mooring
  - Loading
  - Risk
- LNG firefighting
- Liquefaction

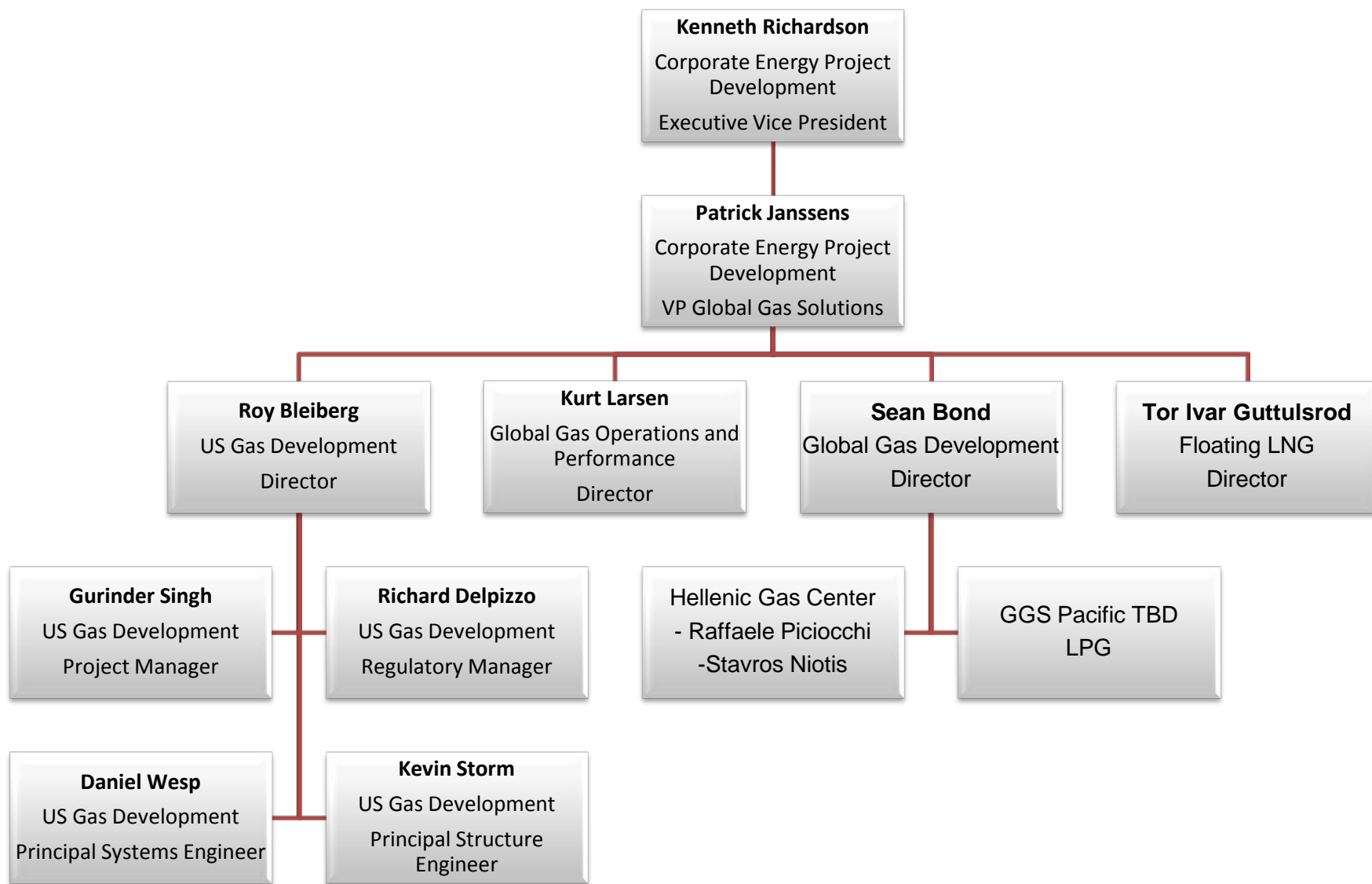


# ABS Global Gas Solutions: Client Focus

- LNG/LPG Carriers, FLNG and LNG as a Marine Fuel
  - Technical, Performance, Operational Guidance and Support
  - Novel Concept Studies – Approval in Principle (AIP)
  - Regulatory Compliance
  - Specification Review
  - Support Engineering and Survey
  - Risk Assessments for Gas Fueled Ships
  - LNG-ready – Design Concept Review
  - Project Management
  - Cost-Benefit Analysis



# Global Gas Solutions: Worldwide Organization



# Contact

- Kurt Larsen  
Director, Global Gas Operations  
and Performance
  - Mobile: 1-832-316-6481
  - Email: [klarsen@eagle.org](mailto:klarsen@eagle.org)







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