LNG Maritime and Truck Transport

Presented to:

TRB Safe Transportation of Liquefied Natural Gas by Railroad Tank Car Committee

David O. Willauer, Chair

AT040 Hazardous Materials Transportation Committee

June 7, 2021

Presentation Outline

- Introduction
- TRB Hazmat Transportation Committee
- LNG Risk Assessment 2018
- LNG National Outlook
- LNG by Maritime Transport
- LNG by Truck Transport

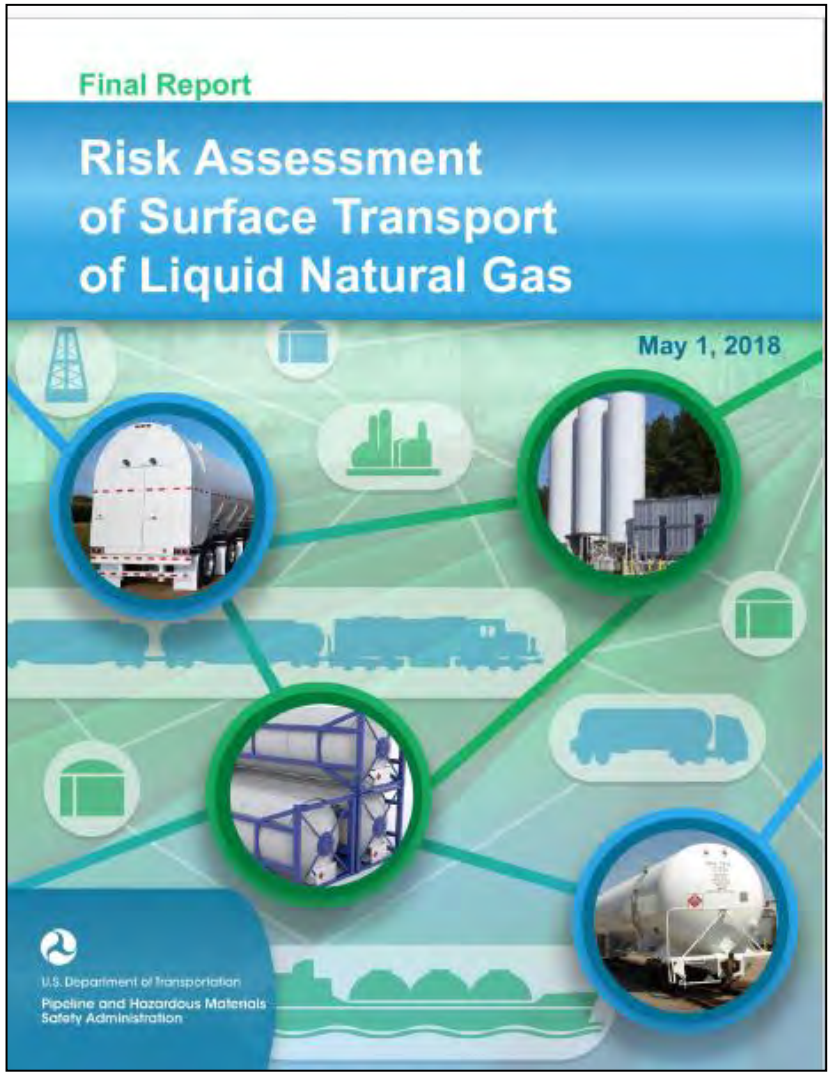
Standing Committee on the Transportation of Hazardous Materials

Mission

To serve as a forum of leaders from federal, state, regional, and local government, industry, academia, and the research community for the discussion and analysis of issues related to improving the safe, secure, and efficient transportation of hazardous materials and the identification of specific research needs.

Transportation Research Board

LNG Risk Assessment 2018 and Follow Up



Presented **study findings** to:

- PHMSA, FRA, FMCSA
- USCG & MARAD

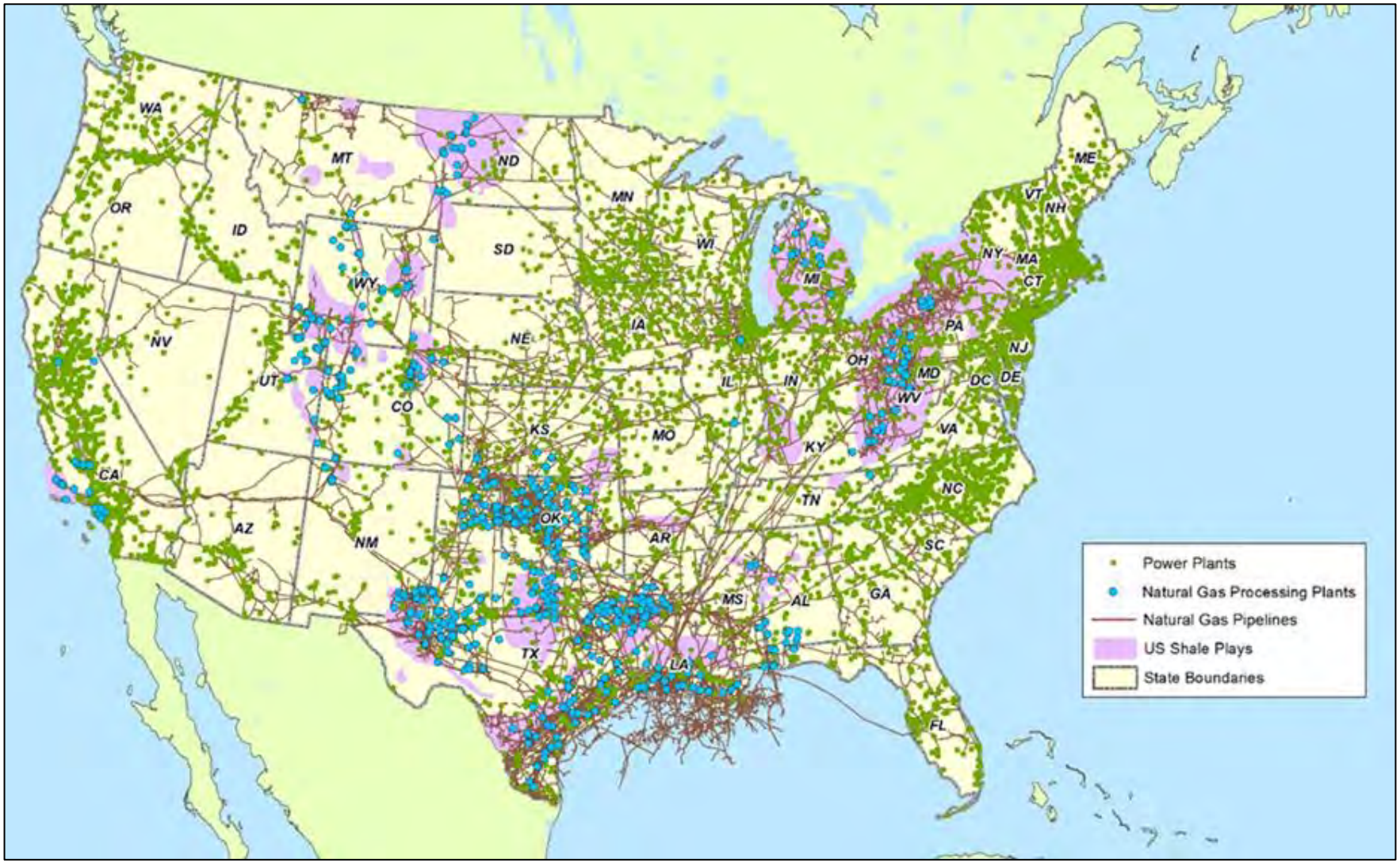
Participated in **LNG Town Hall** for First Responders Oct 2019

TRB 2021 Annual Meeting: LNG Session featuring presentations from FRA, Chart Industries, CanaGas and Gas Technology Institute

US Federal Agency LNG Oversight

Agency	LNG Oversight
DOE	Environmental regulation, permits, imports/exports
EPA	Clean Air Act, Clean Water Act, emergency response
FERC	LNG facility siting, permitting, interstate commerce
FMCSA	Driver safety, enforcement, cargo tank guidance
FRA	LNG locomotive tenders, bulk transport special permits
MARAD	Offshore LNG facility design, siting, naviation
PHMSA	LNG facility design, packaging, transportation
USACE	Dredging, wetland permits
USCG	LNG maritime transfers, inspections, bunkering, response

US Natural Gas Demand and Supply Chain



Source: EIA, CS

Natural Gas Infrastructure – Pipeline Network

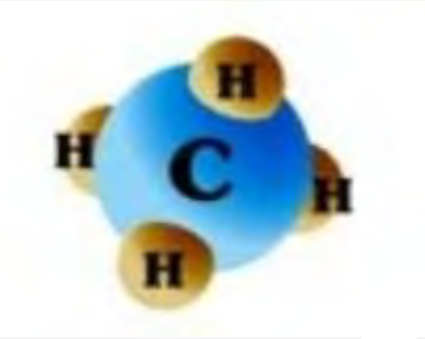
Liquefaction Facilities

New Fortress Energy LNG Liquefaction Plant, Hialeah, FL

Cheniere LNG Liquefaction Plant, Sabine Pass, LA

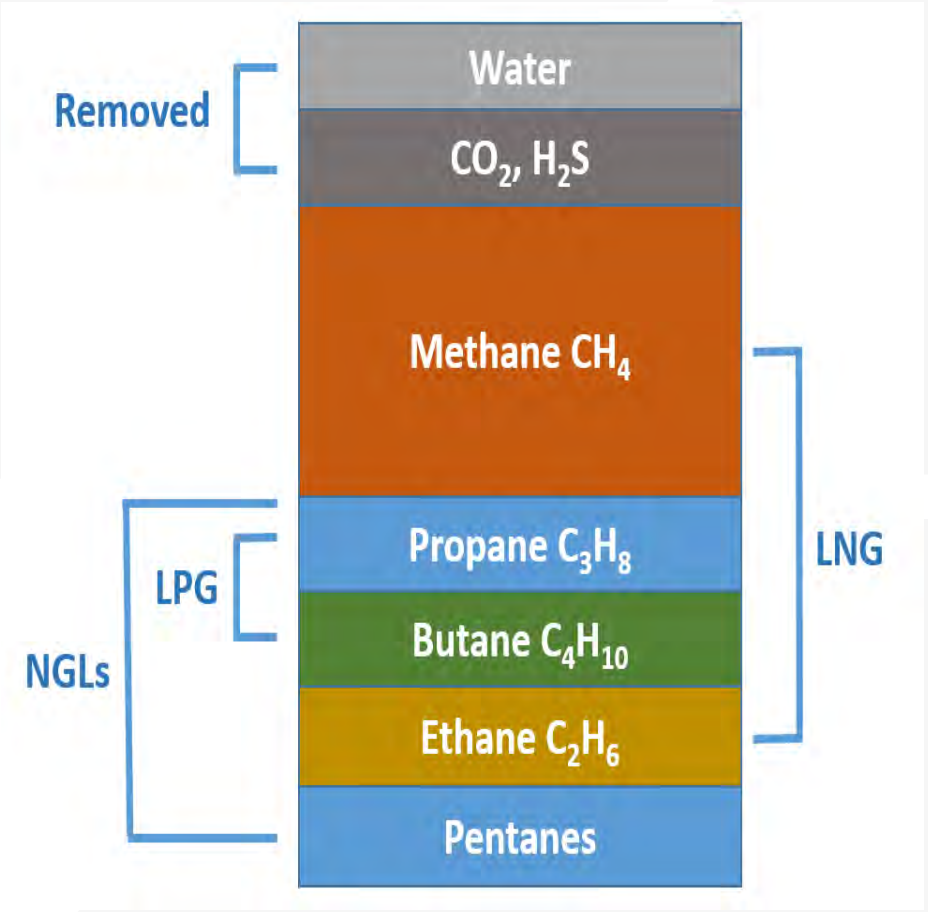
Sources: Cheniere Energy, New Fortress Energy

Natural Gas Properties and Terms



Natural Gas Liquids (NGLs) are used to cool methane gas to produce LNG.

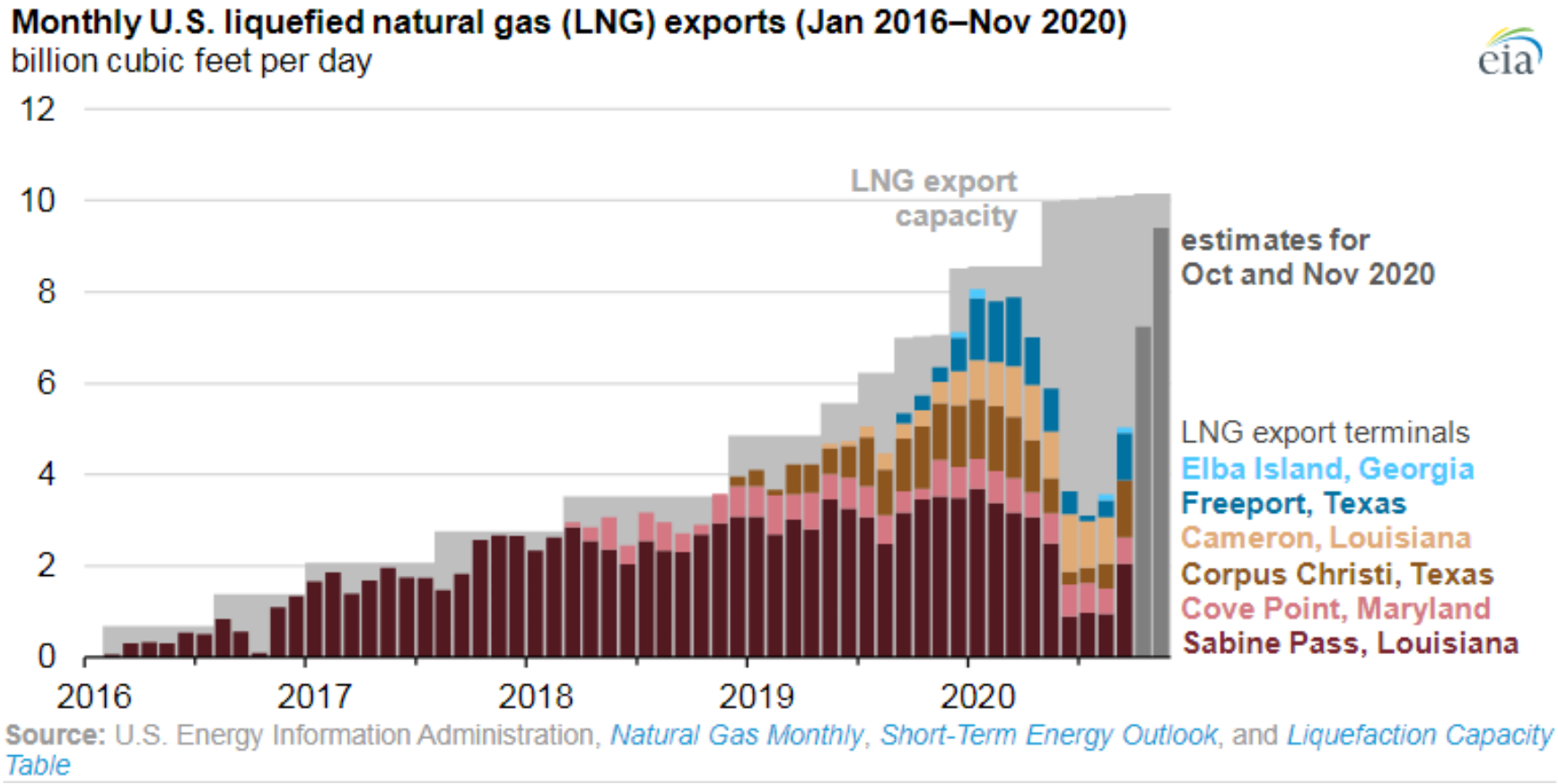
NGLs are transported in pressurized tank trailers to liquefaction facilities by truck.



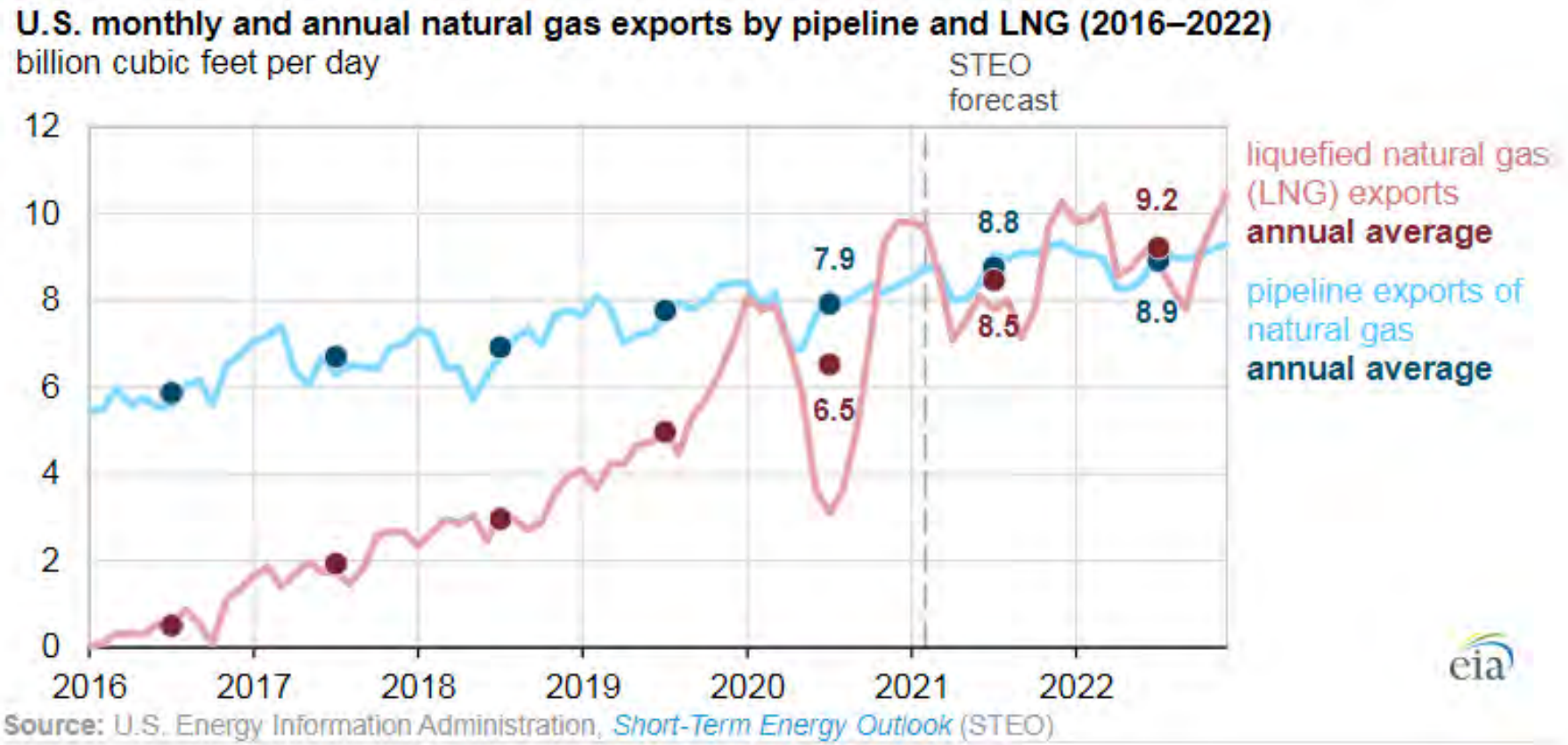
LNG Carriers Loading at Sabine Pass, LA

Source: Oil Price

LNG Exports January 2016 to November 2020



Natural Gas Exports by Pipeline and LNG



Emerging Markets: LNG Fuel and Cargo

Sources: Chart Industries, FECR, Tote Marine, CN Railroad

Maritime LNG Examples in JAXPORT

Tote Marine

- TOTE Maritime imports and exports consumer goods between Jacksonville, Florida and San Juan, Puerto Rico, with additional connections to the U.S. Virgin Islands using LNG-powered vessels.

Crowley Marine

- Crowley Marine has chosen JAXPORT to be homeport to two LNG-powered combination container/Roll-0n, Roll Off vessels exporting LNG to Puerto Rico and other countries in the Caribbean and Latin America.

LNG Bunkering, LNG for Propulsion

Waterfront facilities handling LNG are subject to existing regulations at 33 CFR Part 127. These existing regulations are being applied to LNG bunkering activities to the extent practicable, without allowing alternatives (USCG-OES Policy Letter 02-15)

JAX LNG and TOTE Services conduct their first ship-to-ship LNG bunkering of a foreign-flagged vessel at JAXPORT (Feb, 2021)

Currently, LNG bunkering operations are occurring, or are planned to occur, in Port Fourchon, LA; Jacksonville, FL; Seattle-Tacoma, WA.

USCG LNG Regulations

The Coast Guard exercises regulatory authority over waterfront LNG facilities and LNG vessel traffic. Risks can be mitigated using effective measures to reduce both the vulnerability to and the consequences of a release of LNG from a vessel. This risk analysis should, at a minimum, examine public health and safety; the safety and security of the vessel; protection of critical infrastructure and key assets; and consequence management.

Sandia National Lab Reports 2004

In 2004, the DOE requested that Sandia National Laboratories assess and quantify the potential hazards and consequences of a large spill from LNG carrier designs.

The resulting report provided a framework for assessing hazards and identifying approaches to minimize the consequences to people and property from an LNG spill over water.

Sandia National Lab Report 2008

Building on the 2004 report, Sandia reassessed emerging accidental and intentional threats and conducted detailed breach analyses for the new large LNG carrier designs.

Based on the estimated breach sizes, breach locations, and LNG carrier configurations, SNL estimated LNG spill rates and volumes and conducted thermal hazard and vapor dispersion analyses.

The report summarized the different analyses conducted, the expected range of potential hazards from a large LNG carrier spill over water, and risk management approaches to minimize consequences to people and property from such a spill.

SANDIA REPORT SAND2008-3153 *- Breach and Safety Analysis of Spills Over Water from Large Liquefied Natural Gas Carriers May 2008*

Sandia Report 2008 Selected Findings

The likelihood of a natural gas cloud fully extending, especially in a near-shore urban area, and then igniting is very low. The cloud will most likely ignite from the first available ignition source and progress to a pool fire.

For near-shore operations, risk prevention and risk management should be considered as ways to reduce the hazards to public safety and property.

For offshore operations, there may be fewer ignition sources relative to near-shore operations.

For offshore operations, risk prevention and risk management may have a different focus than near-shore operations, since many spills and associated hazards might not impact the on-shore public and property.

USCG Policy Letter 01-12 April 2012

Policy Letter 01-12 provided a streamlined approach for establishing equivalency under the Code of Federal Regulations, using Interim Guidance published by the International Maritime Organization (IMO) during the development of the *International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels* (IGF) Code as a baseline standard.

This policy provided uniform guidance for the inspection and certification of vessels that are seeking to install an LNG fuel system if there are equivalency provisions included in the regulations applicable to the vessel.

However, this policy is not intended for gas carriers that use their cargo as fuel and comply with the requirements of 46 CFR Part 154 or the IMO's International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

USCG Policy Letter 01-12, Continued

This policy letter only applies to equivalency determinations for U.S.-flagged vessels.

Foreign-flagged vessels using natural gas as fuel while operating in U.S. waters will be expected to provide documentation demonstrating compliance with reference (a) in the form of an endorsement on the vessel's *Safety of Life at Sea* (SOLAS) Passenger Ship Safety Certificate, or Cargo Ship Safety Construction Certificate.

This policy does not provide guidance on operational aspects associated with the use of natural gas as a fuel, nor does it address crew training standards for the handling of natural gas.

LNG by Truck - Top Five Carriers by Trailer Units

In 2017 there were 521 carriers transporting LNG, which represent 9.2 percent of overall hazmat tank truck carriers. While Texas had the most registered power units transporting LNG, Ryl Corp in Florida had the most trailer units.

Photo courtesy of Chart Industries

Table F.1 U.S. LNG Motor Carriers

Carrier	Classification	State	Units
Ryl Corp	Interstate	FL	968
Offshore Petroleum Inc.	Intrastate Hazmat	NJ	659
Willcox Fuel LLC	Intrastate Hazmat	AZ	447
Broedel Fuel Group LLC	Intrastate Hazmat	NY	405
Versaair Services LLC	Interstate	KS	140

Comparing Truck Risk Factors

Photo: Chart Industries

- There are two times as many LPG carriers than LNG carriers.
- Trucks transporting LPG and LNG have historically very low crash rates.
- Truck risk factors include driver behavior, traffic congestion, truck speed, and truck volume
- LNG and LPG carriers require more extensive driver training since drivers must be trained to handle pressurized and cryogenic gas transfers.

LPG and LNG Comparative Risk Factors

LPG (propane, butane) is pressurized to keep in liquid form, the release of which would result in a rapid release of highly flammable product.

By contrast, **LNG** is a cryogenic liquid stored in double-walled containers, the release of which would result in cryogenic liquid releasing at a lower rate, and only igniting within a limited vapor range if an ignition source is present.

FMCSA and PHMSA Regulations for LNG

FMCSA provides safety oversight for all commercial motor vehicles. In the context of this study, FMCSA provides oversight for cargo tank trailers, including MC-338 trailers. This includes conducting inspections of trailers and trailer manufacturing facilities. FMCSA also maintains the Motor Carrier Management Information System (MCMIS) which documents carrier safety fitness and hazardous material shippers subject to the Federal Motor Carrier Safety Regulations.

PHMSA regulates transportation of LNG in commerce, including provisions for portable tank requirements, LNG packaging, and LNG transport by truck, rail and ship. Operator compliance with Federal and state LNG safety regulations is monitored through an inspection and enforcement program with operator management.

LNG and LPG Carrier Crash Analysis

U.S. LNG and LPG carriers and crash rates were evaluated as part of the LNG Risk Assessment. A total of 521 motor carriers transported LNG and 1,237 motor carriers transported LPG in 2017. Both LNG and LPG carriers exhibited crash rates that fell below 0.073 crashes per power unit.

The low crash rates can be attributed to the fact that LNG and LPG carriers represent a small percentage of the overall truck traffic. Also, these carriers have high standards for safety and conduct extensive driver training programs to ensure safe transportation and handling of these fuels.

TRB Standing Committee on the Transportation of Hazardous Materials (AT040)

Mid-Year Meeting - June 23, 2021

David O. Willauer, Chair

June 7, 2019

Washington, DC