



LNG Development Update

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**LSU Center for Energy Studies
Energy Summit 2006
October 25, 2006**

WHAT IS THE CENTER FOR LNG?

- **A broad coalition of more than 60 energy providers, trade associations and consumers**
- **Mission statement:**

‘The Center for LNG strives to be a one-stop information source that distributes educational and technical information. The Center also seeks to facilitate rational issue discussion and the development of public policies that support LNG’s increasing contribution toward meeting the nation’s energy needs and supporting economic growth.’

THE SAFE, CLEAN ENERGY CHOICE



CLNG ACTIVITIES

- **Education**
- **Government outreach**
- **Technical analysis**
- **Legislative & regulatory analysis**
- **Media outreach**



PRESENTATION OVERVIEW

- What is LNG?
- Why the U.S. needs more LNG
- How LNG is brought to market
- LNG has a proven safety record
- Legislative & regulatory activity
- Summary

WHAT IS LIQUEFIED NATURAL GAS?

LNG is natural gas in its liquid form

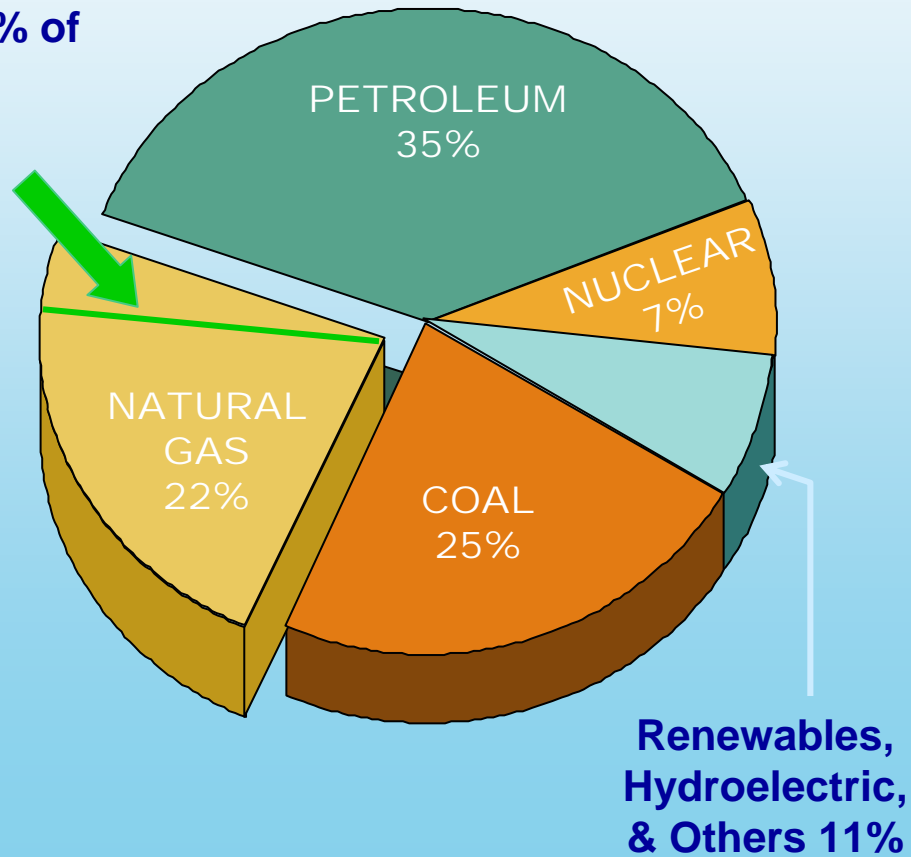
- **It is same natural gas that:**
 - 60 million U.S. consumers use daily to heat and cool their homes;
 - industry uses; and
 - is used for electric power generation
- **LNG has been used safely for over 40 years**
- **Natural gas is converted to LNG by cooling it to -260° F**
- **LNG is 1/600th the volume of gas, allowing for more efficient and economic transportation**
- **LNG is not under pressure for shipping or storage**



Growing LNG Imports to Meet U.S. Energy Needs

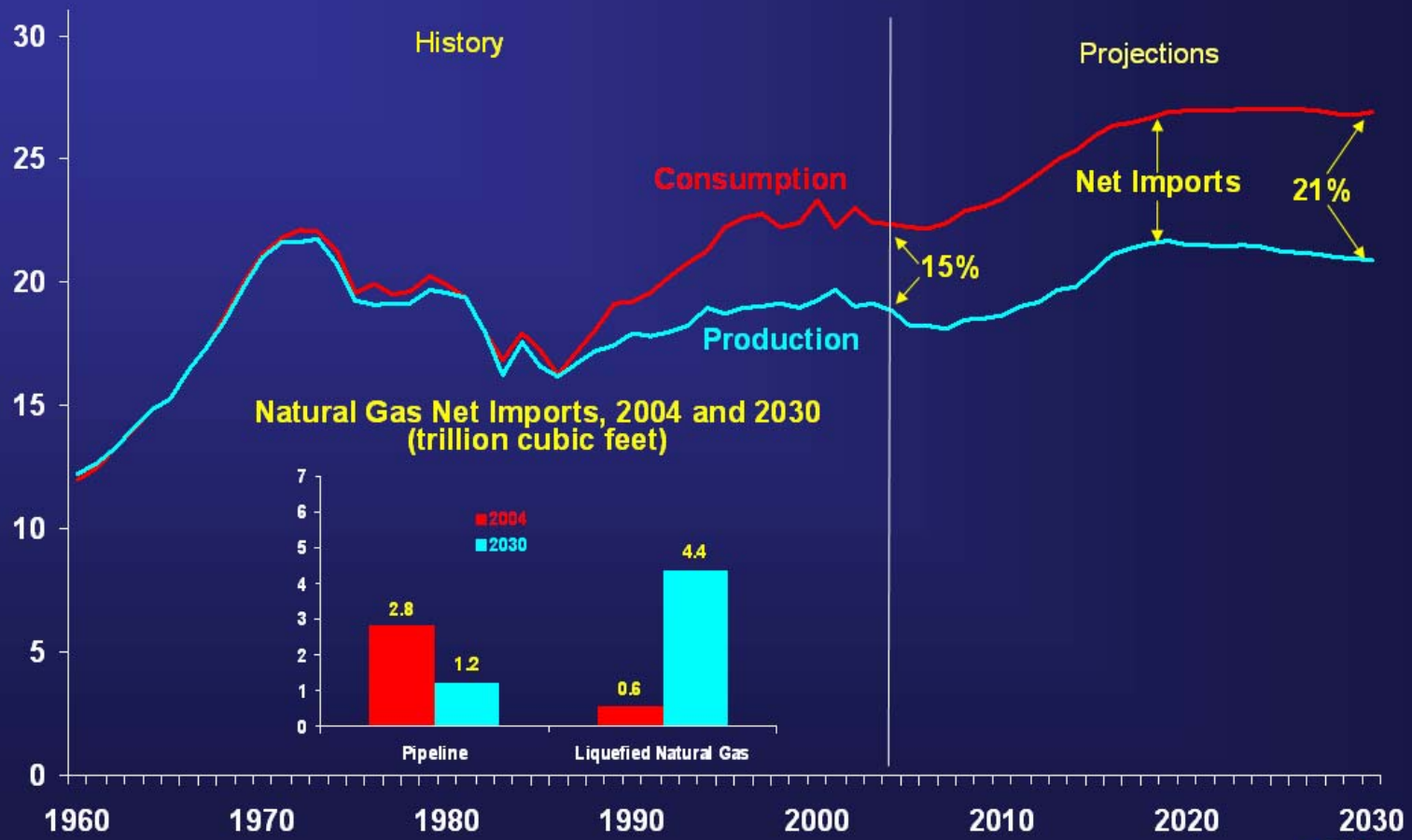
Natural Gas is a Key Element in Projected U.S. Energy Supply 2030 Annual Total

LNG supply forecast as 16% of Natural Gas

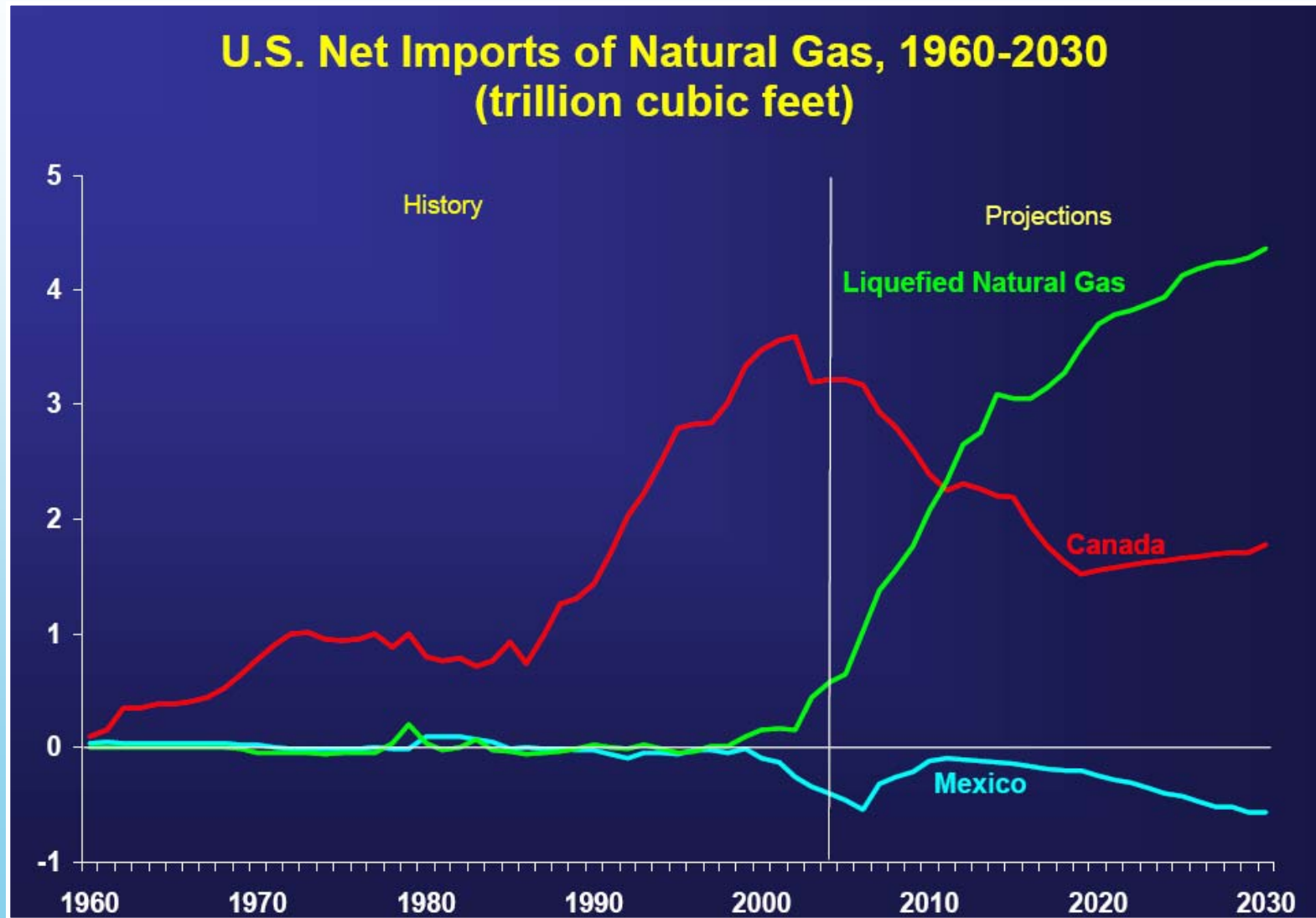


NATURAL GAS CONSUMPTION EXCEEDS SUPPLY

U.S. Natural Gas Production, Consumption, and Net Imports, 1960-2030 (trillion cubic feet)



GROWING LNG IMPORTS TO MEET U.S. ENERGY NEEDS

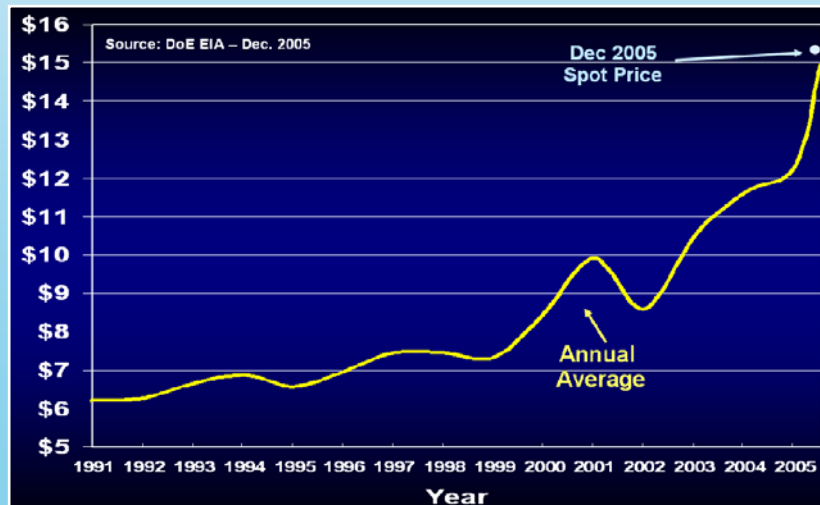


Source: Guy Caruso, *Outlook for U.S. Natural Gas Markets*, DOE EIA , March 2006

WHAT IS THE COST OF DOING NOTHING?

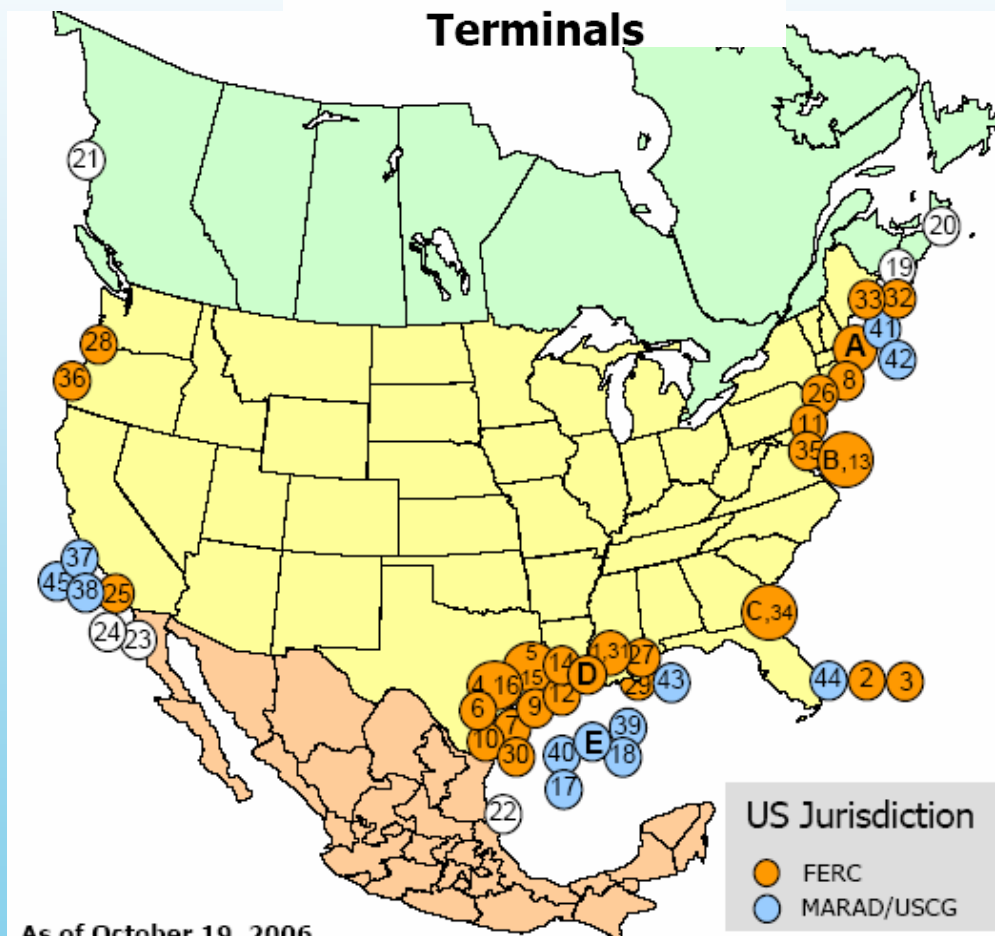
If we expect demand to soar, as every trend suggests ... and if we are finding ourselves increasingly unable to meet that demand ... then how are we going to spare consumers from price shocks? How are we going to continue to power our growing economy? How are we going to generate the electricity to keep the lights on in our factories, our homes, and our schools?'

- Energy Secretary Samuel Bodman



North America LNG Terminal Status October 2006

Existing and Proposed North American LNG Terminals



As of October 19, 2006

* US pipeline approved; LNG terminal pending in Bahamas

** Construction suspended

CONSTRUCTED

- A. Everett, MA : 1.035 Bcfd (SUEZ/Tractebel - DOMAC)
- B. Cove Point, MD : 1.0 Bcfd (Dominion - Cove Point LNG)
- C. Elba Island, GA : 1.2 Bcfd (El Paso - Southern LNG)
- D. Lake Charles, LA : 2.1 Bcfd (Southern Union - Trunkline LNG)
- E. Gulf of Mexico: 0.5 Bcfd (Gulf Gateway Energy Bridge - Excelerate Energy)

APPROVED BY FERC

- 1. Hackberry, LA : 1.5 Bcfd (Cameron LNG - Sempra Energy)
- 2. Bahamas : 0.84 Bcfd (AES Ocean Express)*
- 3. Bahamas : 0.83 Bcfd (Calypso Tractebel)*
- 4. Freeport, TX : 1.5 Bcfd (Cheniere/Freeport LNG Dev.)
- 5. Sabine, LA : 2.6 Bcfd (Sabine Pass Cheniere LNG)
- 6. Corpus Christi, TX: 2.6 Bcfd (Cheniere LNG)
- 7. Corpus Christi, TX : 1.1 Bcfd (Vista Del Sol - ExxonMobil)
- 8. Fall River, MA : 0.8 Bcfd (Weaver's Cove Energy/Hess LNG)
- 9. Sabine, TX : 2.0 Bcfd (Golden Pass - ExxonMobil)
- 10. Corpus Christi, TX : 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)
- 11. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG - BP)
- 12. Port Arthur, TX: 3.0 Bcfd (Sempra)
- 13. Cove Point, MD : 0.8 Bcfd (Dominion)
- 14. Cameron, LA : 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
- 15. Sabine, LA : 1.4 Bcfd (Sabine Pass Cheniere LNG - Expansion)
- 16. Freeport, TX : 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)

APPROVED BY MARAD/COAST GUARD

- 17. Port Pelican: 1.6 Bcfd (Chevron Texaco)
- 18. Louisiana Offshore : 1.0 Bcfd (Gulf Landing - Shell)

CANADIAN APPROVED TERMINALS

- 19. St. John, NB : 1.0 Bcfd (Canaport - Irving Oil)
- 20. Point Tupper, NS : 1.0 Bcfd (Bear Head LNG - Anadarko)
- 21. Kitimat, BC : 0.61 Bcfd (Galveston LNG)

MEXICAN APPROVED TERMINALS

- 22. Altamira, Tamulipas : 0.7 Bcfd (Shell/Total/Mitsui)
- 23. Baja California, MX : 1.0 Bcfd (Energy Costa Azul - Sempra)
- 24. Baja California - Offshore : 1.4 Bcfd (Chevron Texaco)

PROPOSED TO FERC

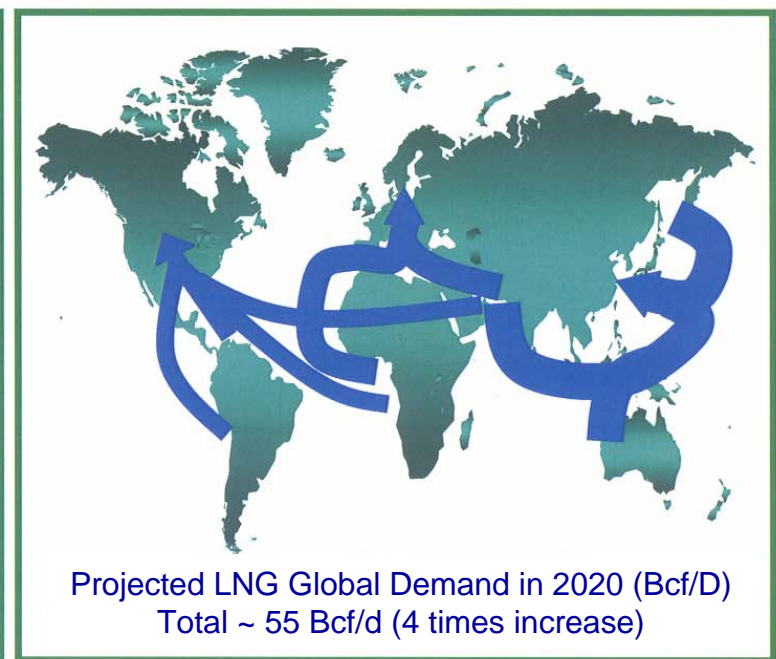
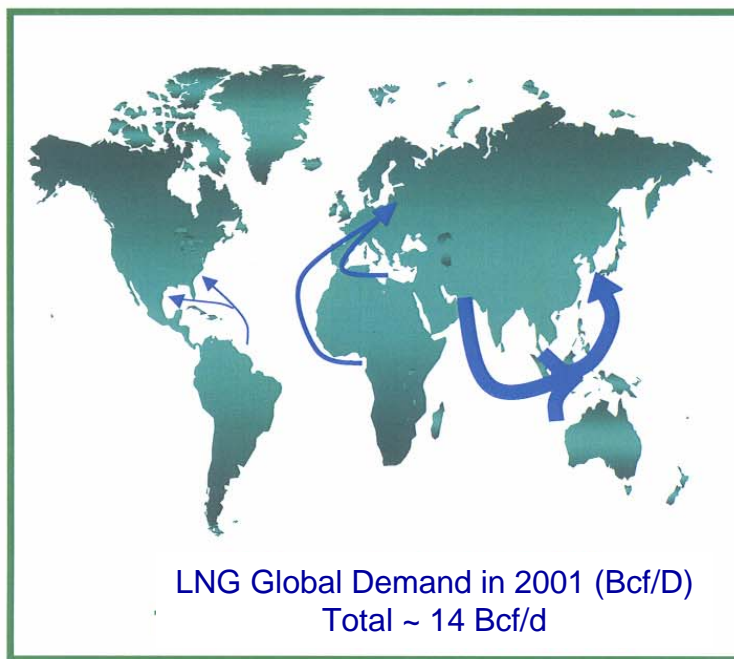
- 25. Long Beach, CA : 0.7 Bcfd, (Mitsubishi/ConocoPhillips - Sound Energy Solutions)
- 26. LI Sound, NY: 1.0 Bcfd (Broadwater Energy - TransCanada/Shell)
- 27. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Energy LLC)
- 28. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
- 29. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - ChevronTexaco)
- 30. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
- 31. Hackberry, LA : 1.15 Bcfd (Cameron LNG - Sempra Energy - Expansion)
- 32. Pleasant Point, ME : 2.0 Bcfd (Quoddy Bay, LLC)
- 33. Robbinston, ME: 0.5 Bcfd (Downeast LNG - Kestrel Energy)
- 34. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG)
- 35. Baltimore, MD: 1.5 Bcfd (AES Sparrows Point - AES Corp.)
- 36. Coos Bay, OR: 1.0 Bcfd (Jordan Cove Energy Project)

PROPOSED TO MARAD/COAST GUARD

- 37. Offshore California : 1.5 Bcfd (Cabrillo Port - BHP Billiton)
- 38. Offshore California : 0.5 Bcfd, (Clearwater Port LLC - NorthernStar NG LLC)
- 39. Offshore Louisiana : 1.0 Bcfd (Main Pass McMoran Exp.)
- 40. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
- 41. Offshore Boston: 0.4 Bcfd (Neptune LNG - SUEZ LNG)
- 42. Offshore Boston: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)
- 43. Gulf of Mexico: 1.4 Bcfd (Bienville Offshore Energy Terminal - TORP)
- 44. Offshore Florida: ? Bcfd (SUEZ Calypso - SUEZ LNG)
- 45. Offshore California: 1.2 Bcfd (OceanWay - Woodside Natural Gas)

GROWING GLOBAL LNG TRADING

- **LNG trade is forecast to increase by a factor of 4 by 2020**
- **U.S. LNG demand is met by countries like Trinidad; more diverse sources to be utilized in future**
- **U.S. market is one of several competing for supply**



BRINGING LNG TO THE MARKET

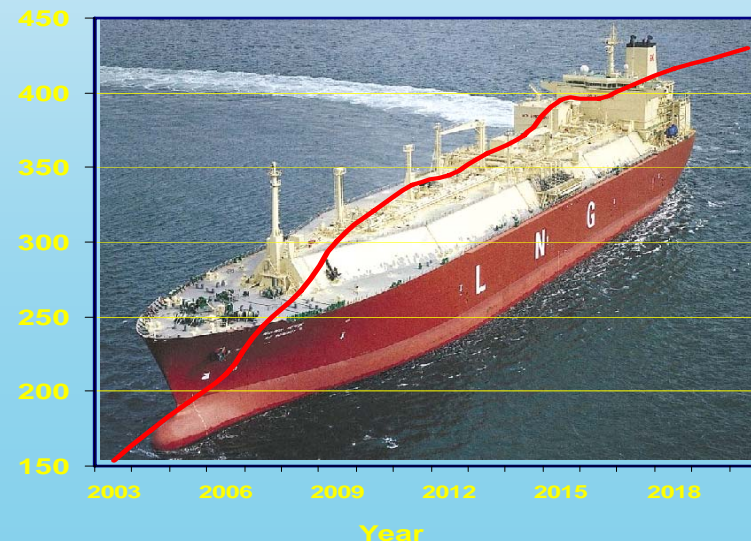
- **Natural gas is produced in countries with vast supplies that exceed their domestic energy demand**
- **Gas is condensed to a liquid and transported by ship**
- **At the receiving terminal, LNG is re-gasified and is distributed via pipeline as ordinary natural gas**



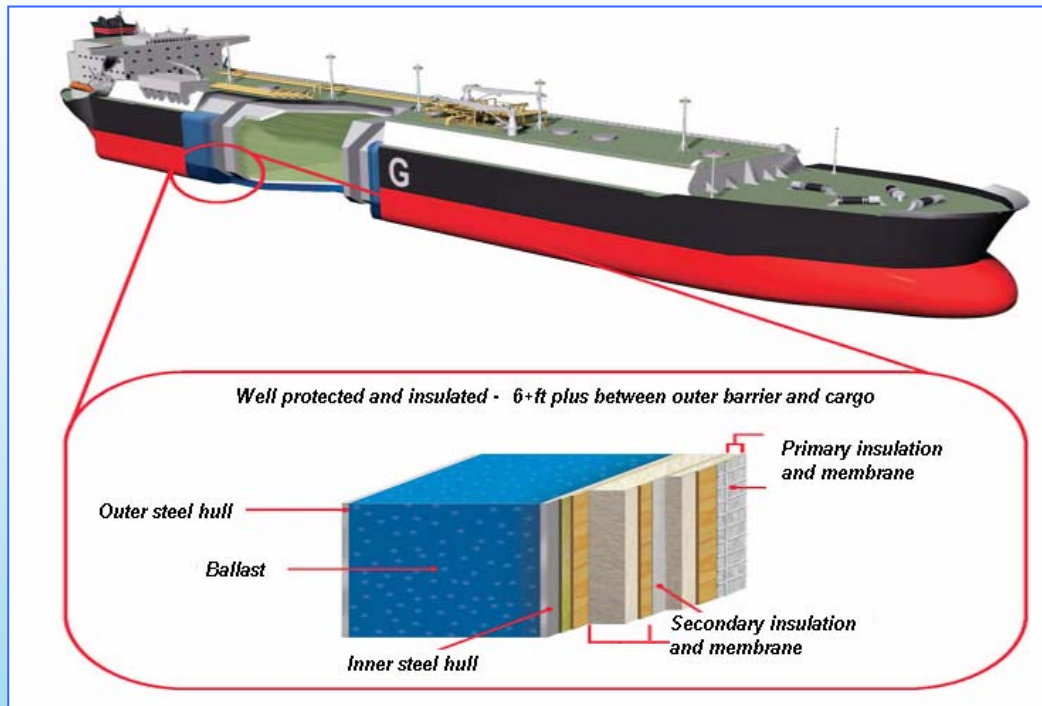
LNG SHIPPING CAPACITY INCREASES

- **First LNG shipment by sea in 1959**
- **Current fleet of more than 190 vessels is expected to double over the next decade**
- **Vessel capacity continues to increase while using technological advances to enhance safety & security**
- **Ships are built and operated according to International Maritime Organization and International Ship & Port Security codes**

Total LNG Vessels in Service



SAFETY FEATURES ON LNG SHIPS



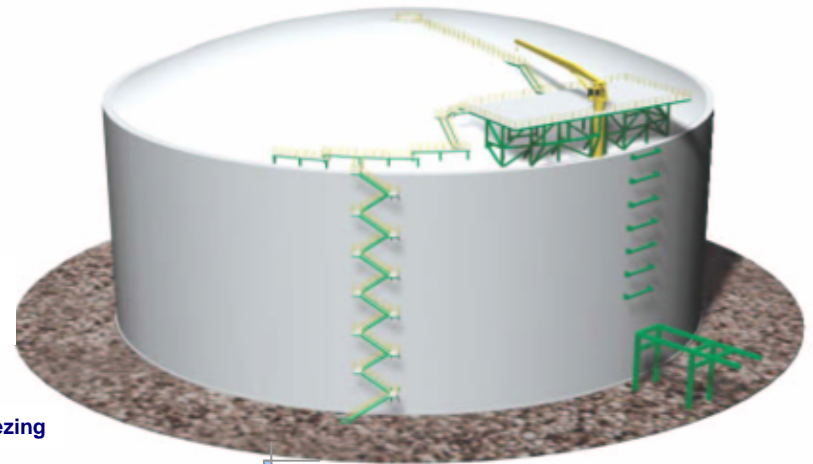
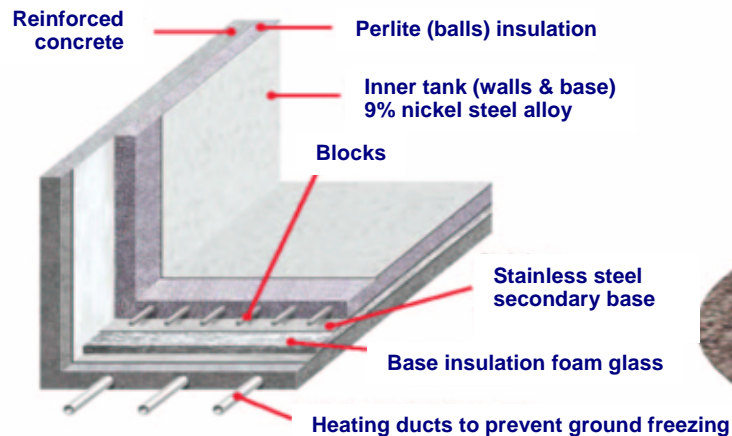
Excellent safety record – more than 80,000 carrier voyages covering more than 100 million miles without a major incident in LNG's 40+ year history.*

- **Multiple layers of containment & security**
- **Double-hull construction; 6-10 ft between hulls**
- **Cargo tanks provide 3rd layer of protection**
- **Gas detectors and safety alarms for continuous leak detection and monitoring**
- **Safety and security zones in established port areas**

*Source: Sandia National Laboratories, December 2004

ROBUST ONSHORE LNG STORAGE DESIGN

Cross section of tank walls:
About 5.5 ft thick



- **Typical LNG storage tank design features multiple containment and security layers**
- **Constructed using proven technology & materials**

‘The Commission’s LNG program illustrates our strong commitment to protecting public health and safety, and we consistently apply very high safety standards.’ -- FERC Chairman Joseph T. Kelliher

RECENT LEGISLATIVE & REGULATORY CHANGES

- **Energy Policy Act of 2005 – LNG provisions**
 - Clarifies the approval process by reaffirming FERC’s role as lead agency for onshore permitting; preserves significant state/local participation in the permitting process
 - Gives authority to FERC to set a specific schedule
 - Authorizes states to review safety aspects and inspect operating facilities
 - Requires emergency response plans including cost sharing for preparedness

- **U.S. Coast Guard – Waterway Suitability Assessment**
 - Complete prior to submitting terminal application
 - Characterization of terminal & tanker route
 - Risk assessment; safety & security resources needs

DRIVERS FOR SITING LNG TERMINALS

Requirements

- Adequate market
- Deepwater accessibility & harbor facility
- Existing pipeline network
- Federal, state and local support

Considerations

- Public perception
- Safety & security
- Environmental impacts
- Permitting
 - NEPA, CWA, CAA, CZMA
- Investment costs
- Long lead times (5-7 years)

SUMMARY

- **LNG is needed to meet increasing U.S. demand for natural gas**
 - LNG will supplement, not replace, domestic natural gas production
- **More LNG receiving terminals and supplies are required to meet growing energy demand**
- **LNG industry's top priorities are safety & security**
- **LNG industry has a proven record of safe & secure operations**
- **LNG industry is extensively regulated**
- **Residential and industrial consumers will benefit from new LNG supplies**

U.S. needs LNG for reliable and balanced energy supply.



FOR MORE INFORMATION

Contact or visit:



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OFFSHORE TERMINAL DESIGNS

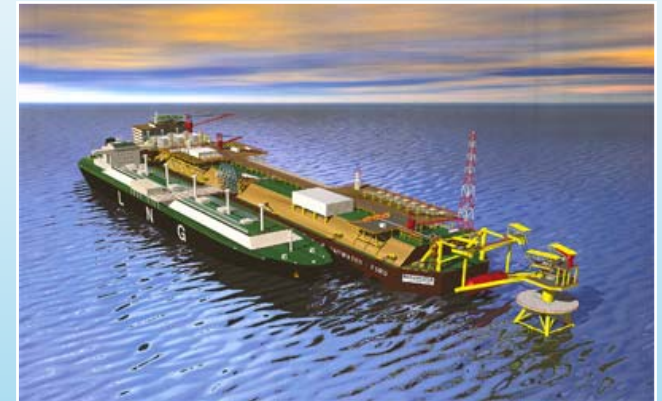


Moored Buoy System with pipeline to shore

- Special ships moor to buoy
- Regasification done on board the ship
- Ship departs once LNG regasified

Floating, Storage and Regasification Unit

- Terminal is a specially designed moored vessel
- LNG storage and regasification done on board
- Natural gas piped to shore



Gravity Based Structure

- Terminal is submerged concrete structure
- LNG storage and regasification done on terminal
- Natural gas piped to shore



LNG IS NATURAL GAS



- **LNG is interchangeable with other natural gas sources**
 - **All natural gas supplies have a variable composition**

- **Gas specifications can be mutually set to ensure safe, reliable and efficient operation of pipeline facilities, customer's equipment, and end user appliances**

- **To encourage development of LNG infrastructure and maximize supply, pipeline gas quality specifications are needed to resolve uncertainty with respect to natural gas quality and interchangeability**

- **On June 15, FERC issued a Policy Statement that provides direction for addressing gas quality and interchangeability concerns**

“Interchangeability is the ability to substitute one gaseous fuel for another in a combustion application without materially changing operational safety, efficiency, performance” NGC – 2005

OFFSHORE LNG TERMINALS SEAWATER USE

- **Some Offshore terminals propose to use seawater to warm the LNG; a process known as Open Loop Vaporization (OLV)**
 - Using seawater for revaporization of LNG is a proven technology used throughout the world for 30 years
- **Impacts to fisheries is the primary environmental concern for using OLVs in the Gulf of Mexico**
- **All GOM terminal Environmental Impact Statements have concluded that OLV use has minimal impacts to fisheries**
 - EISs based on NOAA methodology and 20 years of data
 - Calculations did not reflect protective measures designed to reduce impacts or other site specific mitigation measures
- **CLNG sponsored an independent review of fisheries impact analyses in proposed GOM terminal EISs. Conclusions:**
 - Minor environmental impact with OLV use
 - Minor impacts presented in EISs are over-stated
 - Cumulative impacts even less than insignificant impacts predicted in EISs

SECURITY IS A TOP PRIORITY

Comprehensive Assessment Methodology



Multiple layers of security minimize threats

- Design standards (e.g., double-hulled ships), operational security, intelligence

Collaboration with expert agencies: USCG, DOE, FERC, DHS, etc.

- Multiple agencies working intensely and cooperatively to mitigate risks, overall and on site-specific basis

Sandia National Lab Report (Dec 04) – Risks are manageable:

- Risks from intentional events can be significantly reduced through site-specific security, planning, prevention and mitigation measures

‘The Sandia study confirms that LNG tankers are very strong ships and ... site specific risk management activities that the Coast Guard already has in place can significantly reduce the possibility of a major loss of cargo from an accident or attack.’ - Rear Adm. Thomas H. Gilmour, US Coast Guard (Dec 2004)

PERMITTING AGENCIES

Rigorous 12-18 month process

- FERC lead for onshore terminals
- USCG lead for offshore terminals

NEPA Environmental Impact

Statement drives project

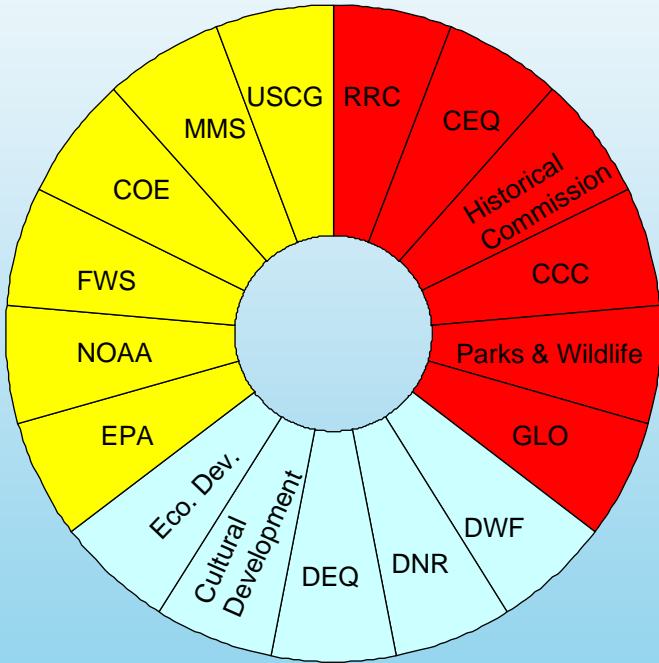
- Collaboration with state and federal agencies
- Multiple opportunities for public input and community meetings

13 resource reports required for terminal; 12 more for associated pipelines

- Engineering design
- Impacts on fish, wildlife, vegetation
- Air and water quality and water usage
- Terminal and ship safety and security
- Impact on cultural resources;
- Socioeconomic effects

Federal Agencies
FERC, Coast Guard,
MMS, etc.

State Agencies
Public Utility Commission,
General Land Office,
Environmental Agencies,
Historical Agencies, etc.



Wheel shows 18 primary agencies for a terminal project in Texas with pipeline extending into Louisiana