



Today's Briefing

- **Introduction of Energy Commission**
- **Overview of LNG and its properties**
- **Review of LNG terminal concepts**
- **Summary of LNG safety and environmental issues**
- **Answer questions**



California Energy Commission

As the state's energy policy agency, the Energy Commission:

- Promotes energy efficiency and renewables
- Manages state's power plant licensing
- Conducts long term energy supply, demand, and price forecasting
- Determines need for new energy infrastructure
- Considers risks to reliable service and reasonable, stable prices



Why the interest lately in liquefied natural gas?

- **The U.S. is relying more on natural gas for cleaner power generation.**
- **Canadian and Lower 48 states' gas production is declining.**
- **LNG links U.S. consumers to transoceanic gas supplies from many countries.**
- **LNG delivery costs have declined.**



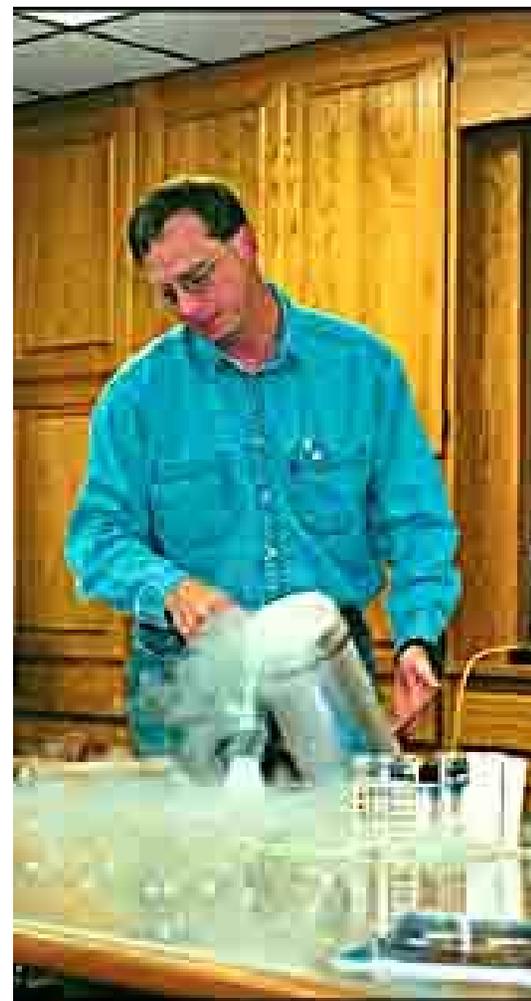
What is LNG?





LNG is natural gas in liquid form.

- Primarily methane
- Cryogenic (-260°F)
- Non-toxic and non-corrosive
- 1/600th volume of natural gas
- Colorless and odorless
- Hazardous due to cold temperature





As a liquid, LNG:

- Is stored as a boiling liquid in well-insulated tanks at near-atmospheric pressure
- Floats on water, then vaporizes
- Spill on water may result in a rapid phase transition (physical explosion)





LNG Vapor Cloud Characteristics

- **Looks like fog**
- **Lighter than air once above -160°F**
- **Leaves no residue on land or water after it disperses**





LNG Vapor Cloud Characteristics, continued

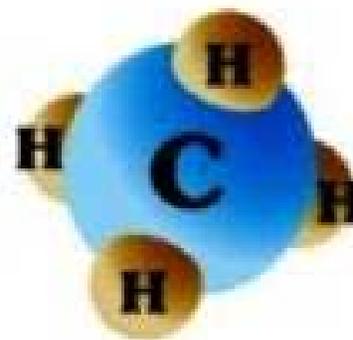


- **Highly flammable when concentration is between 5 and 15 %**
- **Vapor cloud can migrate if not ignited**
- **Not explosive, unless ignited in an enclosed space**



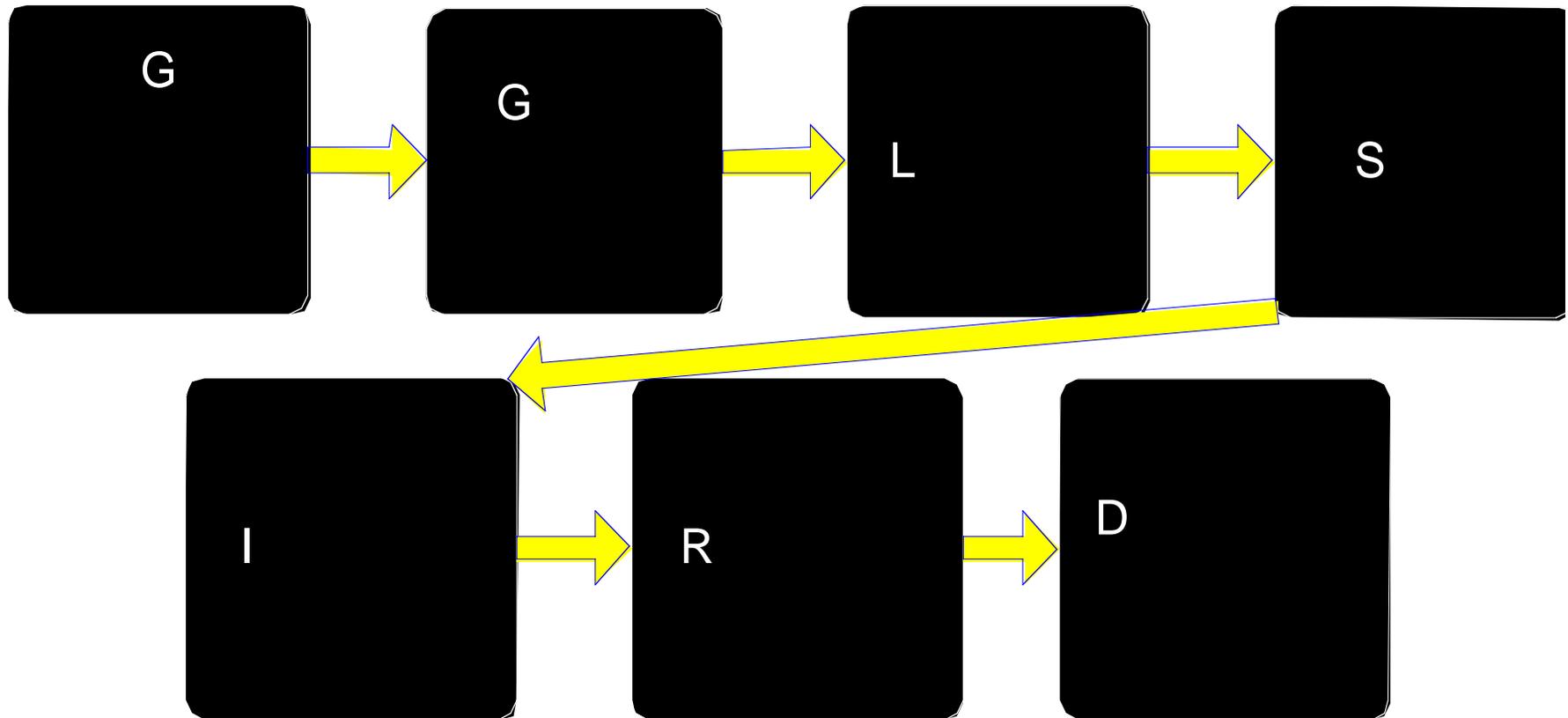
How is LNG Used?

- **As natural gas:**
for heating & cooking, electricity generation, industrial feedstock (e.g., fertilizer and chemicals)
- **As LNG:**
For vehicle fuel, storage supplement to gas utility's inventories





The LNG “Supply Chain”



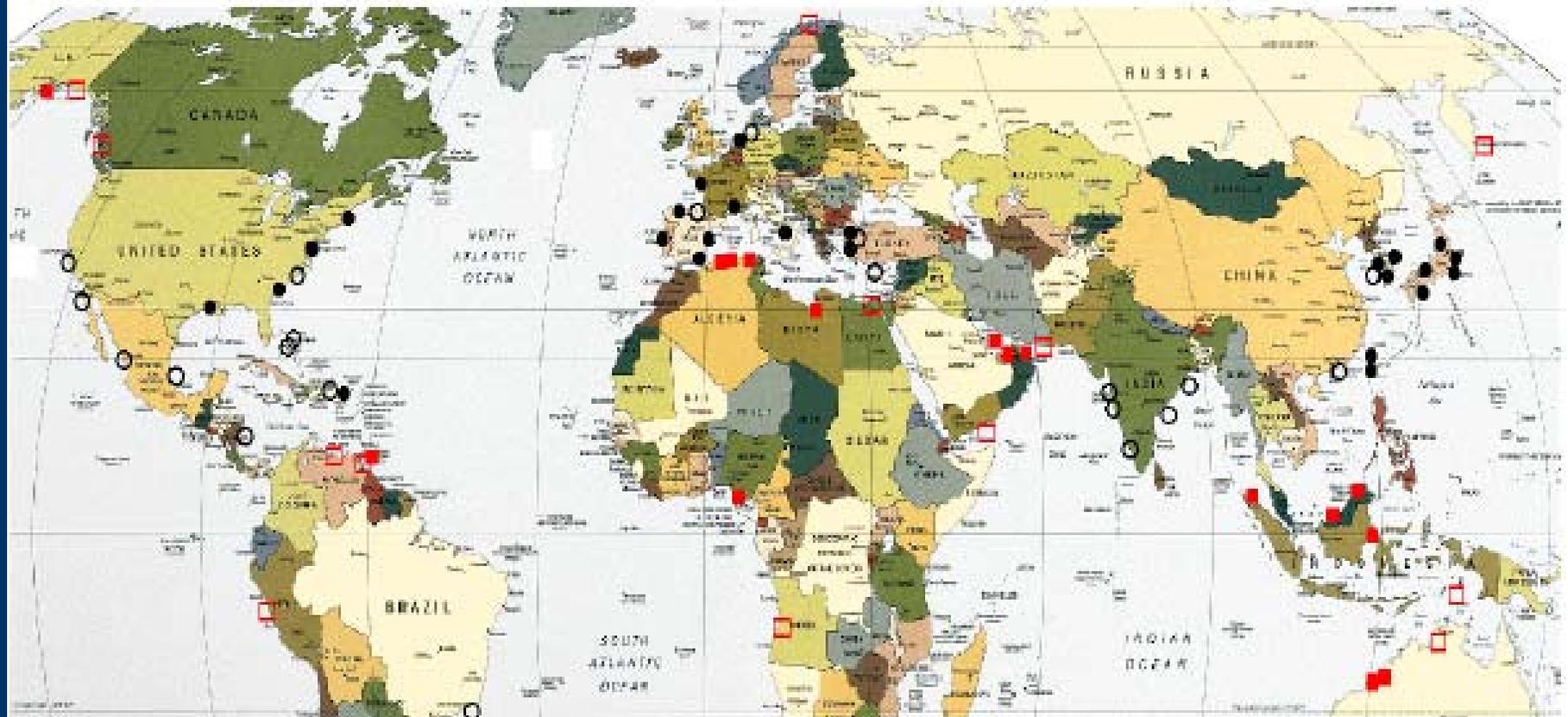


The LNG Industry

- **Approximately 30 years old**
- **Atlantic Basin market:**
 - **Belgium, France, Greece, Italy, Portugal, Spain, Turkey, and the United States**
- **Pacific Rim market:**
 - **Japan, South Korea, and Taiwan**
- **More than 40 receiving terminals worldwide**



Worldwide LNG Facilities



- - Existing LNG Import Terminals
- - Planned Import Terminals
- - Existing LNG Export Terminals
- - Planned Export Terminals

Source: *CH-IV International*



Current Sources of LNG



Algeria



Australia



Brunei



Indonesia



Libya

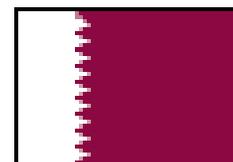


Malaysia

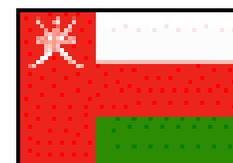
Nigeria



Qatar



Oman



Trinidad and Tobago



United Arab Emirates

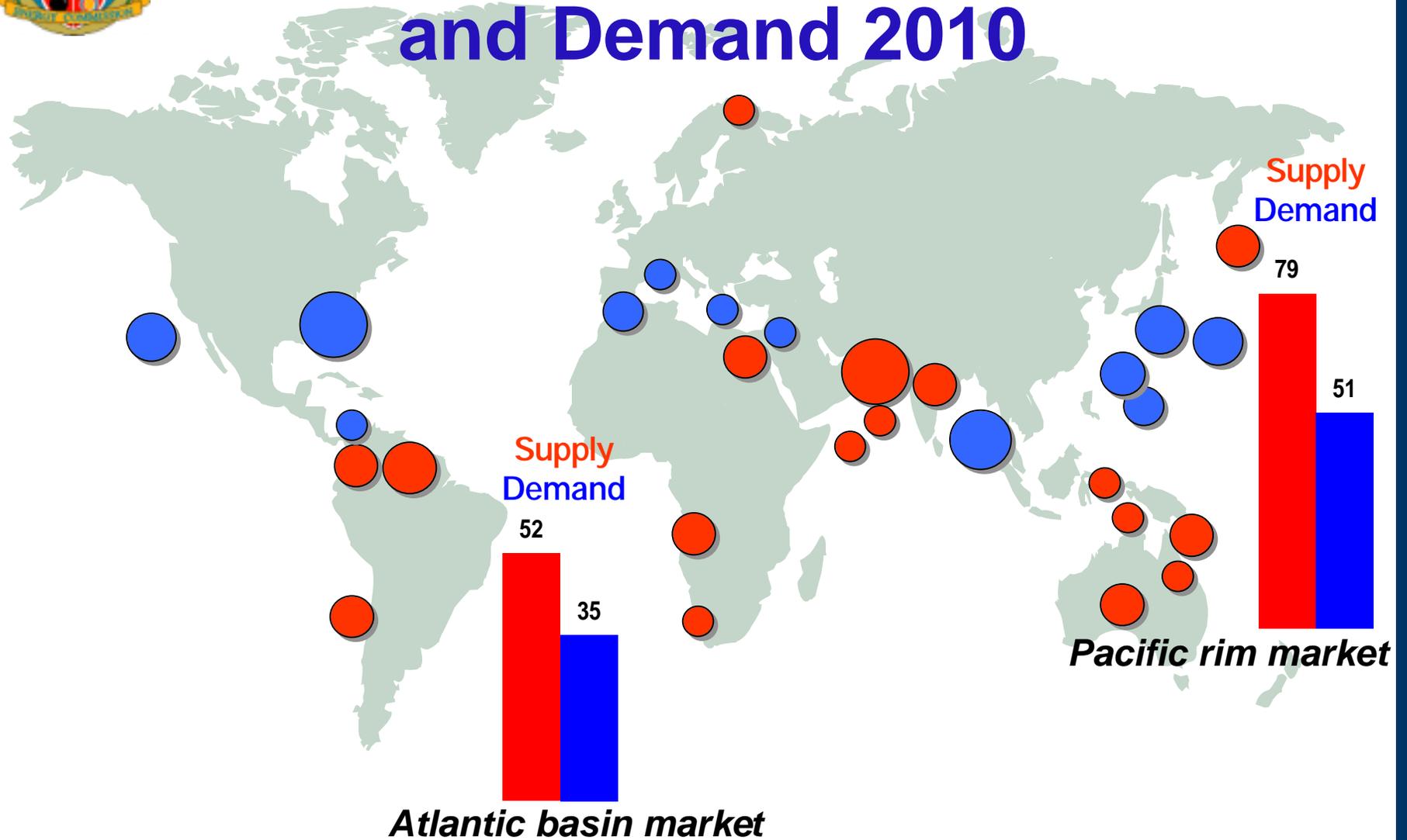


United States





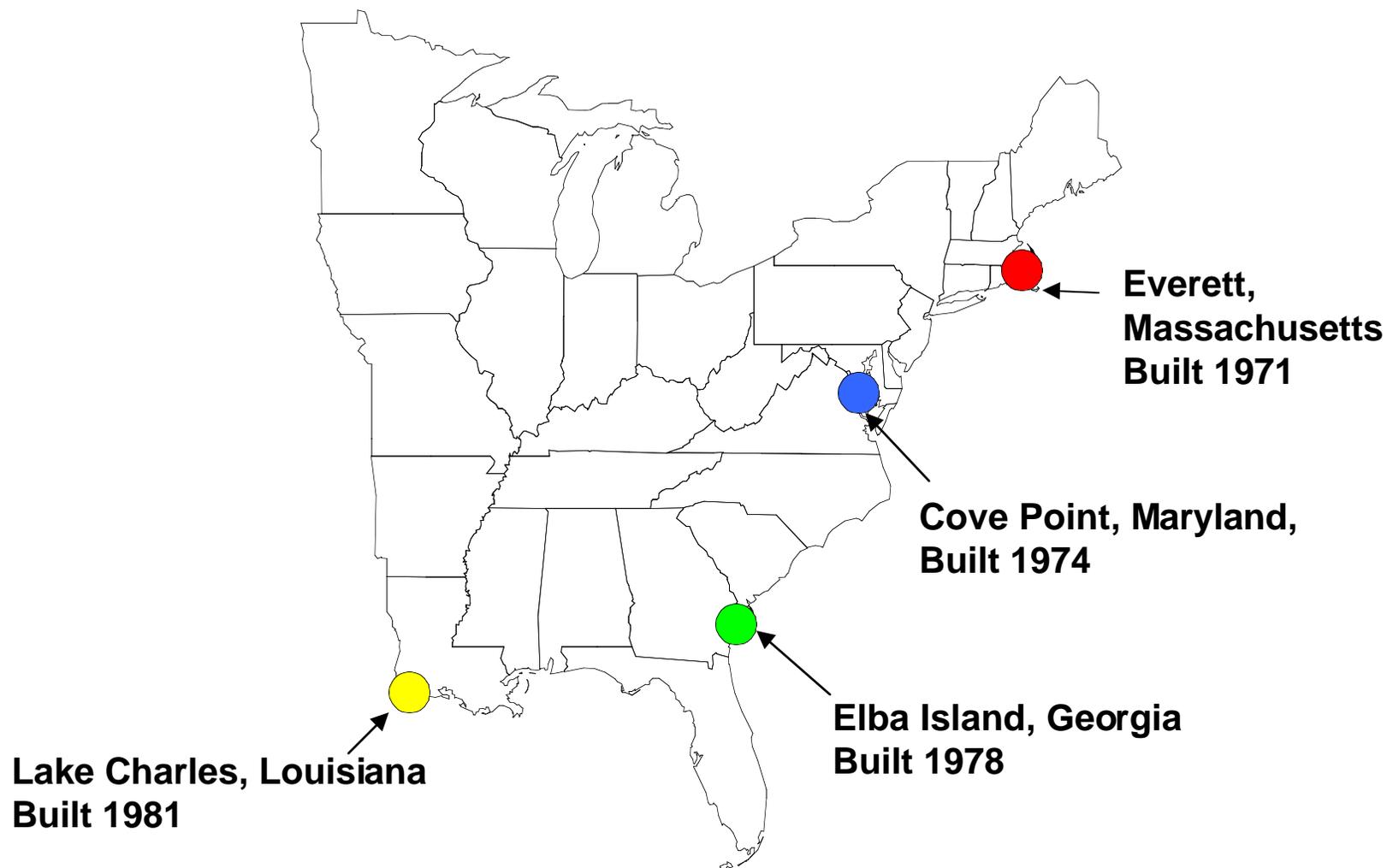
LNG Potential Supply and Demand 2010



(totals in million tons per year)



U.S. LNG Import Facilities





All U.S. import facilities are expanding their output capacity

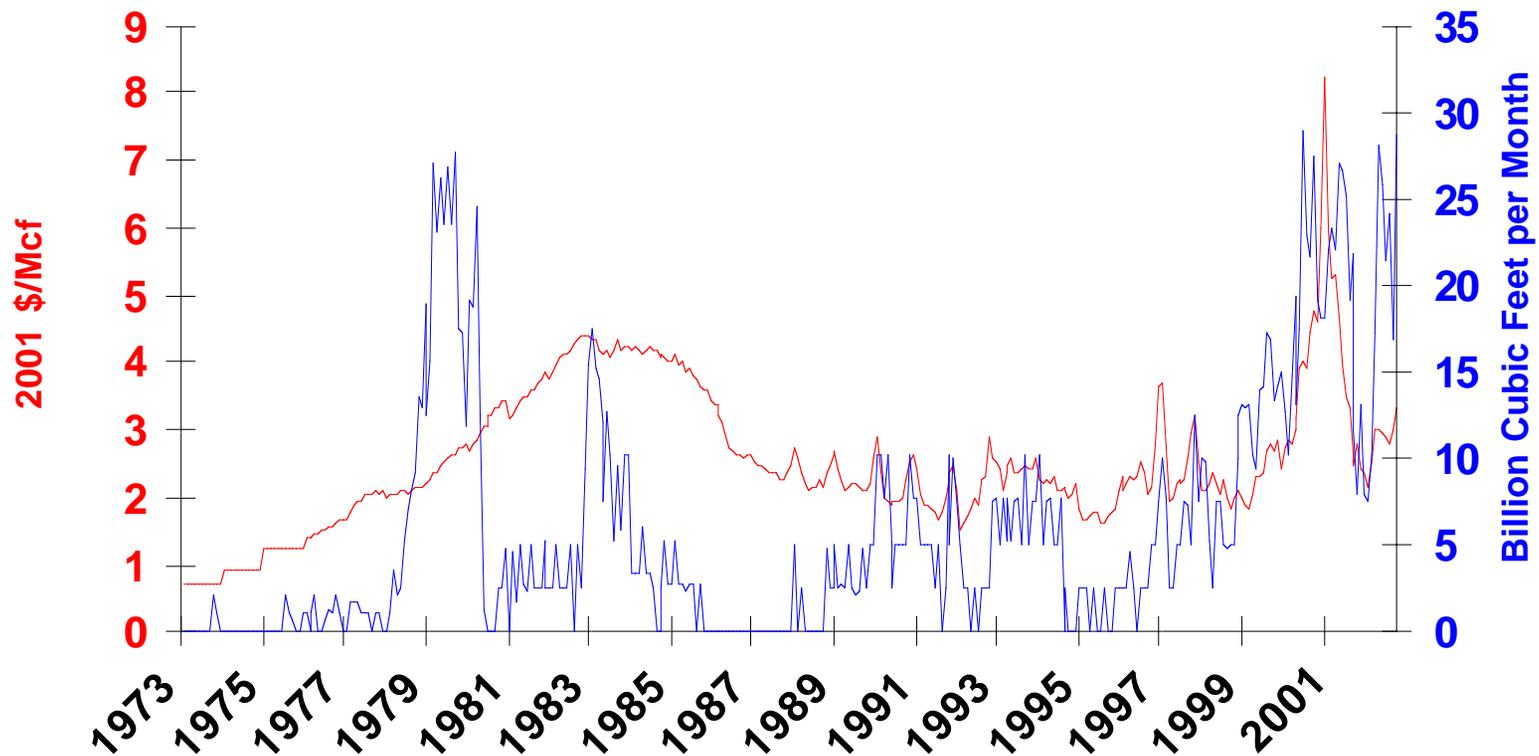
	<u>Existing</u>	<u>Proposed</u>
• Everett, Massachusetts	435 MMcf/d	_ 700 MMcf/d
• Cove Point, Maryland	430 MMcf/d	_ 1 Bcf/d
• Elba Island, Georgia	600 MMcf/d	_ 1.2 Bcf/d
• Lake Charles, Louisiana	750 MMcf/d	_ 1 Bcf/d

Total 2,215 MMcf/d _ 3.9 Bcf/d

(MMcf/d = million cubic feet per day; Bcf/d = billion cubic feet per day)



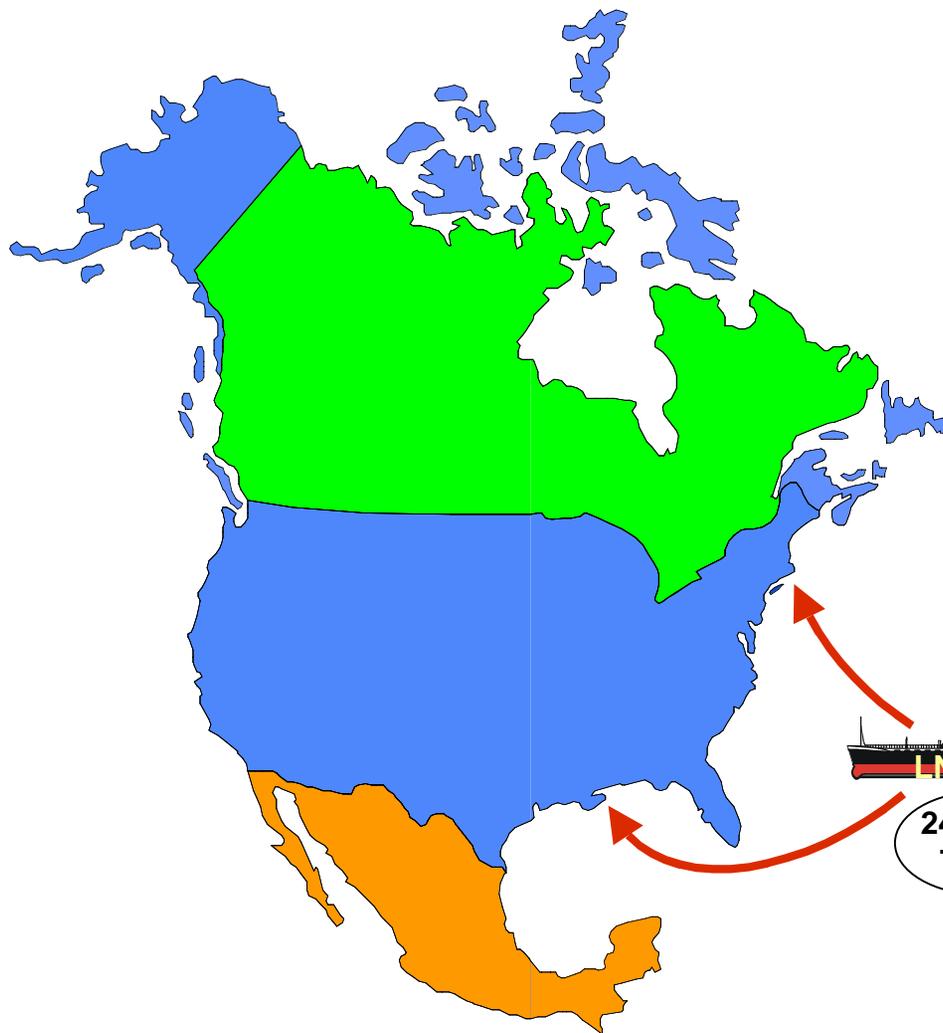
Trends in LNG Imports relative to natural gas prices



SOURCE: *Energy Information Administration*



Current U.S. Sources of LNG



Algeria



Australia



Indonesia



Nigeria



Oman



Qatar



Trinidad and Tobago



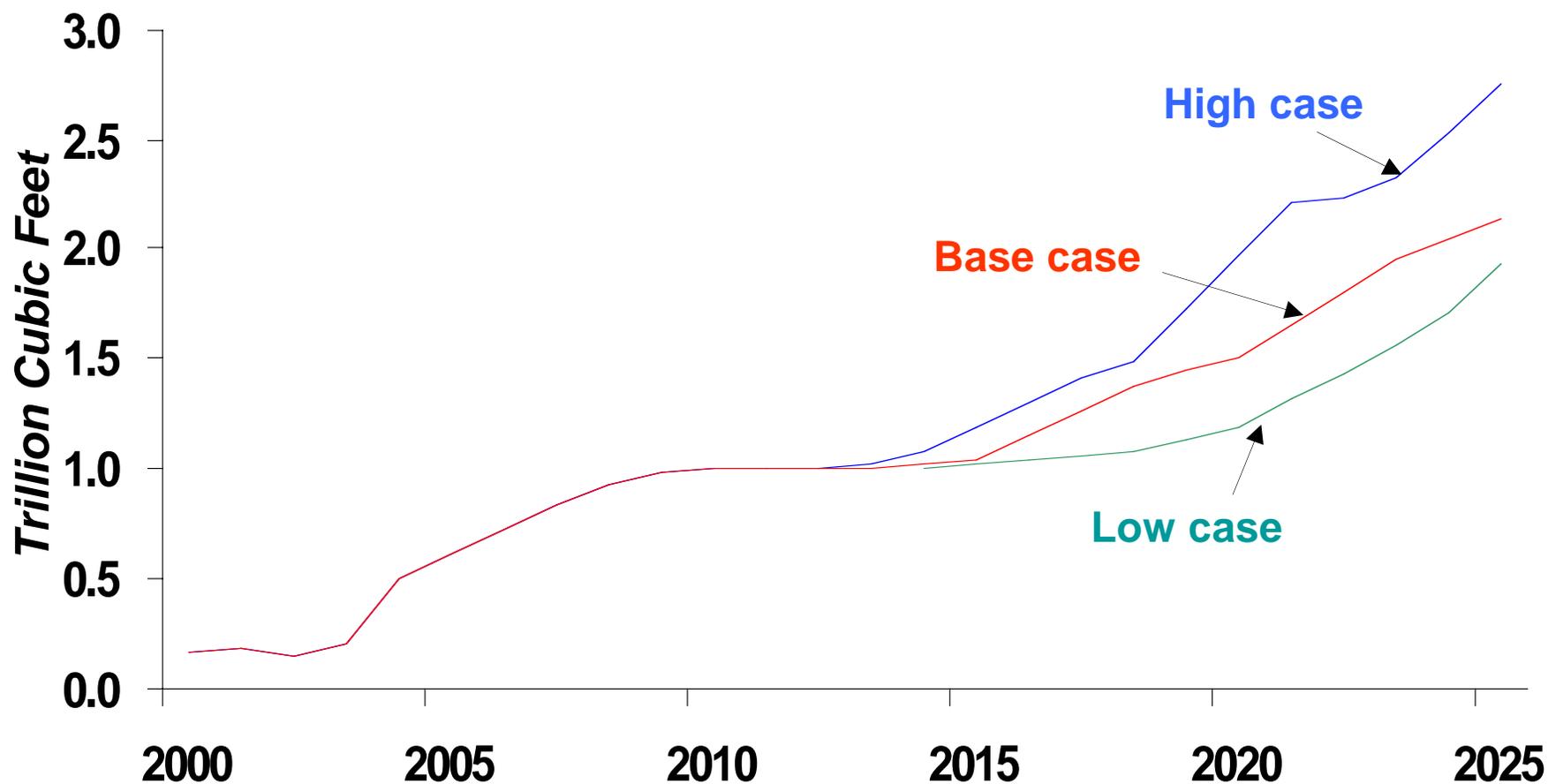
United Arab Emirates



245 Bcf
Total



Projected Net LNG Imports 2000-2025



SOURCE: *Energy Information Administration*



Potential LNG Sources for the West Coast

Source Country	Distance (One-way, @ 18.5 knot ship speed)
Oman	25 days
Australia	18 days
Malaysia	17 days
Indonesia	16 days
Brunei	16 days
Russia	11 days
Alaska	5 days



Transporting LNG





LNG is transported in specially designed ships

- Most carriers are 900 feet long, 140 feet wide, 40 feet high
- Carry \approx 35 million gallons of LNG, 3 Bcf





LNG Carriers

- Are double-hulled and well-insulated
- Store LNG at near-atmospheric pressure (not pressurized)
- Use “boil off” gas as on-board fuel
- Include safety features for ship- and cargo-handling





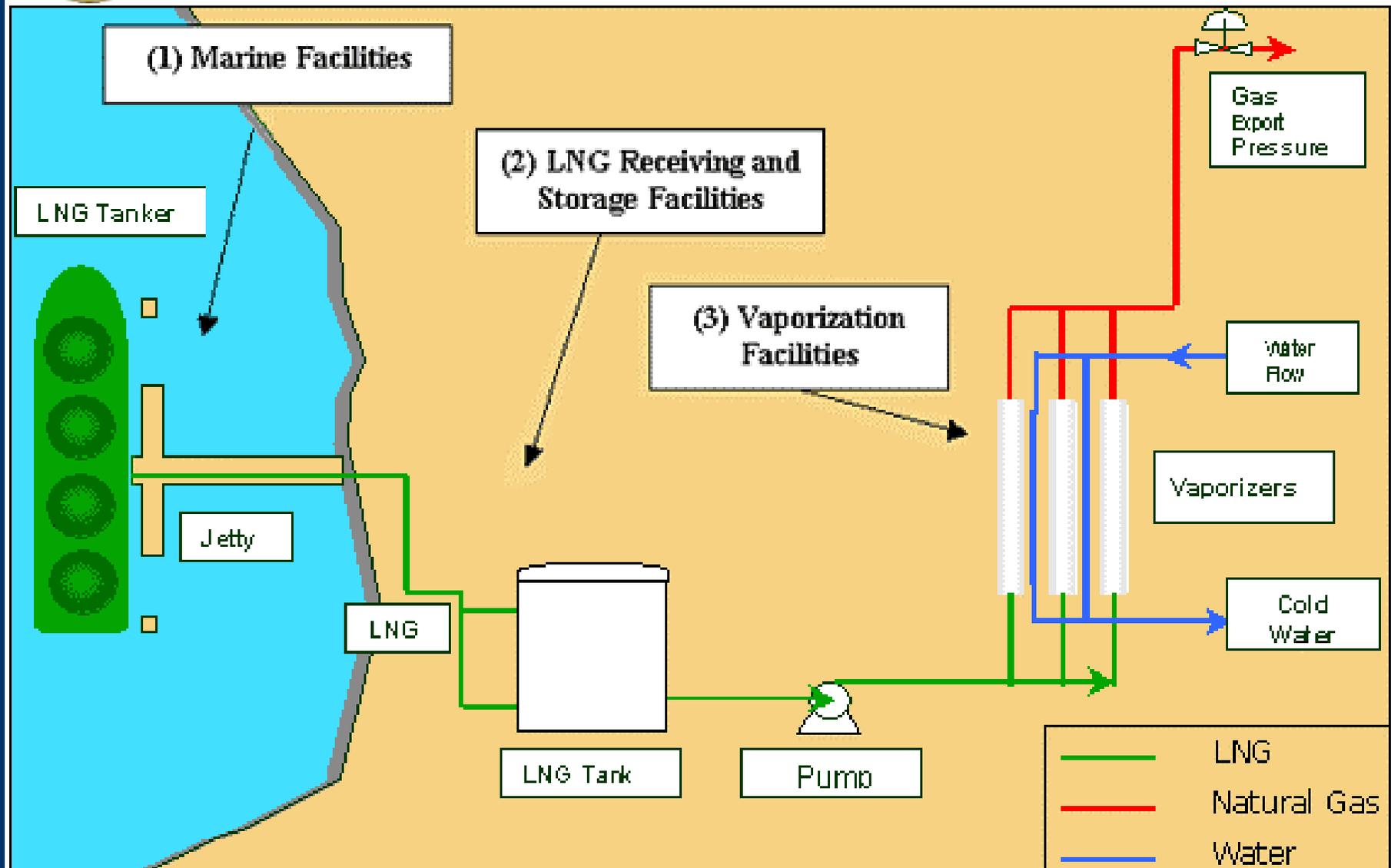
LNG Terminal Components

- **Ship dock**
- **Unloading arms**
- **Storage tanks**
- **Vaporizers**
- **Control room**
- **Connection to utility-pipe network**





LNG Facility Layout





LNG Facility Site Choices

Onshore

- Existing, deep-water port
- Less-populated coastline

Onshore facilities require suitable acreage for safety exclusion zones





LNG Facility Site Choices

Offshore

- Attached to platform
- Attached to pipeline with vaporization on carrier
- Artificial island
- Floating, moored to seabed





LNG Terminal Siting “Best Practices”

- Access to deep-water port
- Carrier traffic compatible with other shipping
- Suitable acreage for safety exclusion zones





LNG Terminal Siting “Best Practices” (cont.)

- **Access to pipeline infrastructure**
- **Local community acceptance**
- **Consistent with current land-use zoning**
- **Coordinated federal, state, and local environmental approvals**
- **Use of latest storage and transfer-system technologies**



LNG Safety Concerns

- **A pool fire or an ignited vapor cloud from a large release of LNG will burn intensely.**
 - Potential harm to plant employees
 - Potential damage to plant facility
 - Potential damage to offsite facilities
- **Limited ability to fight fires**
 - Vapor cloud will burn back to source
 - Foam generators can suppress and extinguish small pool fires
 - Large pool fires must burn themselves out
- **Other: direct contact**
 - Cryogenic temperatures
 - Asphyxiation





LNG facilities have buffer zones for public safety

- ***Thermal exclusion zones* are designed to prevent public exposure to thermal radiation from a fire.**
- ***Vapor dispersion zones* are designed to prevent public exposure to unlit vapor clouds.**



LNG Carrier Safety Record

- **No LNG cargo spills due to ship collisions, groundings, fires, explosions, or hull failures**
- **No damage to land-based property or the environment due to LNG releases from carriers**
- **No fatalities**

SOURCE: *Lloyd's Register*



Two Fatal Accidents at LNG Plants

- **1944 - Cleveland, Ohio (peak-shaving plant)**
Storage tank failed. LNG spilled into the sewer.
Underground explosion killed 128 people.
- **1979 - Cove Point, Maryland**
Valve leaked LNG along an electrical conduit
and into an equipment room. Explosion killed
a plant employee.

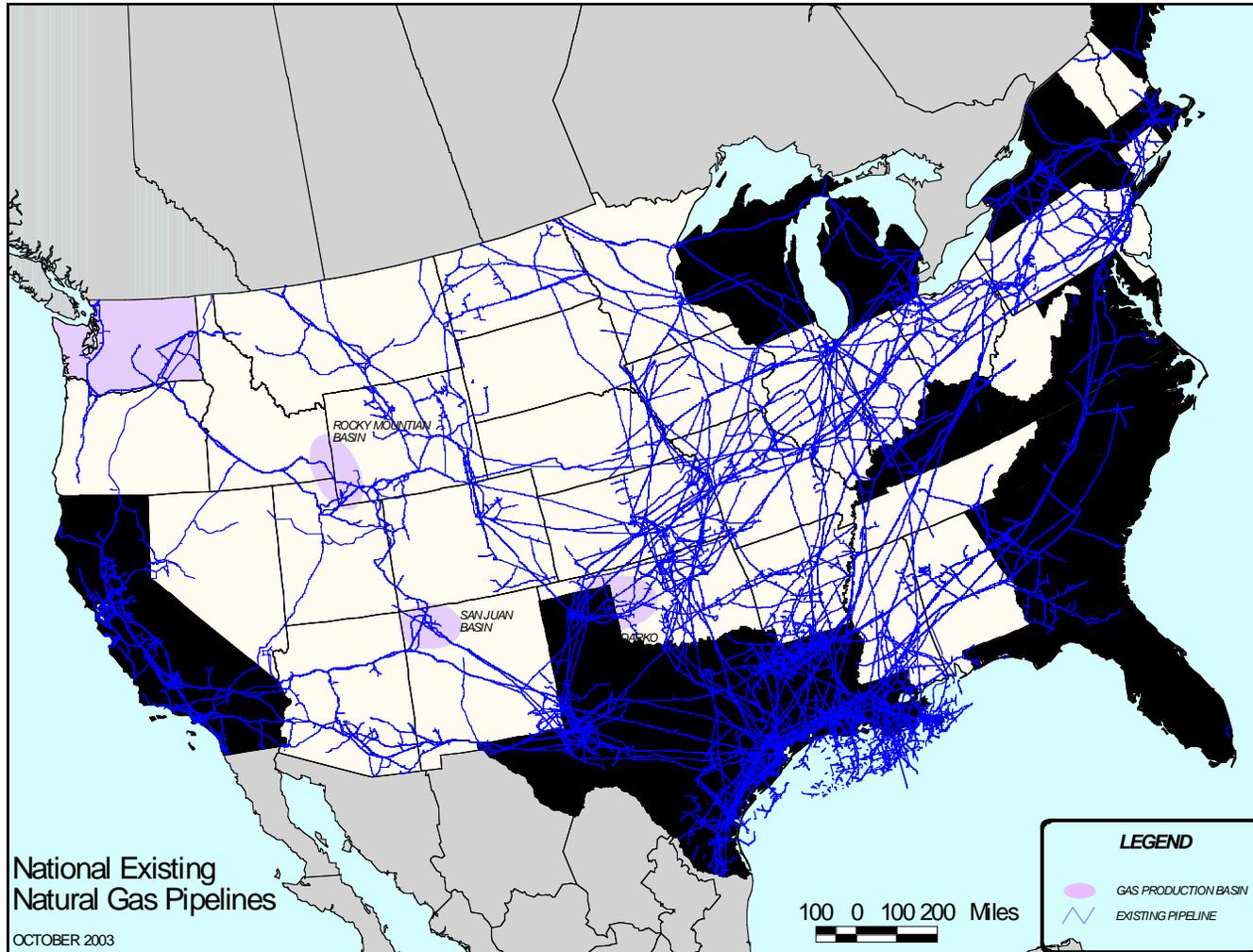


Pipeline Safety

- **Ownership of pipelines determines state or federal safety jurisdiction.**
- **Federal pipeline safety regulated by US Department of Transportation under 49 CFR 192**
- **The CPUC has adopted the federal pipeline safety regulations under General Order 112E, and enforces these regulations on operators under its jurisdiction.**



U.S Pipelines



T:\Projects\CEC\Gas Lines_D_M\Western natural gas pipelines.apr



California Pipelines





Potential Environmental Impacts

LNG projects are subject to environmental review and regulation.

Environmental impact evaluations cover:

- **Air quality**
- **Water resources**
- **Biological resources**
- **Land use**
- **Visual impacts**
- **And more**



Potential air quality impacts from LNG facilities

Emission Sources include:

- Natural gas burned for LNG vaporization
- Diesel-fuel emissions:
 - Emergency back-up generators
 - On-ship power supply
 - Tug boat engines



LNG facilities do not routinely flare or vent natural gas, only in emergencies.



Water resources

LNG plants do not consume large amounts of water or produce a lot of waste water.

If seawater is a heat source for vaporization, large quantities of sea water will flow through the system.

A primary concern would be cold temperatures of seawater discharged after its use.

Entrainment issues must also be addressed.





Biological resources

LNG ships don't discharge ballast after arriving at an import terminal.

May need to dredge and fill waterway for ship passage.

Pipeline routes may:

- **Cross streams or wetlands**
- **Require plant life removal, replacement**





Visual Resource Impacts

**Terminals are
industrial facilities.**



West Coast LNG Projects



Past and Proposed



Past proposals to build terminals in California

- **Point Conception (1970s)**
- **Mare Island (2002)**



Point Conception project history

- Proposed by consortium of California gas utilities
- Multiple sites considered, with Point Conception selected
- Despite public opposition and lawsuits, project eventually approved
- Change in U.S. gas regulations affected LNG economics
- Project never built

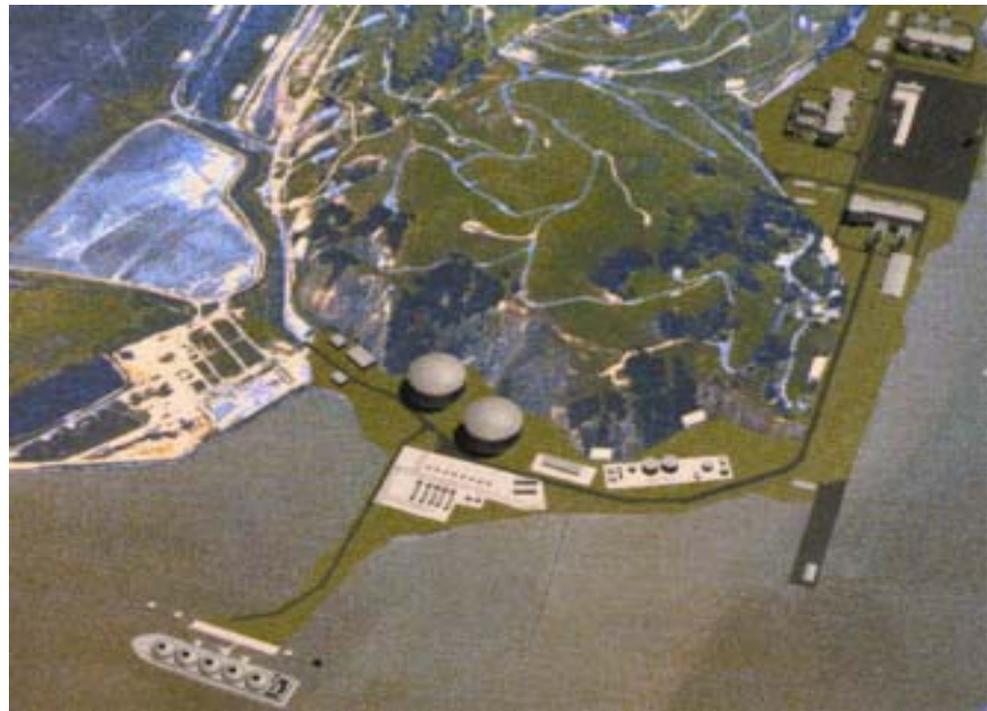


Photo Credit: Kenneth Adelman



Mare Island project history

- **Site was a former naval shipyard within San Francisco Bay**
- **LNG project proposed by Bechtel & Shell in 2002**
- **Citizens opposed the project**
- **Shell, then Bechtel, withdrew proposal**





Proposed LNG projects under consideration for California

Name	Location	Status
Sound Energy Solutions (Mitsubishi)	Port of Long Beach	In pre-filing at FERC
Cabrillo Port (BHP Billiton)	~12 miles off shore of Ventura County	Application filed with state and feds
Crystal Energy LLC	~11 miles off shore of Ventura County	Project announced
Calpine	Humboldt Bay	Project announced



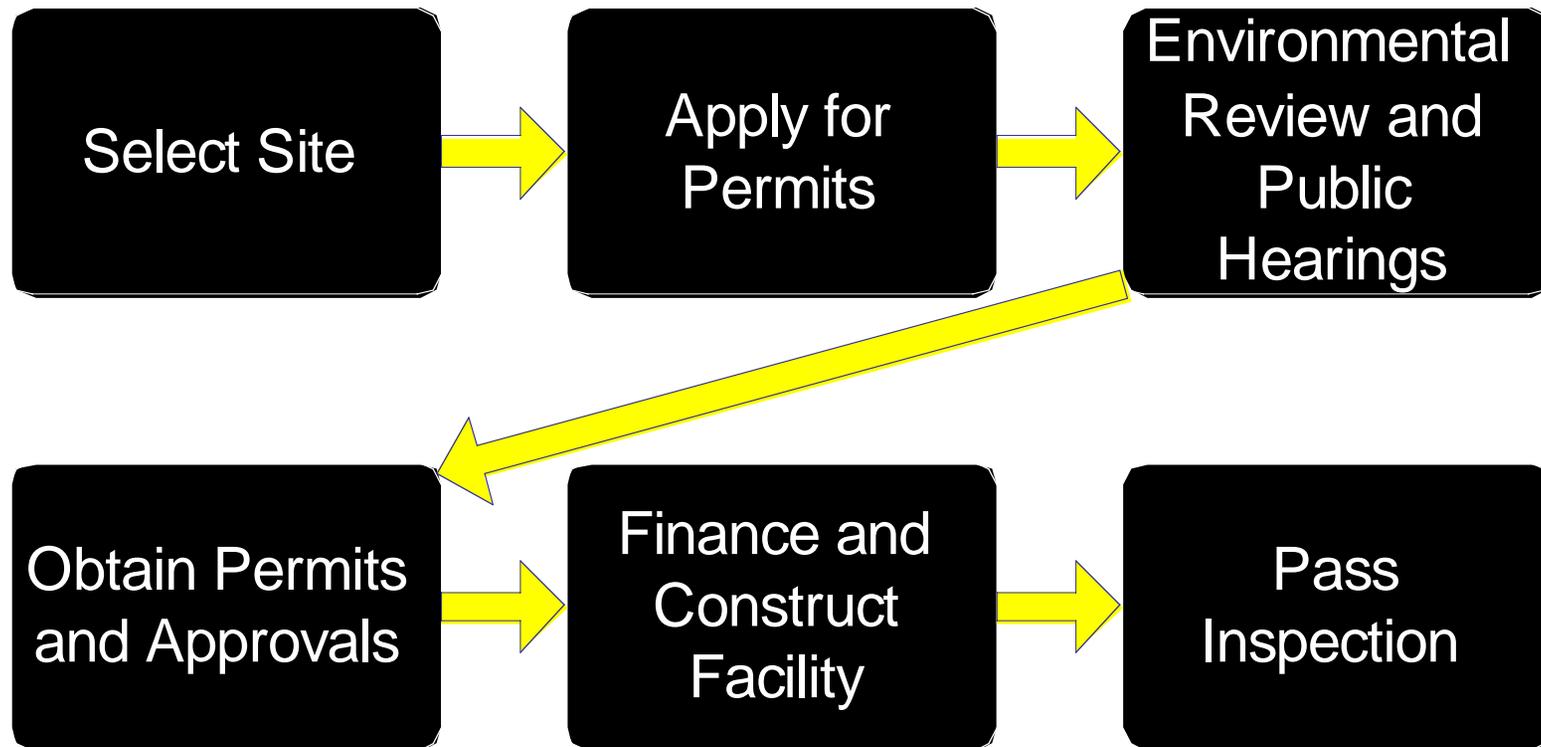
Proposed LNG projects under consideration for Baja California

Name	Location	Status
ChevronTexaco	Tijuana	Project Announced
Marathon	Tijuana	Obtaining permits
Sempra	Ensenada	Obtaining permits
Shell Group	Ensenada	Obtaining permits



LNG is not a near-term supply source for West Coast

- Earliest estimate ~ 2007
- Siting process could take ~ 4 to 7 years:





Federal, State and Local Authorities involved with LNG

CALIFORNIA ENERGY COMMISSION STAFF – OCTOBER 2003



Federal Agencies with LNG Review or Permit Authority over California Facilities

Onshore

Federal Energy Regulatory
Commission

Department of Transportation,
Office of Pipeline Safety

Offshore

Coast Guard

Maritime Administration

Others

Department of Energy

Fish and Wildlife Service and NOAA Fisheries

Minerals Management Service

Army Corps of Engineers



State Agencies with LNG Review or Permit Authority

- **California Public Utilities Commission**
- **Coastal Commission or
San Francisco Bay Area Conservation
and Development Commission**
- **State Lands Commission**
- **Department of Fish and Game**



Local Jurisdictions



- City or county government
- Port authority or harbor district

Photo Credit: Kenneth Adelman



Unresolved Issues

- **No statewide LNG policy**
- **State permitting process issues being resolved**
- **Uncertain regulatory treatment of LNG terminals**
- **Will LNG be cost competitive?**
- **LNG compliance with gas-quality standards**