

# Update to the Board on Liquefied Natural Gas and Compressed Natural Gas Quality in California

May 2005

California Environmental Protection Agency

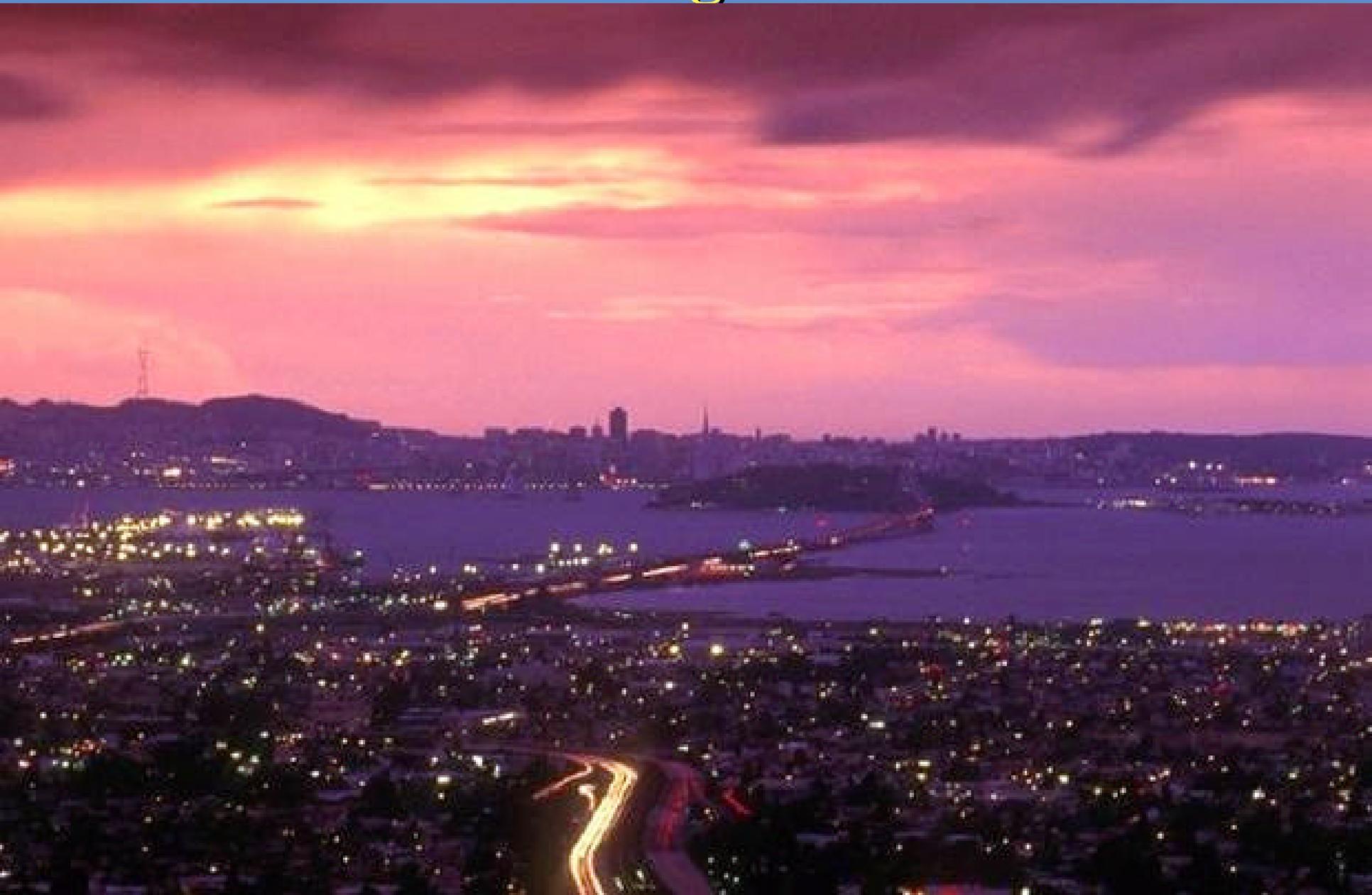


**Air Resources Board**

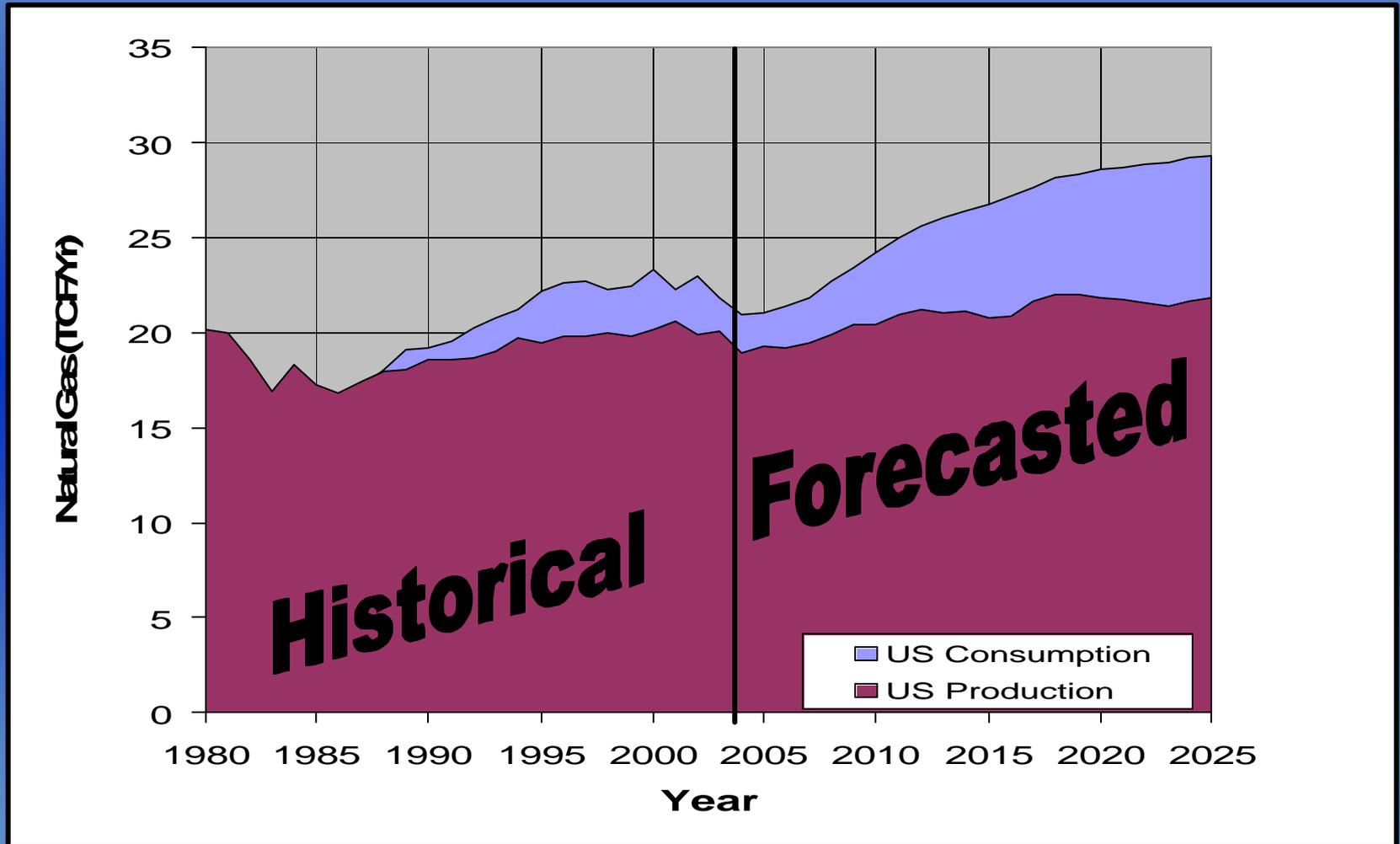
# Overview

- ✦ Background
- ✦ Liquefied Natural Gas
- ✦ Compressed Natural Gas
- ✦ Recent Activities to Investigate Fuel Quality Effects
- ✦ Summary
- ✦ Next Steps

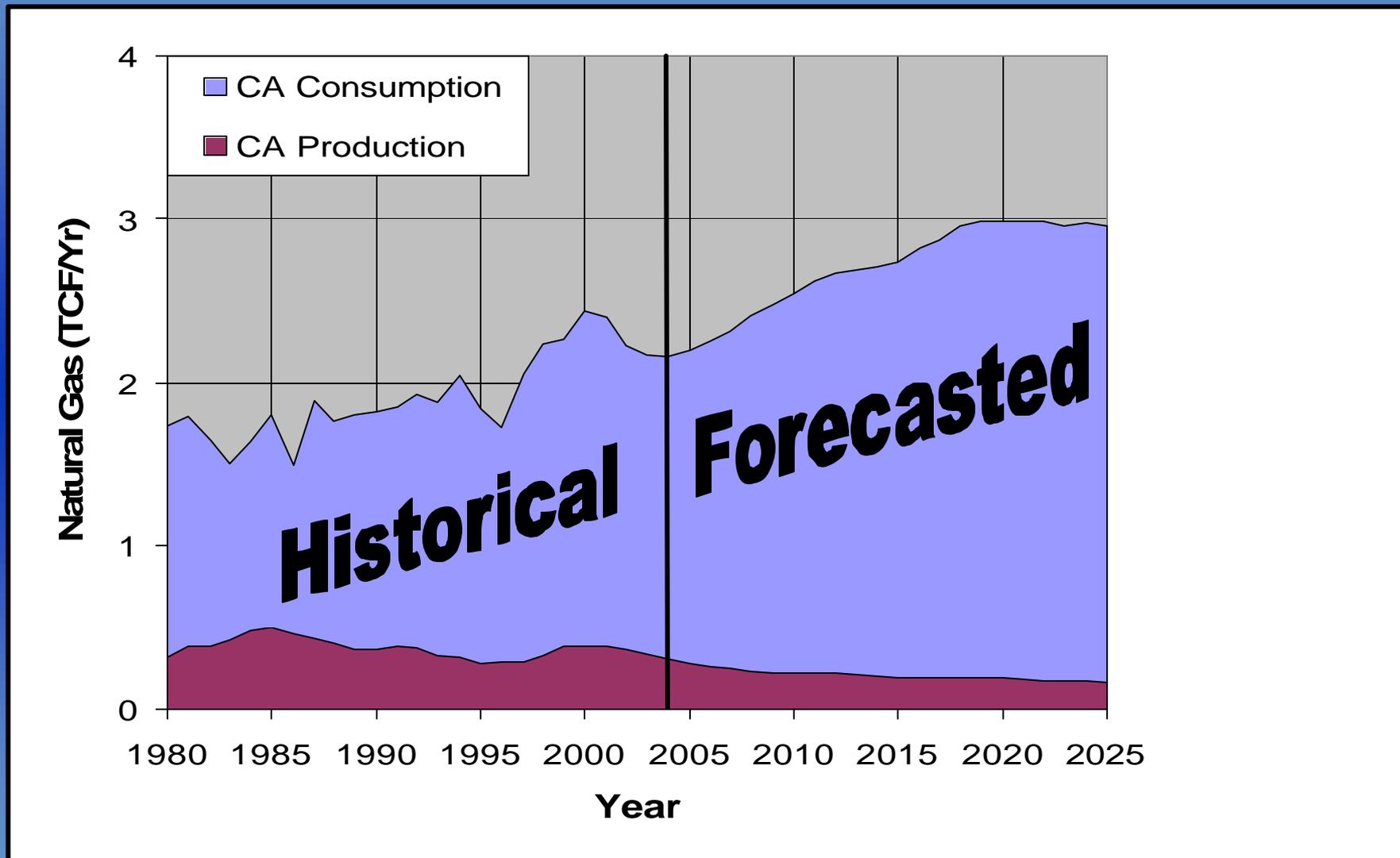
# Background



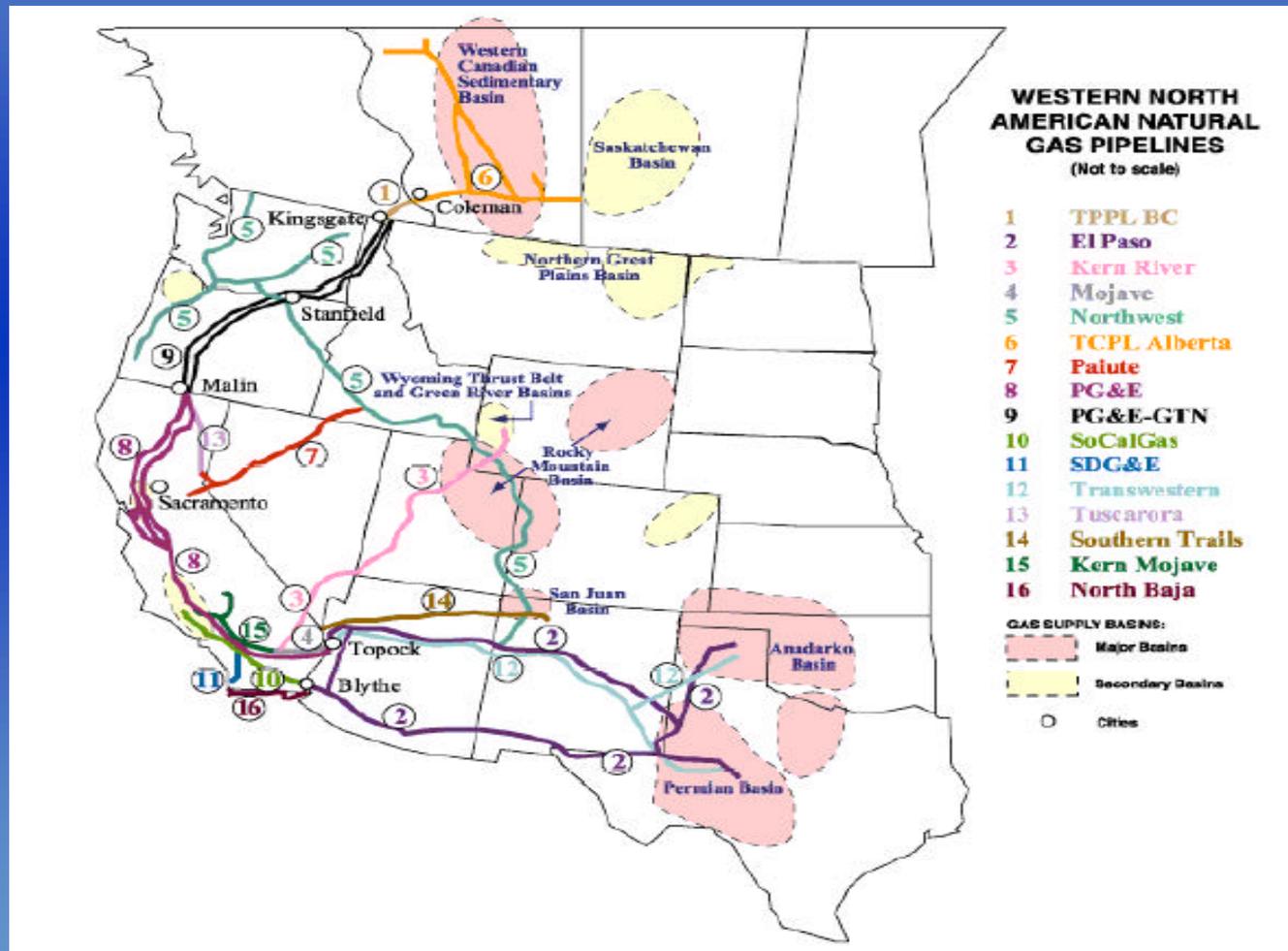
# U.S. NG Demand Outgrowing Production



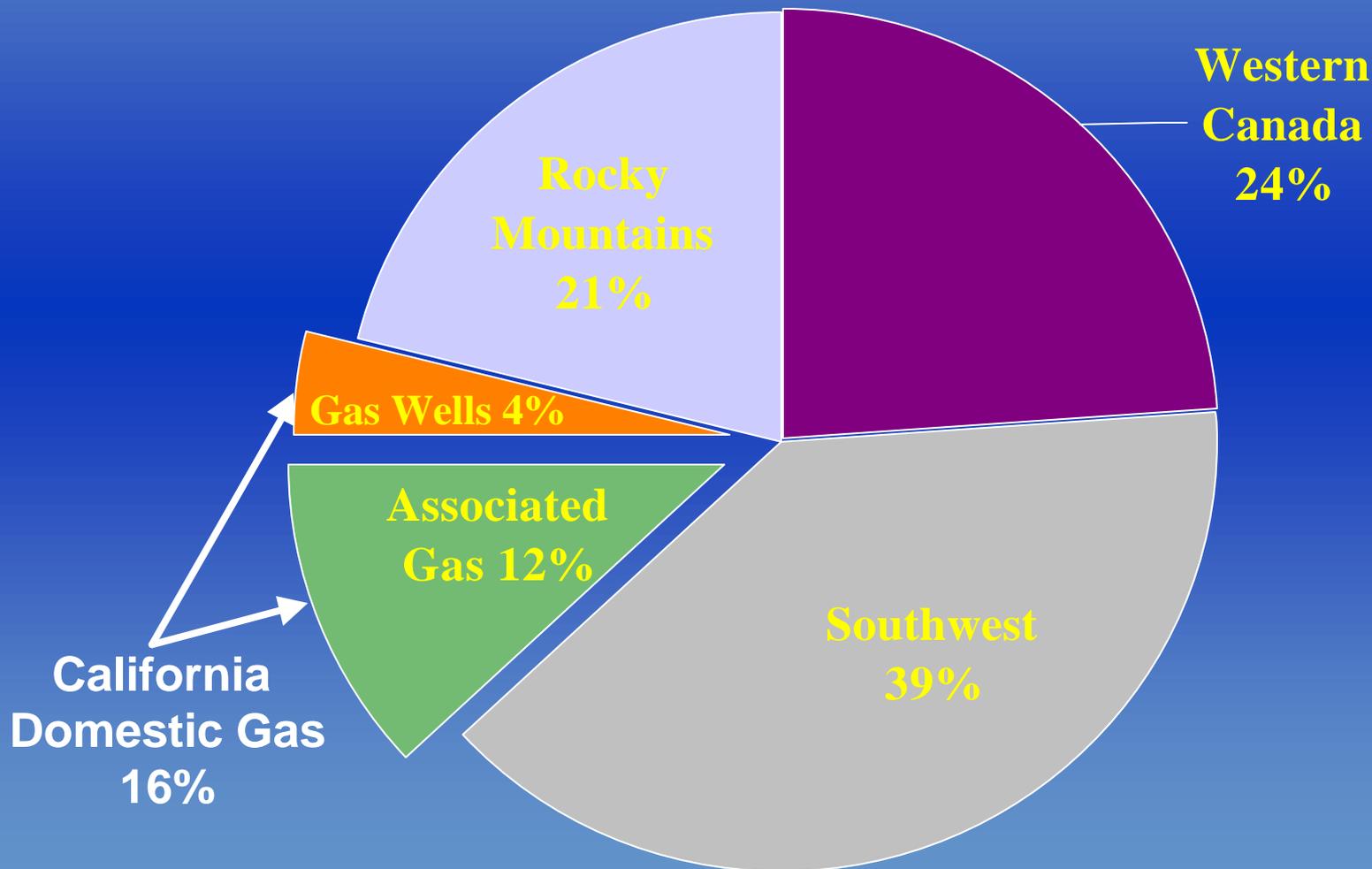
# California NG Demand



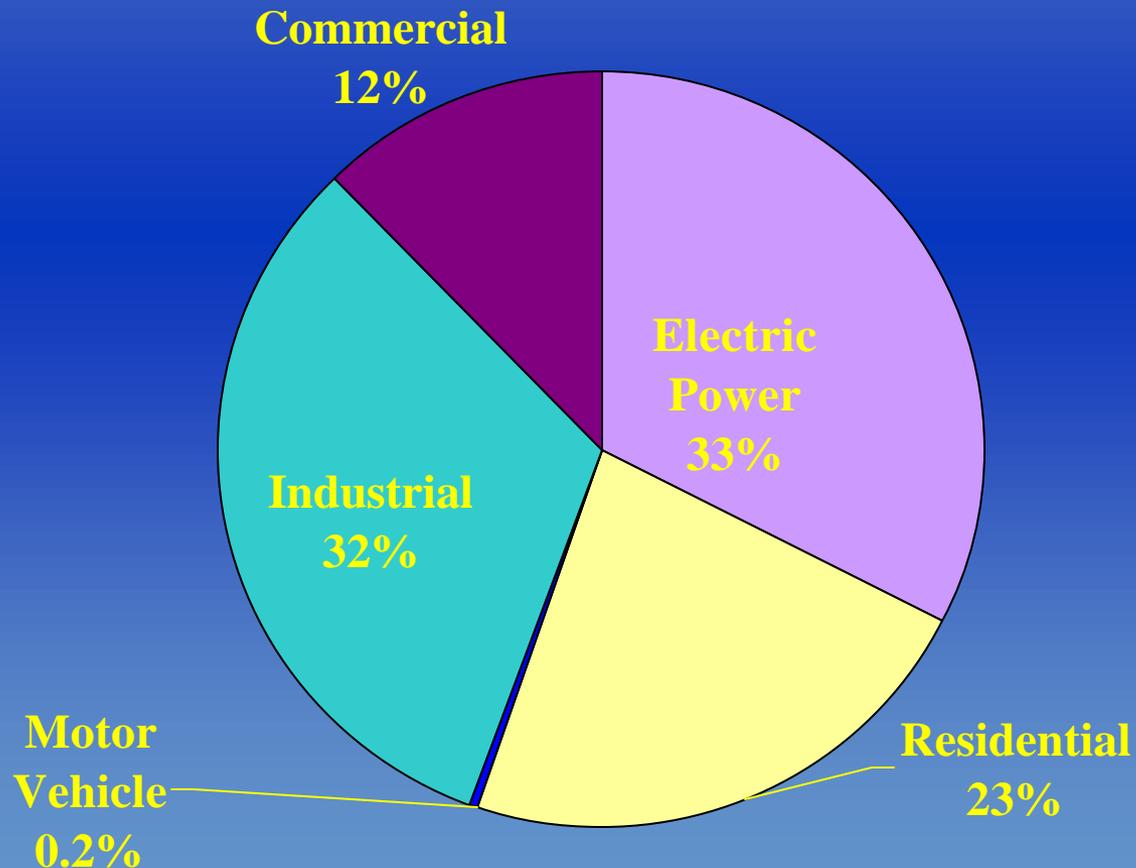
# California's NG Supply System



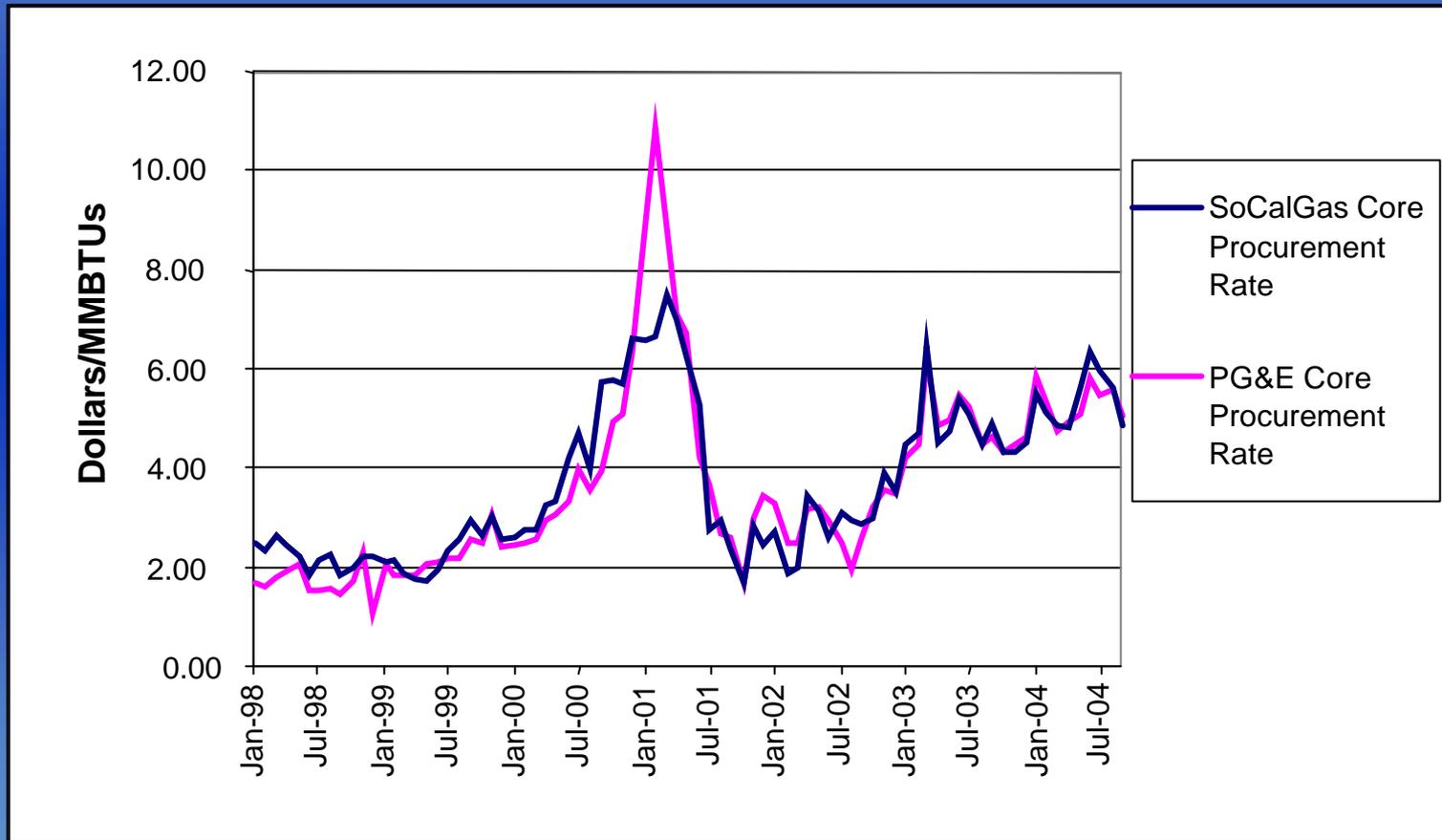
# 84% of California's NG Supply is Imported via Interstate Pipeline



# California's Natural Gas Consumption 7 Billion Cubic Feet/Day



# Cost of NG in California



# Natural Gas Specifications

- ✦ Specifications developed to
  - address safety issues
  - provide an acceptable range of fuel quality
- ✦ CPUC Specifications outlined in Rule 21 & 30
  - limits: BTU content, inerts, water, etc.
- ✦ ARB CNG specifications for motor vehicle fuel

# What is Natural Gas?

- ✦ Comprised primarily of methane
- ✦ May contain other hydrocarbons
- ✦ Amount of other hydrocarbons dependent on market value of those constituents
  - Ethane
    - Valuable to chemical industry
    - Not widely used in California
  - Propane
    - Valuable as LPG fuel
    - Widely used throughout the world

# California Natural Gas Quality

- ✦ Energy content of domestic supplies fairly consistent
  - Avg. 1020 BTUs/cu.ft.
  - Avg. 96% methane, 1.4% ethane, 0.25% propane
- ✦ Equipment
  - Designed and calibrated for this energy content
  - Optimized for performance and reduced emissions
- ✦ A potential for energy content increase
  - Emissions increases are likely
  - Performance and durability may be affected

# LNG is a Possible Source of Natural Gas



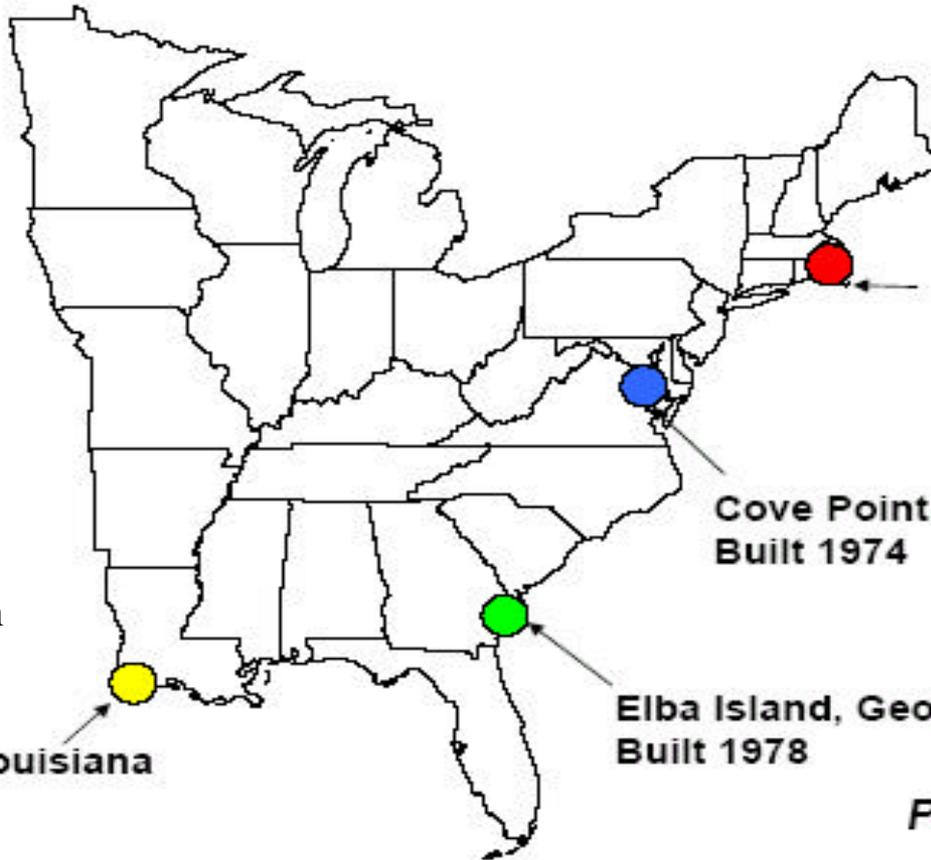
# Liquefied Natural Gas



## U.S. LNG Import Facilities

Note: Energy Bridge Deepwater port in Gulf of Mexico 116 miles off Louisiana started operation in March 2005

Lake Charles, Louisiana  
Built 1981



Everett, Massachusetts  
Built 1971

Cove Point, Maryland  
Built 1974

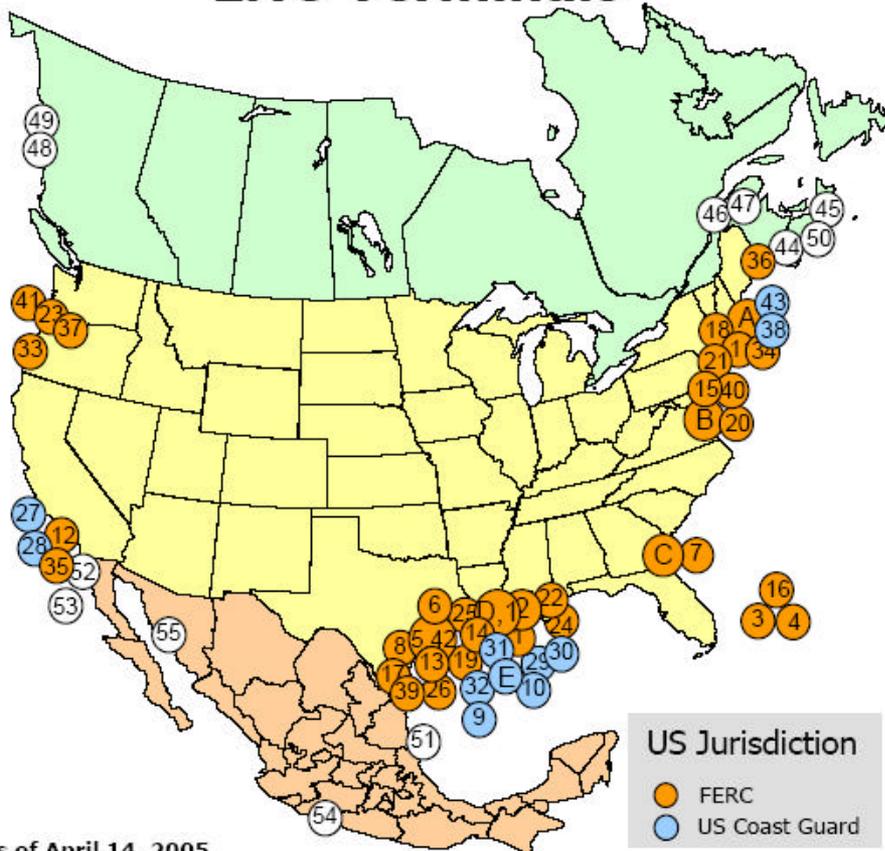
Elba Island, Georgia  
Built 1978

*Plus, Puerto Rico*

# Proposed LNG Terminals

FERC

## Existing, Proposed and Potential North American LNG Terminals



As of April 14, 2005

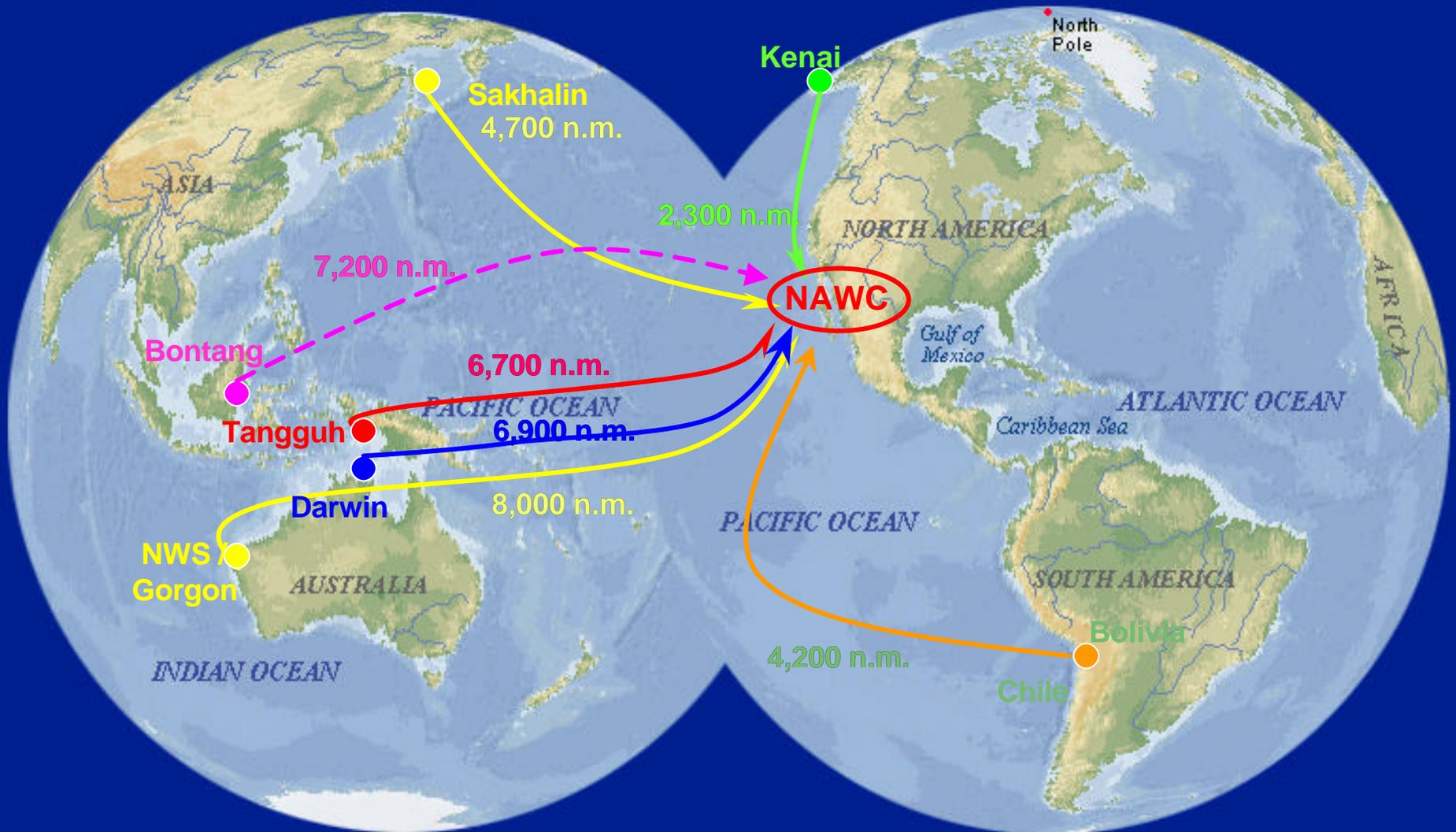
\* US pipeline approved; LNG terminal pending in Bahamas

\*\* These projects have been approved by the Mexican and Canadian authorities

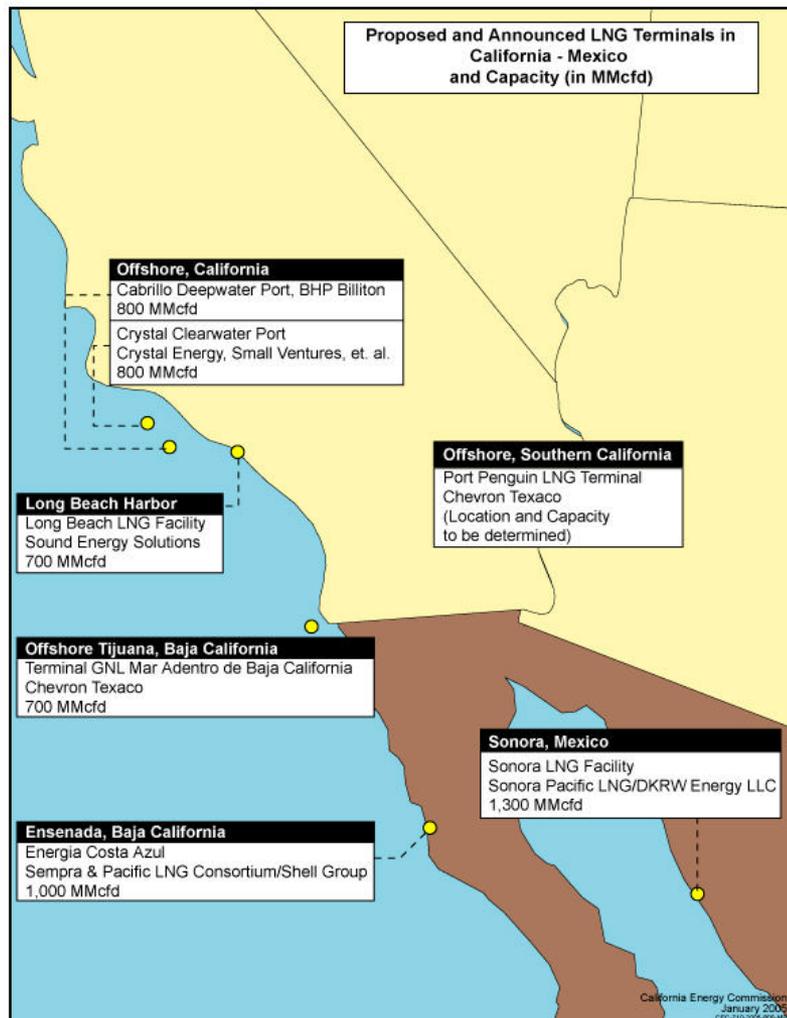
Office of Energy Projects

- ◆ North America  
50 facilities
- ◆ West Coast  
14 facilities

# LNG Imports on the West Coast May be Necessary to Meet Growing U.S. Demand



# Proposed CA Import Terminal Projects



- ✦ 7 projects proposed
- ✦ Market will only support 1- 2 successful projects
- ✦ Sendout capacity:
  - about 1 Bcfd/terminal or
  - 14% of CA Demand

# Projected On-line Dates for Terminals Range from Early 2007 to 2008

- ✦ Permitting agencies include:
  - Federal Energy and Regulatory Commission
  - US Environmental Protection Agency
  - US Coast Guard
  - State Lands Commission
  - California Coastal Commission
  - City and county governments
  - Local air pollution control districts
  - Others

## Quality of Potential LNG Imports

- ✦ Higher energy content than current CA natural gas
  - Energy content varies by source
  - Has less methane and increased ethane & propane
- ✦ Increasing natural gas energy content could impact both stationary and mobile sources
  - Performance and durability
  - Emissions

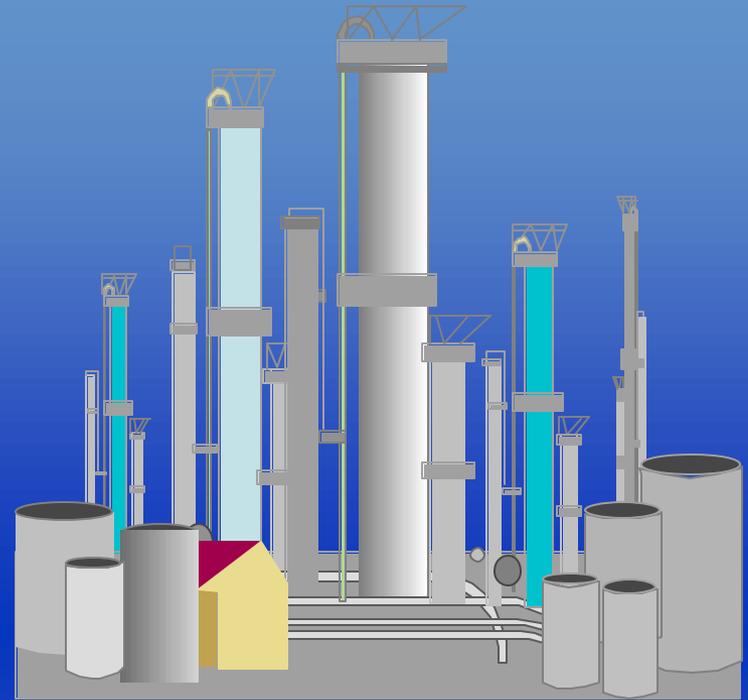
## LNG has the Potential to Impact Current NG Quality

	CA NG Avg.	Range of International LNG Sources
Energy Content	1020	1114-1375
Methane %	96	83 - 91
Ethane %	1.4	4 - 13
C3+ %	0.25	2 - 5

# LNG Needs to be Processed to Preserve Existing Natural Gas Quality

- ✦ What level of natural gas quality is acceptable
  - Small costs for processing gas relative to cost of facility
  - Additional by-products produced
    - Ethane
    - Propane + (C3+)
  - Disposition of fuel by-products (e.g. ethane)
- ✦ Potential LNG suppliers
  - Willing to meet existing quality
  - Want a consistent standard

# Compressed Natural Gas



# **Compressed Natural Gas Motor Vehicle Fuel Regulation**

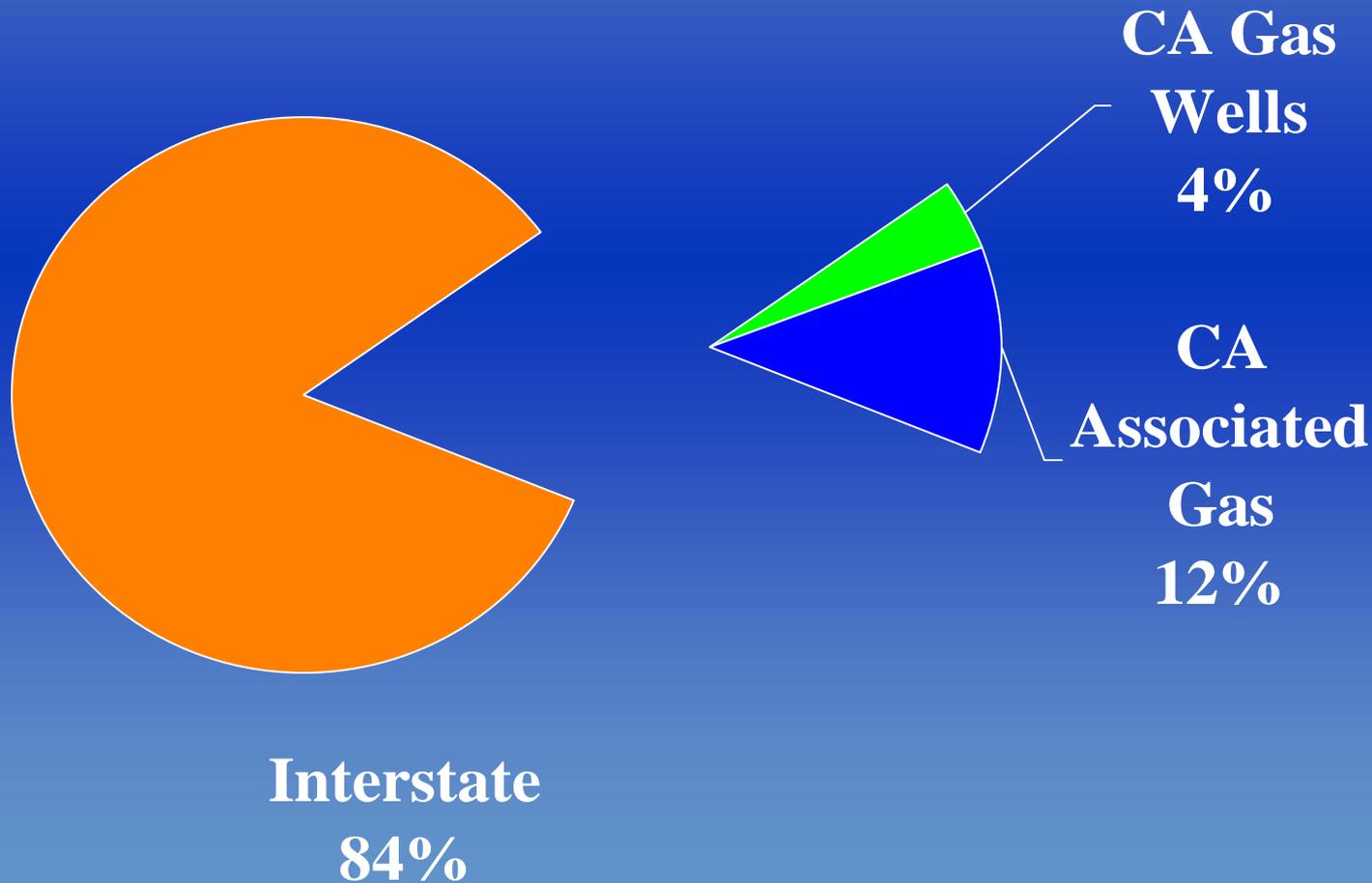
- ✦ Title 13, CCR, section 2292.5 adopted in 1992
- ✦ Compositional specifications
- ✦ Based on technology available at that time
- ✦ Provide engine manufacturers with a known fuel quality for designing engines
- ✦ Addressed fuel related engine performance problems and excess emissions
- ✦ More stringent than CPUC specifications
- ✦ No national motor vehicle specification

# Current Motor Vehicle CNG Specifications

Methane (min.)	88 mol%
Ethane (max.)	6 mol%
C3+higher (max.)	3 mol%
Inert Gases	1.5 - 4.5 mol%

Other specs. to safeguard quality

# 88% of CA Current Supply Meets CNG MV Specifications



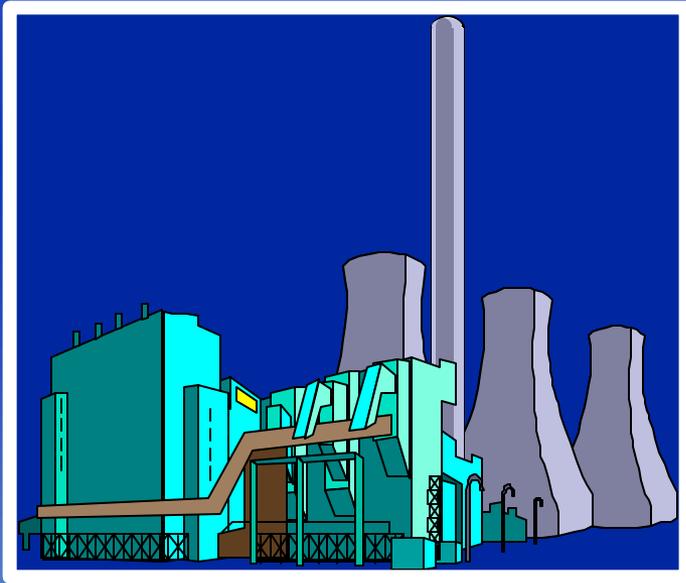
# Associated Gas Production Areas



# Modifications of CNG MV Specifications

- ✦ CNG specifications should be updated to reflect vehicle technology advancements
  - provide flexibility
- ✦ Need to balance cost with air quality and vehicle performance issues
- ✦ Would be optional
- ✦ Would preserve performance and emission benefits

# Recent Activities to Investigate Fuel Quality Effects



# Fuel Quality is a Local and National Concern

- ✦ Gas interchangeability standards are necessary with introduction of high BTU LNG imports
- ✦ National efforts:
  - Federal Energy Regulatory Commission (FERC)
  - USA Natural Gas Council (NGC+)
- ✦ California efforts:
  - California Public Utilities Commission (CPUC) in cooperation with CEC, ARB, DOGGR
  - Gas utility companies

## CA Test Programs

- ✦ CNG fuel quality effects on vehicle driveability, emissions and fuel economy
  - Natural Gas Vehicle Technology and Fuel Performance Evaluation Program (PEP) conducted in late 1990's
  - Studies supported by collaborative government/industry group
- ✦ NG fuel quality effects stationary source emissions and performance
  - Evaluated residential, commercial, and industrial equipment
  - Directed by Southern California Gas Company

# Fuel Quality and Emissions

- ✦ Test programs confirm that an increase in energy content will increase NO<sub>x</sub> emissions
  - Stationary sources
  - Mobile sources
- ✦ Current information indicates that NO<sub>x</sub> emission increases may be significant
- ✦ Additional tests need to be conducted to fully quantify the performance and emissions impacts

# Fuel Effects on Performance and Durability

- ✦ Light duty engines are equipped with advanced feedback control systems and do not experience any significant effects
- ✦ Heavy duty engines without advanced feedback control systems can experience significant performance and durability effects
- ✦ Stationary applications can experience modified flame and combustion characteristics that can affect performance and durability

## **Joint Workshop on Gas Quality held on February 16<sup>th</sup> and 17<sup>th</sup>, 2005**

- ✦ Hosted by CPUC, CEC, ARB, and DOGGR
- ✦ Explored potential issues involving natural gas quality, interchangeability, and related specifications affecting its use in California
- ✦ Helped provide a foundation for agencies to develop recommendations to resolve issues

# Stakeholders

- ✦ California natural gas producers
- ✦ LNG proponents
- ✦ Natural gas distributors (e.g. pipeline)
- ✦ Motor vehicle engine manufacturers
- ✦ Stationary equipment manufacturers
- ✦ End users
- ✦ Regulatory agencies
- ✦ Air Districts

## **General Stakeholder Consensus**

- ✦ Pipeline specifications should be updated and consider limits on:
  - Heating value (BTU), or index such as Wobbe Index
  - Heavy hydrocarbons, and inerts
  - Other specifications (e.g. odorant)
- ✦ Revise ARB's CNG specifications to incorporate:
  - Performance and emission based specifications such as methane number and Wobbe Index
  - No consensus on a performance value
- ✦ Any change in natural gas specifications should address air quality impacts

# Next Steps



# Next Steps

- ✦ Continue to work with other state agencies & stakeholders
- ✦ Work with CEC to develop CNG strawman proposal to incorporate cost, supply, and air quality issues
- ✦ Conduct workshops
- ✦ As appropriate, bring proposed revisions to the CNG specifications to the Board for consideration including emissions and cost impacts