An Examination of the Development of LNG on the Gulf of Mexico

Kristi A. R. Darby and David E. Dismukes
Center for Energy Studies
Louisiana State University

Overview

- Background on Natural Gas and LNG
- Why LNG?
- Current and Proposed LNG Facilities
- Importance of LNG on Future U.S. Supply Disposition
- The Gulf Coast's Relationship with Natural Gas
- Why is the Gulf Coast such a Good Place to Locate LNG?
- Importance of LNG to the Gulf Coast

What is Natural Gas?

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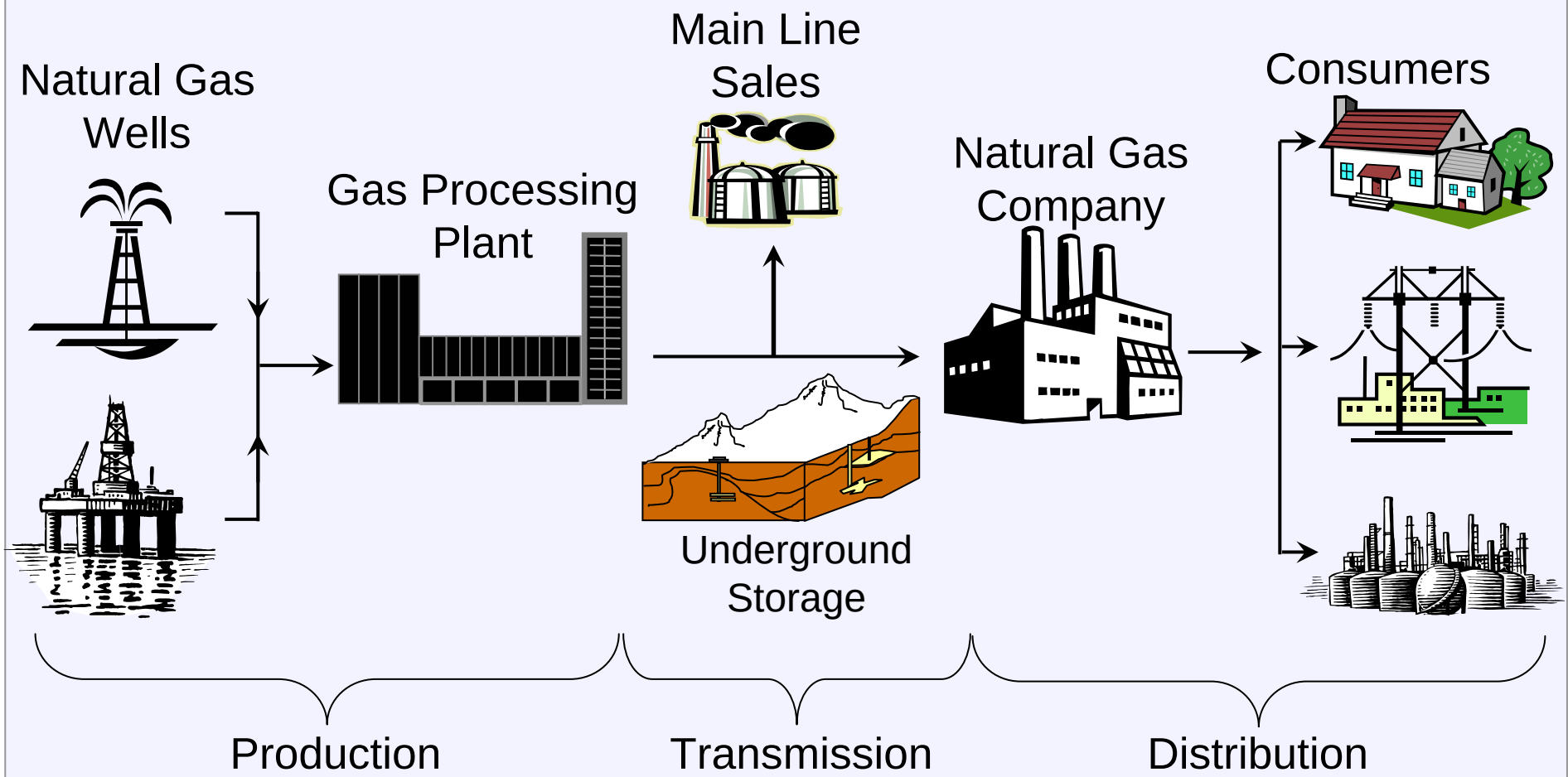
The Natural Gas Industry



Source: Energy Information Administration, Department of Energy

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Natural Gas Usage

Natural gas important for all consumers

Natural
Gas

- Residential
- Commercial
- Industrial
  - Furnace/Heat
  - Boiler/Steam
  - Feedstock
  - Power Generation
- Power Generation

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Components of Natural Gas

Natural gas is the basic building block of many household goods

Natural Gas Stream → Methane, Ethane, Propane, Butane →

- Ethylene
- Propylene
- Butylene
- Xylene
- Toulene

Background on LNG

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LNG History

19th century - British chemist and physicist Michael Faraday experimented with liquefying different types of gases

1873 - German engineer Karl van Linde built the first practical compressor refrigerator machine

1912 - First LNG plant built in West Virginia

1941- First commercial liquefication plant is built in Cleveland, Ohio

January 1959 - The world's first LNG tanker, the Methane Pioneer carries LNG from Lake Charles, LA, to Canvey Island, UK

1964 - British Gas Council imports from Algeria, making the UK the world's first LNG importer and Algeria the first exporter

1969 - LNG exported from Kenai plant, AK to Japan

1971 – Everett, MA import facility is built

1974 – Cove Point, MD import facility is built

1978 – Elba Island, GA import facility is built

1981 – Lake Charles, LA import facility is built

2005 – Energy Bridge in GOM receives its first delivery

1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000

Properties of LNG

- Liquefied natural gas (LNG) is natural gas that has been turned into a liquid by cooling it to a temperature of -256°F at atmospheric pressure
- It consists of primarily methane (typically, at least 90%)
- LNG is odorless, colorless, non-corrosive, and non-toxic
- Liquefying natural gas reduces its volume by a factor of approximately 610
- Methane's flammability range limits are 5–15% in air

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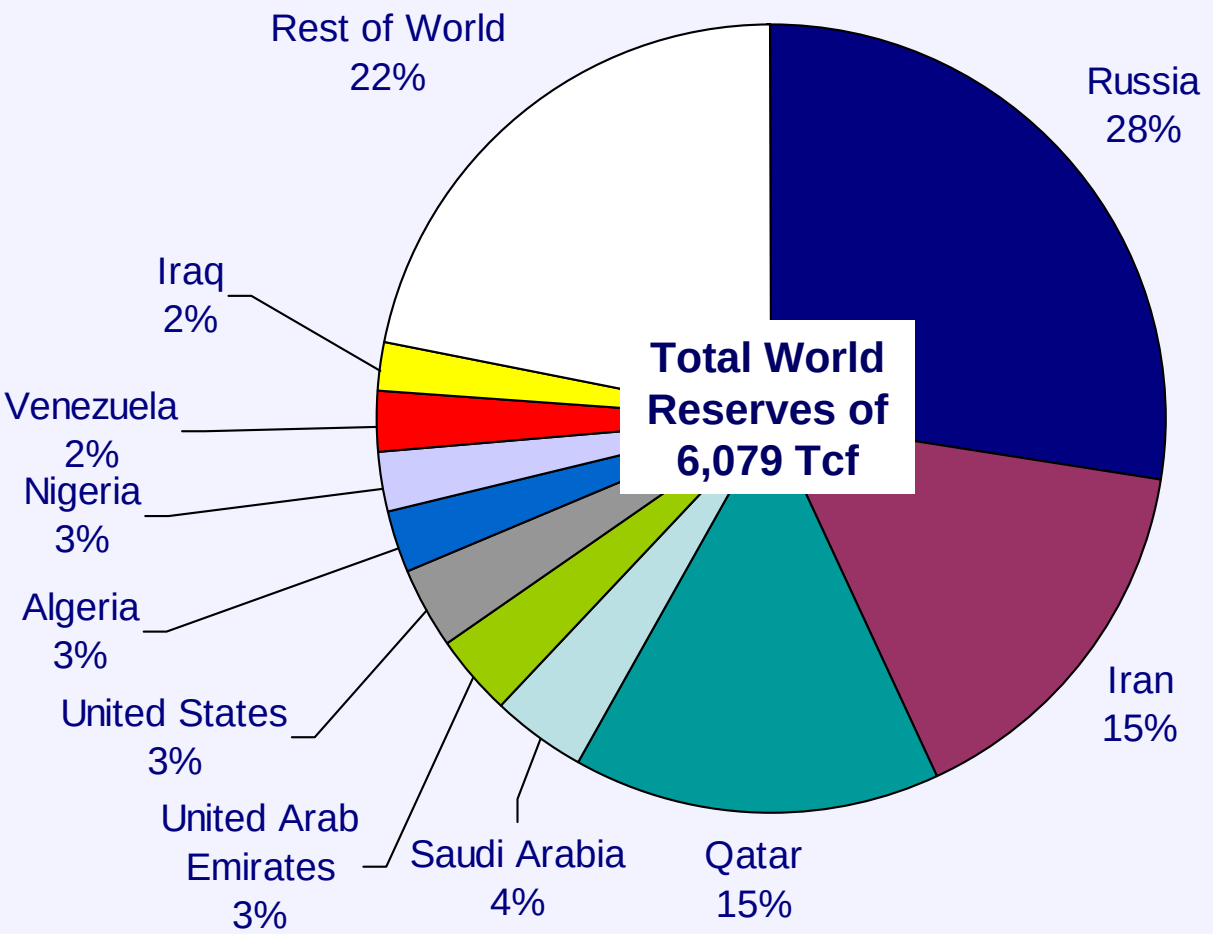
Natural Gas Reserves by Country (2004)

Considerable reserves around the world—just not in the areas where the gas is needed



Source: Energy Information Administration, Department of Energy

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Economic Sharing in the LNG Chain

Regasification terminals are one small portion of the development of an overall LNG project

Gas Producer
$0.5 to $1.0 billion
$0.50 - $1.00 / MMBtu
23% of total cost

Liquefaction
$0.8 to $1.0 billion
$0.80 - $1.00 / MMBtu
28% of total cost

Shipping*
$0.6 to $1.2 billion
$0.65 - $1.60 / MMBtu
35% of total cost

Receiving Terminal
$300-$400 million
$0.40 - $0.50 / MMBtu
14% of total cost

Cost out of Plant
Total Investment: $2.2 to $3.6 billion
$2.50 – $3.50 / MMBtu

Note: *depends upon the distance shipped

Source: Cheniere LNG Industry Profile, http://www.cheniere.com/LNGIndustryProfile.htm

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LNG Schematic: Production to End-User

to fuel Entergy Louisiana's Little Gypsy Plant (1,251 MW) for 1 month or Waterford 1&2 (891 MW) for 2 months

OR

to fuel over 5% of Louisiana's residential customers for 1 year (over 51,000 customers)

OR

to fuel 5 industrial plants for 1 year

Note: Assumes average monthly power usage of 1,275 MMcf and average annual industrial usage of 536 MMcf.

Source: Energy Information Administration; Federal Energy Regulatory Commission; Center for Energy Economics, BEG, UT-Austin; and Statoil.com.

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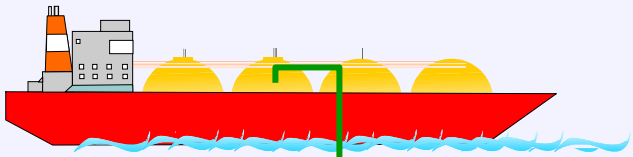
Receiving Terminal – LNG Gas Flow

- LNG – Ship to Tanks
- Natural Gas
- LNG – Tanks to Vaporizers



Boiloff Compressors

As LNG boils off, the gas is withdrawn from the tanks and compressed.

Tank 1

Tank 2

Tank 3

As gas is required, pumps inside the tanks transfer LNG to the plant vaporizers.

Gas Pipeline

The plant vaporizers warm the LNG until it vaporizes.

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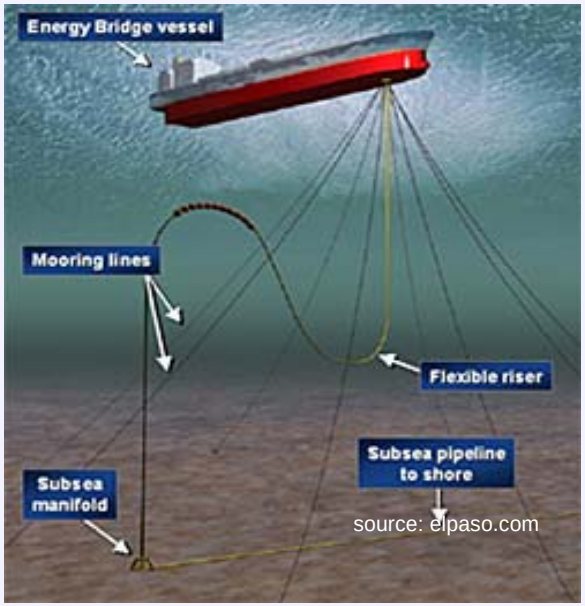
Types of Offshore LNG Receiving Terminals



Onboard Vessel Regasification System (with submerged buoy)

Gravity-Based Structure

Floating Storage and Regasification Unit

Why LNG?

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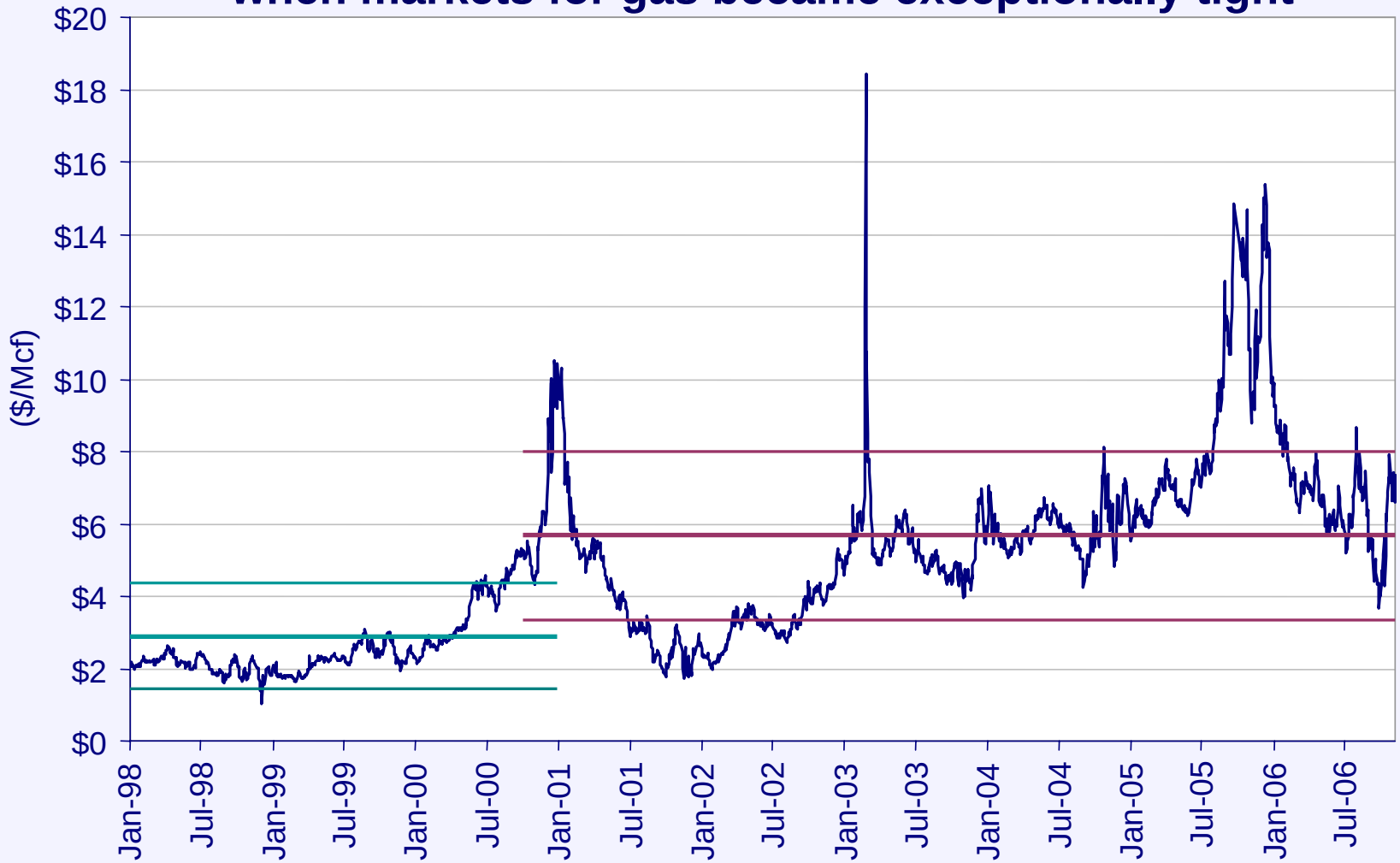
Daily Henry Hub Prices (1998–Present)

Prices have changed dramatically since winter 2000-01 when markets for gas became exceptionally tight



Source: Intercontinental Exchange

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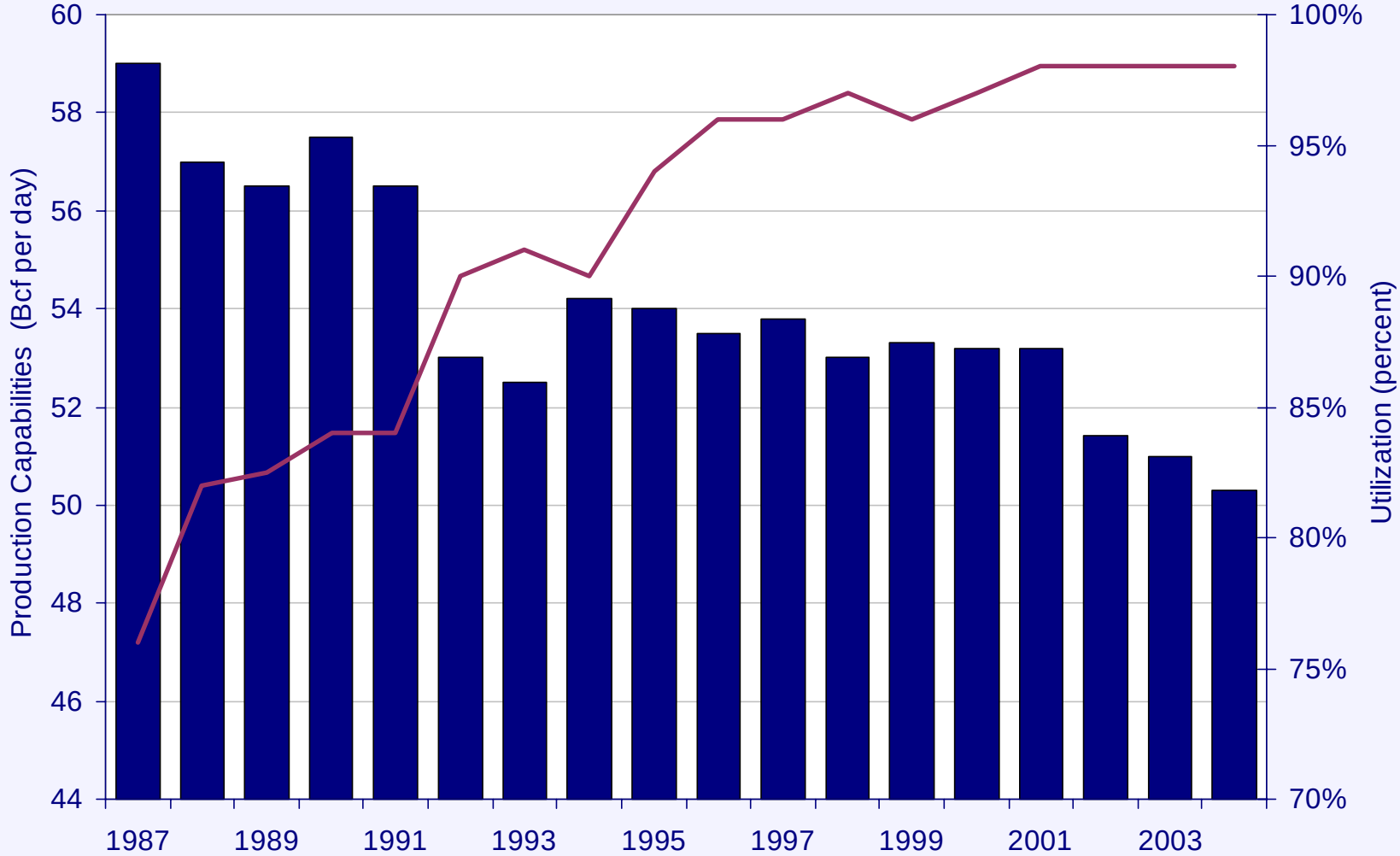
Natural Gas Productive Capacity and Utilization

Producers are at the limits of production capabilities



Note: This is an approximation.
Source: EnergySeer.com

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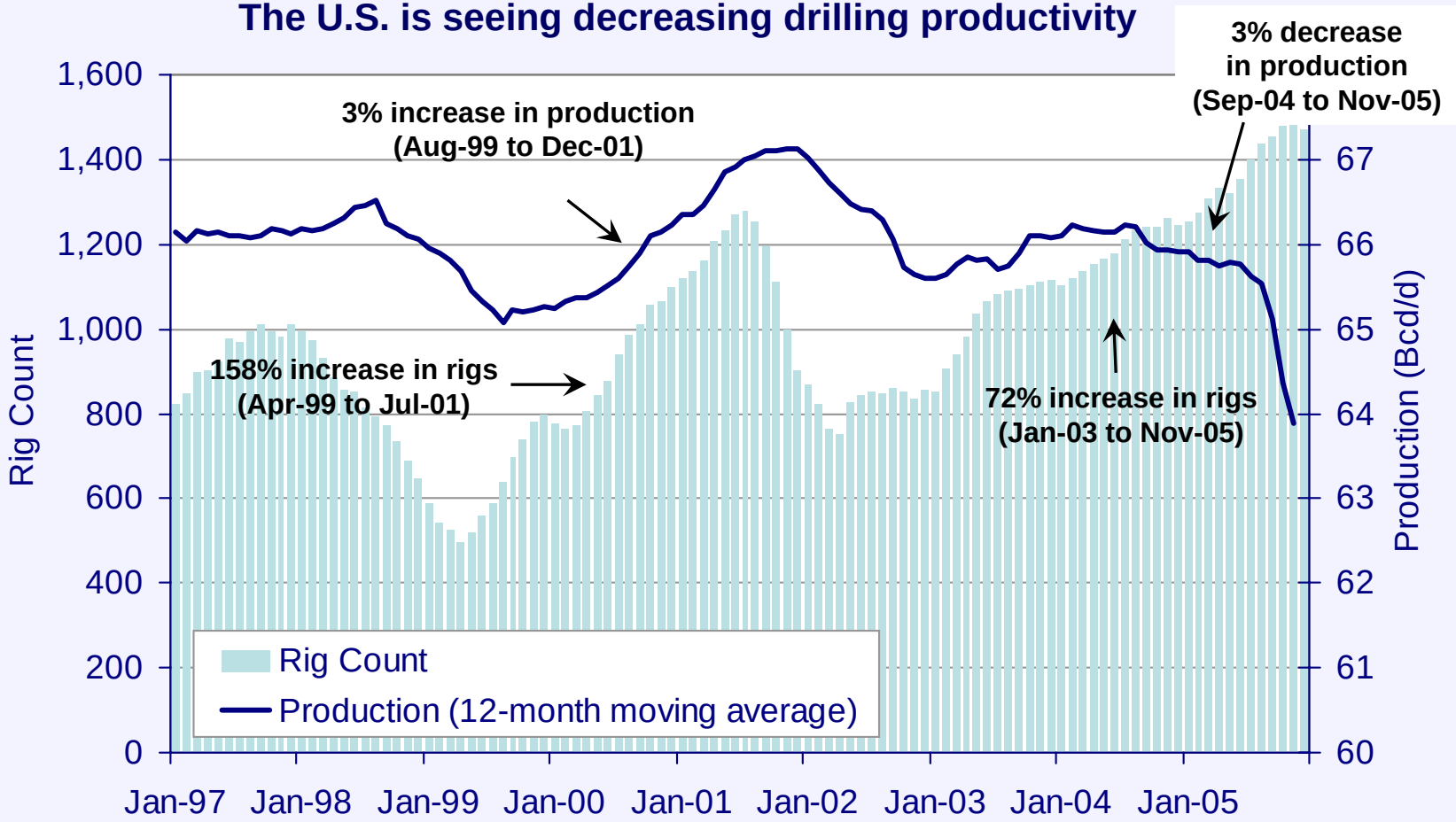
U.S. Natural Gas Production and Monthly Rig Count (1997–Present)

Despite increased drilling efforts, production is falling;
The U.S. is seeing decreasing drilling productivity



Source: Energy Information Administration, Department of Energy; and Baker-Hughes Inc.

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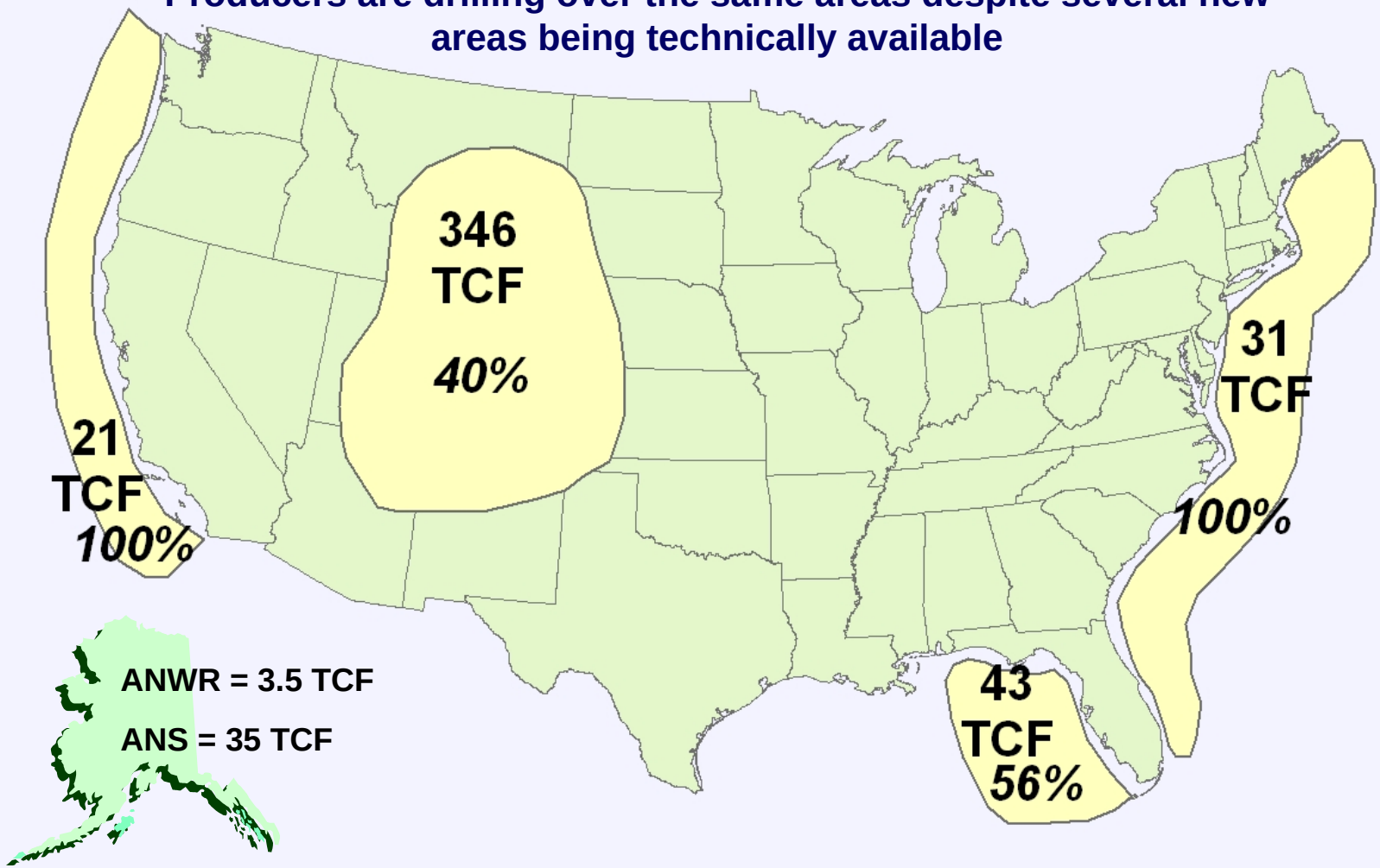
Resource Estimates – Restricted Areas
Estimated Percentage Restricted

Producers are drilling over the same areas despite several new areas being technically available



Source: Independent Petroleum Association of America

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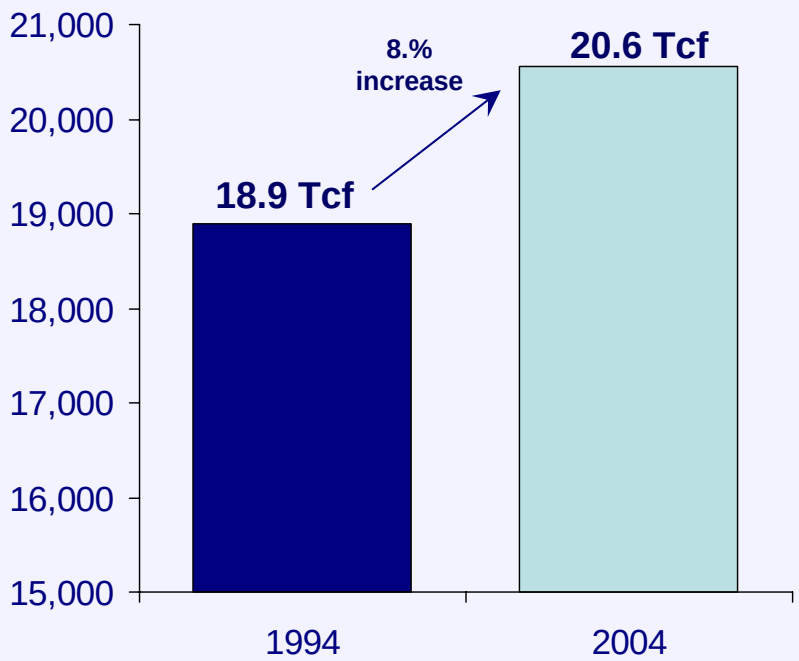
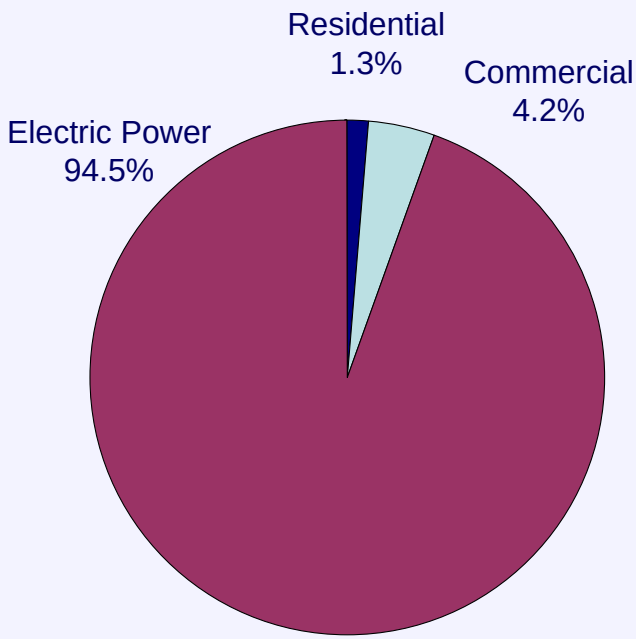
Increase in Natural Gas Usage by Major Sector (1994 and 2004)

Total Natural Gas Delivered to End Users



Increase by Sector



Note: Industrial consumption decreased by 11%

Source: Energy Information Administration, Department of Energy

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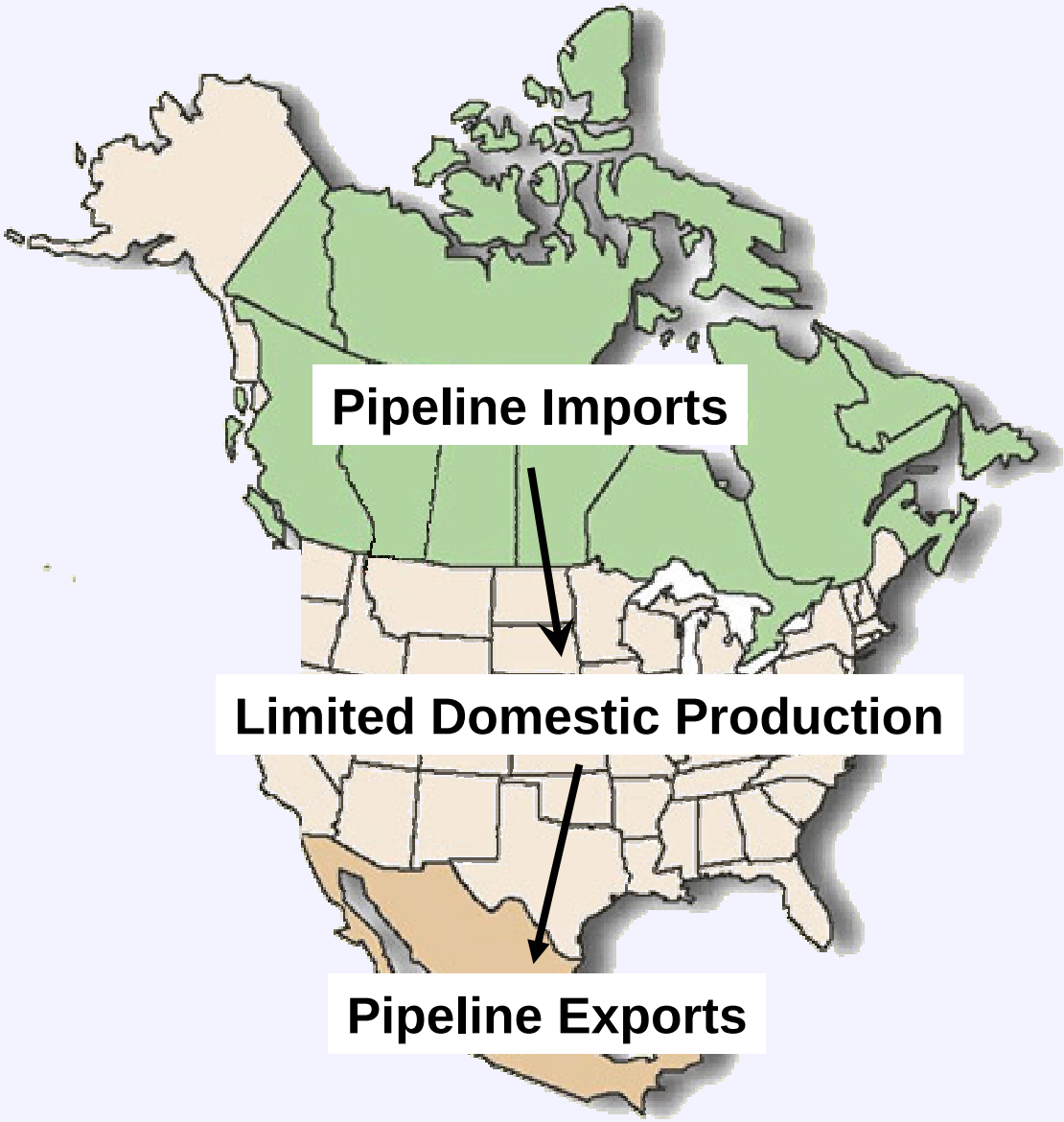
U.S. Natural Gas Market Status



In addition, the U.S. has limitations on importing natural gas from other parts of North America and it can't be shipped in its natural form.

Current and Proposed LNG Facilities

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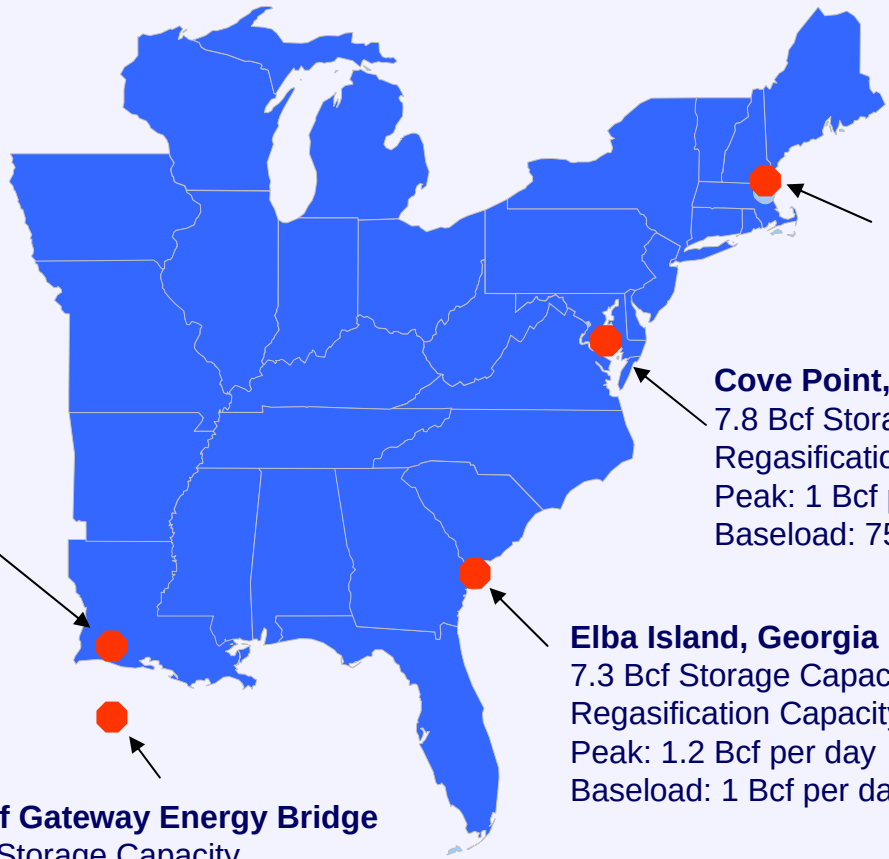
Current U.S. LNG Import Terminals



Everett, Massachusetts
3.5 Bcf Storage Capacity
Regasification Capacity:
Peak: 885 MMcf per day
Baseload: 710 MMcf per day

Cove Point, Maryland
7.8 Bcf Storage Capacity
Regasification Capacity:
Peak: 1 Bcf per day
Baseload: 750 MMcf per day

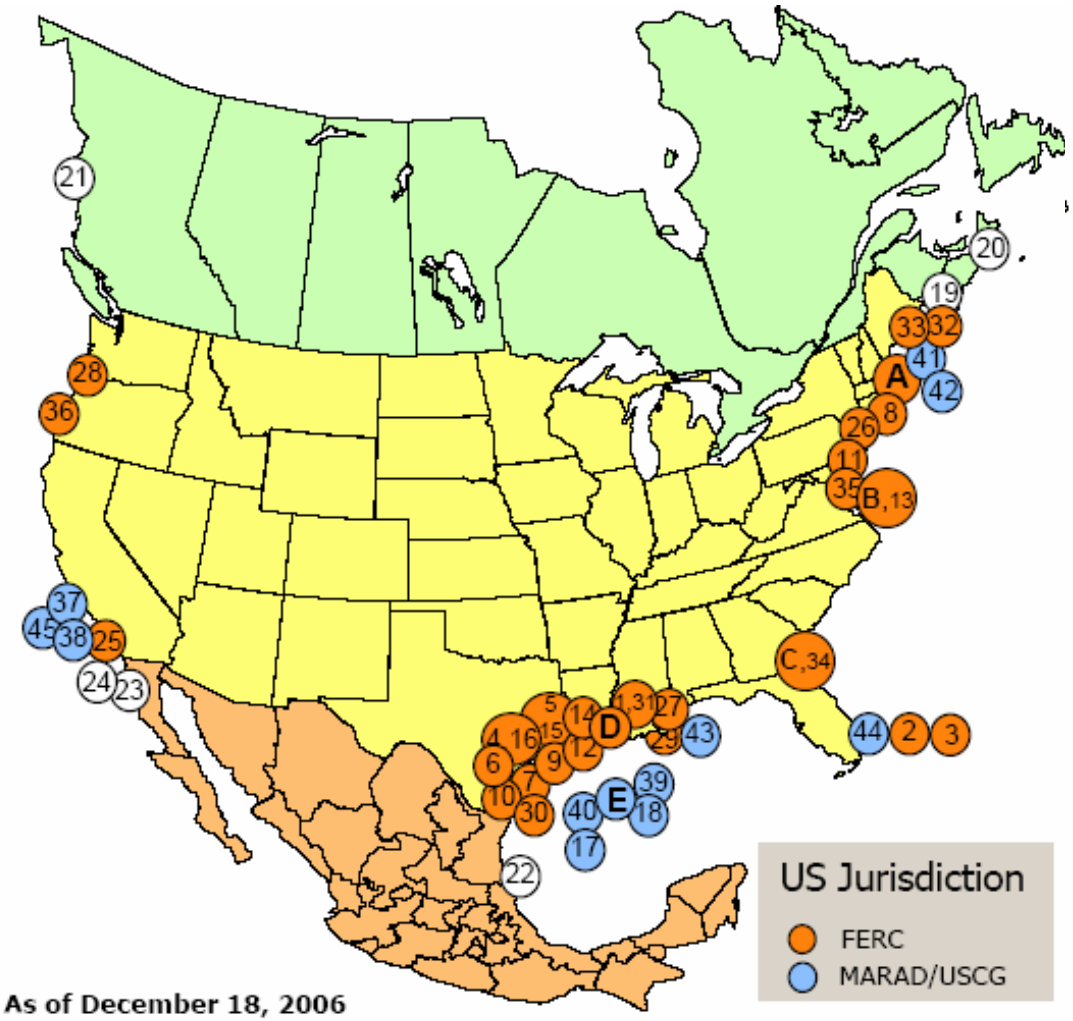
Lake Charles, Louisiana
6.3 Bcf Storage Capacity
Regasification Capacity:
Peak: 1.2 Bcf per day
Baseload: 1 Bcf per day

Elba Island, Georgia
7.3 Bcf Storage Capacity
Regasification Capacity:
Peak: 1.2 Bcf per day
Baseload: 1 Bcf per day

Gulf Gateway Energy Bridge
No Storage Capacity
Regasification Capacity:
Peak & Baseload: 500 MMcf per day

Source: Energy Information Administration, Department of Energy

Existing and Proposed LNG Terminals



As of December 18, 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/Repsol)
20. Point Tupper, NS 1.0 Bcfd (Bear Head LNG - Anadarko)
21. Kitimat, BC: 1.0 Bcfd (Kitimat LNG - 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)

Source: Federal Energy Regulatory Commission

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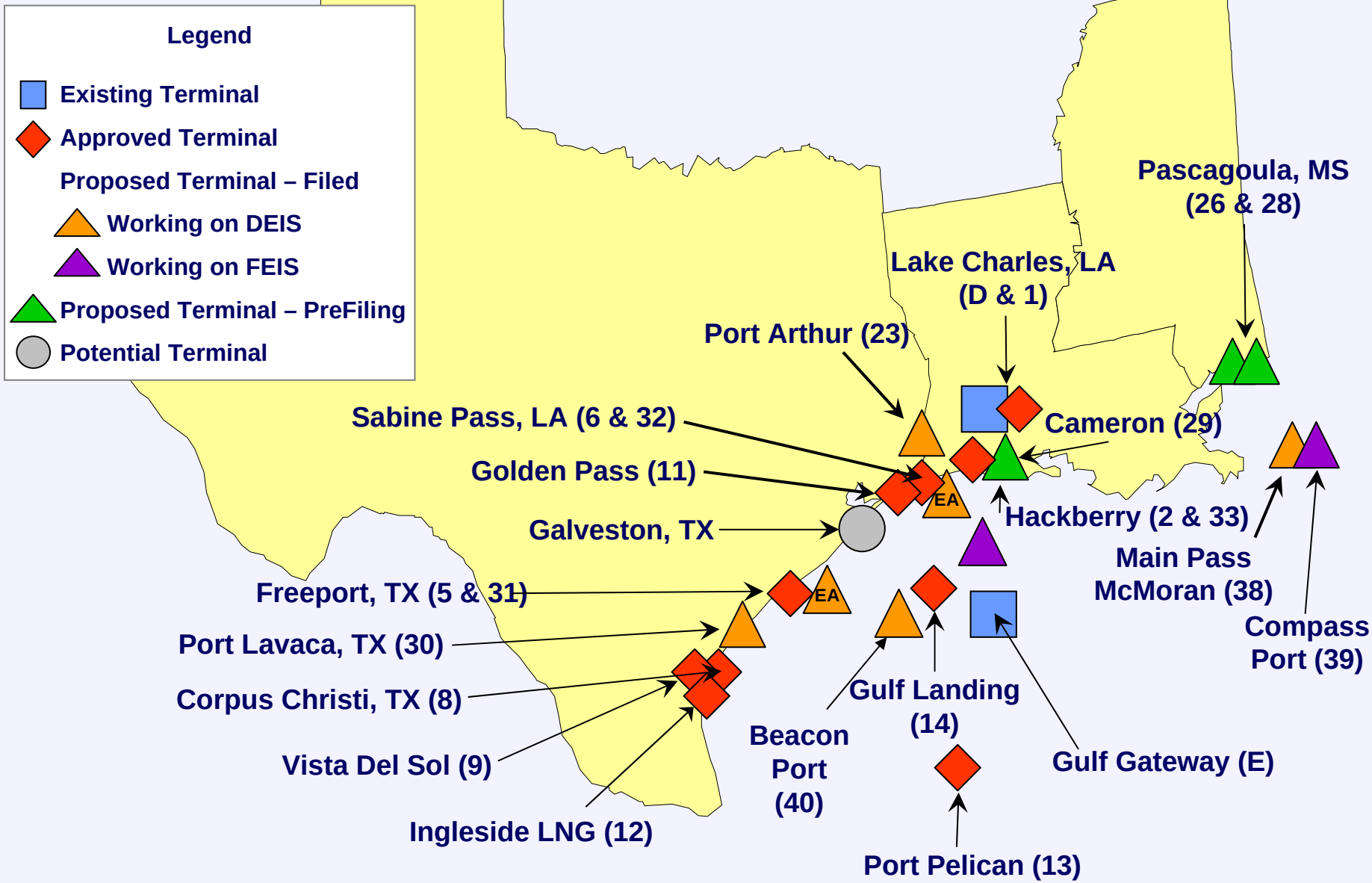
Gulf Coast LNG Terminals



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Importance of LNG on Future U.S. Supply Disposition

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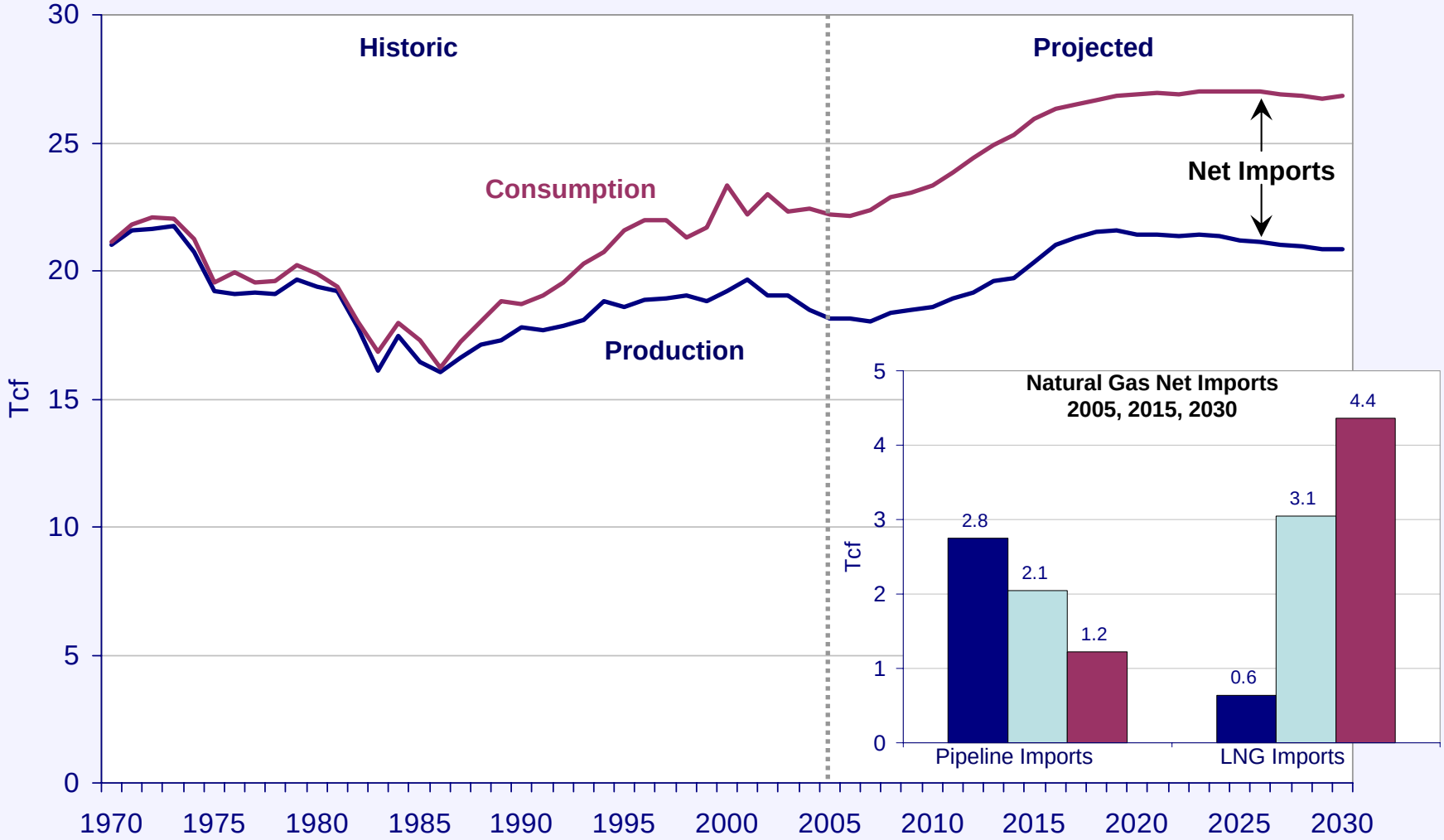
Natural Gas Production, Consumption and Imports (1970–2030)

DOE forecasts that LNG will be an important component of our natural gas supplies



Source: Energy Information Administration, Department of Energy

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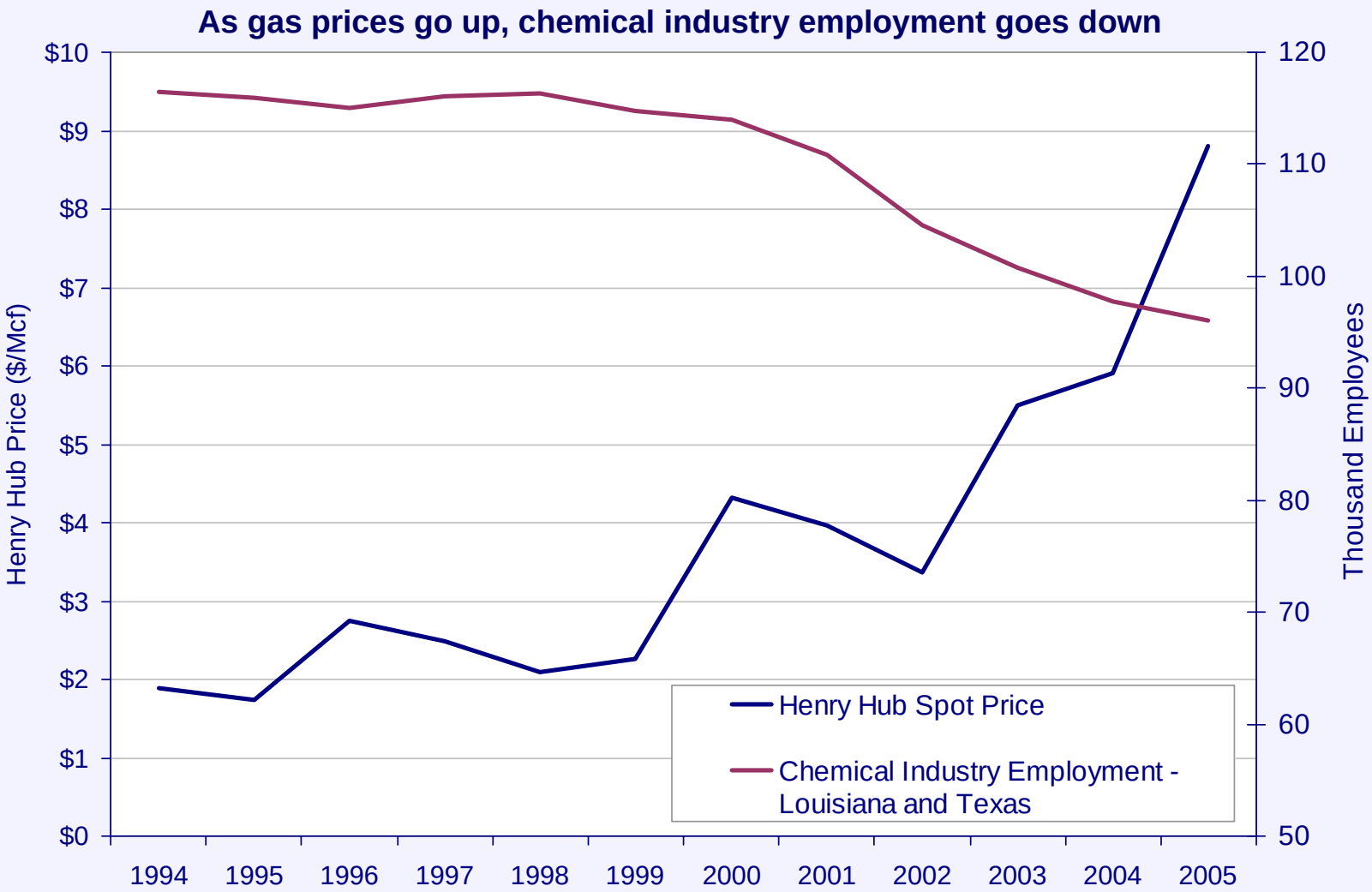
Natural Gas Spot Price and Louisiana/ Texas Chemical Industry Employment



Source: Bureau of Labor Statistics, U.S. Department of Labor; and Federal Reserve Bank of St. Louis

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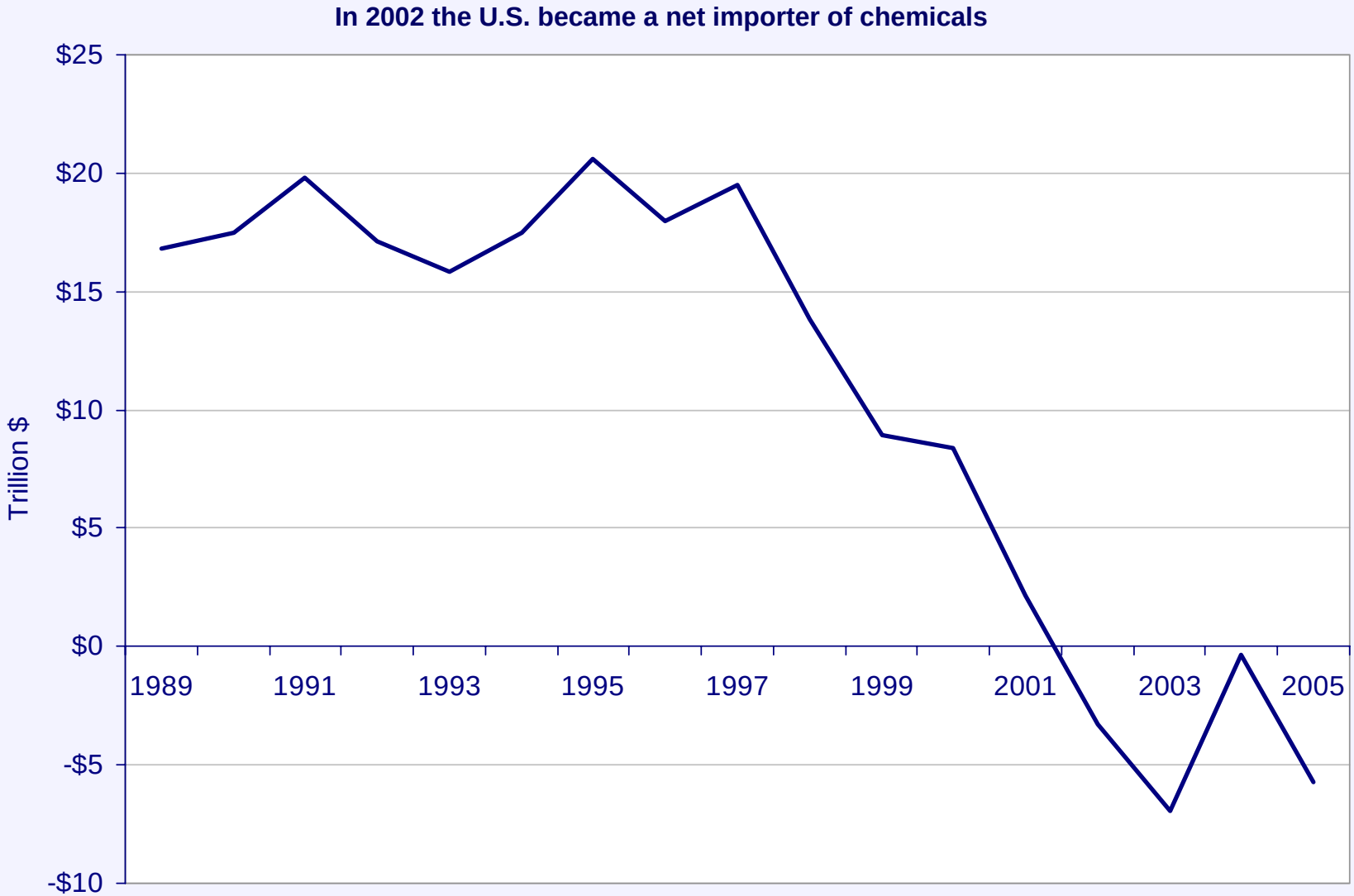
Value of Net Exports of NAICS 325 – Chemicals



Source: Office of Trade and Economic Analysis, Trade Development, International Trade Administration, U.S. Department of Commerce

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World Natural Gas Prices for Industry ($US/MMBtu)

Industries may be forced to other countries where natural gas can be considerably cheaper

Source: Energy Information Administration

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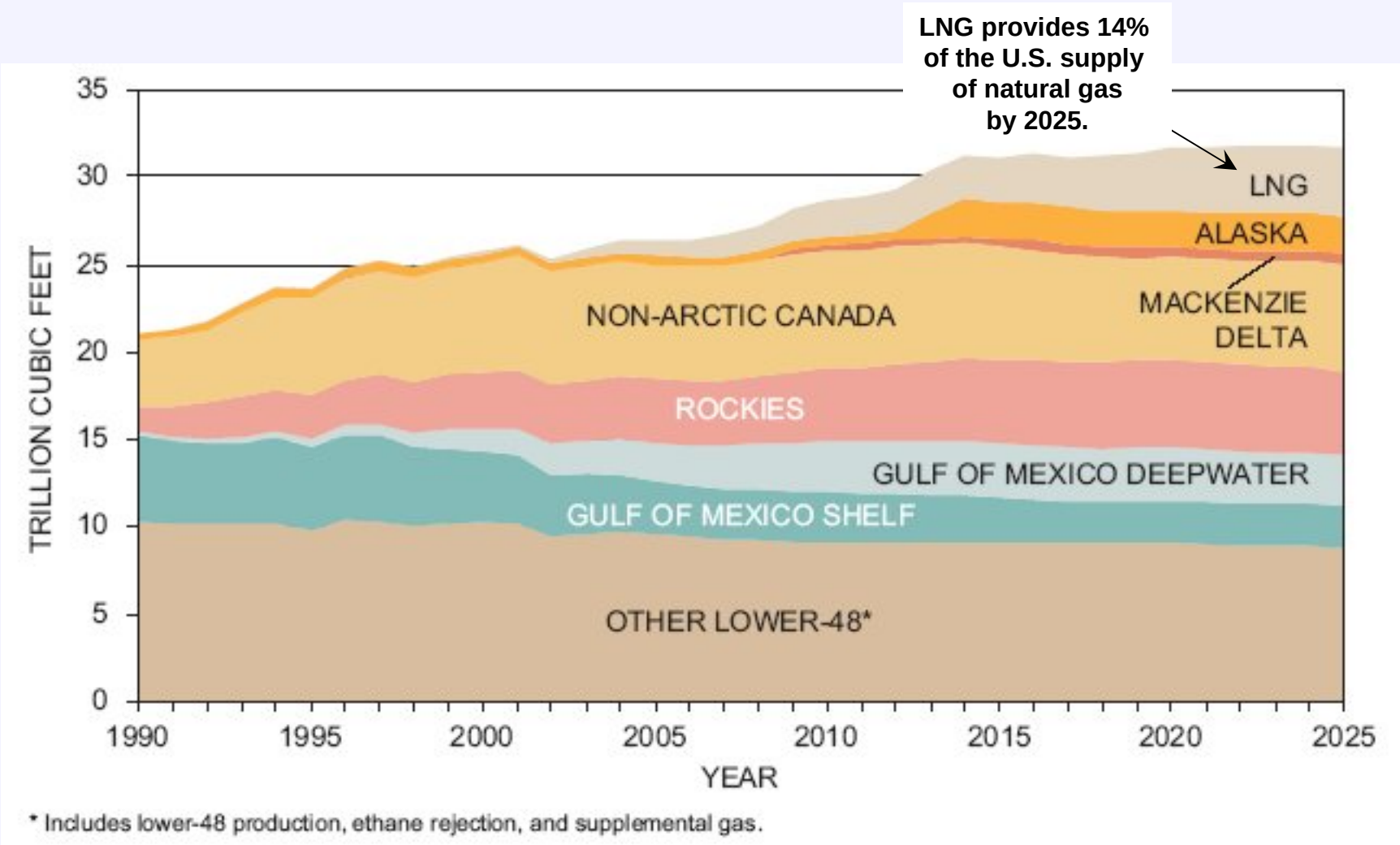
U.S. and Canadian Natural Gas Supply



Source: National Petroleum Council

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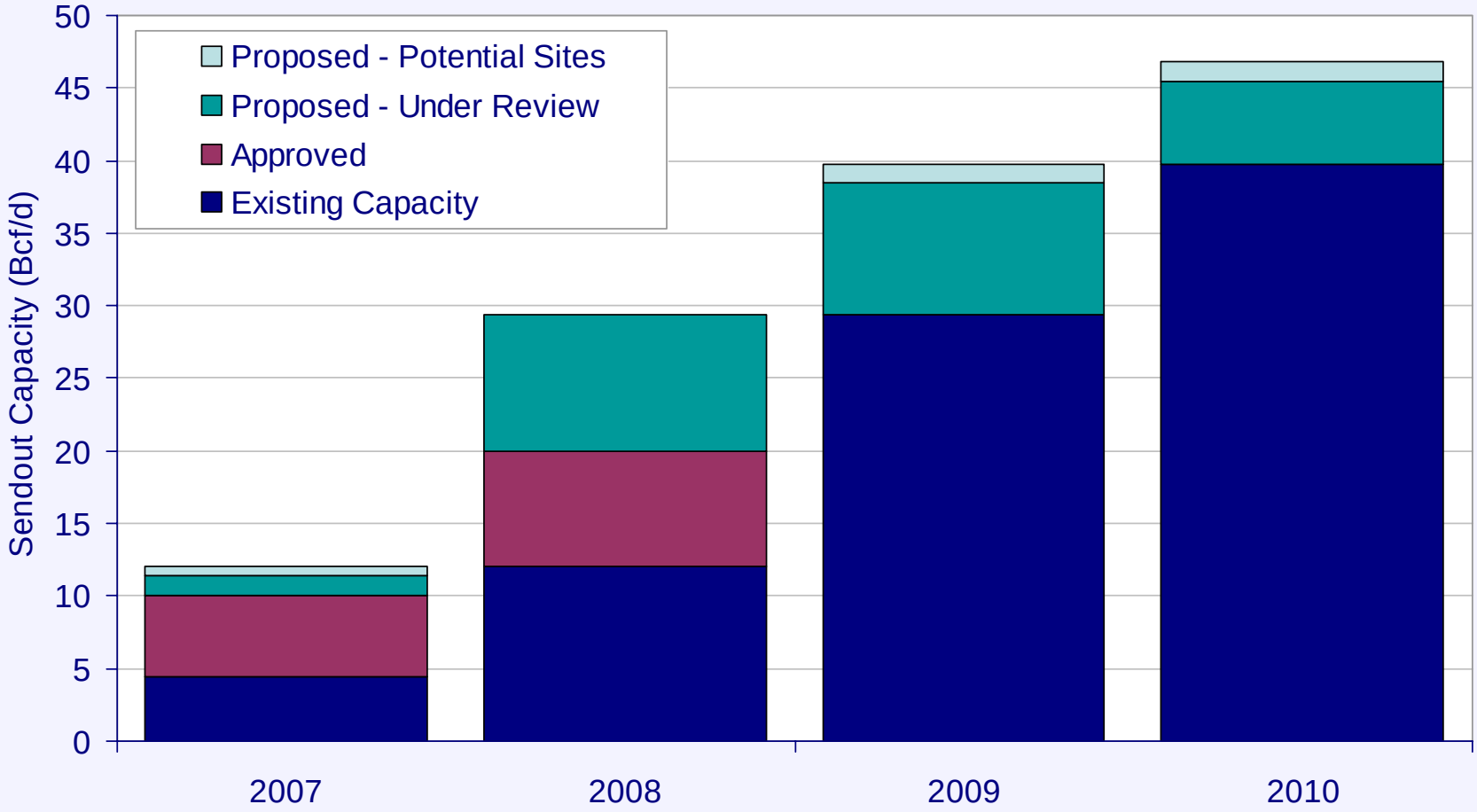
Planned LNG Capacity Additions and Expansions



Note: New capacity includes terminals that have been approved, or are pending approval.
Source: FERC and various tradepress and company websites

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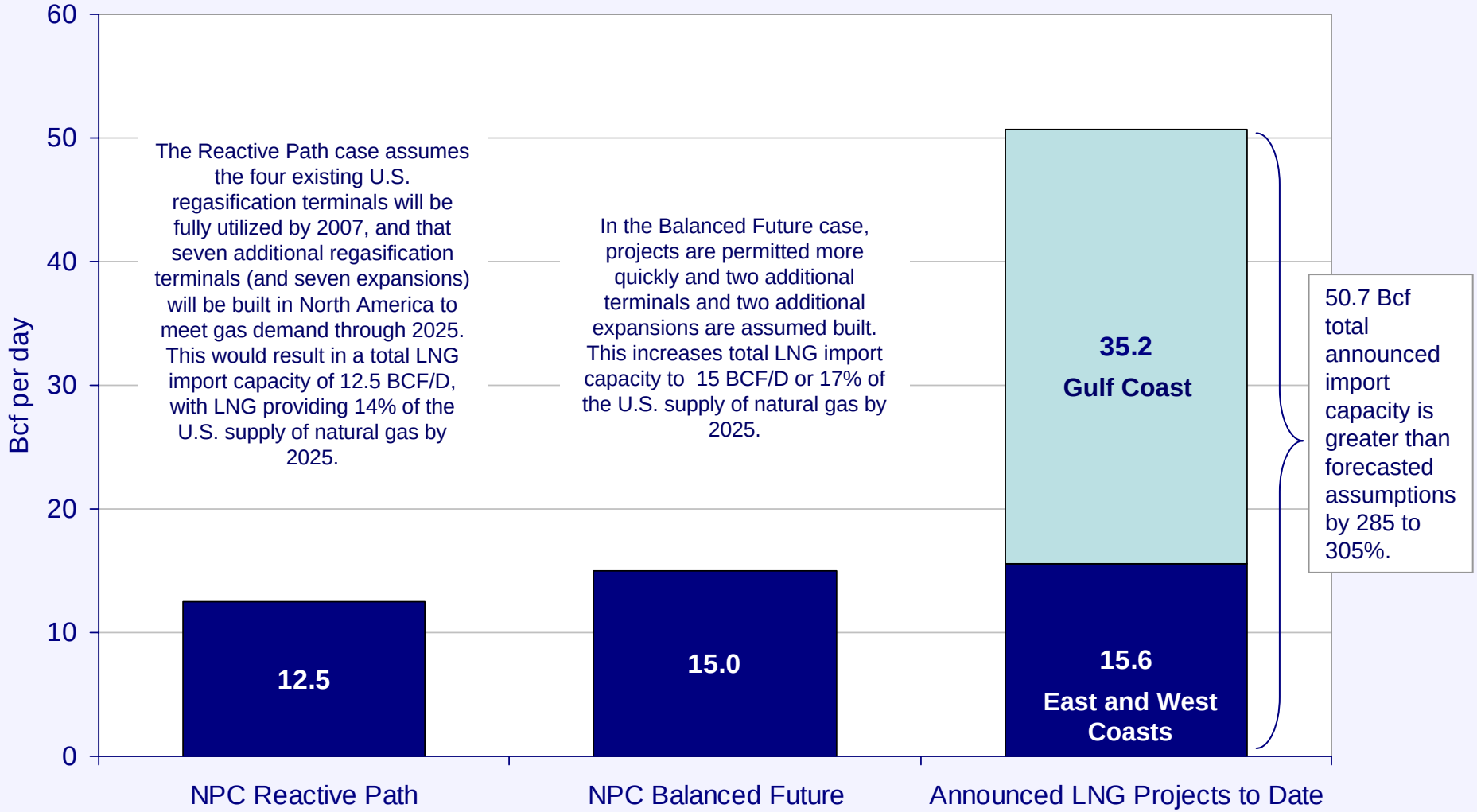
Balancing Natural Gas Demand and Supply: NPC's Natural Gas Study

Clearly not all of these LNG facilities will be developed.



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The Gulf Coast's Relationship with Natural Gas

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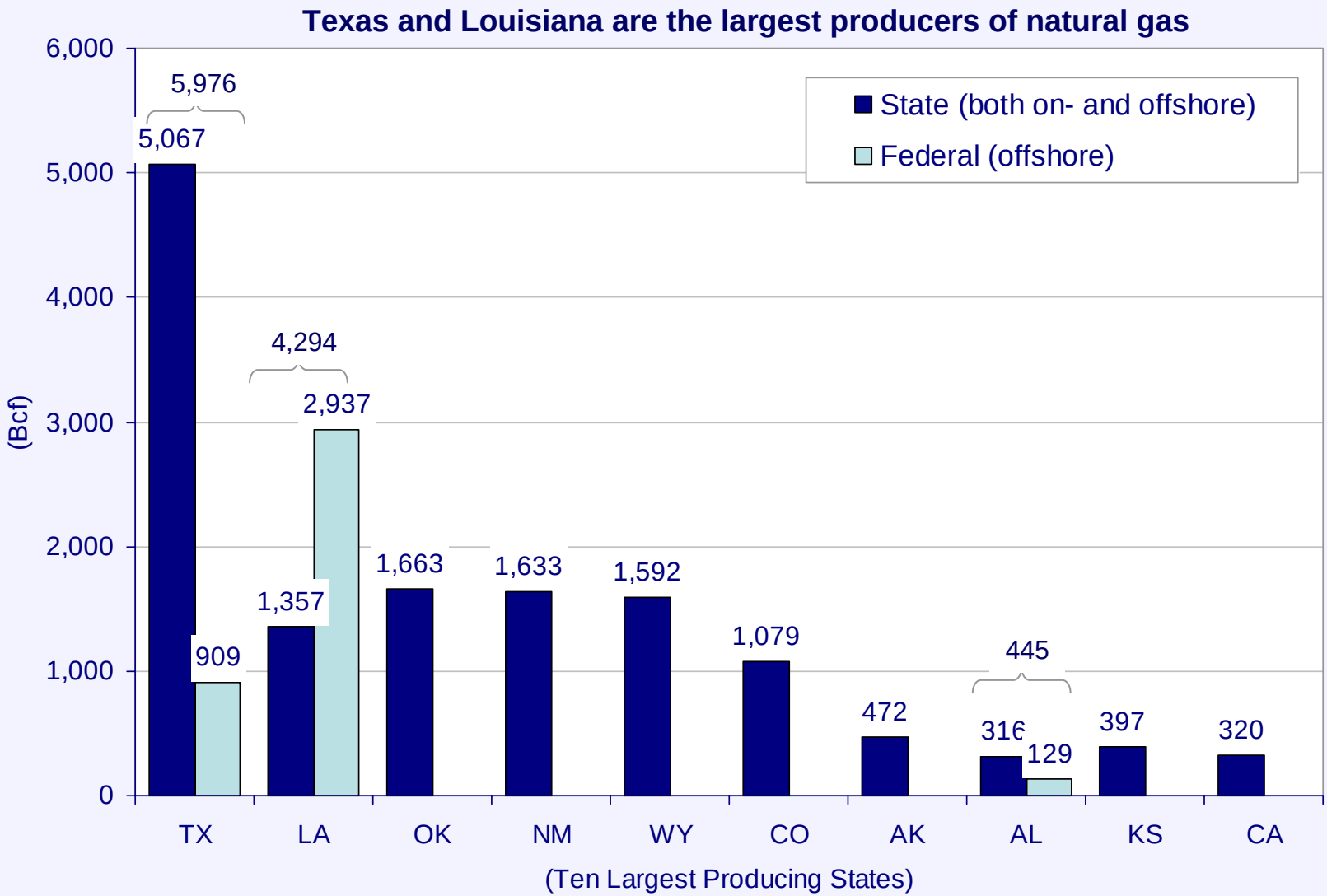
Marketed Production of Natural Gas by State (2004)



Source: Energy Information Administration, Department of Energy.

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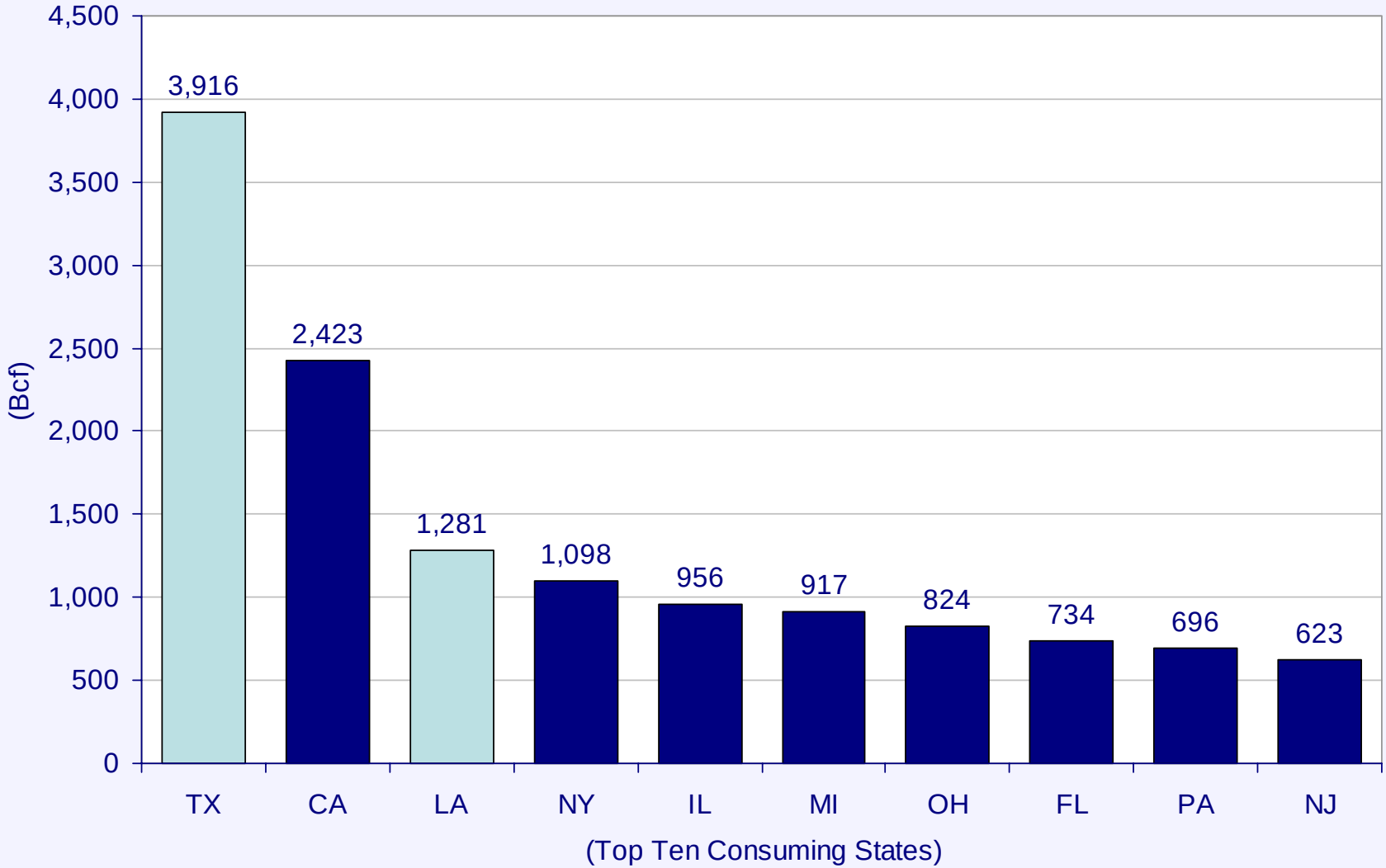
Natural Gas Consumption in the U.S. (2004)

Texas and Louisiana are the 1st and 3rd largest consumers of natural gas in the U.S.



Source: Energy Information Administration, Department of Energy.

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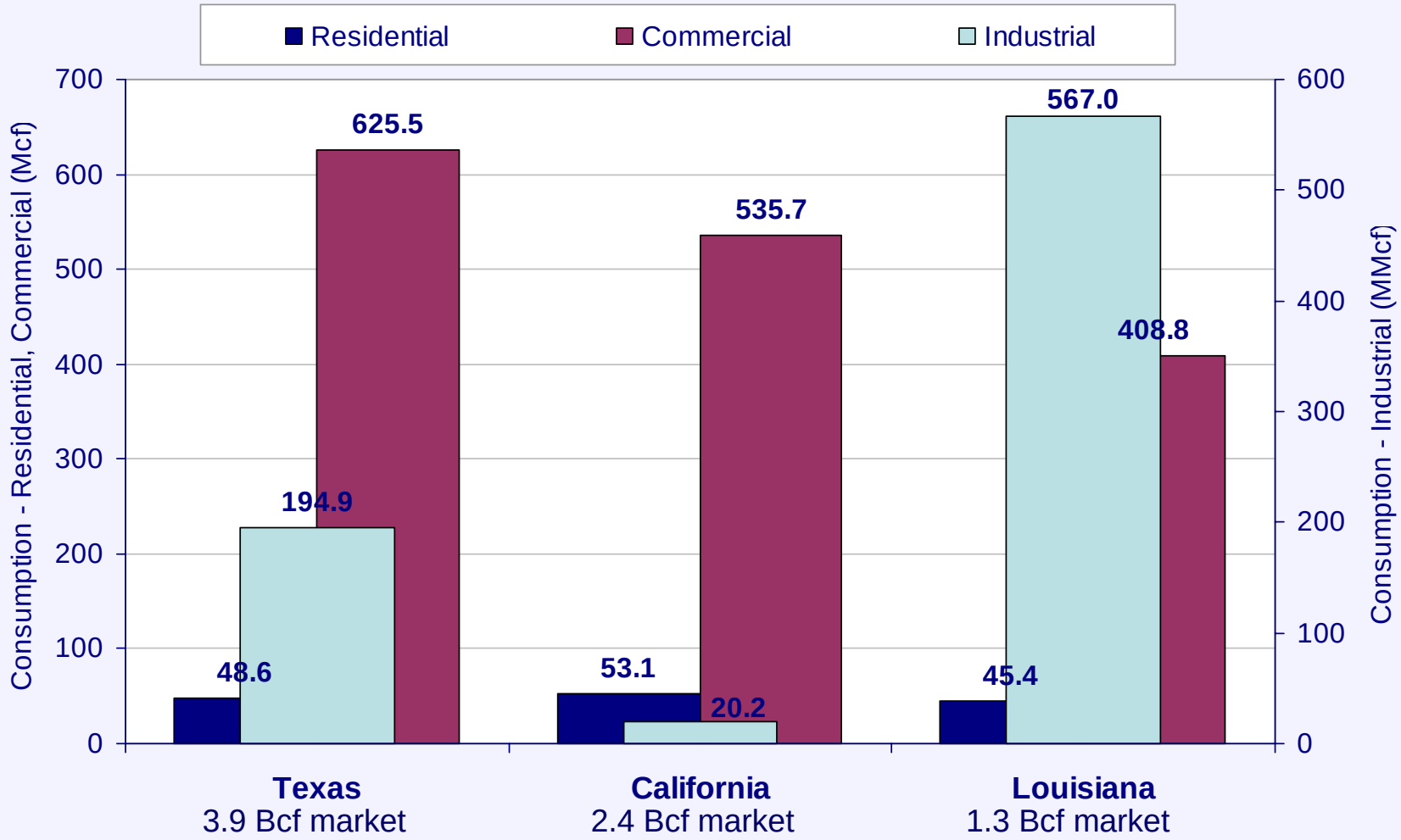
Per Customer Natural Gas Consumption by Sector (2004)

Louisiana's high national gas consumption ranking is due in large part to high industrial use per customer



Source: Energy Information Administration, Department of Energy.

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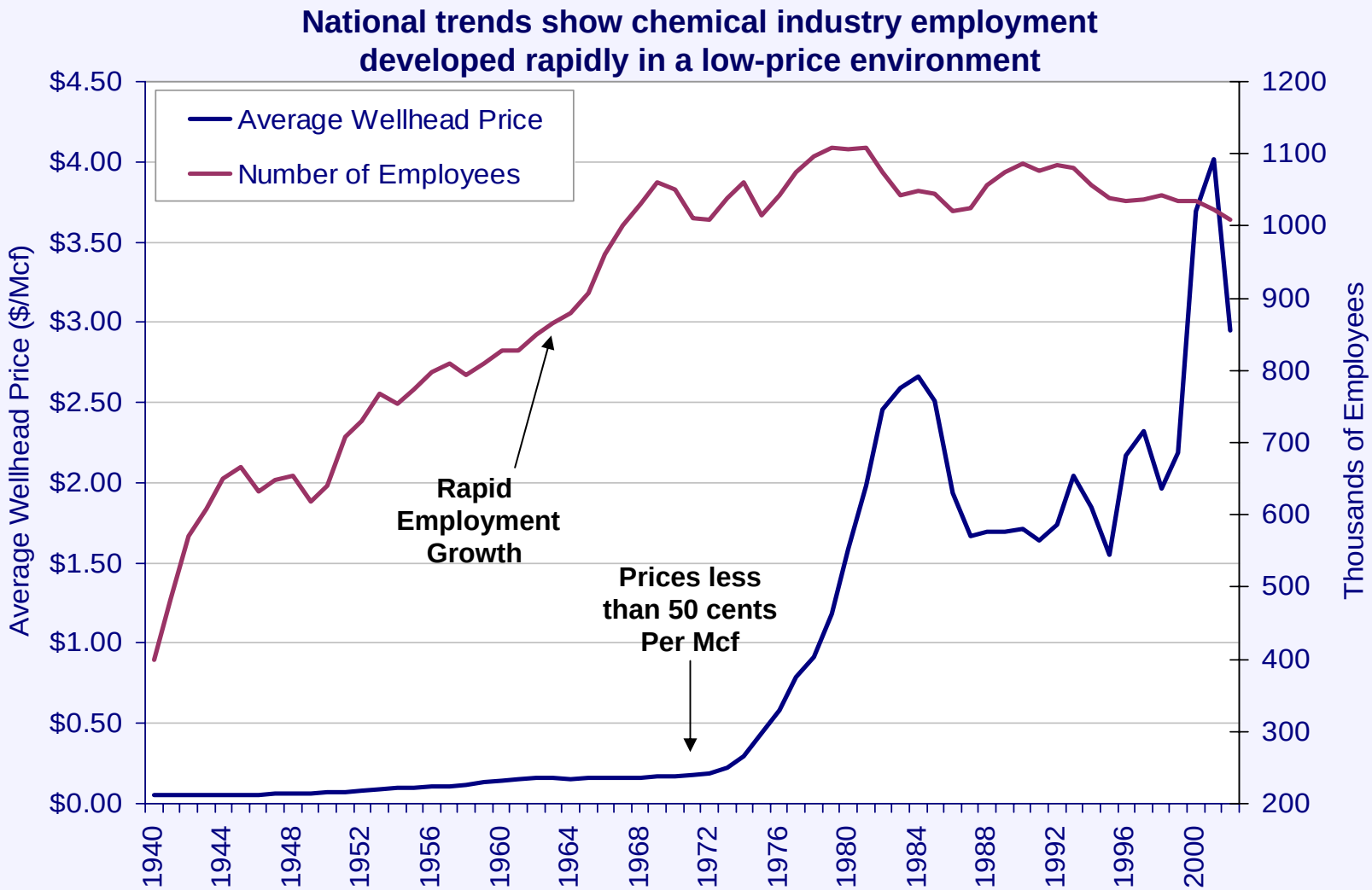
Historic Annual U.S. Average Wellhead Price and Chemical Industry Employment



Source: Energy Information Administration, Department of Energy; and Bureau of Labor Statistics, Department of Labor.

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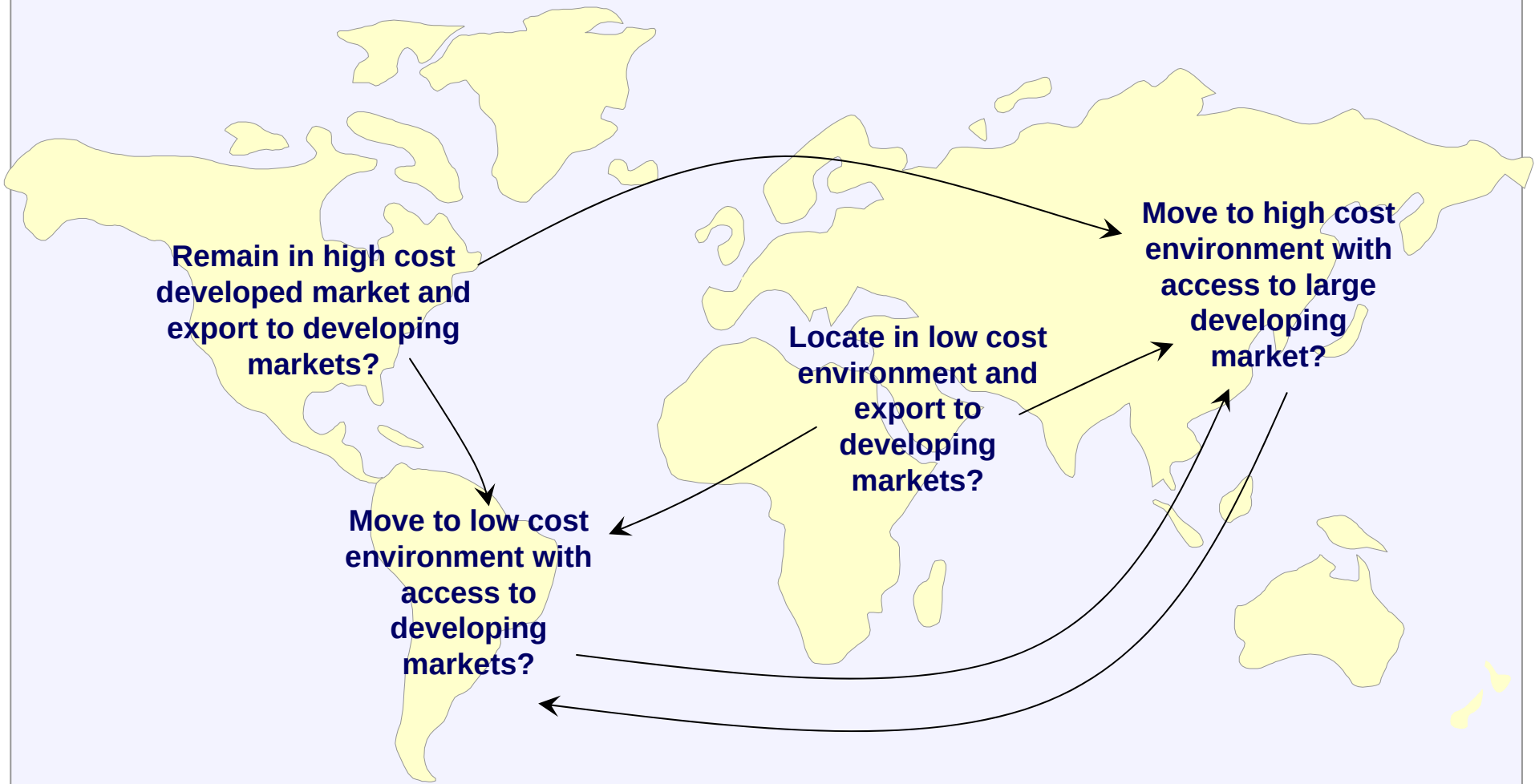
Global Local Considerations

Do U.S. chemical companies remain in a high-cost environment (U.S.) or move to other locations around the world?



Why is the Gulf Coast Such a Good Place to Locate LNG?

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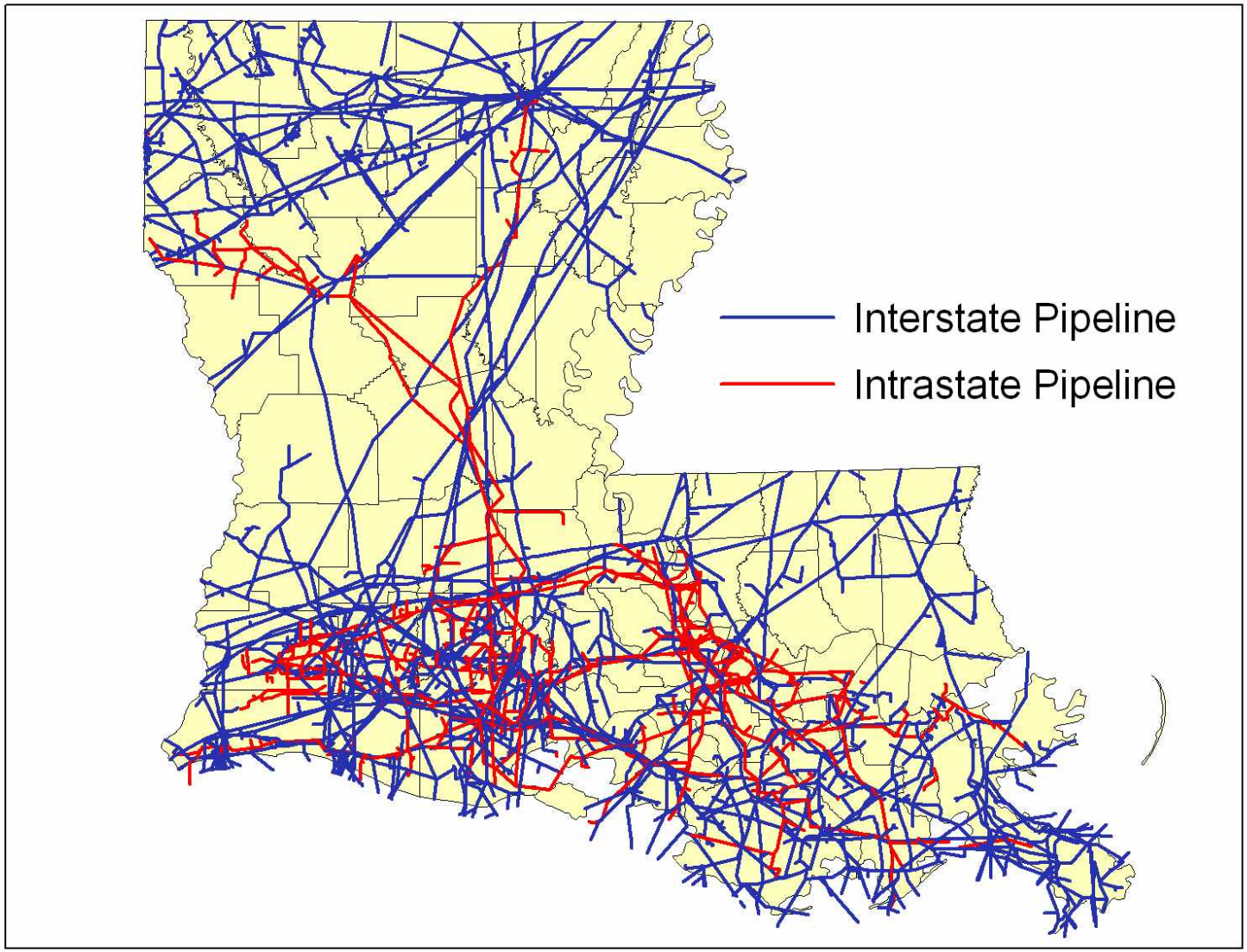
Louisiana Natural Gas Transmission Pipelines



Source: Energy Information Administration, Department of Energy.

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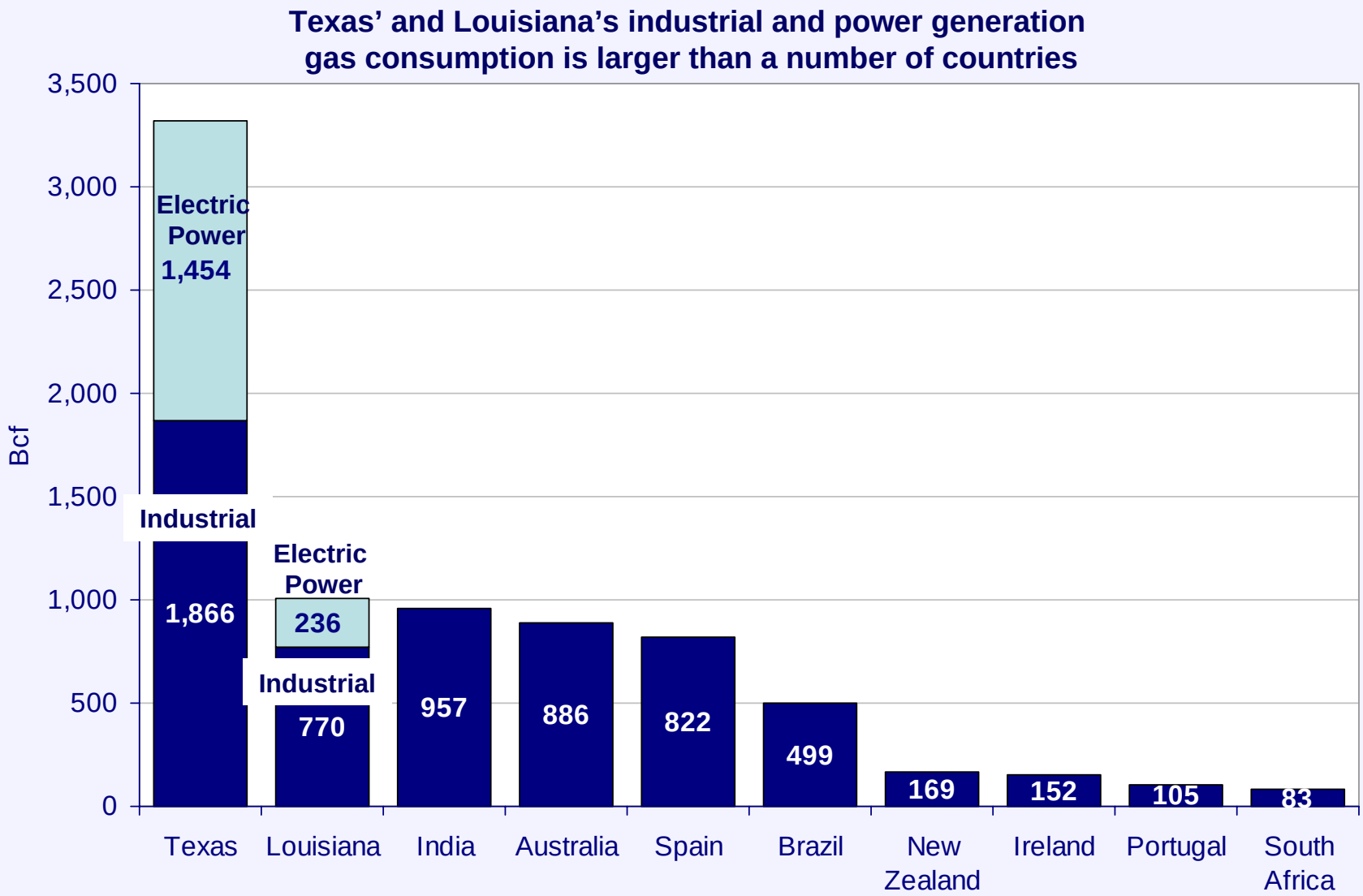
Natural Gas Consumption – Louisiana and World Comparison (2003)



Source: Energy Information Administration, Department of Energy.

Why Is This Important for the Gulf Coast?

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Why Should the Gulf Coast Be Interested in LNG?

1. LNG regasification facilities represent a major capital investment for the region.

2. LNG allows the Gulf Coast to leverage and even extend our existing energy infrastructure.

3. The Gulf Coast has energy-intensive users of natural gas and LNG expands a vital energy resource needed to preserve these industries.

4. The development of LNG is an important national energy concern in which the Gulf Coast can make a significant contribution.

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LNG as a Major Capital Investment

- Potentially a $2.2 billion impact associated with the construction of LNG regasification facilities in Louisiana and the Gulf of Mexico. Potentially 13,877 jobs associated with the construction of these facilities.

- Potentially a $220.7 million impact associated with the annual operation of LNG facilities in Louisiana and the Gulf of Mexico. Potentially 1,607 jobs associated with the operation of these facilities.

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LNG Leverages and Potentially Expands the Gulf Coast's Existing Energy Infrastructure

- If all offshore GOM regional facilities are developed it could be as much as a 237% increase in gas export volumes through the existing pipeline system, which currently averages about 50–65% utilization (annually).

- Potentially $350 million impact associated with announced pipeline additions and new natural gas storage facilities. Potentially 3,487 jobs associated with the construction of these facilities.

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LNG Benefits the Gulf Coast's Energy Intensive Industries

- Extensive LNG development (15 or greater new projects) is forecasted to lower future natural gas prices and have considerable impacts on energy-intensive industries
  - As much as $929 million benefit (positive impact) associated with the lower cost gas associated with high LNG development
  - As many as 11,612 jobs could be regained from recent losses
- Low LNG development (6 to 12 new projects), and higher resulting prices, could hurt Gulf Coast industries
  - As much as $1,672 million cost (negative impact) associated with the higher cost gas associated with low LNG development
  - As many as 20,902 jobs could be lost
- **Failure to act on LNG development** (less than 6 new plants), in addition to other negative resource development factors could lead to the worst case, "do nothing" scenario which would have devastating impacts on the Gulf Coast's economy
  - As much as **$2,803 million cost** (negative impact) associated with the higher cost gas associated with low LNG development
  - As many as **61,926 jobs could be lost**

LNG Issues

Economic Issues

- Impact of constructing facilities (or not constructing facilities)
- Contracting/pooling issues for large users
- Impacts for utilities
- Impacts for small customers

Regulatory Issues

- What is the appropriate sharing of regulatory responsibilities?
- Between state and federal agencies?
- Within state and federal agencies?

Safety and Risk Issues

- What are the potential risks and how do they vary along the value chain?
- How likely are risks?
- What is the scope of the area potentially impacted?
- Does the scope of current development make comparisons with other areas difficult?

Environmental Issues

- Fisheries
- Air emissions

Center for
Energy Studies

kdarby@lsu.edu

www.enrg.lsu.edu