The Transportation of Petroleum and Derived Products in the American Market

Transpetro Company

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Instructor

His experience spans the product line spectrum from hydraulic components and bulk chemicals, fresh poultry and frozen foods to consumer goods. His projects encompass work with manufacturers, wholesalers, government, retailers and e-tailers and have been conducted throughout North America, Europe (both Western and Eastern) and Asia.

Tom serves on the editorial review board of the Journal of Business Logistic and the CSCMP Technology Review Committee, is the 1st Vice President of the NE Ohio WERCouncil and a member of the WERC Knowledge Committee. A well recognized expert in supply chain management and logistics he has written numerous articles and delivered over 200 professional presentations in China, Dubai, Europe, Korea, Malaysia, Russia, Brazil, and the United States.

Instructor

Tom is an active member in the Association of Transportation Law, Logistics and Policy (**ATLLP**), Council of Supply Chain Management Professionals (**CSCMP**), International Customer Service Association (**ICSA**), and Warehousing Education and Research Council (**WERC**).

Education

- M.B.A., with a depth of field in Business Logistics, The Ohio State University
- B.S.B.A., with a major in Marketing, The Ohio State University

Instructor

Mr. Thomas L. Freese in his roles at UNOCAL (Union Oil Company of California) held numerous line and staff petroleum distribution positions overseeing company operated light oil and lubricant mixing terminals, bulk storage facilities, pipeline terminals, tank farms and truck transportation fleets. His responsibilities included:

- Managing the region's forecasting inventory control and product supply operation
- All transportation functions (private fleet, contract and common carrier dry and bulk commodities, truck, rail, water and pipeline operations) for the region

His experience spans pipeline, barge, ocean, rail and truck transportation, terminal and lube blending operations.

Agenda

- Introduction
- US Petroleum Network
- Forecasting
- Transportation
- Liquefied Natural Gas
- Ethanol and Bio diesel
- Competition and Integration
- Management Issues
- Summary & Conclusion

Petroleum Logistics

Petroleum logistics is at its base is merely the physical supply and transportation of crude reserves to a point of processing, and the storage and distribution of finished product to its end users.

The Transportation of Petroleum and Derived Products in the American Market

This session is an examination of how that process operates in the American Market and what is different as well as what can be learned that is applicable to the Brazilian Market.

Key topics that will be addressed:

- Forecasting
- Transportation
- Integration
- Management Issues
- Competition
- Ethanol & Bio diesel
- Liquefied Natural Gas

This session will examine;

- competitive influence on the US petroleum industry,
- governmental influence on the US petroleum industry,
- the various types of transportation,
- the impacts and influence of alternative fuels,
- integration of various energy organizations,
- the future and how it will change today's infrastructure.

Specifics to be covered:

1) What is the forecasting regarding the balance between supply and demand of petroleum products for next ten years?
2) What is the transportation infrastructure for the movement of petroleum and derived products?
3) What are the major modes of transportation for petroleum and derived products as well as ethanol and bio diesel? What are the major advantage and disadvantage of each mode? What are the costs of transportation for each mode?
4) Who are the top companies that offer this service? Are the producers also responsible for the transportation or there are specifics companies focused in the movement of petroleum and derived product?
5) How is the integration among the pipeline mode of transportation and the others modes. Particularly between pipeline and railroad; pipeline and river boats; pipeline and maritime transportation.

Specifics to be covered:

6) How structured are the commercial relationships among the several players involved in the process of transportation of petroleum and derived product? For instance, the relationship among producers, logistics providers and distributors
7) What are the principle management issues faced by a transportation company in the movement of petroleum and derived product?
8) What is the competition among the companies in the market of transportation of petroleum and derived products?
9) What is the American government planning in terms of adding ethanol and bio diesel to the portfolio of fuels available to the final consumer? What are the targets for the next ten years?
10) What are the plans for adding ethanol to gasoline and offering the blend to the final consumer? What is the size of this market, taking into consideration the amount already being produced by the domestic producers?

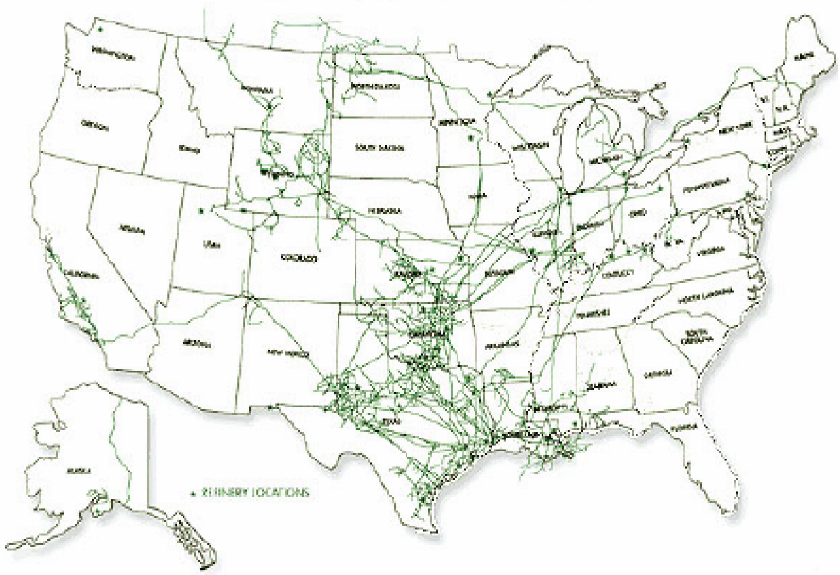
Specifics to be covered:

11) How is Liquefied Natural Gas transported? How many companies are in this business? What are the requirements for the transportation? What are the cost of transportation of this product?
12) What is the bio fuel energy policy in America?
13) What are the incentives to the production and use of bio fuel, specially bio diesel and bio ethanol storage?
14) How is bio fuel transported and distributed of in America?

US Petroleum Network

US Supply Chain Infrastructure

MAJOR CRUDE OIL PIPELINES



MAJOR REFINED PIPE LINES

US Petroleum Supply Chain Selected Physical Statistics
(Latest Available Estimates)

Refining		Pipelines		Terminals	
Number	144	Total Miles	~190,000	Number	1,612
Capacity (kBPD)	16,761	• Crude trunk line	~55,000	Total storage capacity (mBBL)	700
Throughput (kBPD)	14,926	• Crude gathering line	~40,000	Typical stocks (mBBL)	237
Utilization (%)	89	• Refined Product	~95,000	Utilization (%)	34
Crude stocks (mBBL)	294	Throughput (kBPD) Crude + Product	25,000		
Barge (Excludes Ocean Tankers)		**Truck**		**Rail**	
Liquid carriers	3,614	Petroleum Tank Trucks (thousands)	170.4	Number of Tank Cars (thousands)	3,411
Throughput (kBPD)	4,180	Throughput (kBPD)	600	Throughput (kBPD)	300

US Petroleum Supply Chain
Selected Physical Statistics

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Throughput (kBPD)	600	Throughput (kBPD)	300

The Complexity of the Supply Chain

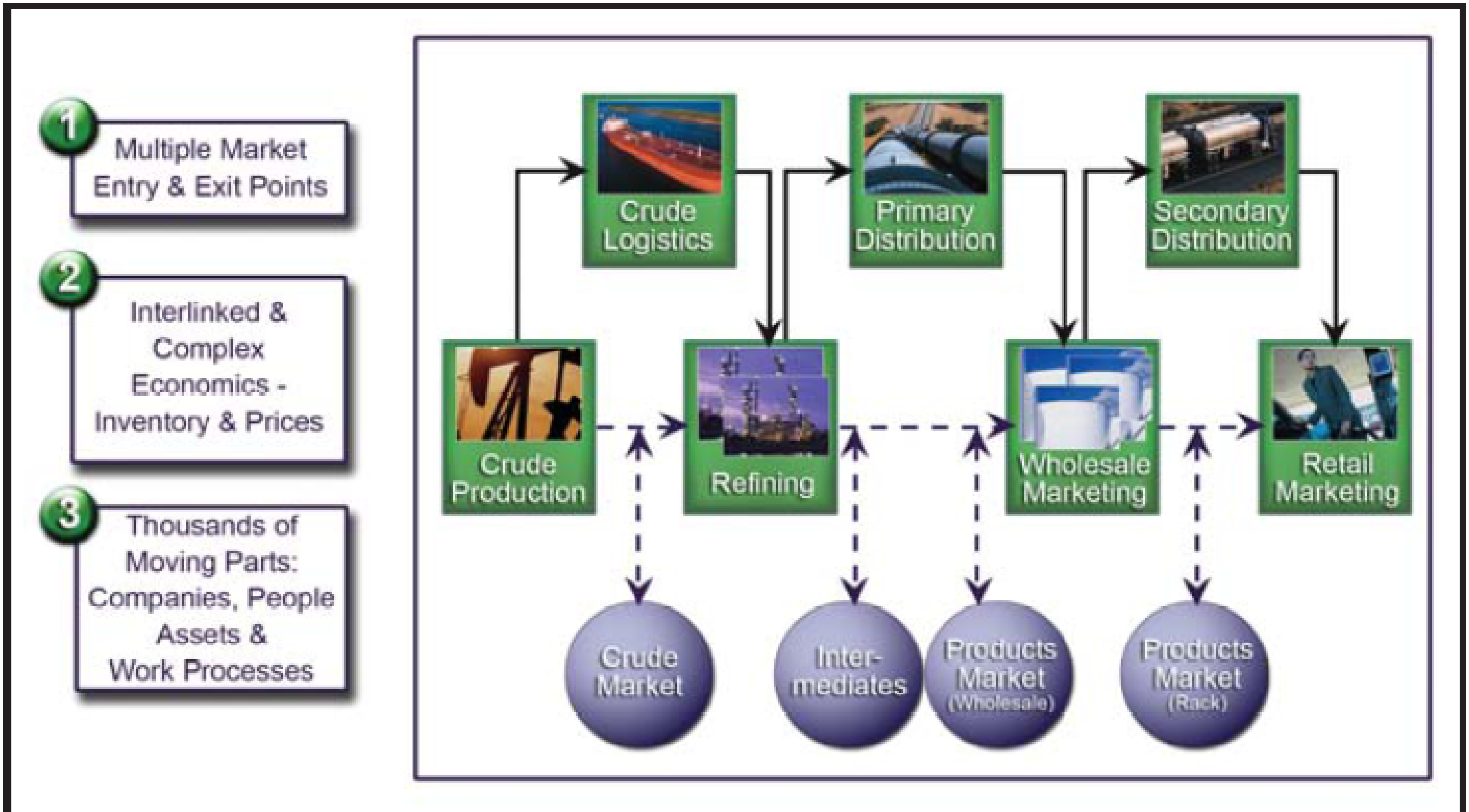
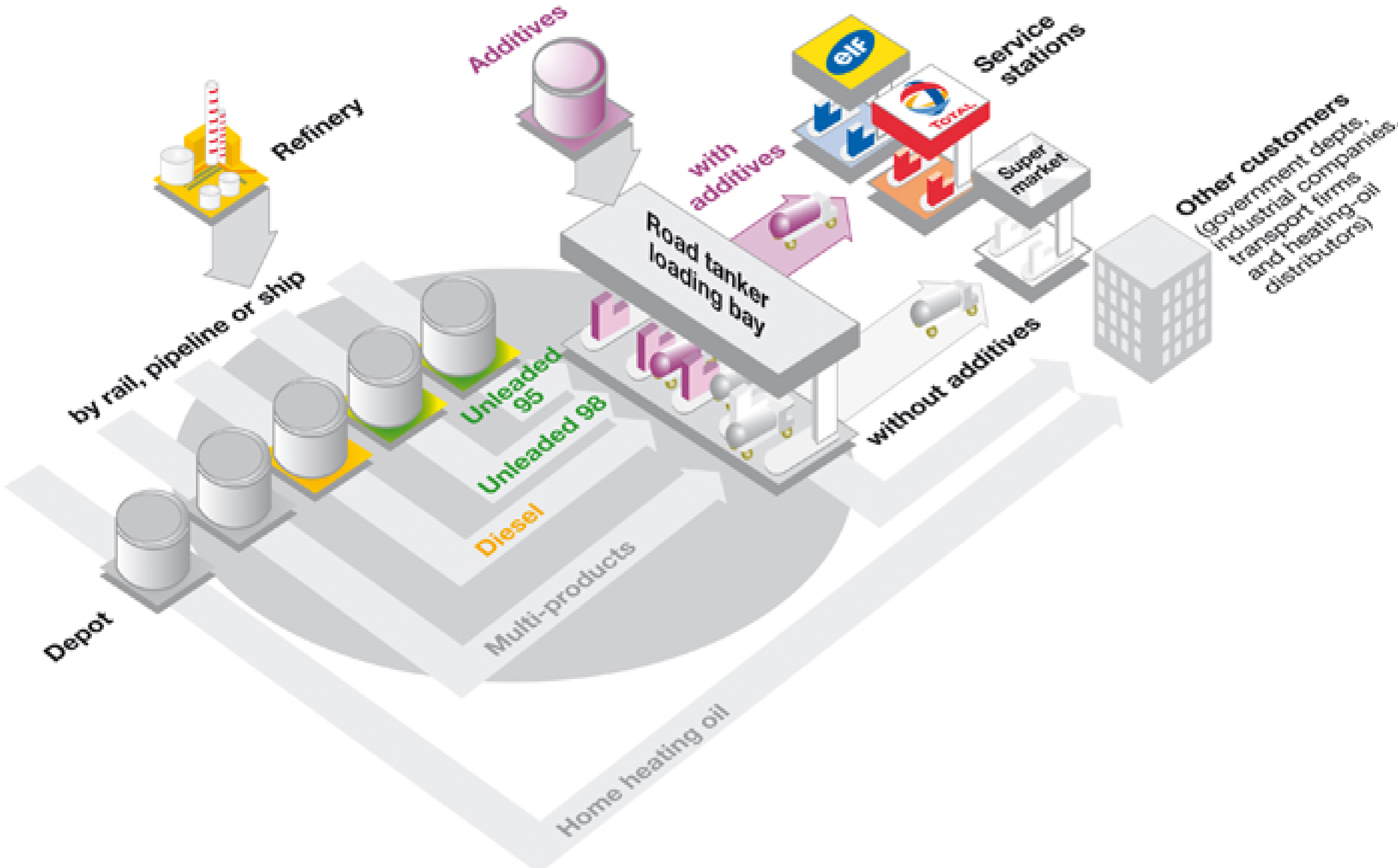


Figure 1: The petroleum supply chain is highly complex

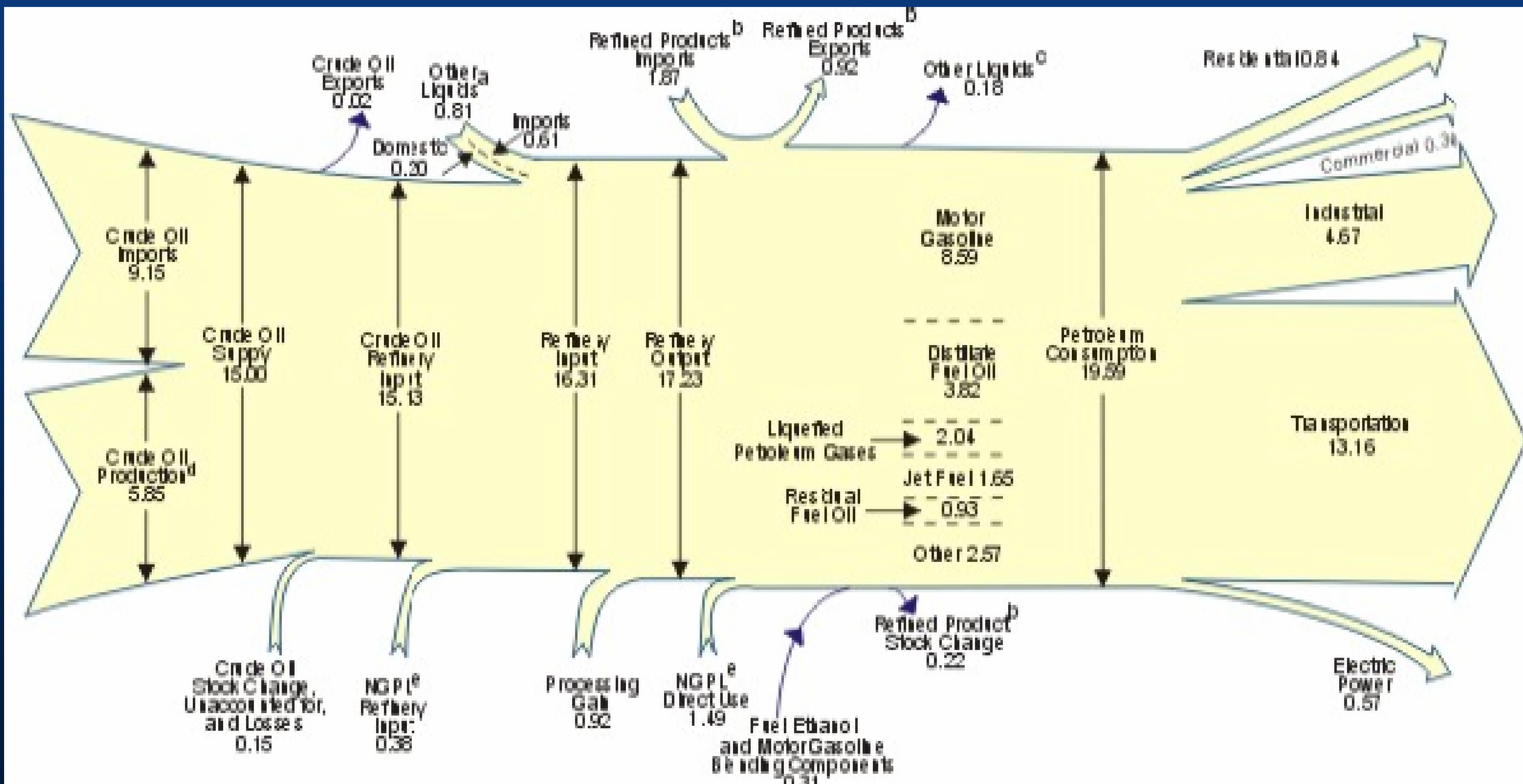
Source: Aspen Technologies

US Petroleum Supply Chain



Petroleum Enters & Leaves US Supply Chain at Many Points

US Petroleum Oil Flow - Supply Chain Energy Balance - 2000
(Quadrillion Btu)



US Petroleum Supply Chain

Supply chain solutions that work well in other industries must be modified for downstream petroleum. This industry presents complexities not present in others:

- The inventory is commodity-based and fungible. Competitors within the same part of the supply chain can, and do, trade with each other. Associated financial markets for both crude and refined products play a large part in how supply chains are managed, and these markets can be exceptionally volatile.

- Companies' supply chains are often discontinuous. Because inventory is a commodity, any given molecule is often traded several times or resold before it is consumed. Oil companies regularly trade inventory in and out of their systems multiple times, increasing transaction volume but not necessarily increasing or decreasing actual inventory. In most other industries, inventory that's been acquired is not traded again.

US Petroleum Supply Chain

- Inventory is process-based and nondiscrete. Inventory is not packaged and can't be separately identified. Typical techniques and tools for tracking inventory, such as stock keeping unit (SKU) or part numbers, bar codes, radio frequency identification (RFID) and packaging (pallets and containers), do not yet apply to crude or refined products.

- Compared with other industries, the production flow is reversed. In downstream petroleum companies, inventory starts as a few products (crudes) and creates many products, which can then be recombined. An end product, such as gasoline, can be created in many different ways. Tools that calculate derived demand based on bills of material are ineffective.

US Petroleum Supply Chain

- Transportation costs and low relative value combine to limit the number of locations products can cost-effectively be shipped to.

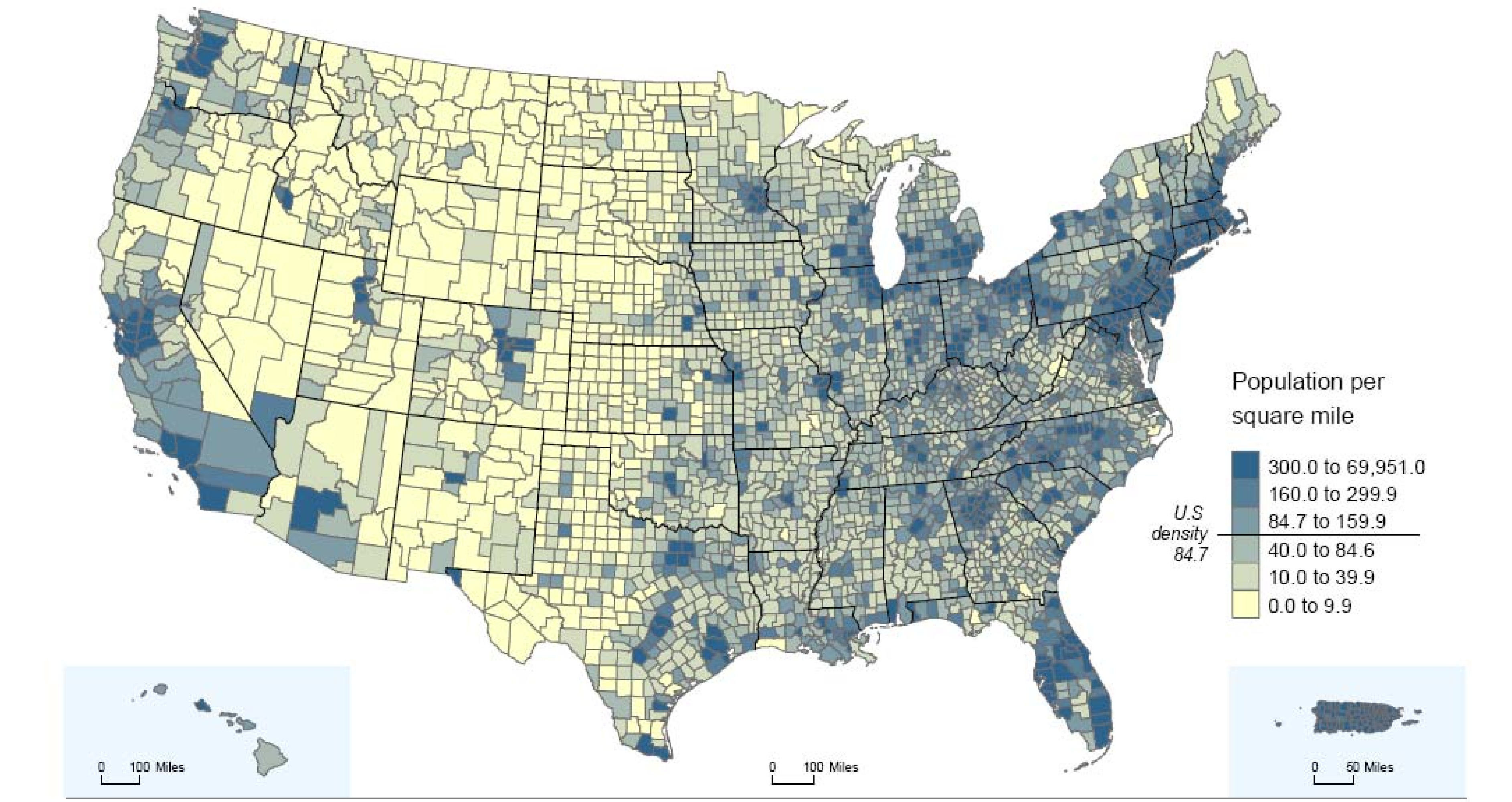
- Product life cycles are longer. Unlike other industries that must contend with the product obsolescence that follows constant innovation, downstream petroleum has a stable and static product mix.

US Petroleum Supply Chain

- Products are not perishable. Holding inventory may be costly from a capital standpoint, but these costs can be recovered. Aging and stock rotation issues do not affect downstream petroleum companies.

- Demand is less fickle. Though demand may vary among petroleum companies, total demand for a given market is much more stable than it is in other industries. Demand does not change based on product innovation or consumer tastes, and downstream petroleum companies can use history as a reliable forecast base.

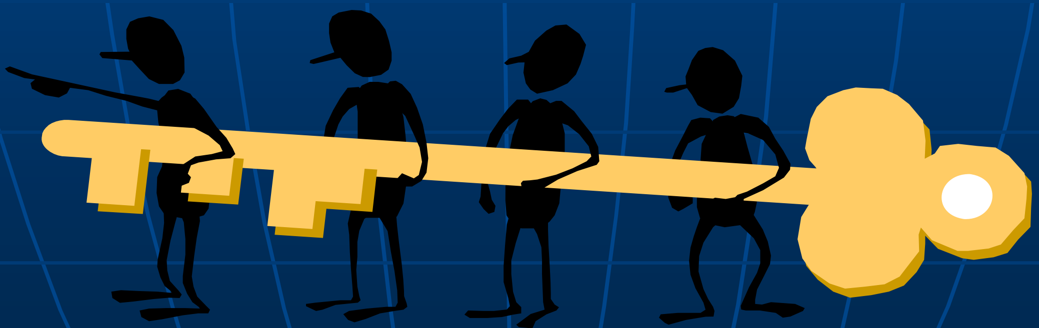
US Population Density



Source: U.S. Census Bureau, Population Estimates Program, 2006

Key Concepts

- The US petroleum network is quite complex.
- Product is often sold, traded or exchanged instead of physical movement / transport.
- Multiple parties are involved in the supply chain some of who may be competitors.
- Physical movement may be along owned channels, competitors channels and/or third party's.



US Petroleum Network's Challenges

Logistics Infrastructure Challenges

- The US logistics infrastructure supporting petroleum imports is already near capacity and permitting and funding these types of facilities, such as wharf's terminals, pipelines, etc.) will take a minimum of several years.
- Future import growth does not necessarily match up to where spare capacity exists in the system.
- The future need to import more refined products and rude oil into the U.S. West Coast is causing the petroleum industry and the government to scramble to find supply-chain solutions that will alleviate the upcoming bottlenecks of the current infrastructure.

U.S. Refineries

- In 1981 there were over 300 refineries in the U.S. while today there are less than 150.
- Refineries have kept pace with demand during the last 20 years by expanding capacity and running at higher utilization. In the future refineries cannot look towards improved utilization as a means to satisfy increasing demand.
- In 2004 refineries operated at around 95% utilization, which experts believe to be the maximum
- A series of costly upgrades have been imposed on the refining industry in order to produce cleaner burning fuels as mandated by the federal government.

U.S. Refining Capacity

U.S. refining capacity, as measured by daily processing capacity of crude oil, has appeared relatively stable in recent years, at about 16 million barrels per day of operable capacity.

While the level is a reduction from the capacity of twenty years ago, the refineries that were shut down as demand fell in the early 1980's were those that were limited to simple distillation, small facilities were not economically viable.

When Federal price control system subsidies ended in 1981, additional refineries were shut down. At the same time, refiners improved the efficiency of the crude oil distillation units that remained by improving the flow and matching capacity among units and turning more to computer control of the processing.

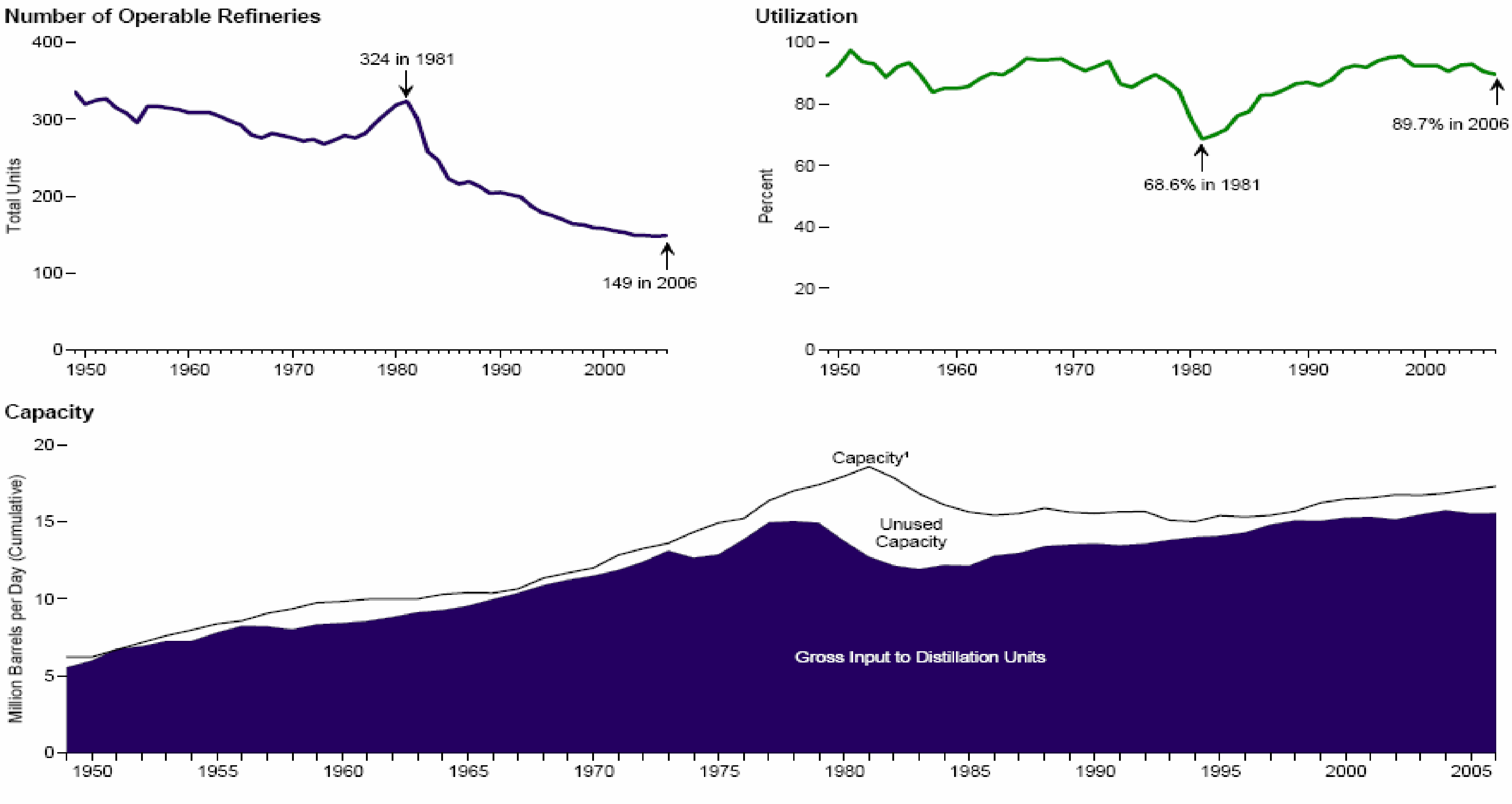
U.S. Refining Utilization

Following government mandates for environmentally more benign products as well as commercial economics, refiners enhanced their upgrading (downstream processing) capacity. As a result, the capacity of the downstream units ceased to be the constraining factor on the amount of crude oil processed (or "run") through the crude oil distillation system. Thus crude oil inputs to refineries ("runs") have continued to rise, and along with them -- given the stability of crude oil distillation capacity -- capacity "utilization" rose throughout much of the 1990's. Utilization -- the share of capacity filled with crude oil -- reached truly record levels in the last half of the decade, nominally exceeding 100 percent for brief periods.

As with most aspects of the U.S. oil industry, the Gulf Coast is by far the leader in refinery capacity, with more than twice the crude oil distillation capacity as any other United States region. (The difference is even greater for downstream processing capacity, because the Gulf Coast has the highest concentration of sophisticated facilities in the world.)

Refinery Capacity & Utilization

Figure 5.9 Refinery Capacity and Utilization, 1949-2006



¹ Operable refineries capacity on January 1.

Source: Table 5.9.

Domestic Petroleum Industry

- The domestic petroleum is having difficulty meeting consumer demands for refined products like gasoline, diesel and jet fuel.
- With the economic recovery that has taken place in the U.S. since 2003, demand for energy and particularly petroleum products has resumed the growth that had been temporarily stalled since 9/11/2001.

Domestic Petroleum Industry

- August year over year demand growth of approximately 2% for gasoline, 10% for diesel and 14% for jet fuel is exceeding the historical growth rates for these products.
- The West Coast anticipates that for the next 5 years gasoline demand will continue to grow at 2.2% per year while diesel fuel will grow at 2.6% and jet fuel will grow at 1.7% per year. This continued growth will add stress to a refining system that is already running at maximum output.

Domestic vs. Foreign Refining

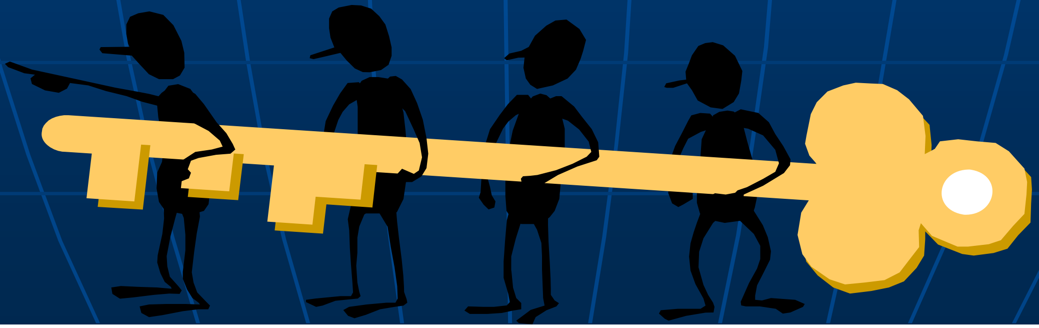
- While cleaner burning fuels are being supported, the upgrades required to produce them are consuming resources that a refining company may have used to expand capacity.
- There will not be enough refinery expansion to address growth in demand and focus resources on upgrading plants to produce cleaner burning fuels.
- Refiners on the U.S. West Coast market will have to rely more on foreign imports of refined products like gasoline, diesel and jet fuel in order to meet future demand for these products.

Domestic vs. Foreign Refining

- Based upon supply and demand growth projections we assume that by 2008 the West Coast petroleum industry will have to more than triple its current levels of refined product imports from approximately 160,000 barrels per day to approximately 480,000 bpd in 2008 in order to meet consumer demands in PADD V.
- Imports primarily come on tanker ships through the three major West Coast storage and distribution hubs of Los Angeles, San Francisco, and Portland.

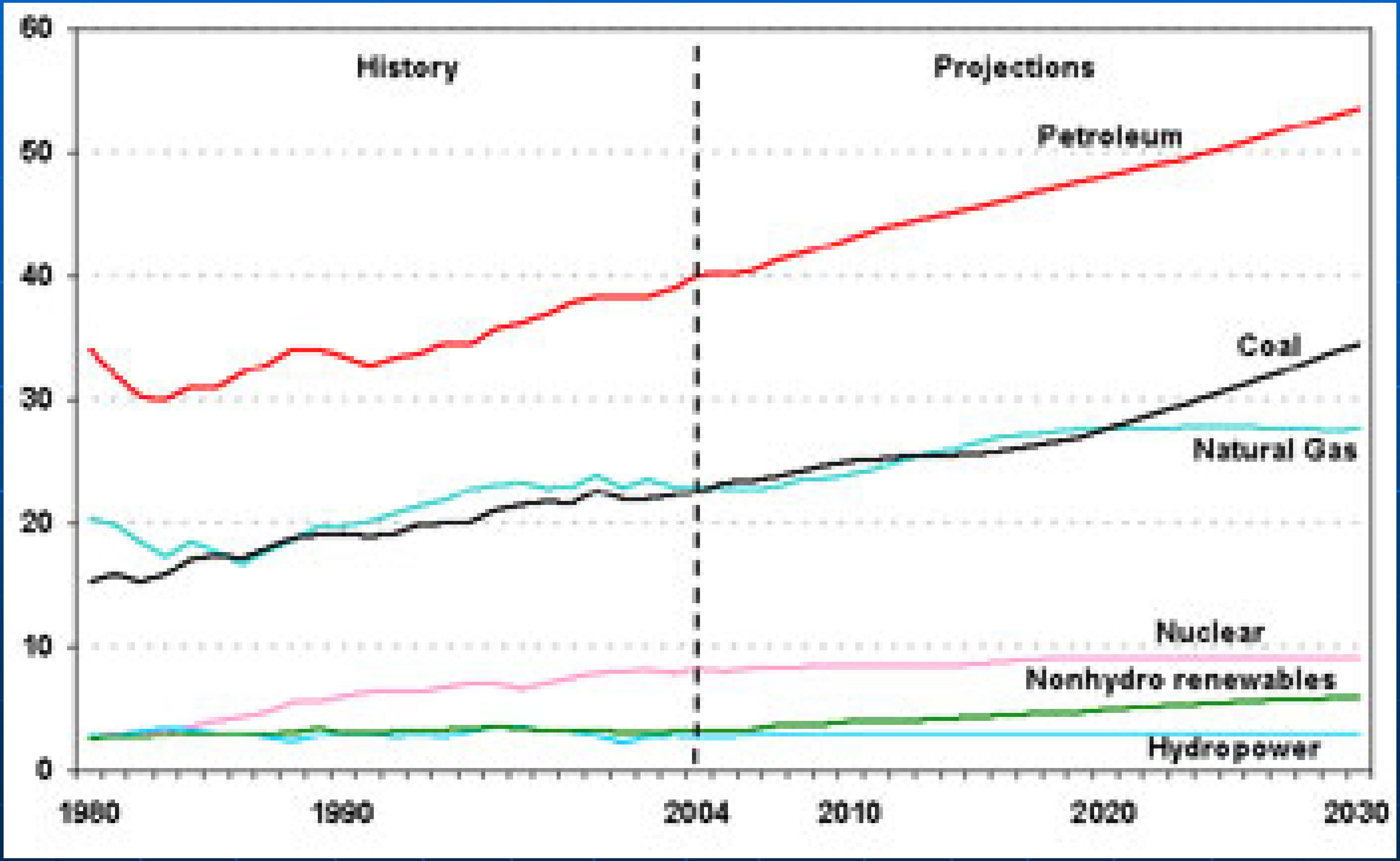
Key Concepts

- US logistics infrastructure for petroleum imports is at capacity
- Since 1981 refineries in the U.S. have declined from 300 to less than 150.
- Refinery capacity has actually increased
- The West Coast is projected to triple its imports by 2008
- The US is having difficulty meeting current demands for refined products

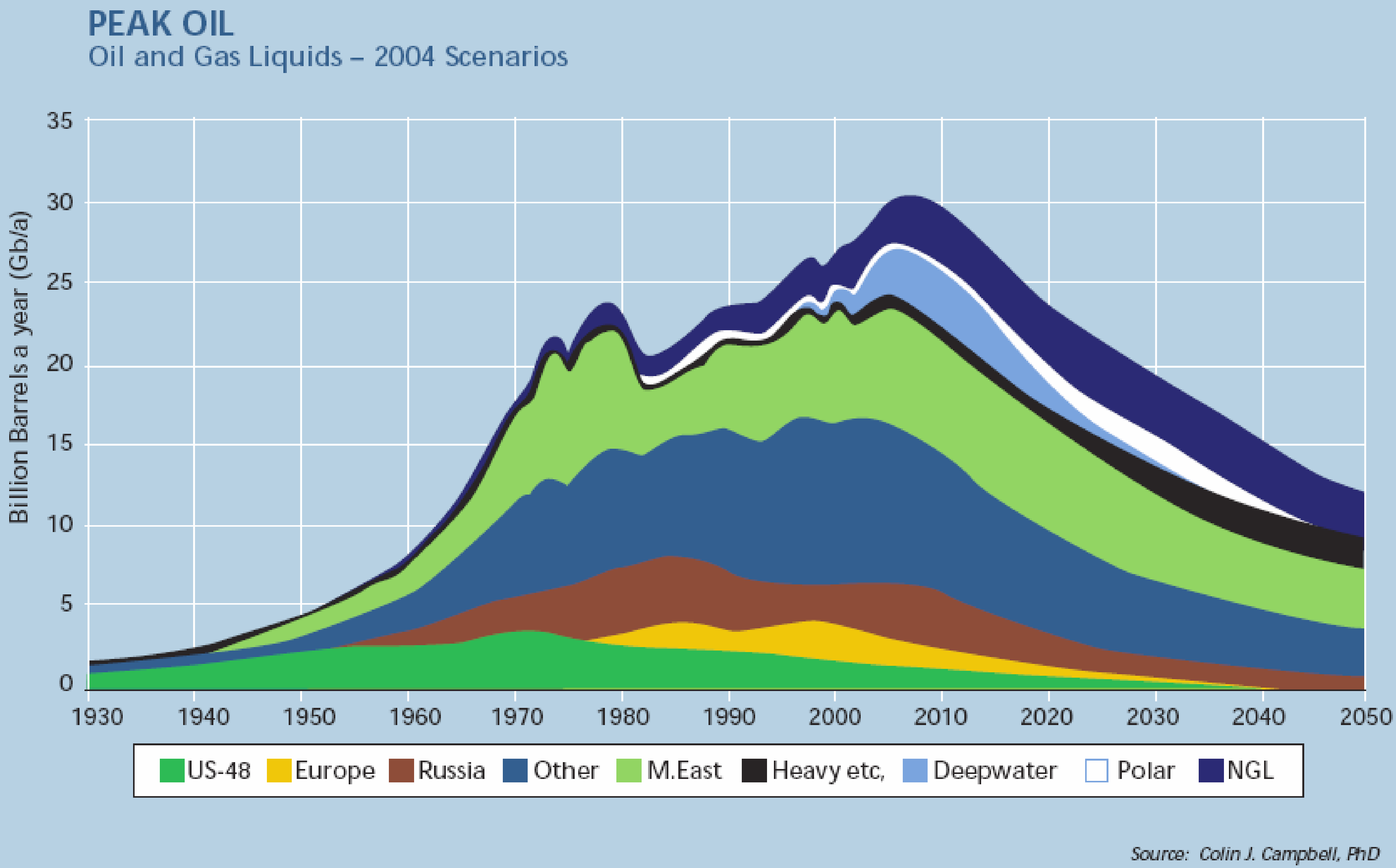


Forecasting

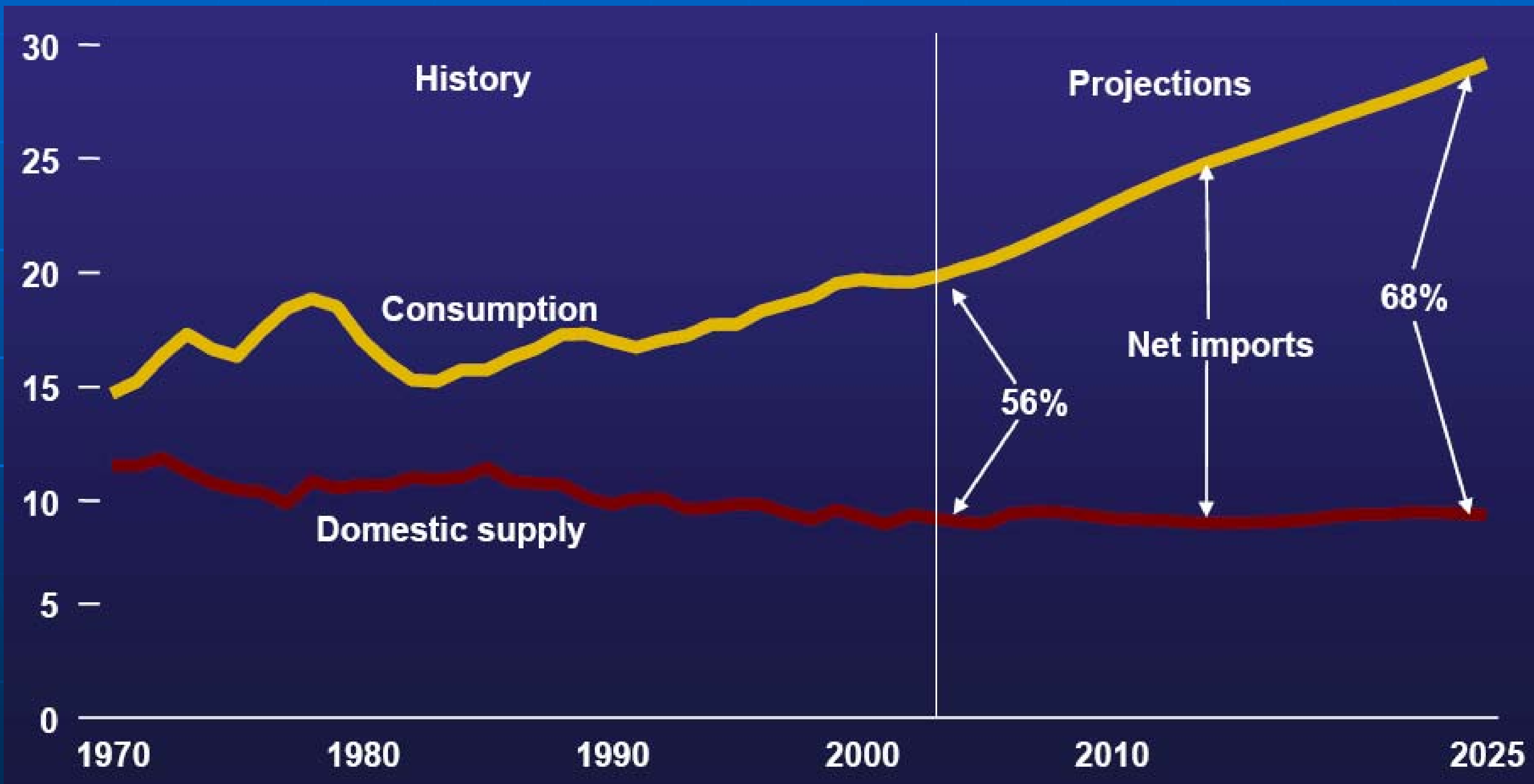
U.S. Energy Consumption by Fuel (1980-2030)



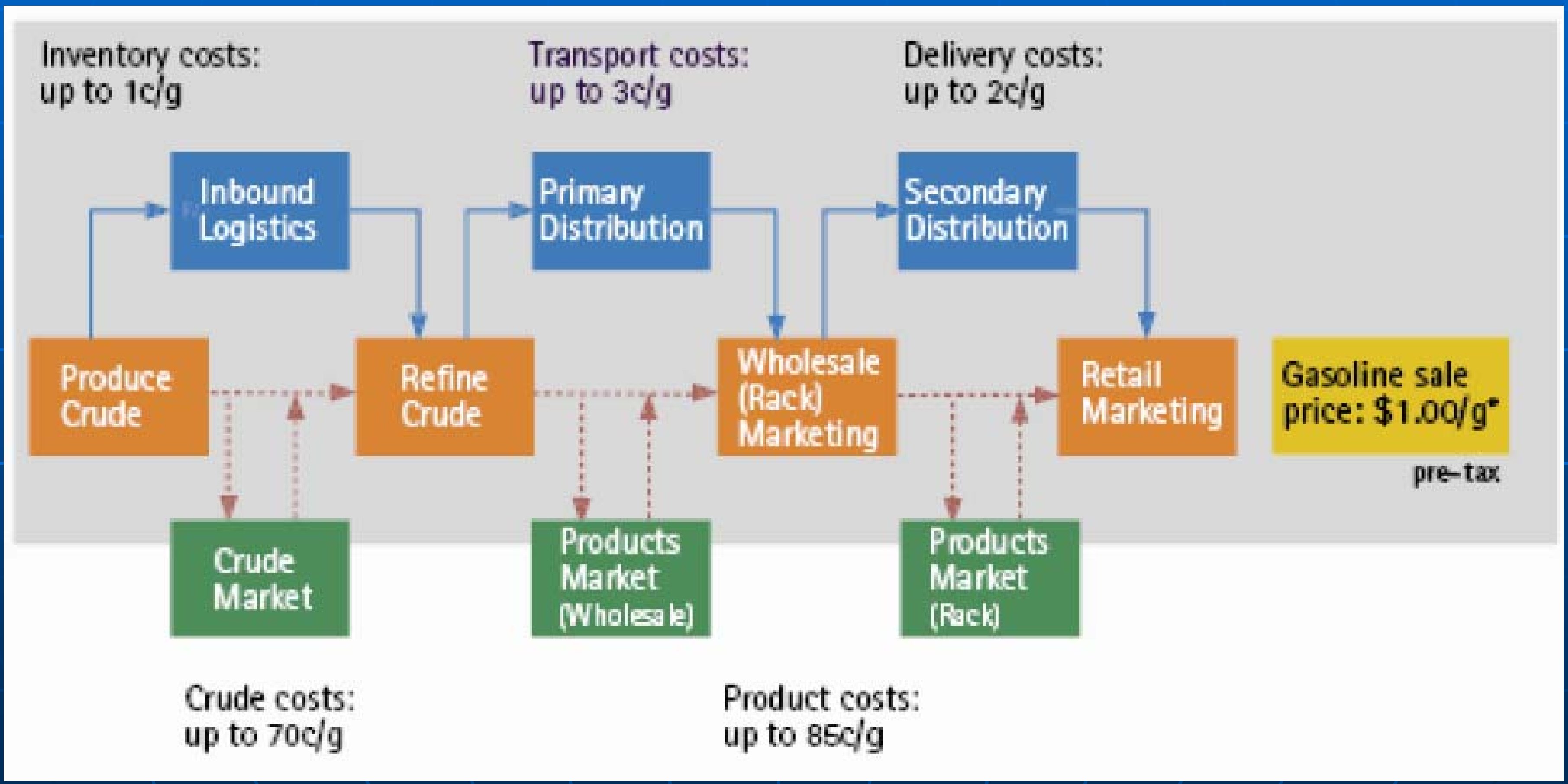
Peak Oil Sources



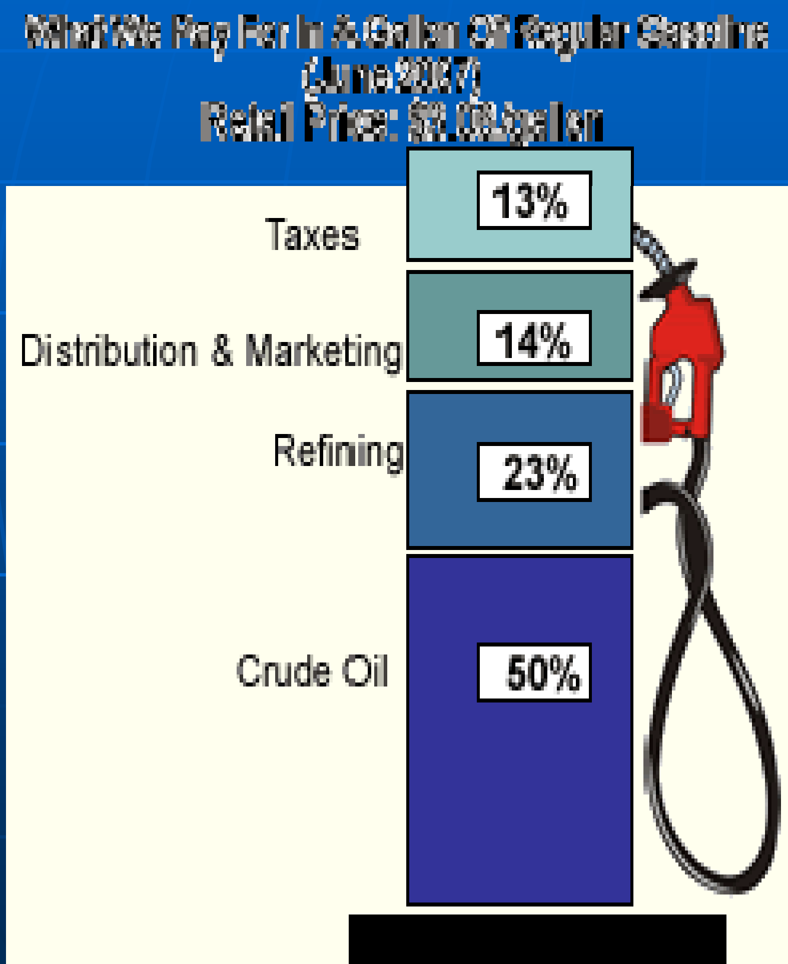
U.S. Petroleum Supply, Consumption & Imports, 1970-2025

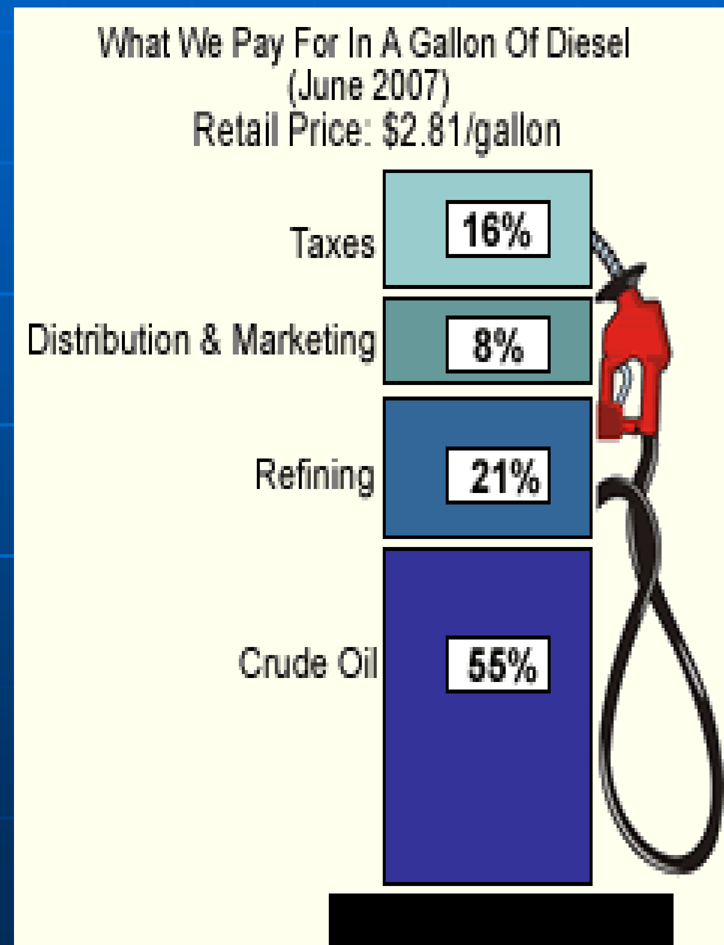


Supply Chain Costs to Sell Gas

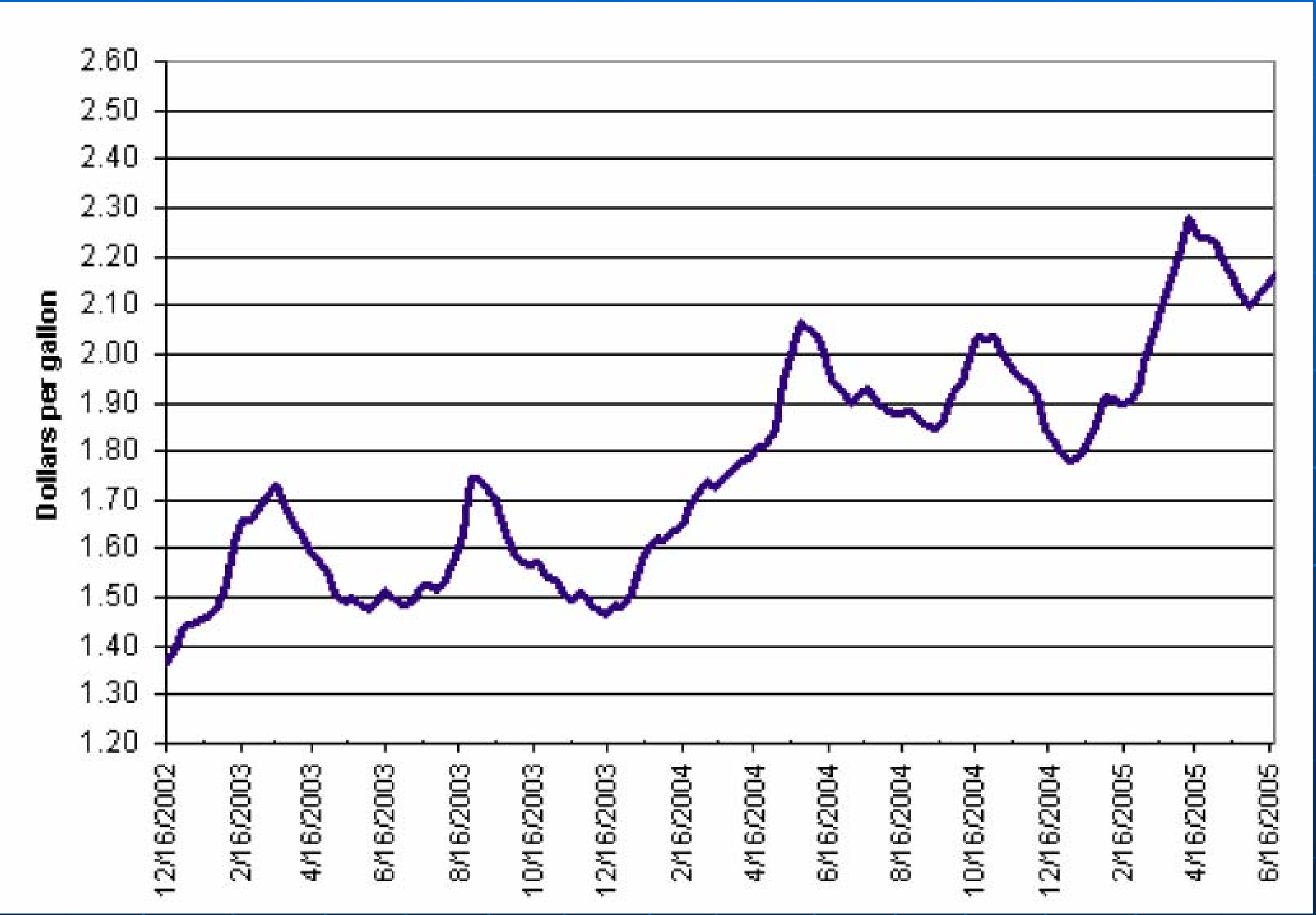


Distribution as a % of Sale Price

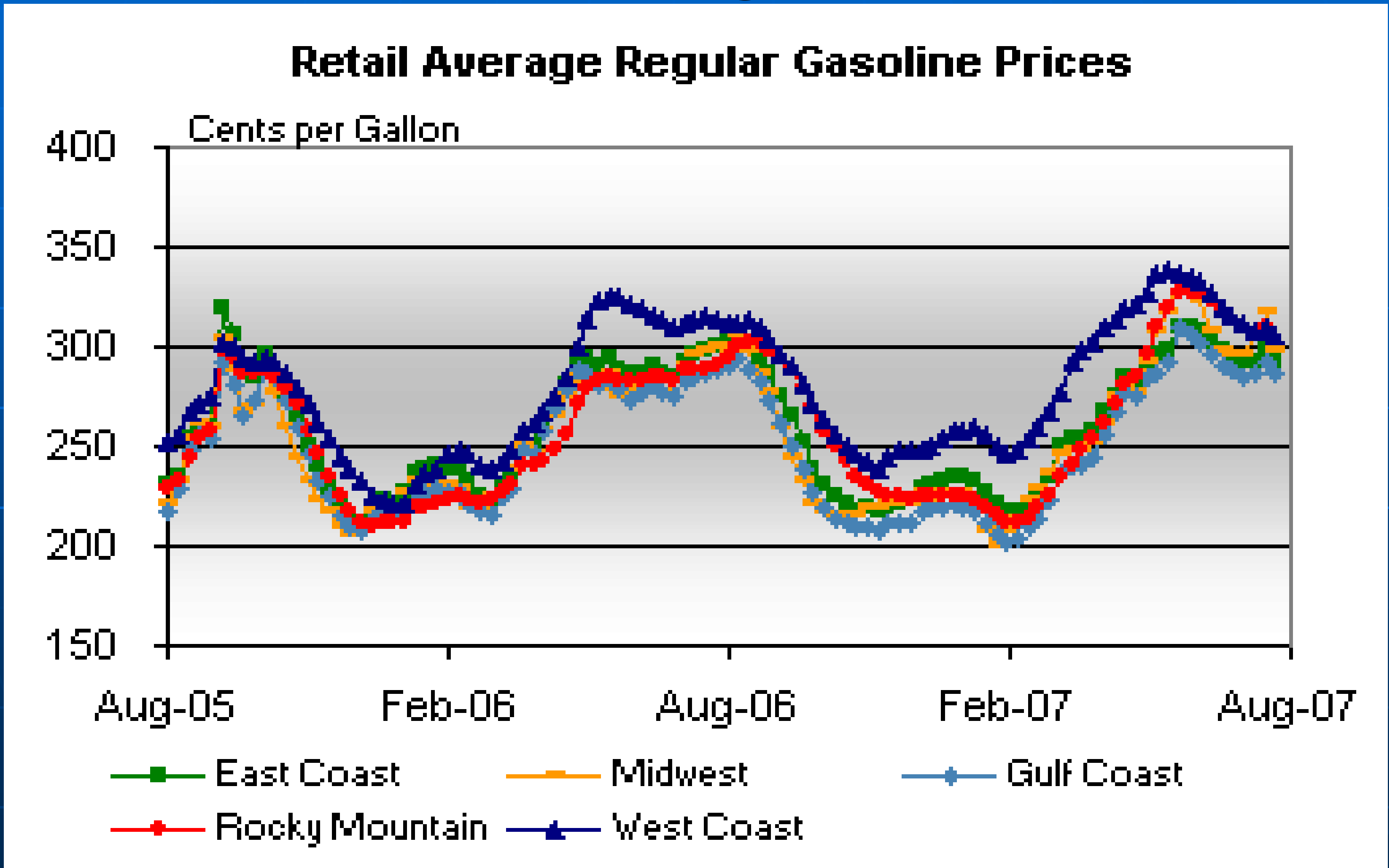




Weekly U.S. Retail Gasoline Prices, Regular Grade

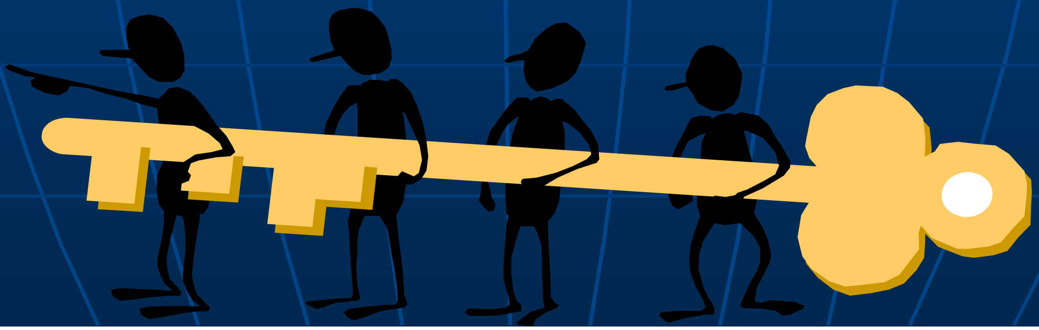


Variable Pricing of Gasoline



Key Concepts

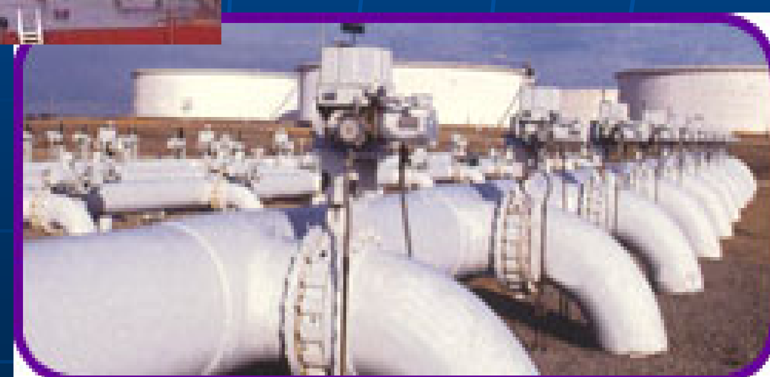
- Energy consumption particularly petroleum is projected to continue its rise for the foreseeable future
- Distribution and marketing costs represent 8-14% averaging <10% with a < 50/50 split
- Prices will continue to increase based upon this supply and demand
- Pricing is seriously impacted by regionalization of supply formulas



Transportation

Pipeline
Rail
Barge
Marine
Truck

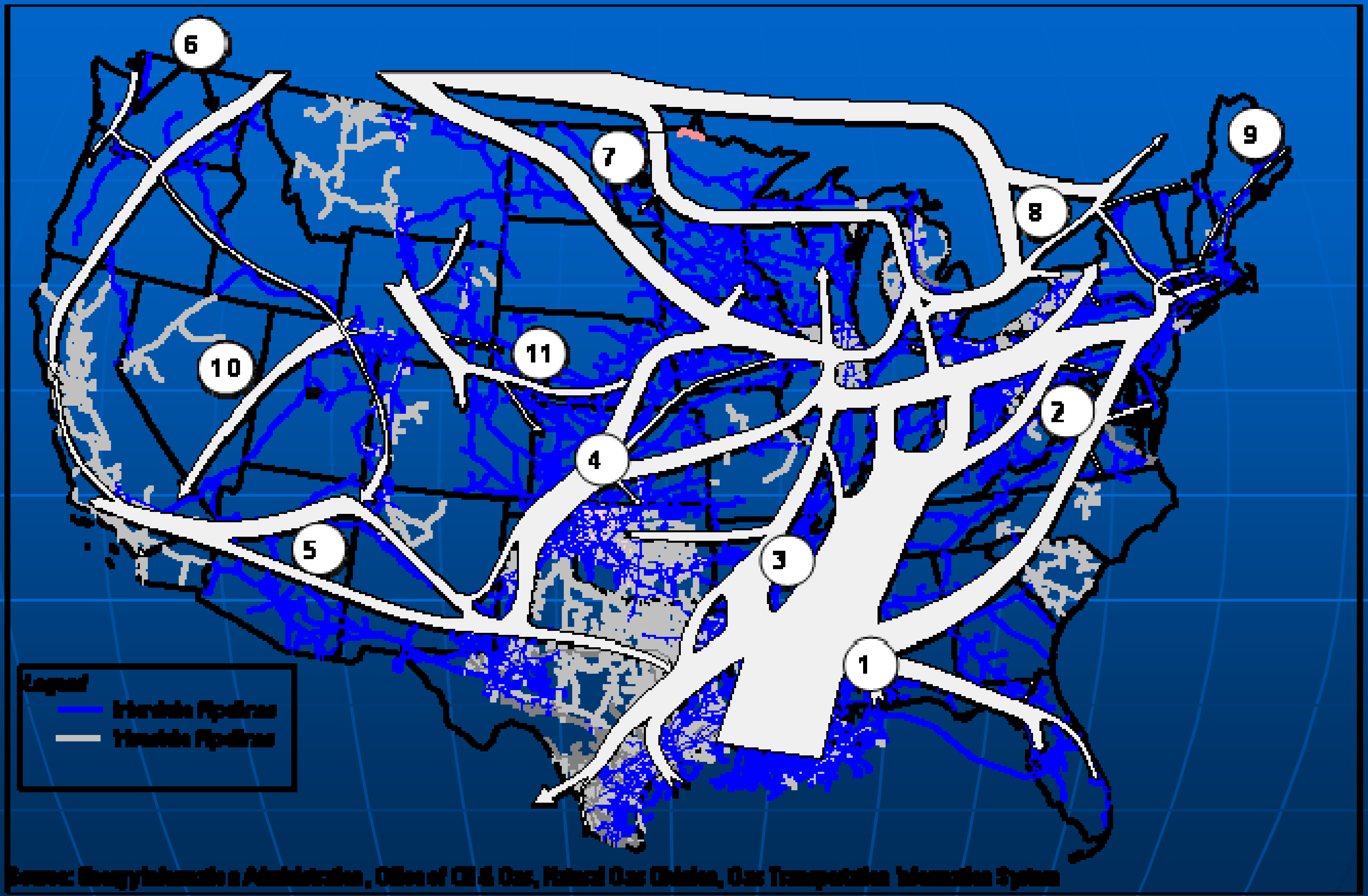
Today's Petroleum Transportation



Pipelines

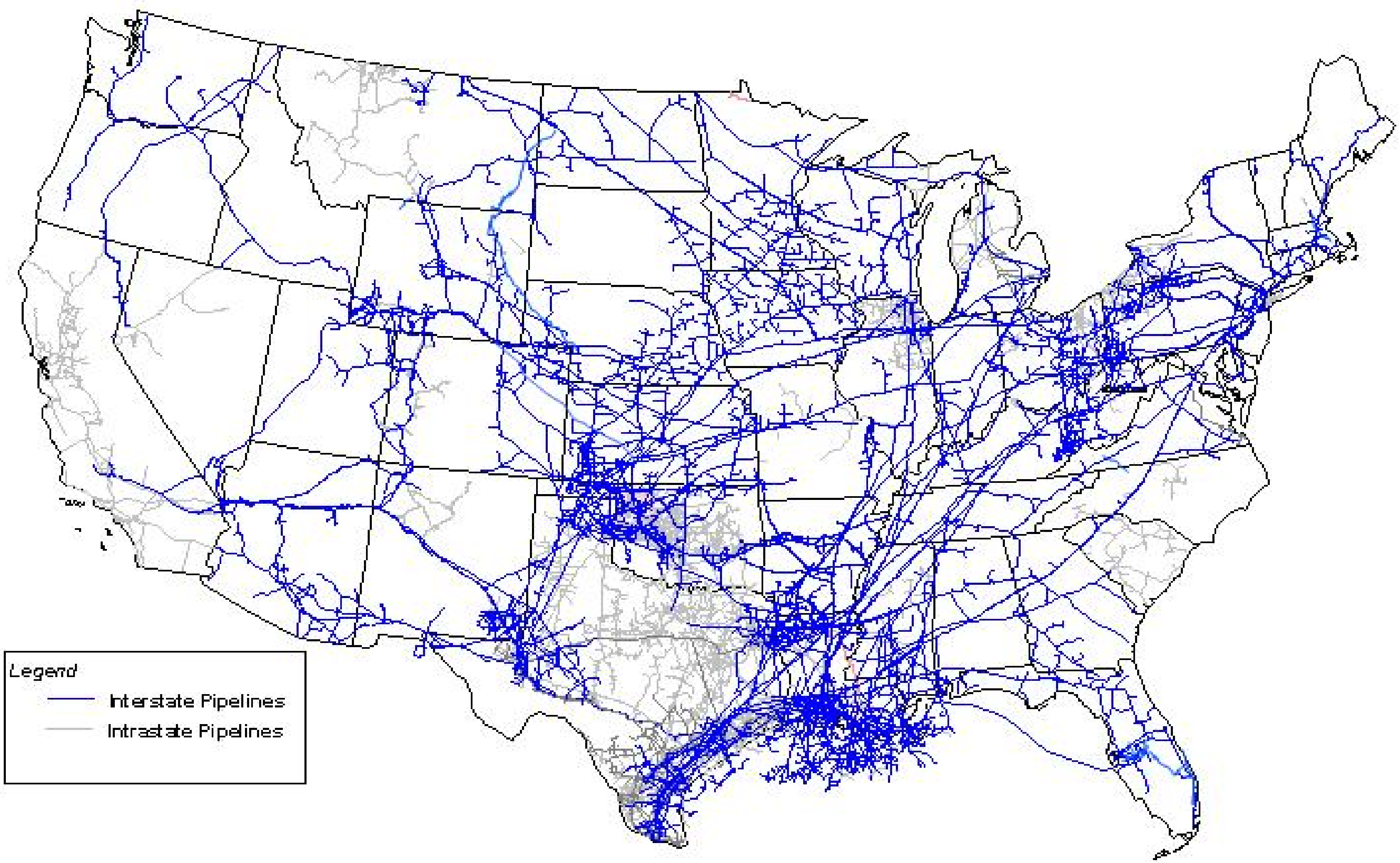
More than 65% of the oil and petroleum products used in the U.S. each year moves by pipeline

Major U.S. Natural Gas Transportation Corridors



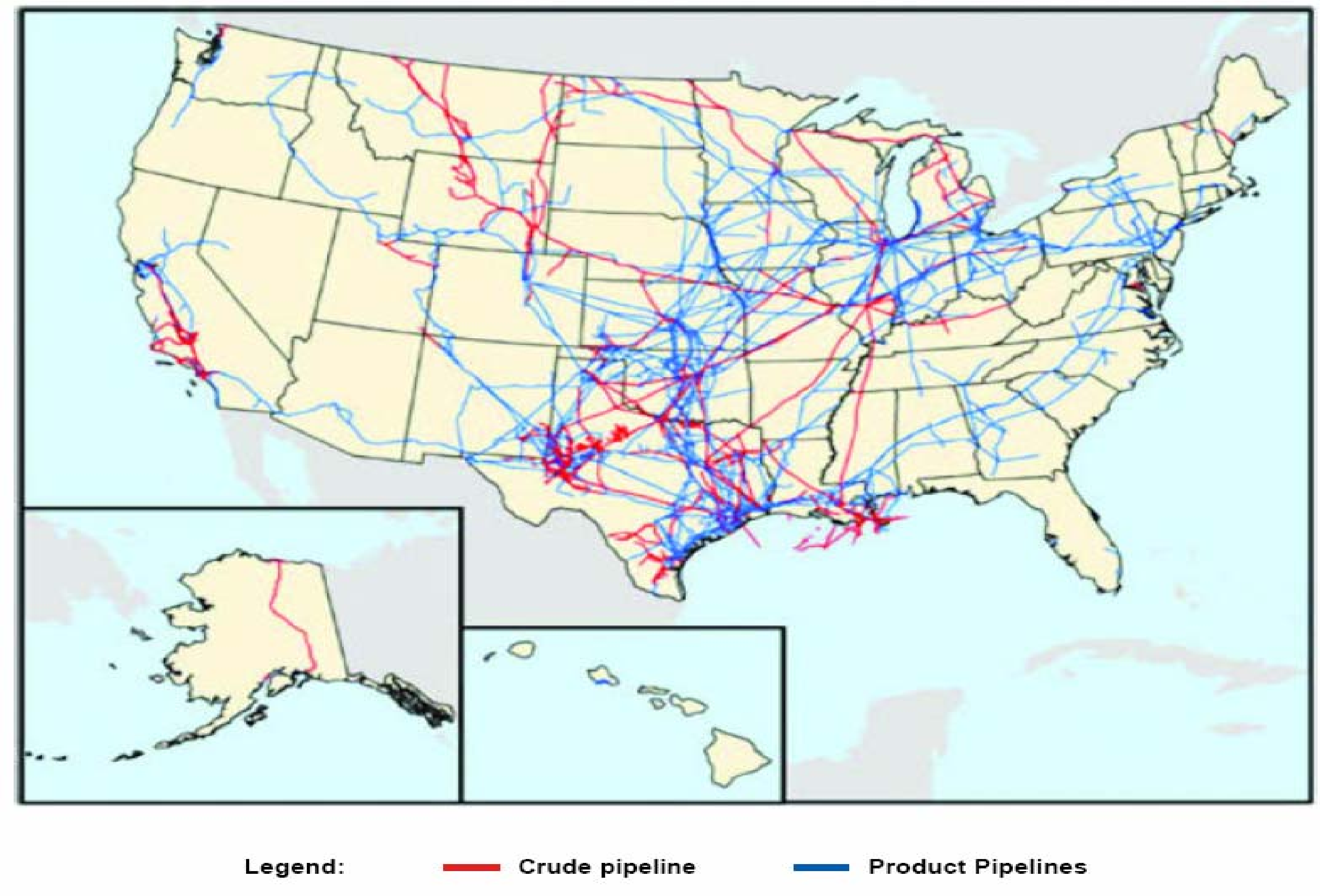
The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.

Natural Gas Pipelines



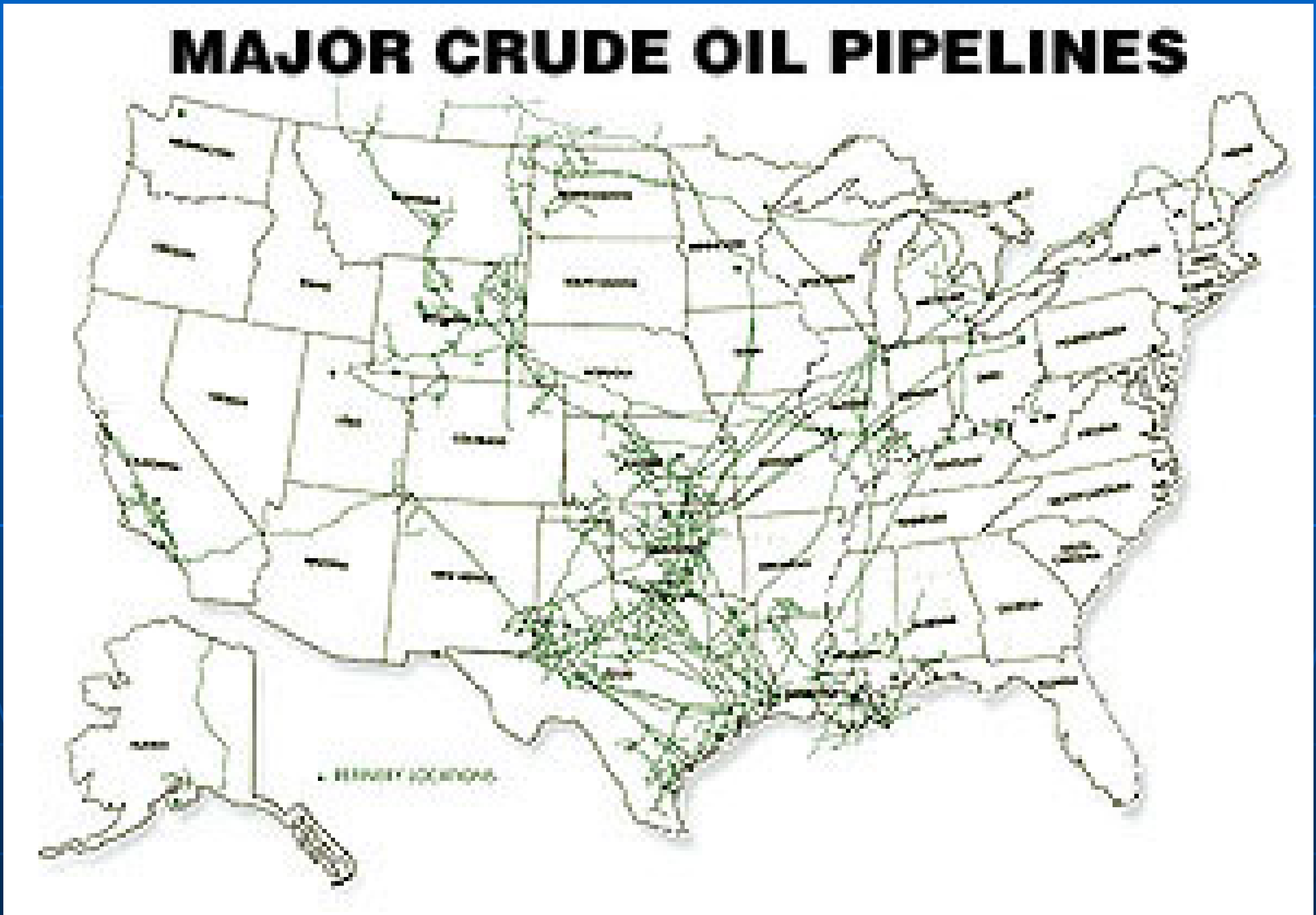
Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

U.S. Crude Oil and Product Pipeline Systems

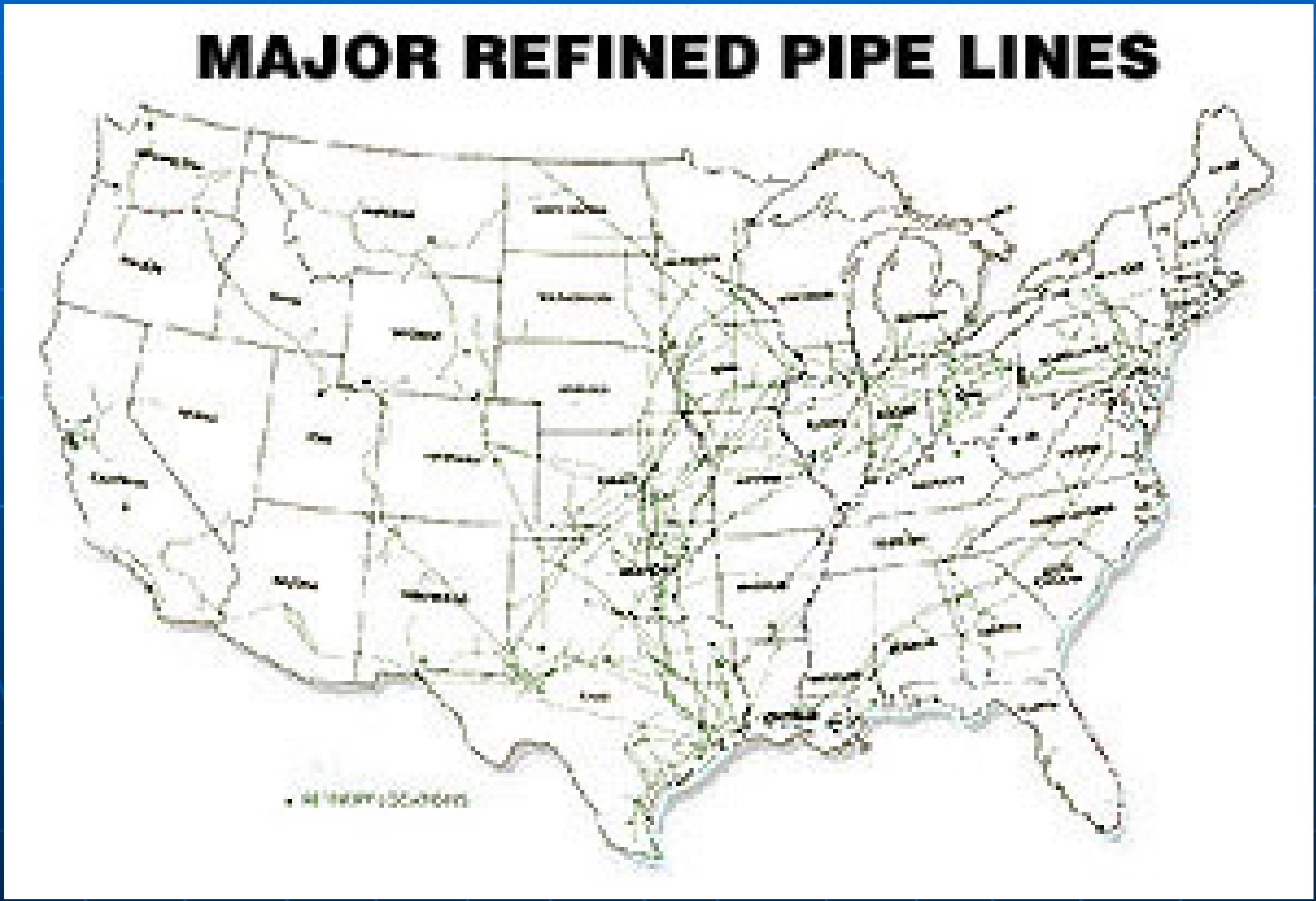


Over 200,000 miles of petroleum pipelines

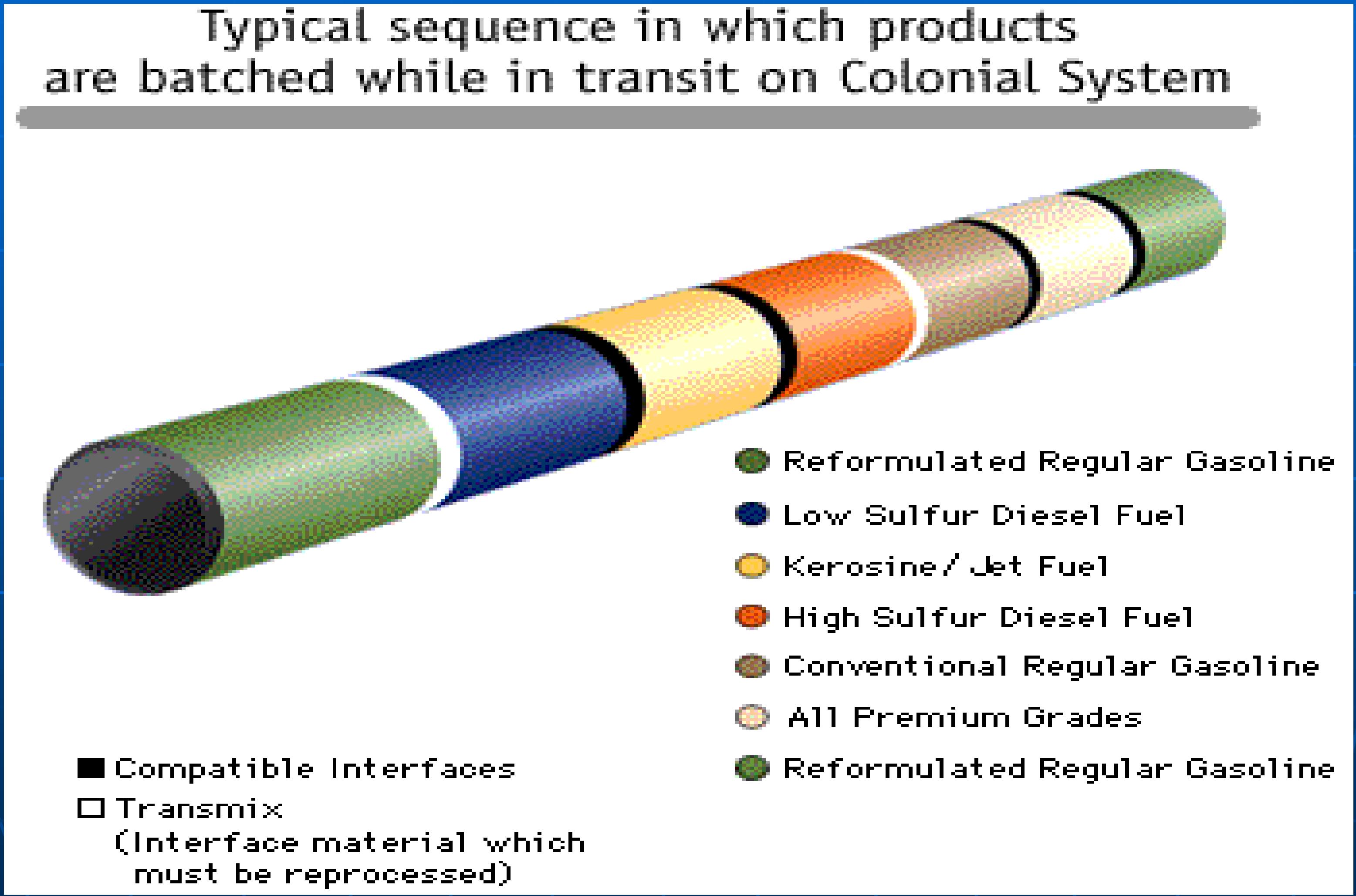
Pipelines in US



Pipelines in US



Grades in Pipeline



Source: Colonial Pipeline Company

Largest U.S. Interstate Pipeline Companies

Rank by 2005 Mileage	Company	Mileage
1	Magellan Pipeline Co. LLC	8,525
2	ConocoPhillips Pipe Line Co.	8,067
3	Plains All-American Pipeline LP	7,976
4	Mid-American Pipeline	7,117
5	BP Pipelines North America	6,948
6	Colonial Pipeline Co.	5,588
7	ExxonMobil Pipeline Company	4,725
8	Chevron Pipeline Co.	3,825
9	Enbridge Energy LP	3,340
10	Marathon Pipeline LLC	3,177

Ranked in order of 2005 mileage as reported in "SPECIAL REPORT: US gas carriers' 2005 net incomes climb; construction costs plummet", *Oil & Gas Journal*, September 11, 2006.

Transport by Mode

Crude petroleum and petroleum products carried in domestic transportation by the various modes of transport in 1976 are tabulated showing a total of 1,945,234,800 net tons, of which

- **48.02 percent was transported by pipelines,**
- **21.86 percent by water carriers,**
- **28.75 percent by motor carriers, and**
- **1.37 percent by railroads.**

The comparative figure for 1975 was 1,831,515,800 net tons, of which

- **48.02 percent was carried by pipelines,**
- **22.06 percent by water carriers,**
- **28.42 percent by motor carriers, and**
- **1.50 percent by railroads.**

Crude vs. Finished Transportation

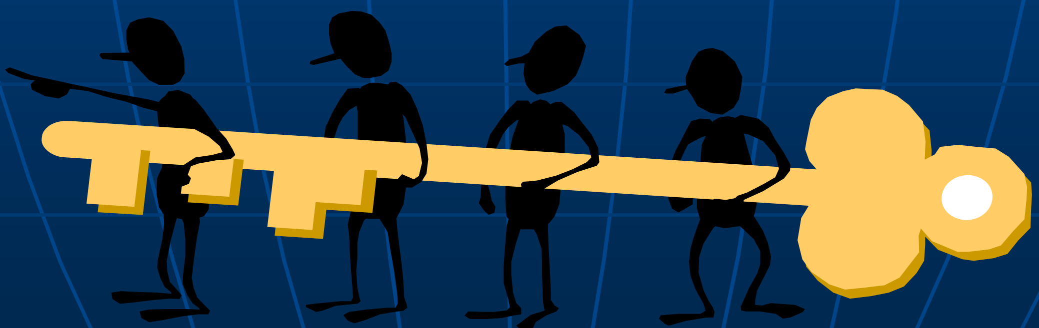
In the movement in 1976 of crude petroleum only the pipelines carried 75.33 percent of the total 608,630,800 tons transported.

- **This compares with 74.34 percent of the total net tons transported in 1975.**
- **In the movement in 1976 of petroleum products the pipelines, which carry only the light products (gasoline, heating and fuel oils, liquid petroleum gas, kerosene, and jet fuel), carried 35.58 percent of the total 1,336,604,000 net tons transported.**
- **This compares with 34.82 percent of the total net tons transported in 1975.**
- **The increase in 1976 over 1975 in the tonnage of crude petroleum and petroleum products carried by the pipelines was 6.2 percent, compared with an increase of 6.2 percent in total demand.**
- **Included is a comparison of the ton-miles of crude petroleum and petroleum products carried in domestic transportation by the various modes of transport.**

Publisher Association of Oil Pipe Lines,Washington, DC

Key Concepts

- The US has a well defined pipeline network
- Crude pipelines distribute Gulf Coast crude to Midwestern refineries
- Finished goods pipelines distribute refined product to Midwest and East Coast markets
- Natural gas pipelines distribute Gulf Coast & Canadian gas to demand markets



Railroads

Less than 3% of the total barrel miles of petroleum product transportation used in the U.S. each year is rail

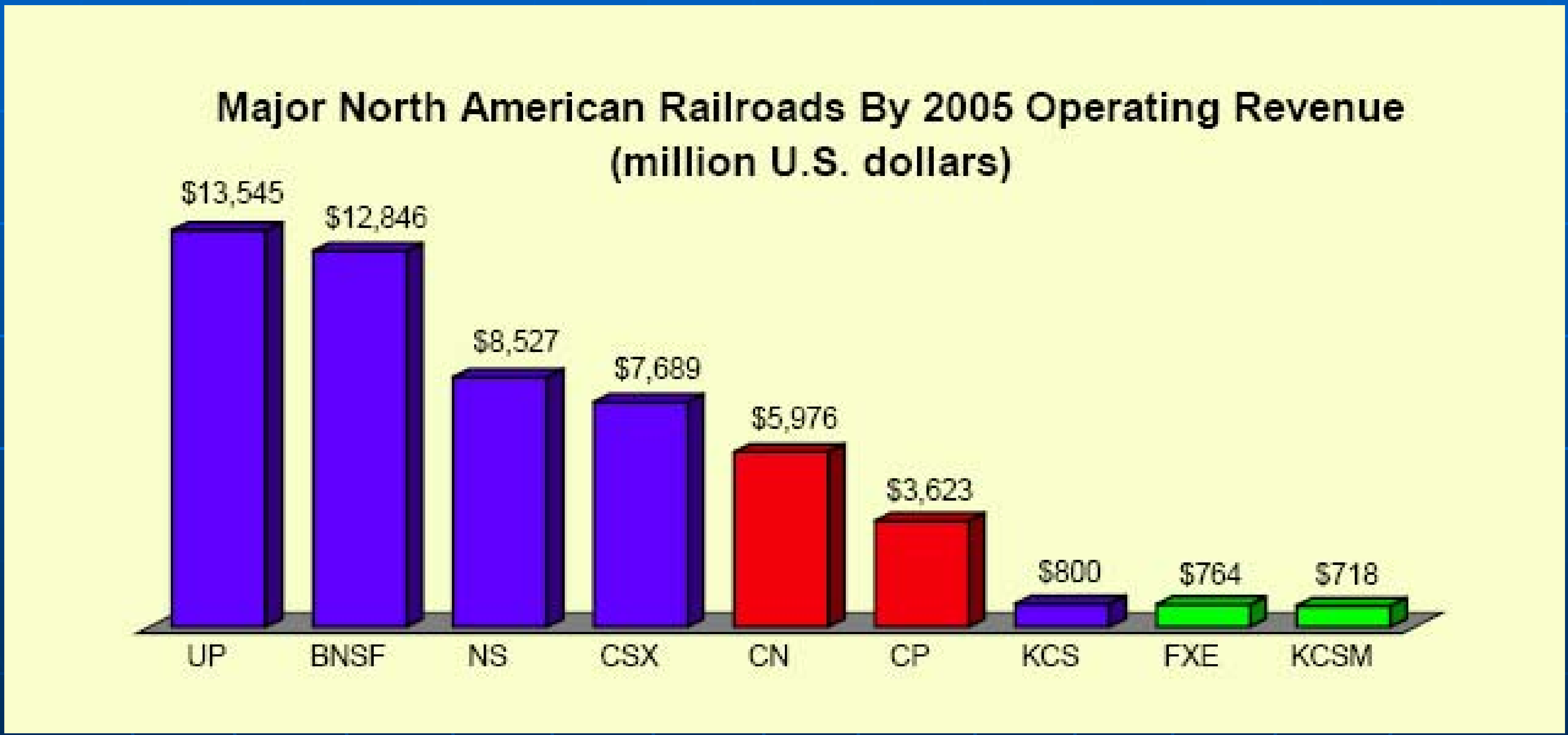
Railroad Companies

- Burlington Northern-Santa Fe
- Conrail
- CSX Transportation
- IC&E Railroad
- Illinois Central
- Kansas City Southern
- Montana Rail Link
- Norfolk Southern
- Pacific Harbor Line
- Union Pacific
- Wisconsin Central

BNSF Intermodal Network

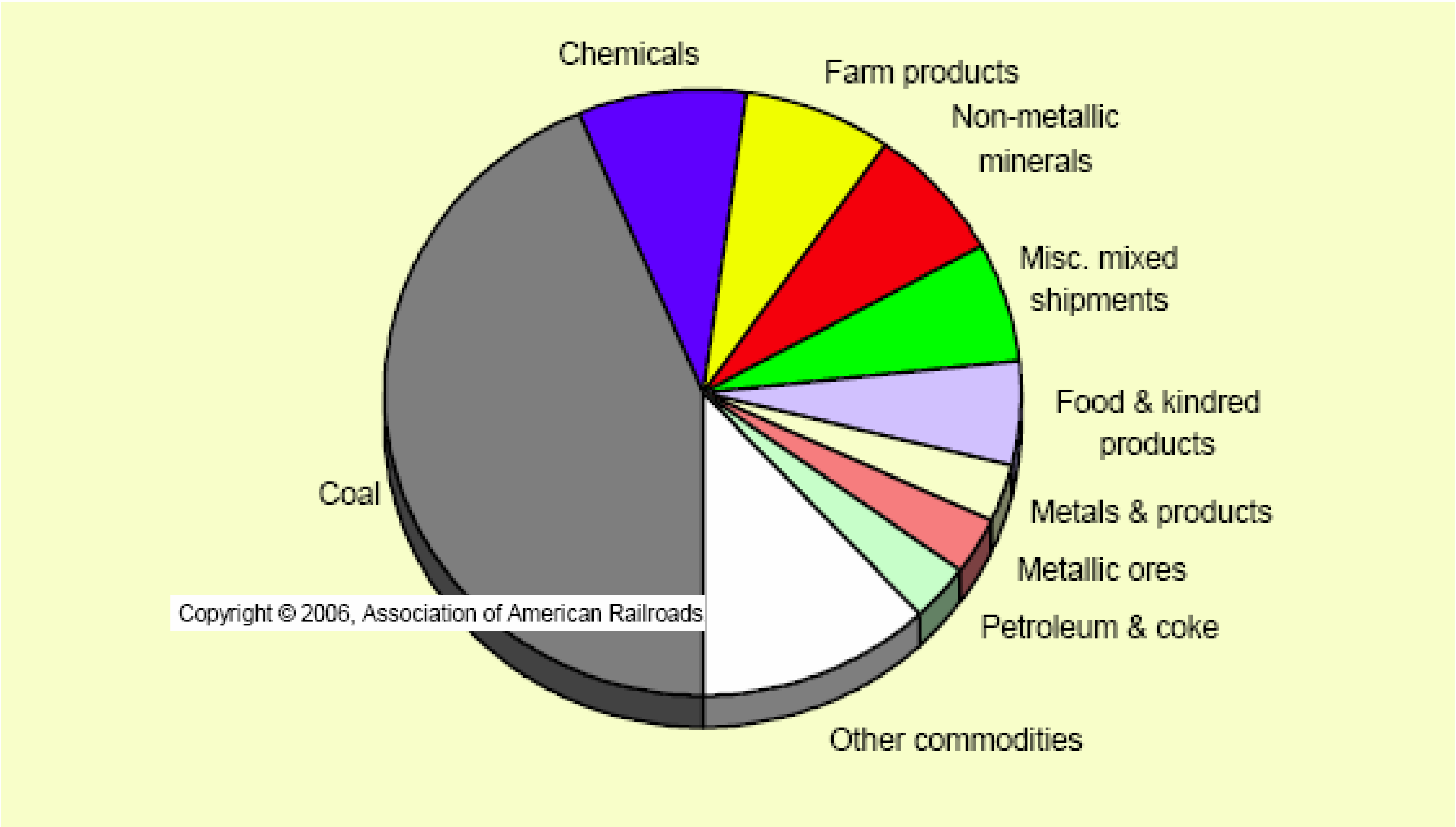
Union Pacific Network

Major Railroads by Revenue



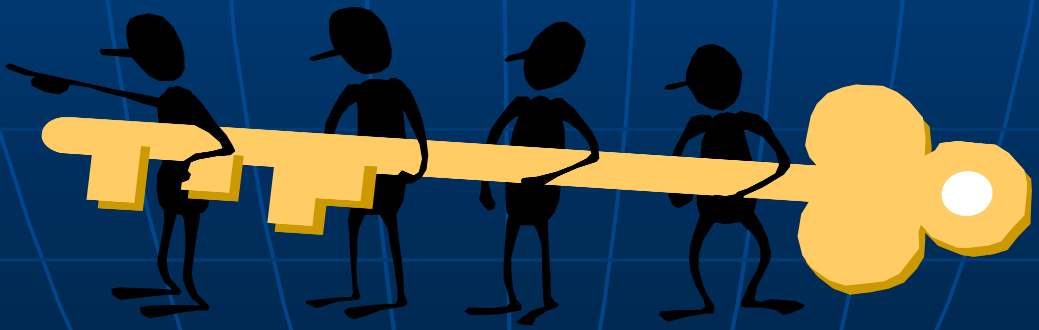
2006 Class I Tons Carried

2006 Class I Railroad Tons Originated

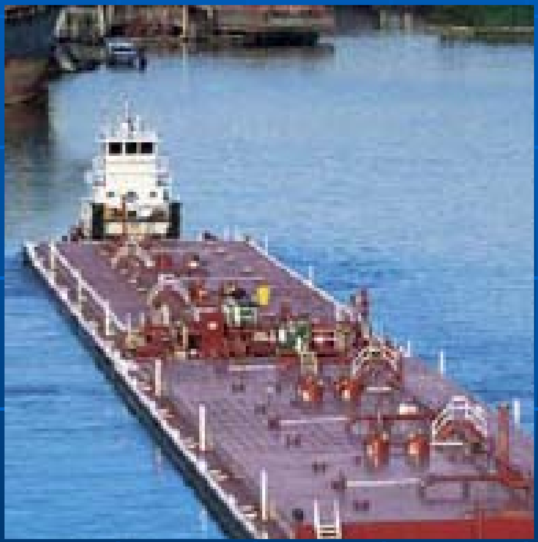


Key Concepts

- US freight railroads are dominated by four carriers
- Petroleum products are a small segment of total rail tonnage
- Railroads represent less than 3% of the total barrel miles of petroleum transportation

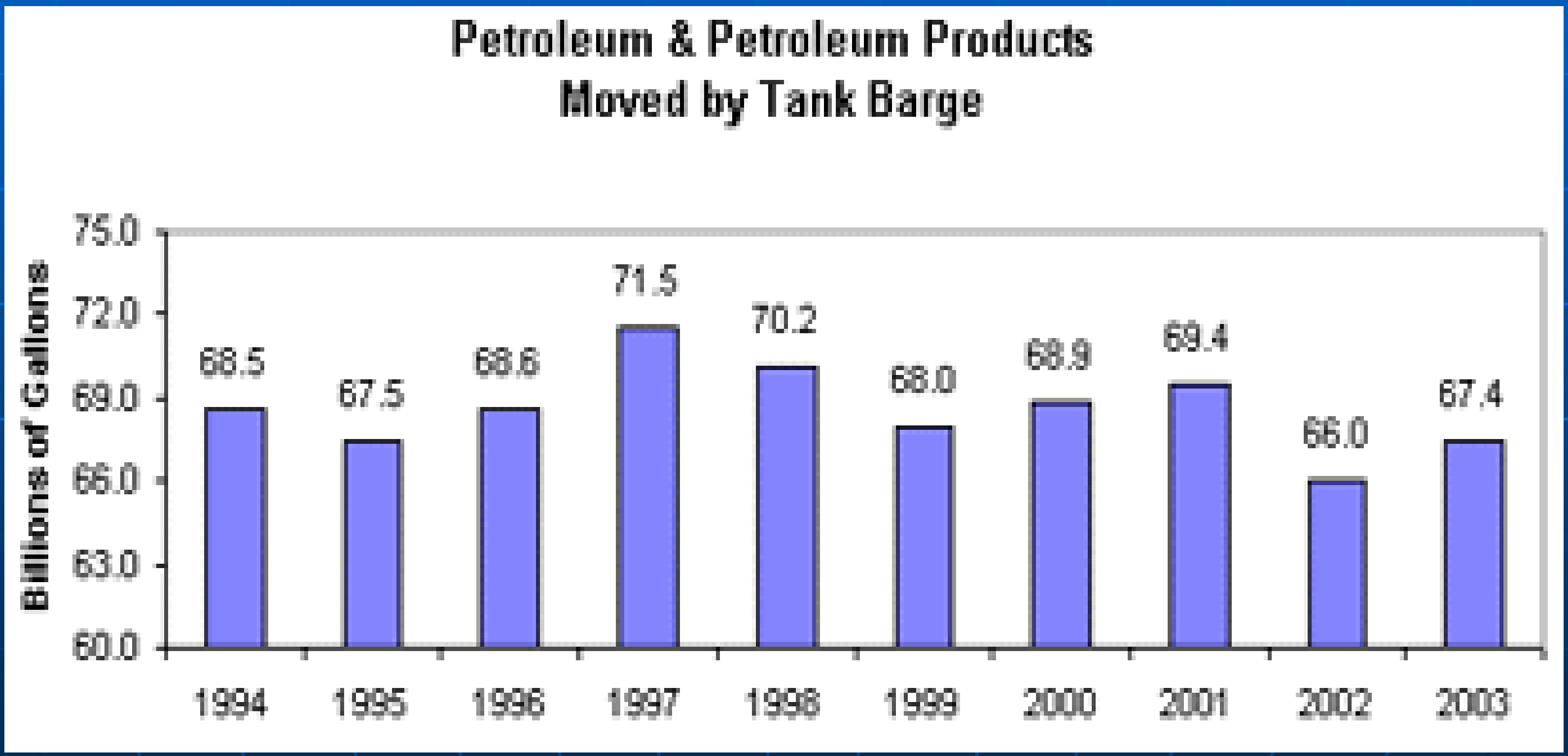


Barge



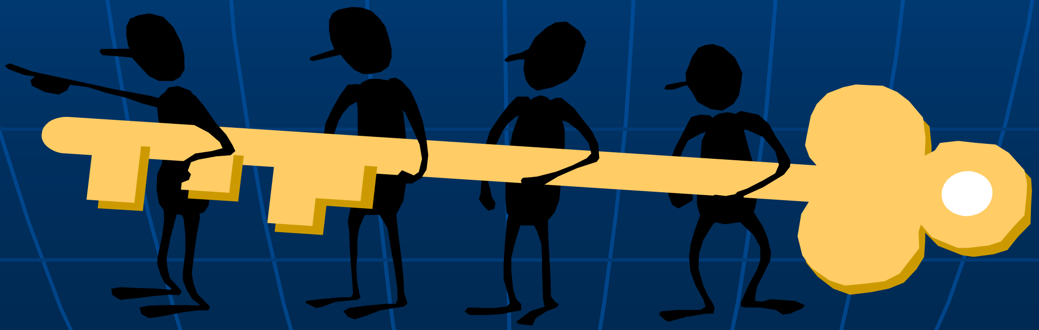
More than 30% of the oil and petroleum products used in the U.S. each year moves by barge

Petroleum Moved by Barge



Key Concepts

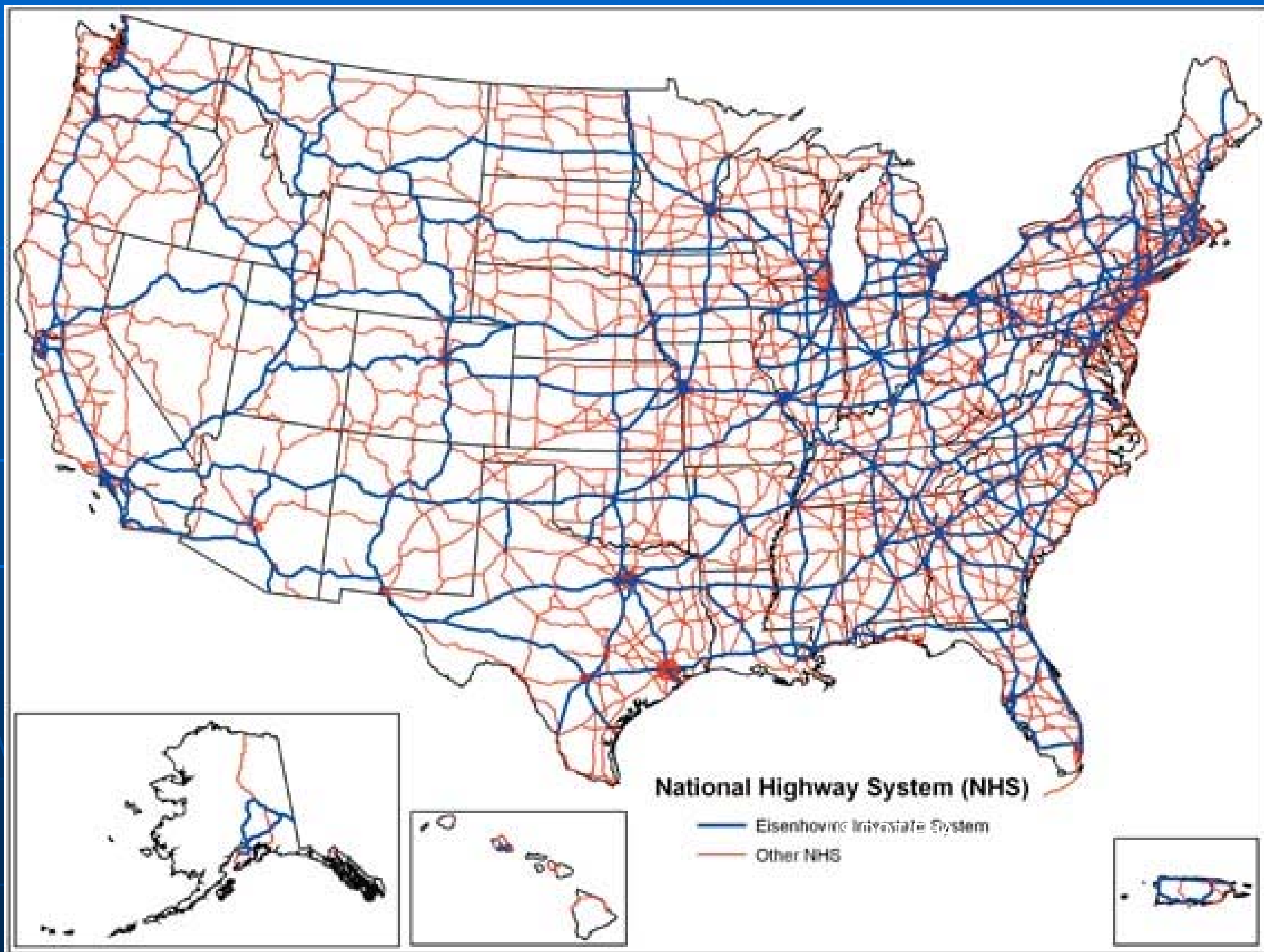
- More than 30% of the oil and petroleum products used in the U.S. each year moves by barge
- Barge transportation is more expensive than pipeline but cheaper then rail
- Barge transport is limited in the Midwest upper Mississippi due to frozen conditions during winter months



Highway Transportation

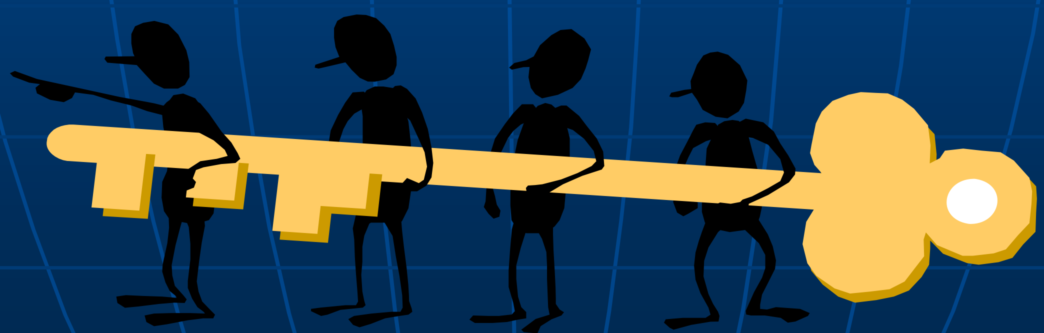
While the last link in the transportation chain is often by truck less than 4% of the total barrel miles of petroleum transportation in the U.S. each year is by truck.

National Defense & Highway System

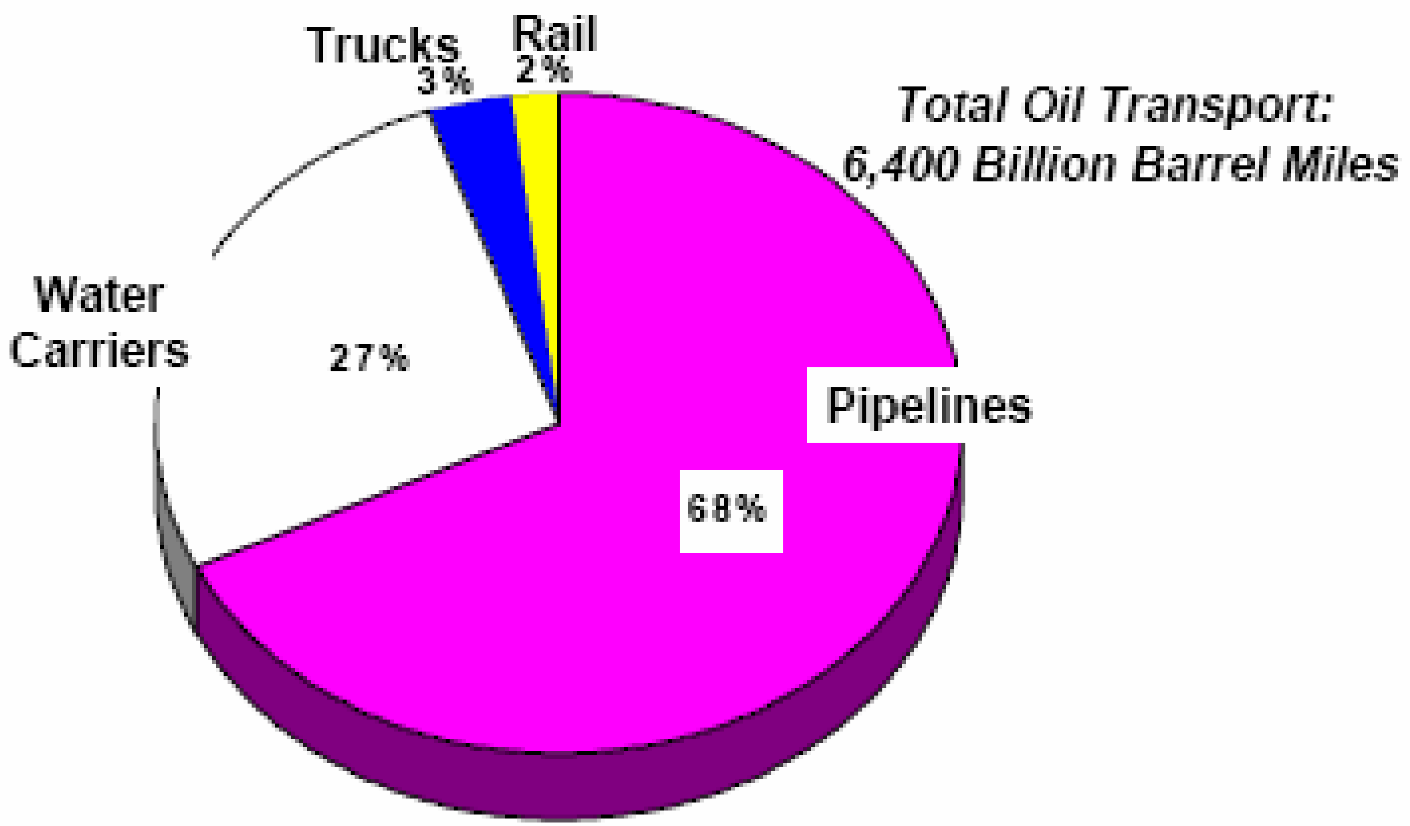


Key Concepts

- The US has an extensive highway network
- Truck transport is most commonly the final delivery mode
- Truck transport is the most costly mode
- Truck transport represents less than 4% of the total barrel miles of petroleum transportation in the US



Transportation by Mode



Source: Estimated from Association of Oil Pipe Lines, *Shifts in Petroleum Transportation*, 2000

Pipelines accounted for two-thirds of the domestic movement of petroleum and petroleum products in 2004.

Table 1.14
Ton-Miles of Petroleum and Petroleum Products in the U.S. by Mode, 1975–2004

Year	Pipelines[a]	Water carriers	Motor carriers[b]	Railroads	Total
	(percent)				(billion ton-miles)
1975	59.9%	35.2%	3.3%	1.7%	846.7
1976	59.4%	35.4%	3.8%	1.5%	867.7
1977	59.1%	36.1%	3.2%	1.6%	923.4
1978	50.5%	45.7%	2.7%	1.1%	1160.2
1979	51.8%	44.5%	2.6%	1.2%	1174.8
1980	47.2%	49.6%	2.2%	1.0%	1245.3
1981	46.3%	50.7%	2.0%	1.0%	1218.4
1982	46.4%	50.6%	1.9%	1.1%	1218.2
1983	45.5%	51.5%	2.1%	1.0%	1223.5
1984	48.1%	48.4%	2.5%	1.0%	1180.2
1985	47.2%	49.4%	2.4%	1.0%	1195.5
1986	48.7%	47.8%	2.5%	1.0%	1187.8
1987	49.1%	47.4%	2.5%	1.0%	1195.8
1988	50.6%	45.8%	2.6%	1.1%	1188.1
1989	53.4%	42.6%	2.8%	1.2%	1094.2
1990	54.2%	41.7%	2.8%	1.3%	1076.8
1991	53.3%	42.8%	2.7%	1.3%	1086.1
1992	53.9%	42.1%	2.6%	1.4%	1091.7
1993	57.3%	38.8%	2.4%	1.5%	1034.6
1994	56.5%	39.3%	2.7%	1.5%	1046.7
1995	57.5%	38.4%	2.5%	1.6%	1044.9
1996	60.6%	34.9%	2.9%	1.6%	1022.2
1997	64.5%	30.9%	2.9%	1.8%	956.5
1998	66.7%	28.5%	3.0%	1.8%	929.8
1999	67.7%	27.1%	3.2%	2.1%	912.9
2000	66.1%	28.0%	3.6%	2.3%	873.3
2001	66.2%	28.1%	3.5%	2.2%	869.8
2002	67.8%	26.3%	3.5%	2.3%	864.6
2003	66.8%	27.2%	3.8%	2.2%	883.3
2004	66.4%	27.4%	3.8%	2.4%	902.5
		Average annual percentage change			
1975–2004					0.2%
1994–2004					-1.5%

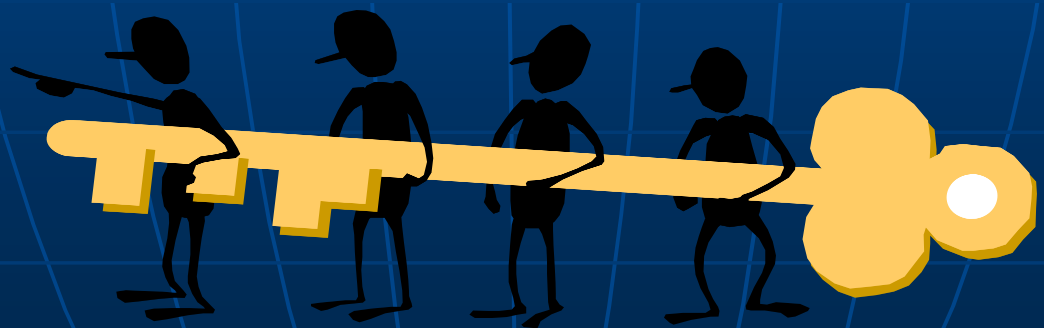
Source:
Association of Oil Pipelines, *Shifts in Petroleum Transportation* , Washington, DC, June 2006, Table 1. (Additional resources: www.aopl.org)

[a] The amounts carried by pipeline are based on ton-miles of crude and petroleum products for Federally regulated pipelines (84 percent) plus an estimated breakdown of crude and petroleum products of the ton-miles for pipelines not Federally regulated (16 percent).

[b] The amounts carried by motor carriers are estimated.

Key Concepts

- US petroleum transportation is dominated by pipelines
- Water inland waterway barges are the second mode
- While rail and truck are minor carriers they are the primary final deliver mode
- While not indicated as a mode of transportation exchanges are a primary means to of repositioning product

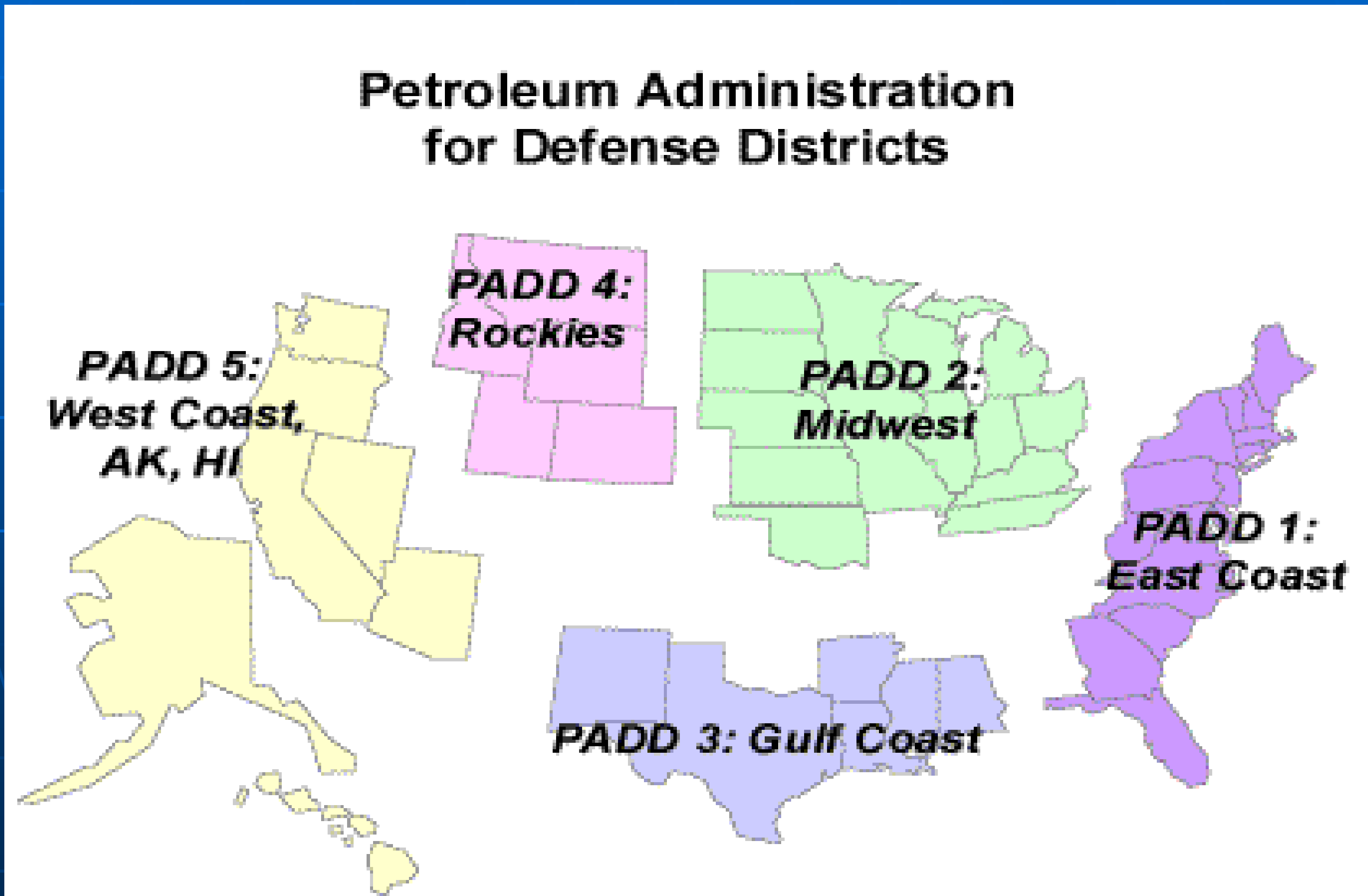


Management Issues

Government Regulations

Environmental Requirements

US Petroleum Administration for Defense Districts



Source:www.eia.doe.gov

PADD: Petroleum Administration for Defense District

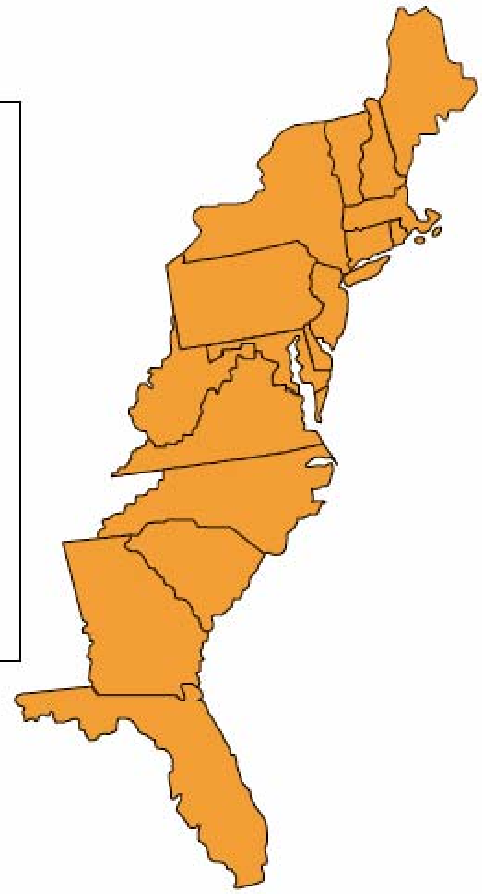
PADD I: East Coast-17 States

13 % U.S. Gasoline Production

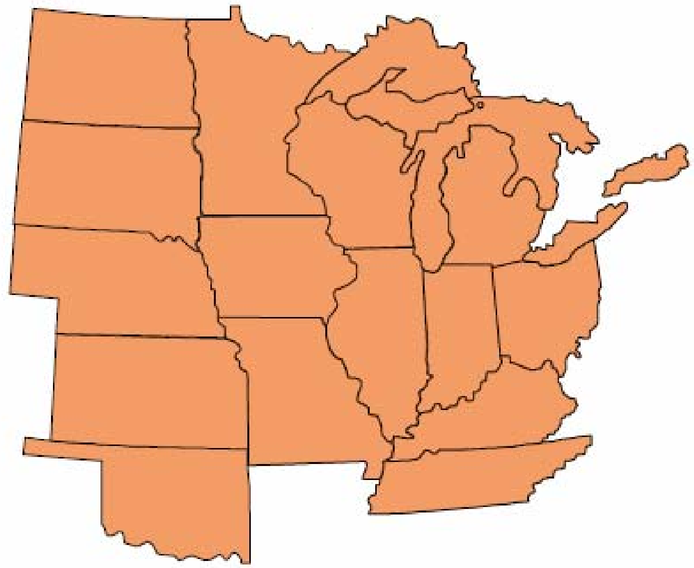
36% U.S. Gasoline Demand

Short 2120 MBPD of Gasoline

Receives 94 % Gasoline Imports



PADD: Petroleum Administration for Defense District



PADD II: Mid Continent- 15 States

22 % U.S. Gasoline Production

29% U.S. Gasoline Demand

Short 725 MBPD of Gasoline

Source: (EIA)

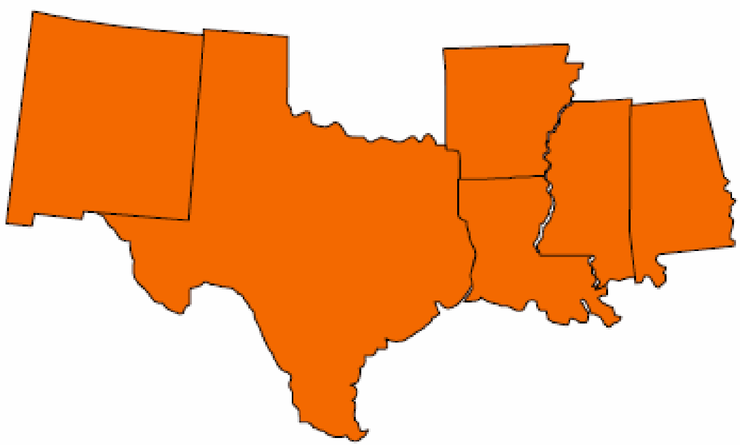
PADD: Petroleum Administration for Defense District

PADD III: Gulf Coast- 6 States

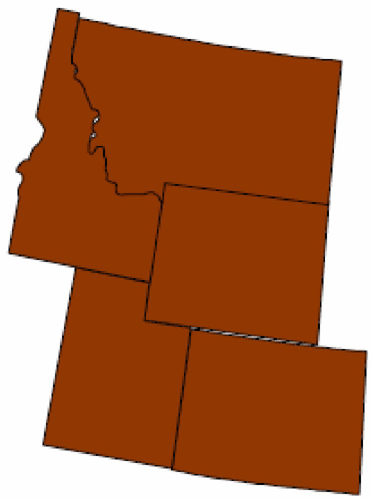
44 % U.S. Gasoline Production

15% U.S. Gasoline Demand

Long 2294 MBPD of Gasoline



PADD: Petroleum Administration for Defense District



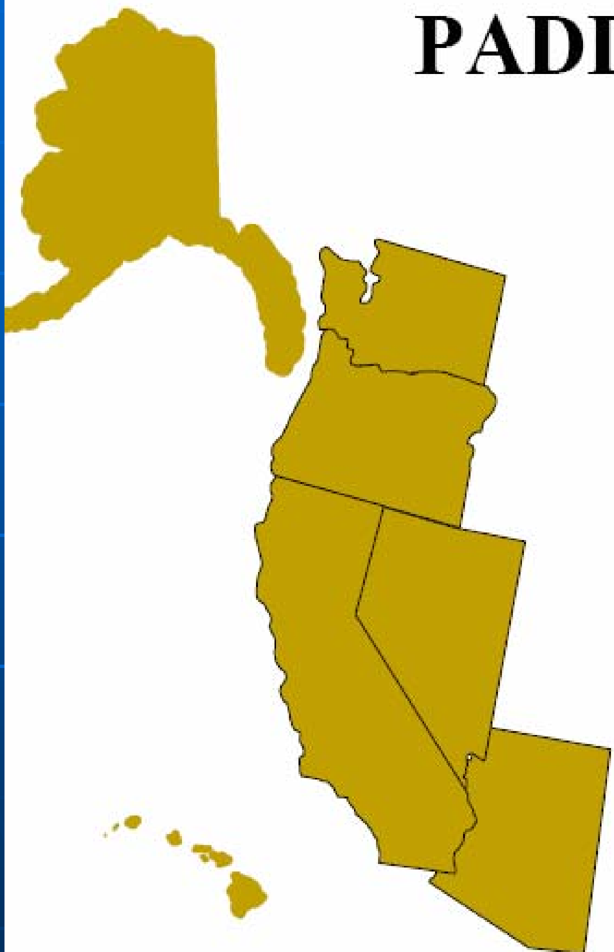
PADD IV: Rocky Mountain- 5 States

3 % U.S. Gasoline Production

3% U.S. Gasoline Demand

Balanced in Gasoline

PADD: Petroleum Administration for Defense District



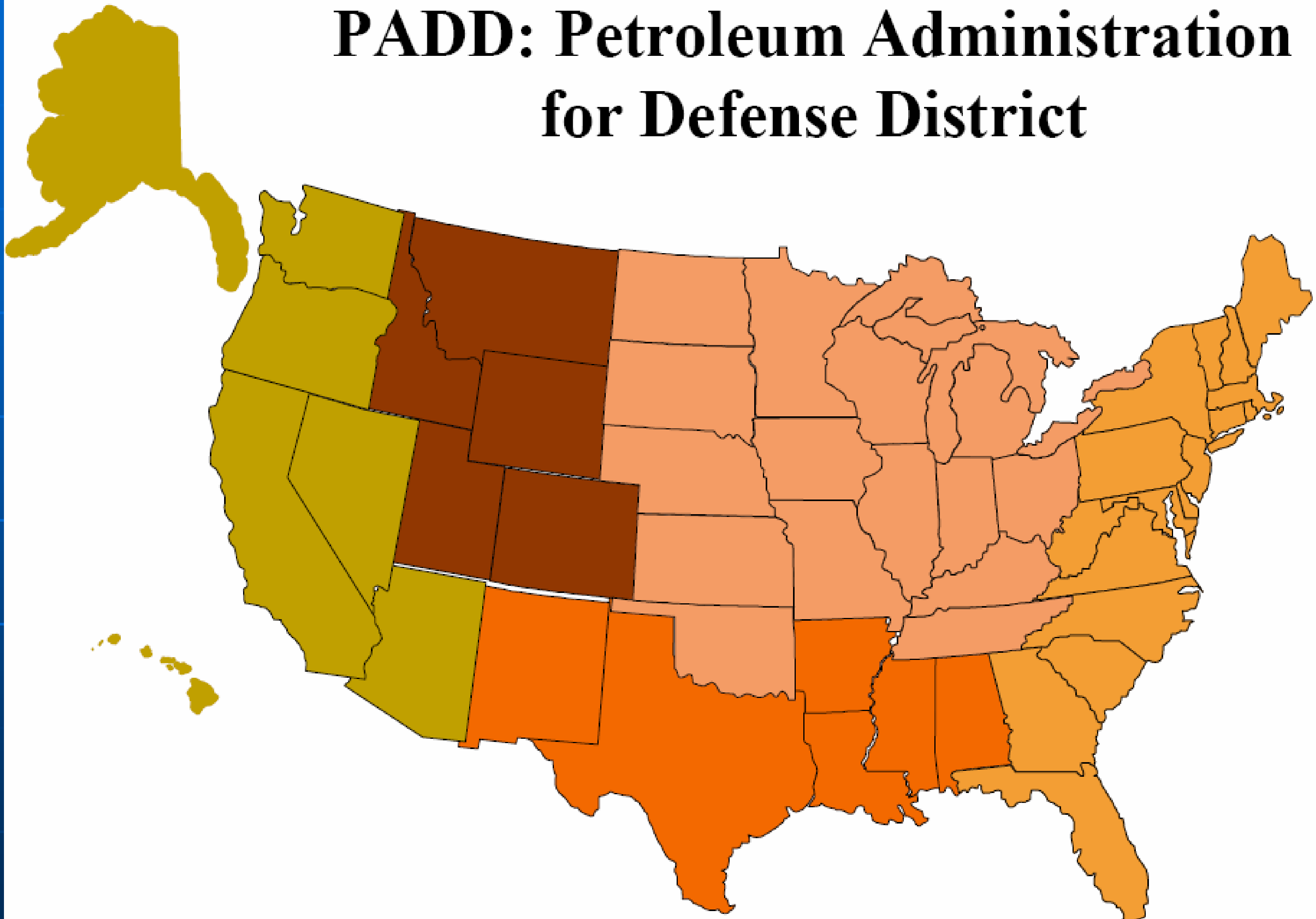
PADD V: West Coast- 7 States

18 % U.S. Gasoline Production

18% U.S. Gasoline Demand

Short 110 MBPD of Gasoline

PADD: Petroleum Administration for Defense District



Current Government Fuel Regulations

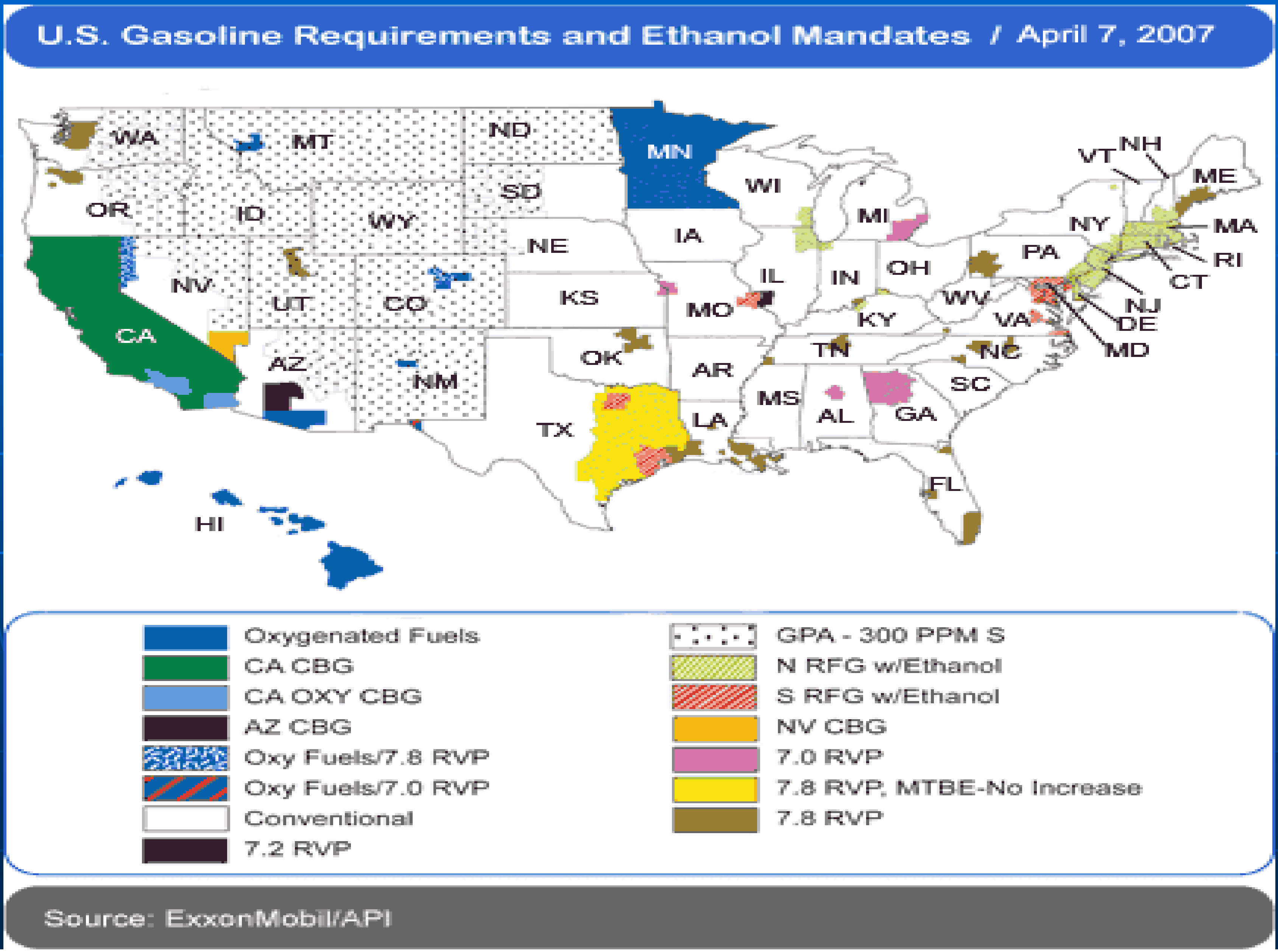
1990 Federal Clean Air Act

- Gasoline
  - Severe Smog Areas- Reformulated Gasoline
    - Must Contain an Oxygenate (MTBE, Ethanol)
  - Winter Carbon Monoxide- Oxygenate
- Diesel
  - Low Sulfur (500 ppm) for all On Road Uses

MTBE Bans

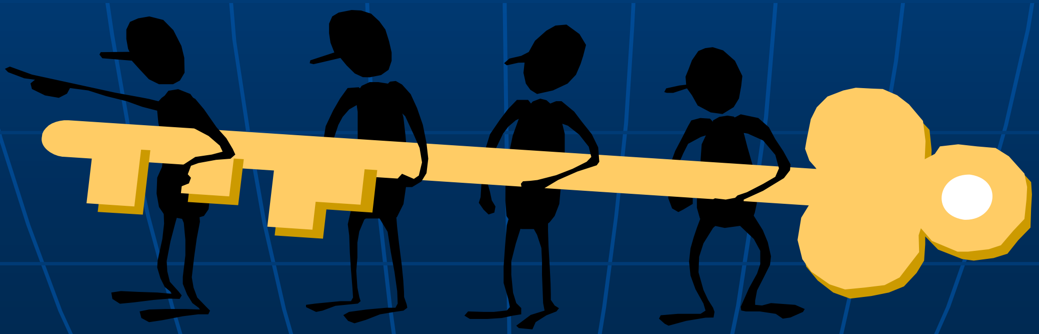
- Various states banning MTBE in gasoline in 2003/2004

Required Ozone Fuel Blending



Key Concepts

- The PADD system splits the US into 5 districts
- These districts along with the smog emission controls disrupts the normal flow of supply and demand
- This disruption artificially impacts supply creating shortages and influencing pump prices



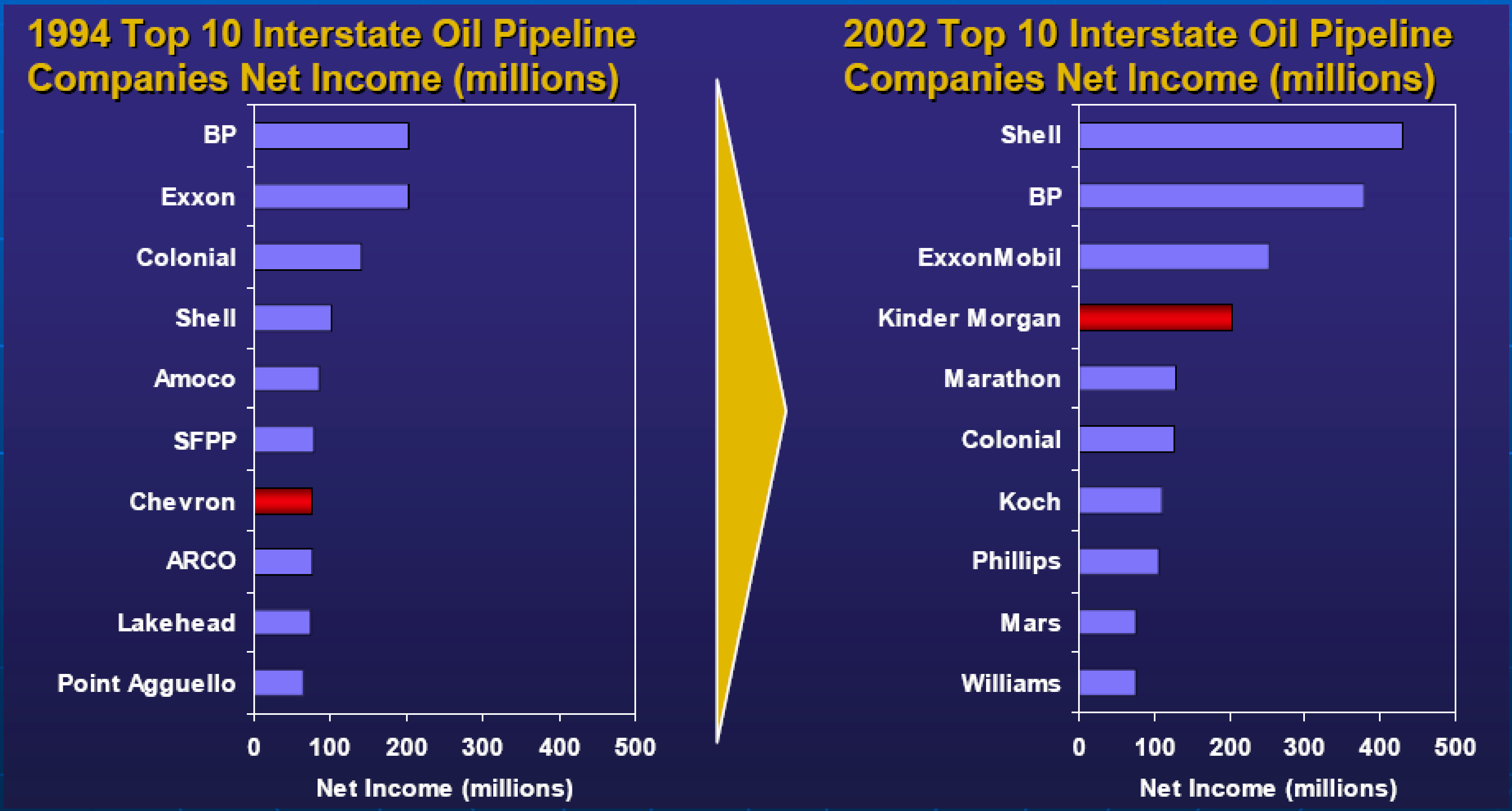
Competition & Integration

Largest U.S. Interstate Pipeline Companies

Rank by 2005 Mileage	Company	Mileage
1	Magellan Pipeline Co. LLC	8,525
2	ConocoPhillips Pipe Line Co.	8,067
3	Plains All-American Pipeline LP	7,976
4	Mid-American Pipeline	7,117
5	BP Pipelines North America	6,948
6	Colonial Pipeline Co.	5,588
7	ExxonMobil Pipeline Company	4,725
8	Chevron Pipeline Co.	3,825
9	Enbridge Energy LP	3,340
10	Marathon Pipeline LLC	3,177

Ranked in order of 2005 mileage as reported in "SPECIAL REPORT: US gas carriers' 2005 net incomes climb; construction costs plummet", *Oil & Gas Journal*, September 11, 2006.

1994 vs. 2002 Pipeline Operators



Largest U.S. Interstate Natural Gas Pipeline Systems

(2005 Ranked by system capacity, million cubic feet per day (MMcf/d))

Pipeline Name	Market Regions Served	Primary Supply Regions	States in Which Pipeline Operates	Transported (billion cubic dekatherms)	System Capacity (MMcf/d) [1]	System Mileage
Columbia Gas Transmission Co.	Northeast	Southwest, Appalachia	DE, PA, MD, KY, NC, NJ, NY, OH, VA, WV	3,431	8,700	10,354
Transcontinental Gas Pipeline Co.	Northeast, Southeast	Southwest	AL, GA, LA, MD, MS, NC, NY, SC, TX, VA, GM	3,338	8,161	10,469
Northern Natural Gas Co.	Central, Midwest	Southwest	IA, IL, KS, NE, NM, OK, SD, TX, WI, GM	1,195	7,923	15,854
ANR Pipeline Co.	Midwest	Southwest	AR, IA, IL, IN, KS, KY, LA, MI, MO, MS, NE, OH, OK, WI, GM	2,815	6,844	9,616
Tennessee Gas Pipeline Co.	Northeast, Midwest	Southwest, Canada	AR, KY, LA, MA, NY, OH, PA, TN, TX, WV, GM	1,920	6,686	13,302
Texas Eastern Transmission Corp.	Northeast	Southwest	AL, AR, IL, IN, KS, KY, LA, MI, MO, MS, NJ, NY, OH, OK, PA, TX, WV, GM	1,364	6,523	9,179
El Paso Natural Gas Co.	Western, Southwest	Southwest	AZ, CO, NM, TX	4,864	6,152	10,661
Dominion Transmission Co.	Northeast	Southwest, Appalachia	PA, MD, NY, OH, VA, WV	1,344	5,734	3,142
Northwest Pipeline Corp.	Western	Canada, Central	CO, ID, OR, UT, WA, WY	700	4,500	4,046
Natural Gas Pipeline Co. of America	Midwest	Southwest	AR, IA, IL, KS, LA, MO, NE, OK, TX, GM	2,69	4,485	9,111
Southern Natural Gas Co.	Southeast	Southwest	AL, GA, LA, MS, SC, TN, TX, GM	937	3,365	7,671
Centerpoint Gas Transmission Co.	Southwest	Southwest	AR, KS, LA, OK, TX	928	3,339	6,182
Gulf South Pipeline Co.	Southeast, Southwest	Southwest	AL, FL, LA, MS, TX, GM	1,015	3,038	6,580
Colorado Interstate Gas Co.	Central	Central, Southwest	CO, KS, OK, TX, WY	939	3,000	3,996
Texas Gas Transmission Corp.	Midwest	Southwest	AR, IN, KY, LA, MS, OH, TN	2,178	2,979	5,643
Great Lakes Gas Transmission Co.	Midwest	Canada	MI, MN, WI	958	2,859	2,115

Largest U.S. Interstate Natural Gas Pipeline Systems

(2006 Ranked by system capacity, million cubic feet per day (MMcf/d))

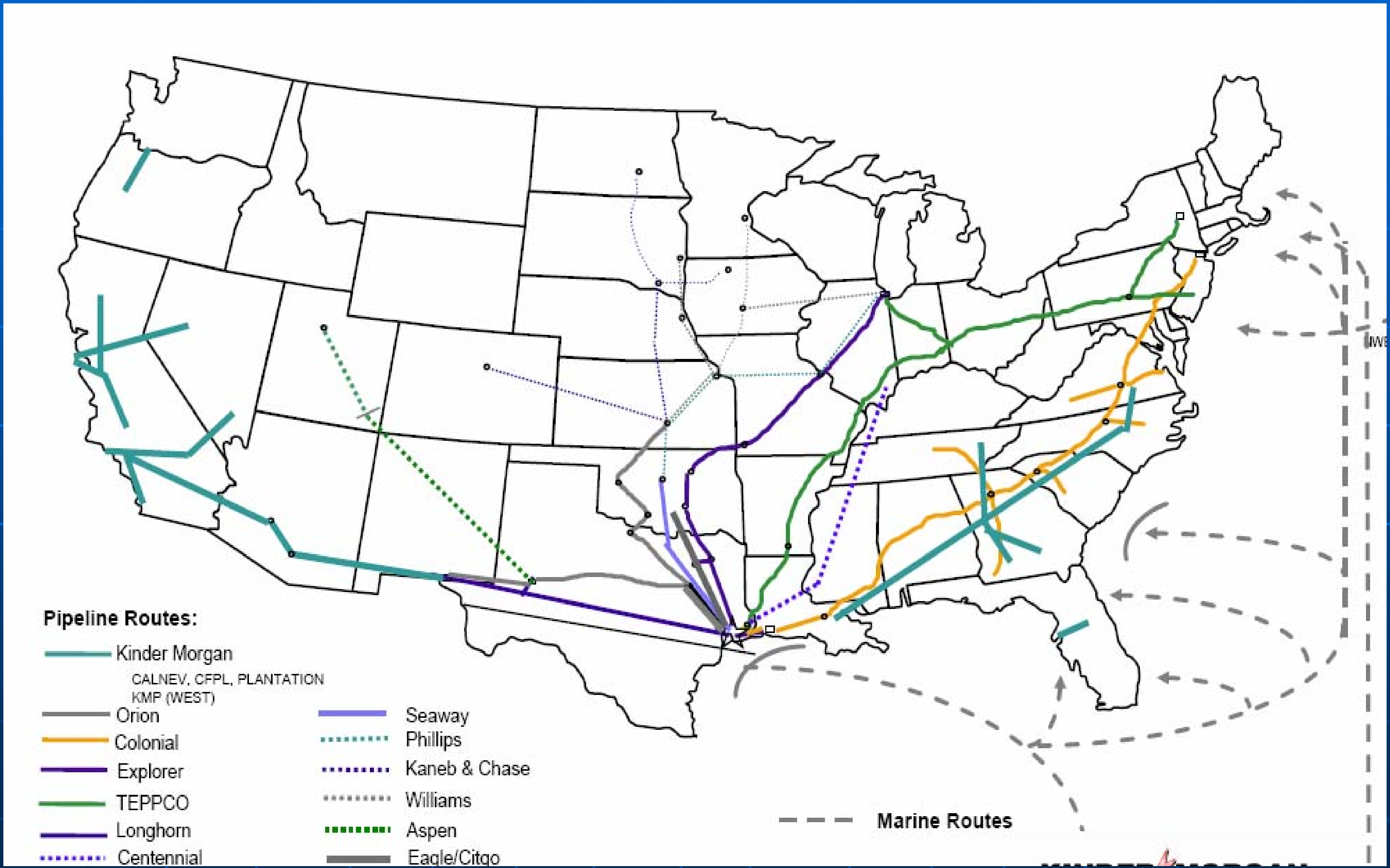
Pipeline Name	Market Regions Served	Primary Supply Regions	States in Which Pipeline Operates	Transported (billion cubic dekatherms)	System Capacity (MMcf/d) [1]	System Mileage
Panhandle Eastern Pipeline Co.	Midwest	Southwest	IL, IN, KS, MI, MO, OH, OK, TX	709	2,840	6,445
Gas Transmission Northwest Corp.	Western	Canada	ID, OR, WA	767	2,636	1,356
Northern Border Pipeline Co.	Midwest, Central	Canada	IA, IL, IN, MN, MT, ND, SD	898	2,496	1,399
Southern Star Central Pipeline Co.	Central	Central	CO, KS, MO, NE, OK, TX, WY	354	2,451	5,788
National Fuel Gas Supply Co.	Northeast	Canada, Appalachia	NY, PA	417	2,312	1,504
Questar Pipeline Co.	Central	Central	CO, UT, WY	379	2,192	1,745
Florida Gas Transmission Co.	Southeast	Southwest	AL, FL, LA, MS, TX, GM	757	2,190	4,867
Algonquin Gas Transmission Co.	Northeast	Southwest	CT, MA, NJ, NY, RI	346	2,174	1,103
Columbia Gulf Transmission Co.	Southeast, Northeast	Southwest	KY, LA, MS, TN, GM	2,041	2,156	4,105
Alliance Pipeline Co. (US)	Midwest	Canada	ND, MN, IA, IL	652	2,053	888
Wyoming Interstate Gas Co.	Central	Central	CO, WY	594	1,997	585
Kern River Gas Transmission Co.	Western	Central	CA, NV, UT, WY	718	1,833	1,680
High Island Offshore System	Southwest	Gulf of Mexico	LA, GM	234	1,800	212
Trunkline Gas Co.	Midwest	Southwest	AR, IL, IN, KY, LA, MS, OH, TN, TX	606	1,680	3,558
Sub-total				37,398	115,098	163,156
Other Interstate Systems (79)	- -	- -	- -	10,242	33,235	49,531
Total				47,640	148,333	212,687

[1] Capacity levels are reported to FERC in Btu, dekatherms, or volumetric units. For this presentation, reported capacity figures are presented as volumetric (MMcf/d = million cubic feet per day) assuming a conversion factor of 1 MMcf/d = 1 MDth/d (thousand dekatherms per day) = 1 Bbtu/d (billion btus per day).

Note: GM = Gulf of Mexico.

Source: Federal Energy Regulatory Commission (FERC), **Mileage & Transport**: FERC Form 2 & 2A "Major and Non-major Natural Gas Pipeline Annual Report," **Capacity:** FERC Annual Peak Day Capacity Report Section 284.13(d).

KM Delivery Market Access

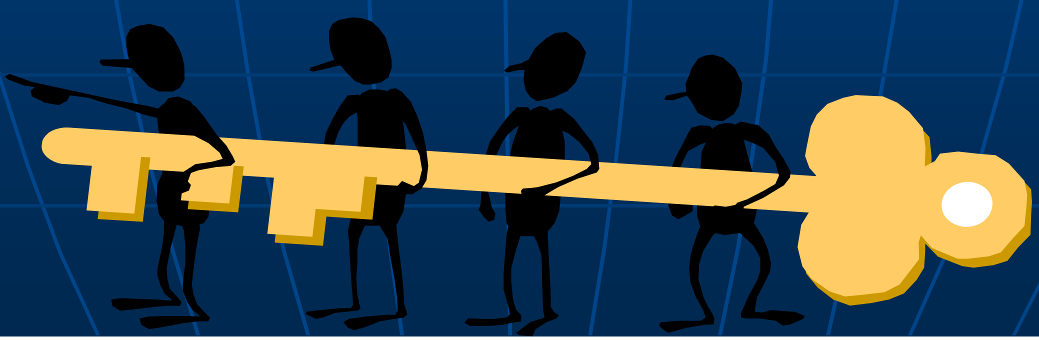


Major US Crude & Gas Produces

Rank	Company Name	Crude Oil Production (thousand barrels/day)	Rank	Company Name	Total Natural Gas Production (milion cubic feet/day)
1	BP PLC	825	1	BP PLC	3,465
2	CHEVRON CORP	478	2	CHEVRON CORP	2,355
3	CONOCOPHILLIPS	346	3	CONOCOPHILLIPS	2,110
4	SHELL OIL CO	324	4	EXXONMOBIL CORP	2,057
5	OCCIDENTAL OIL & GAS CORP	283	5	DEVON ENERGY CORP	2,002
6	AERA ENERGY LLC	199	6	BURLINGTON RESOURCES INC	1,942
7	EXXONMOBIL CORP	145	7	CHESAPEAKE ENERGY CORP	1,657
8	KERR-MCGEE CORP	133	8	SHELL OIL CO	1,608
9	APACHE CORP	91	9	ANADARKO PETROLEUM CORP	1,471
10	AMERADA HESS CORP	72	10	ENCANA CORP	1,419
	Top 10 Volume Subtotal	*2,896*		*Top 10 Volume Subtotal*	*20,086*
	Top 10 Percentage of U.S. Total	*55%*		*Top 10 Percentage of U.S. Total*	*38%*

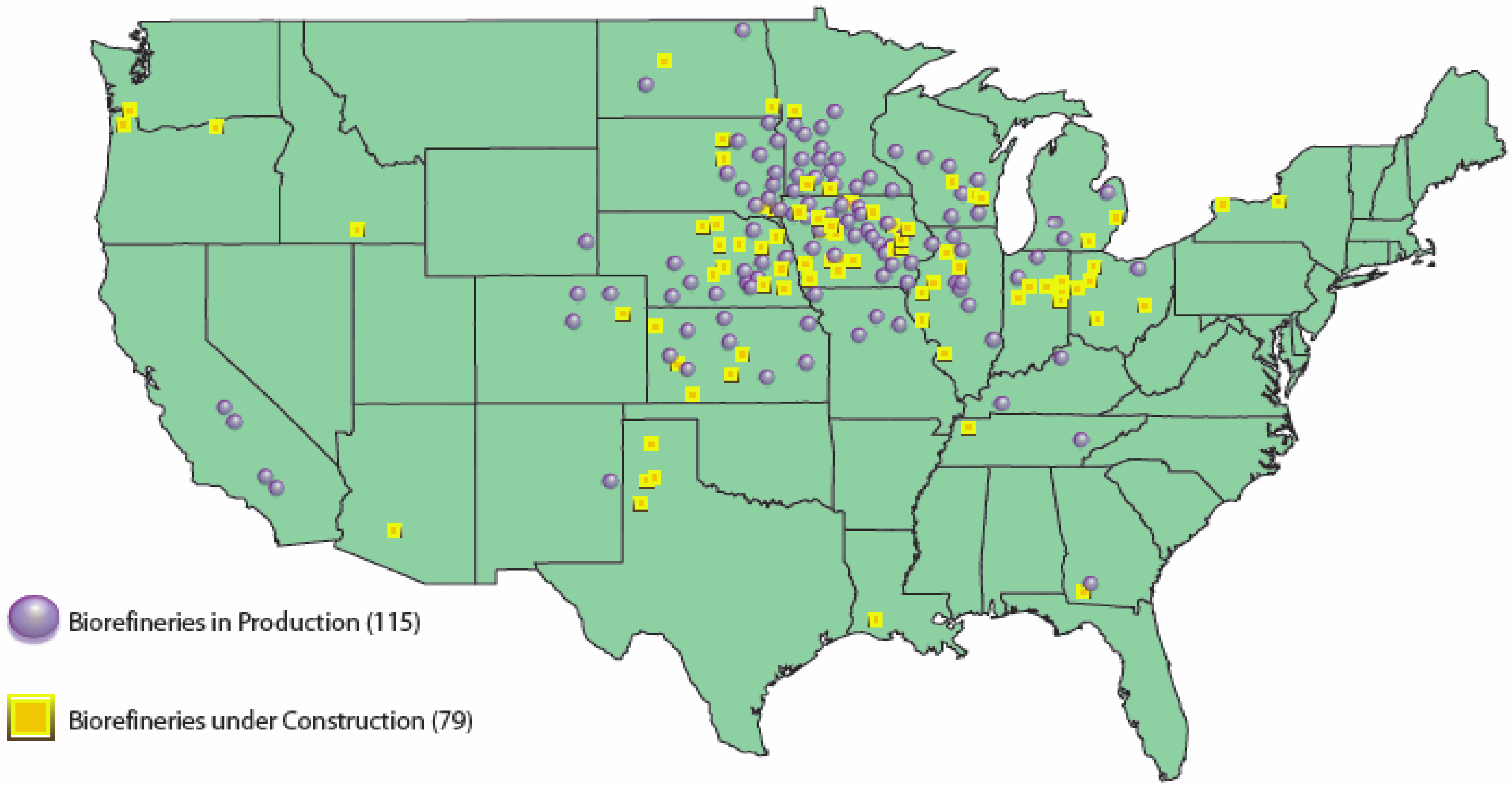
Key Concepts

- Major oil companies and partnerships of major oil companies dominate the pipeline industry
- Barge transportation companies are independent from oil company ownership
- Railroads and truck lines are independent of oil company ownership
- There does not appear to be any trend towards multimode ownership to control petroleum transportation in the US



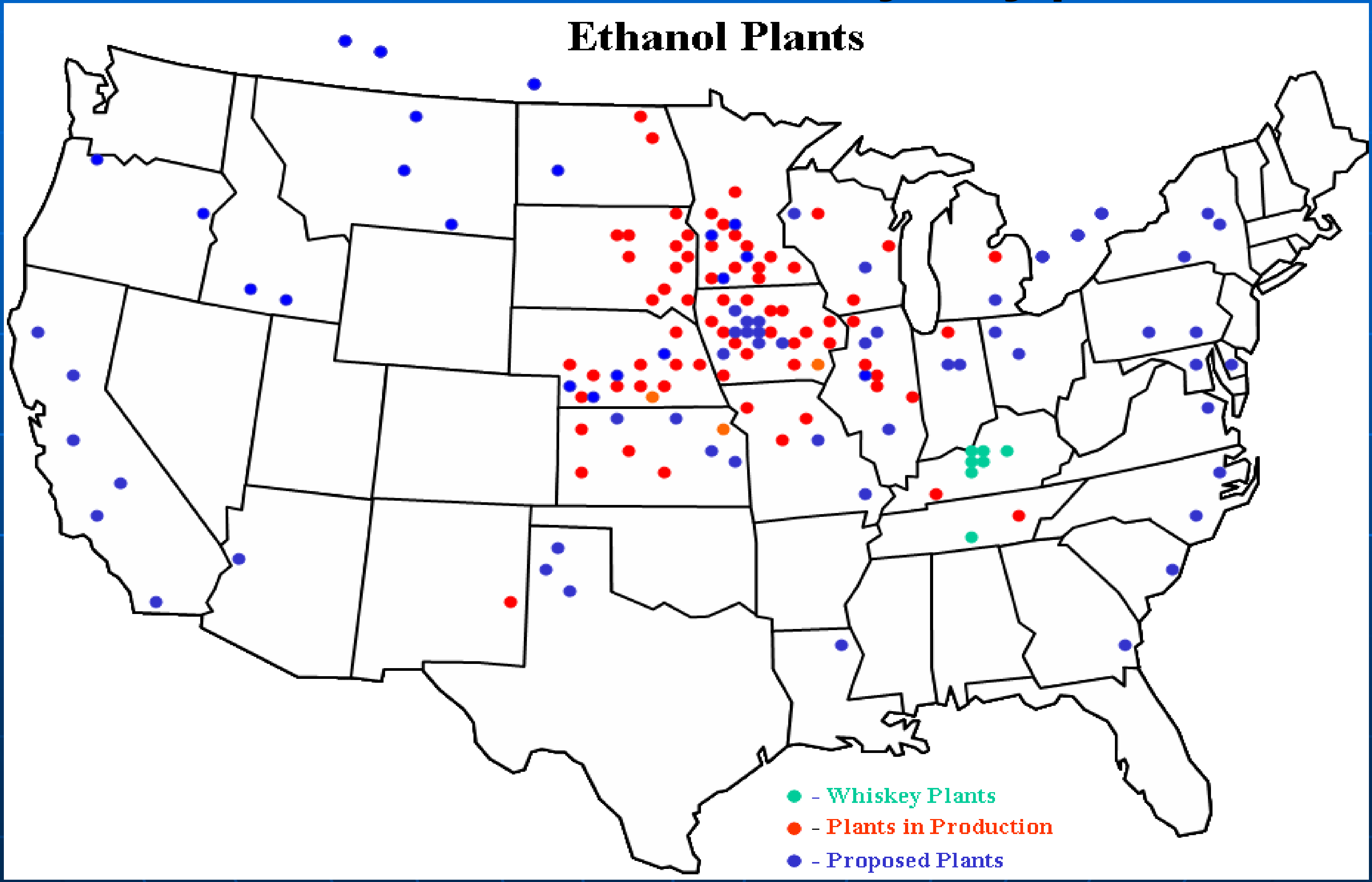
Ethanol and Bio diesel

U.S. Ethanol Refinery Locations



Source: Renewable Fuels Association 4.3.07

Ethanol Plants by Type



Source: University of Minnesota

Ethanol Facts

What is ethanol?

Ethanol is ethyl alcohol, essentially 200-proof grain alcohol. An ethanol production facility, a "plant" or "biorefinery," produces pure fuel-grade ethanol, and then that ethanol is blended in a percentage with gasoline to create a finished motor fuel. A small amount of gasoline is blended into the ethanol at the plant to denature it, or make it unfit for human consumption.

What kinds of ethanol-blended fuels are available?

Ethanol can be blended into varying percentages in gasoline, the two most common blends being 10% and 85%.

Source American Coalition for Ethanol

Ethanol Facts

E10 - 10% ethanol and 90% unleaded gasoline - is the most common way ethanol is available to motorists. All automakers approve ethanol blends up to this 10% level by warranty, no matter the make or model of the vehicle. About 99% of America's ethanol is retailed as E10.

E85 - 85% ethanol and 15% unleaded gasoline - is an alternative fuel for use in Flexible Fuel Vehicles (FFVs). FFVs can use unleaded gasoline or any blend of ethanol up to this 85% level.

Some areas of the country use ethanol blends in other percentages; for example, gasoline in California contains 5.7% of ethanol instead of the more common 10% blend.

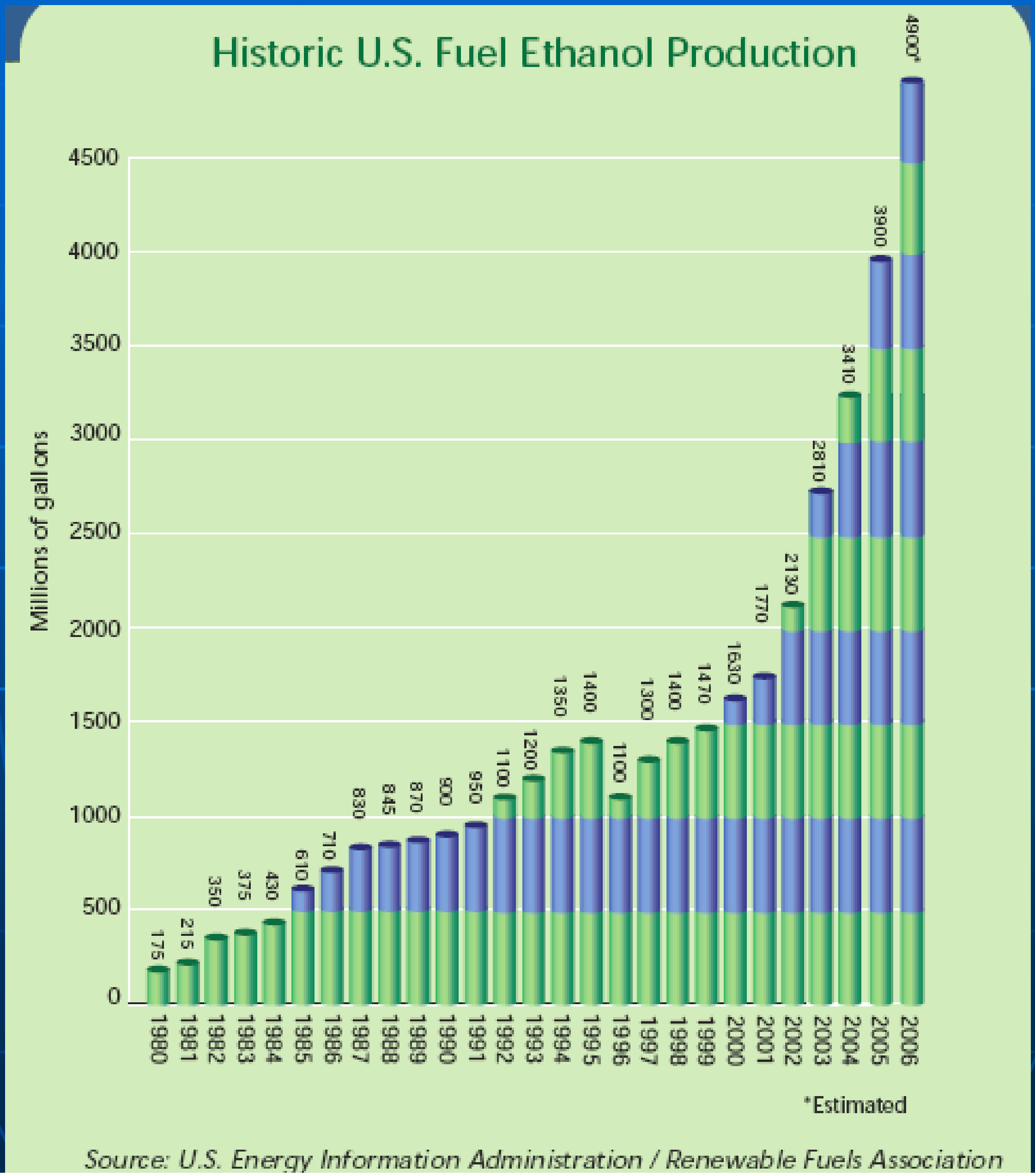
Source American Coalition for Ethanol

U.S. Ethanol Production Capacity by State

	Online	Under Construction/ Expansion	Total
Iowa	1701.5	1535	3236.5
Nebraska	655.5	965	1620.5
Illinois	831	341	1172
South Dakota	532	378	910
Minnesota	541.6	240.5	782.1
Indiana	102	551	653
Kansas	212.5	295	507.5
Wisconsin	230	272	502
Texas	0	370	370
Ohio	3	330	333
Michigan	155	107	262
North Dakota	83.5	150	233.5
New York	0	164	164
Missouri	155	0	155
Oregon	0	143	143
Colorado	85	40	125
Tennessee	67	38	105
Georgia	0.4	100	100.4
California	68	0	68
Arizona	0	55	55
Washington	0	55	55
Kentucky	35.4	0	35.4
New Mexico	30	0	30
Wyoming	5	0	5
Total	5493.4	6129.5	11,622.9

Source: Renewable Fuels Association, January 2007

U.S. Fuel Ethanol Production



2004 Ethanol-Blended Fuel Use by State

2004 ETHANOL-BLENDED FUEL USE BY STAT

STATE	TOTAL (thousands of gallons
Alabama	313,837
Alaska	3,209
Arizona	—
Arkansas	—
California	15,779,408
Colorado	840,135
Connecticut	1,590,629
Delaware	—
Dist. of Col.	—
Florida	552
Georgia	—
Hawaii	—
Idaho	—
Illinois	4,215,207
Indiana	1,480,385
Iowa	1,167,313
Kansas	43,295
Kentucky	302,696
Louisiana	1,793
Maine	—
Maryland	3,033
Massachusetts	—
Michigan	—
Minnesota	2,766,931
Mississippi	—
Missouri	1,220,178
Montana	18,898
Nebraska	371,983
Nevada	466,421
New Hampshire	—
New Jersey	—
New Mexico	64,975
New York	—
North Carolina	1,795
North Dakota	105,022
Ohio	1,916,299
Oklahoma	—
Oregon	—
Pennsylvania	—
Rhode Island	—
South Carolina	—
South Dakota	239,001
Tennessee	—
Texas	332,940
Utah	—
Vermont	—
Virginia	32
Washington	4,785
West Virginia	12,660
Wisconsin	1,085,639
Wyoming	—
U.S. Total	**34,349,052**

Source: Federal Highway Administration, October, 2005 (compiled from state fuel-tax reports)

2006 World Ethanol Production

(1000s of gallons)

Austria	2.6
Denmark	4.9
France	251.0
Germany	202.2
Hungary	17.2
Italy	42.9
Poland	66.1
Spain	122.5
Sweden	30.4
U.K.	74.0
Other European Union	84.0
European Union	897.6
Russia	171.7
Switzerland	2.2
Turkey	17.2
Ukraine	71.3
Other Europe	63.4
Europe	1,223.5
Egypt	7.9
Kenya	4.5
Malawi	4.0
Mauritius	2.4
Nigeria	7.9
South Africa	102.4
Swaziland	4.6
Zimbabwe	6.6
Other Africa	19.8
Africa	160.1
Canada	153.2
Costa Rica	10.6
Cuba	11.9
Guatemala	21.1
Jamaica	6.5
Mexico	13.2
Nicaragua	7.7
Panama	4.2
U.S.A.	5,276.9
Other North & Central America	25.1
North & Central America	5,530.4
Argentina	44.9
Bolivia	18.5
Brazil	4,491.4
Colombia	74.0
Ecuador	11.6
Other South America	50.2
South America	4,690.6
China	1,017.2
India	502.0
Indonesia	44.9
Iran	7.9
Japan	29.9
Korea, South	15.9
Pakistan	23.8
Philippines	22.2
Saudi Arabia	52.8
Taiwan	2.6
Thailand	93.3
Other Asia	26.4
Asia	1,838.8
Australia	39.4
New Zealand	4.2
Other Oceania	2.1
Oceania	45.7
WORLD	13,489.2

Source: F.O. Licht

Eth

Brazil	Requi
Argentina	Requi
Thailand	All ga
India	Requi
Australia	Volum
Great Britain	Provid
European Union	2% (e
Canada	Tax be

Ethanol Industry Overview

In 2006, 110 ethanol plants in 21 states produced a record 5.2 billion gallons of ethanol—nearly double the amount produced in 2000.

In 2006, the U.S. produced about 5.2 billion gallons of ethanol. The nations' annual consumption of gasoline is approximately 140 billion gallons.

In 2005, 14 percent of the U.S. corn crop went for ethanol production, and for the '06 crop that figure is expected to rise to 20 percent.

Source: ethanolfacts.com; ethanol.org

Ethanol Projections

The US Congress passed a bill requiring that by 2012 5.1 billion gallons (BGY) of ethanol will be available as useable fuels in the US.

U S ethanol is produced from corn that is transported to Ethanol plants by truck not rail.

Pipeline and truck shipments are not considered to be an economically means of transport due to special handling regulations.

Source: ethanolfacts.com; ethanol.org

Demand and Planning

The majority of the logistic obstacles to ethanol distributions can be overcome given adequate planning and sufficient capital investments. The question becomes one of the potential of return on such an investment.

One of the major demand areas is California that has been mandated to replace MTBE (an imported product exempt from the Jones Act) with ethanol.

Significant investments are required in that the source of the input materials corn are predominantly in the Midwest while the demand markets are on the east and west coasts .

Source: ethanolfacts.com; ethanol.org

Water Transport

Ocean water transport to California via the Panama Canal is subject to reliability issues transit requiring a month with delays ranging 5 to 10 days.

Inland water transport is limited due to three issues;

- Marine Vessels that compile with The Jones Act
- Various water control acts
- That the upper Mississippi river in the Midwest tend to be frozen during a key portion of the demand period
- The increase of 5.1 (BGY) represents a 0.58% increase at a time that other traffic is anticipated to rise at a rate of 1.3% annually.

Source: eia Energy Information Administration

Rail Transport

Rail transport is most economical and results in optimal transit times if moved as unit trains.

A typical car holds 30,000 gallons of which there are currently 41,000 nearly all non-railroad owned.

Rail transport limitations would be yard space, switching capacity at terminals and unloading capacity. Most terminals equipped to unload ethanol are limited to spotting 3-5 cars even larger terminals cannot routinely spot more then 15-20 cars at a time. Consequently a unit train of 100 cars would need to be broken into segments.

Source: eia Energy Information Administration
AAR Association of American Railroads

Rail Transport

Rail transport comparisons single car movements to unit train movements Illinois to Phoenix, AZ:

Single Car	Activity	Unit Train
10 days	Outbound	7 days
2 days	in yard	< 1 day
3 days	switching	< 1 day
10 days	return	7 days
25 days	Totals	15-16 days

Source: eia Energy Information Administration

Ethanol Transportation Costs

Expanding the US ethanol production to 5 billion gallons per year will result in an estimated average cost of $.08US per gallon for ethanol transportation.

PADD	Cost/ Gallon
1	$0.111
2	$0.043
3	$0.066
4	$0.047
5	$0.127
Average	$0.077

Source: eia Energy Information Administration

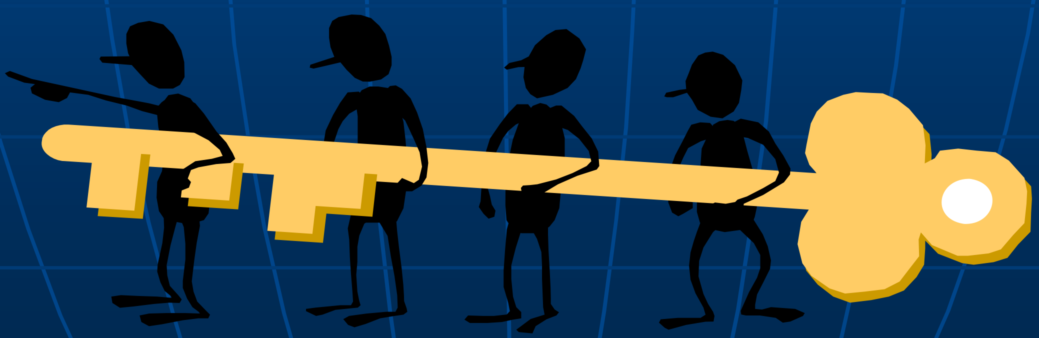
Terminals

There has been a significant increase in competition in the "for-hire" segment of the independent liquid terminal industry. Many terminals have responded to rising ethanol demand by escalating their marketing of ethanol storage services. A number of master limited partnerships have been rapidly acquiring additional terminals and aggressively marketing the increased storage capacity. At the same time, several oil companies have brought new storage capacity to the for-hire market as they have converted some of their own storage tanks and loading racks to "profit centers."

Source National Petroleum News

Key Concepts

- US ethanol is produced from corn as a base stock
- Corn is a Midwest crop
- The bulk of all ethanol plants are in the Midwest
- Rail is the most economical mode of transport for ethanol in the US



Liquefied Natural Gas

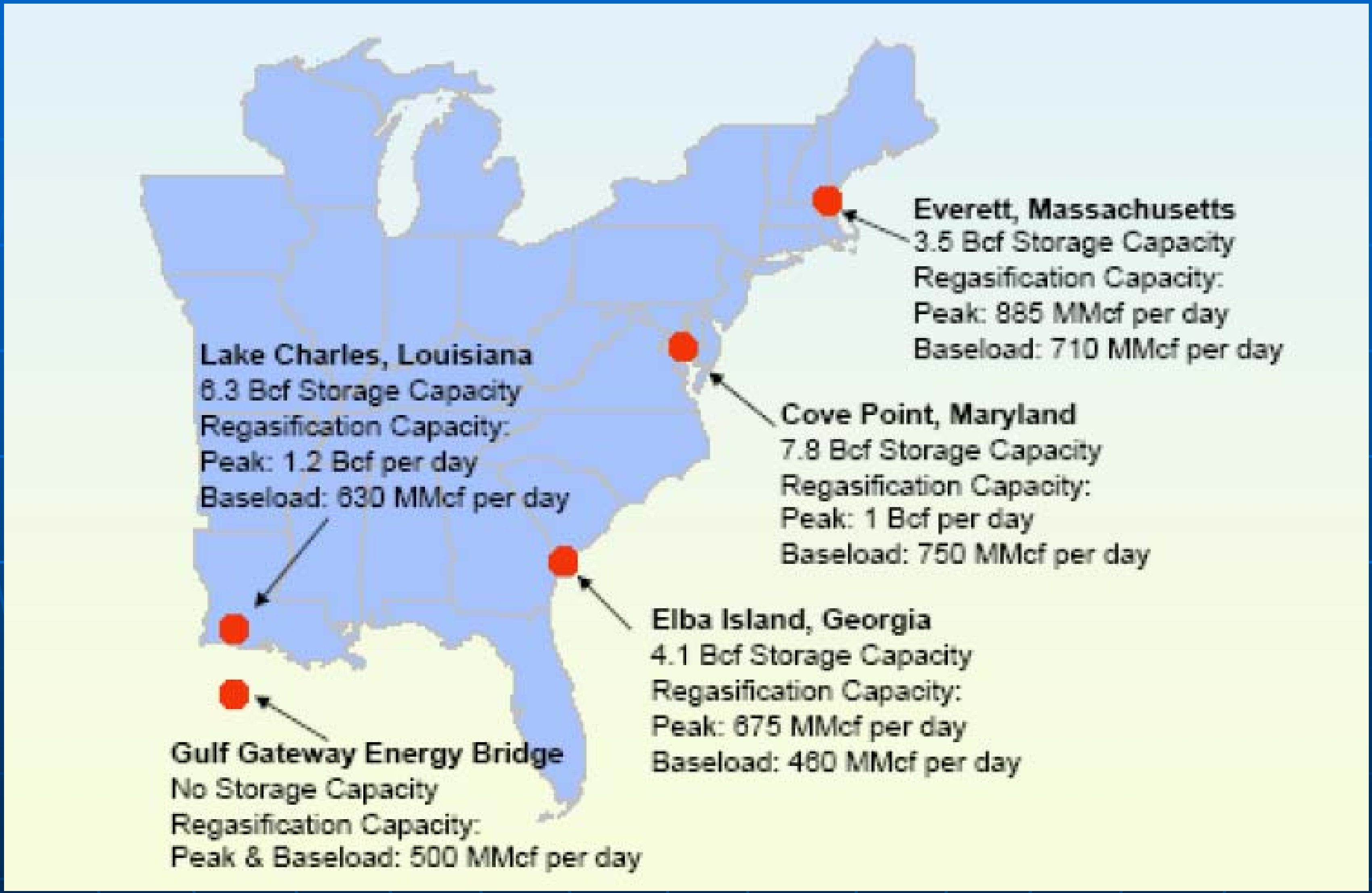
LNG Import Terminals

Today, there are only five U.S. facilities (and one facility in Puerto Rico) capable of importing LNG – not nearly enough to handle the amount of LNG needed.

There is also a export facility in Kenai, Alaska. Natural gas is exported here because without a pipeline or an LNG import terminal on the West Coast, it is impossible to bring the Alaskan natural gas to the lower 48 states for domestic consumption.

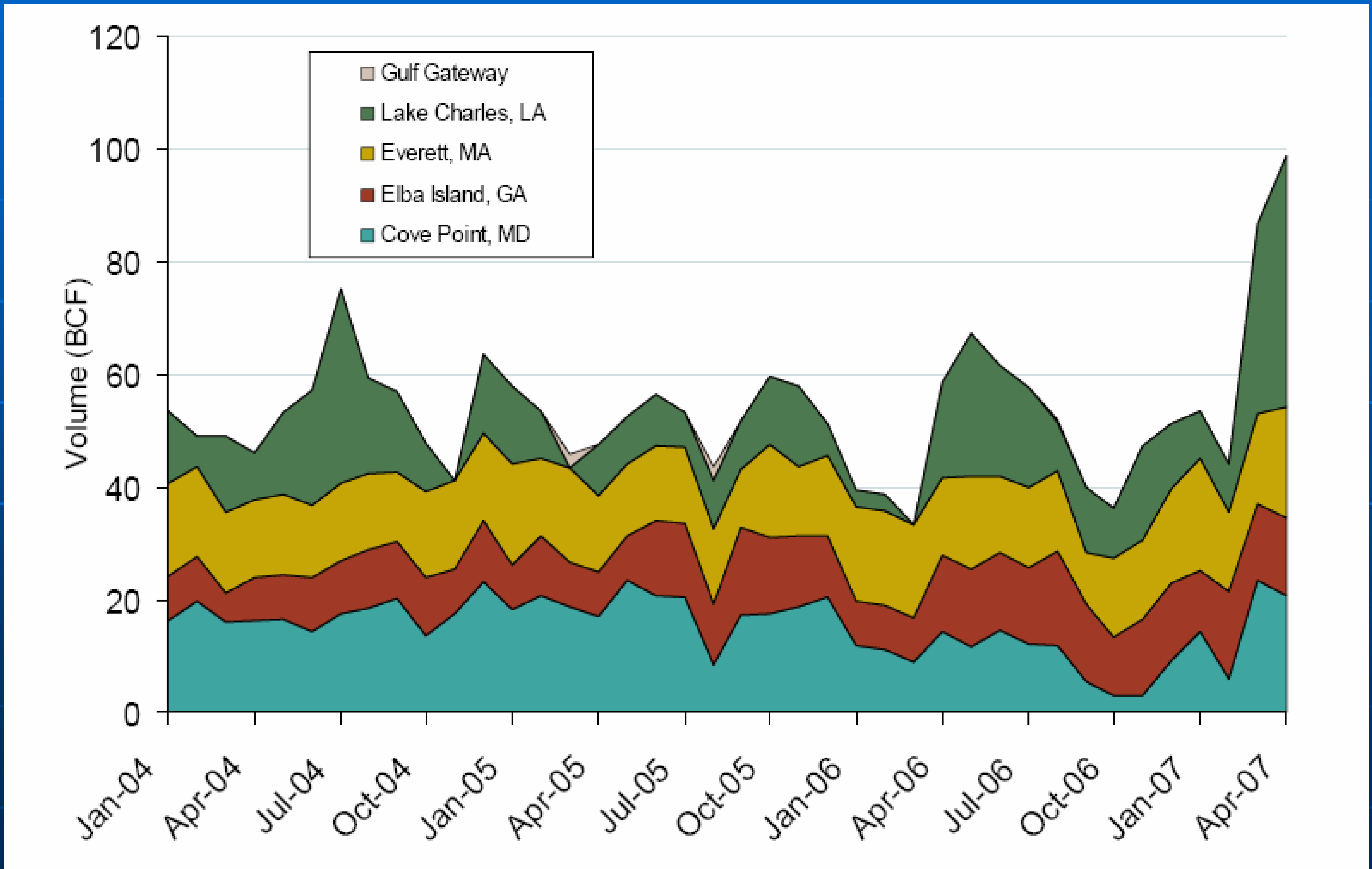
Source: Federal Energy Regulatory Commission January 17, 2007
Center for LNG

U.S. LNG Import Terminals



Source: Guy Caruso, EIA, 10th Annual Asia Oil and Gas Conference, June 14, 2005

Monthly Gas Imports



Source: Derived from *EIA* data.

Liquefied Natural Gas

Natural gas cannot be efficiently transported very long distances (e.g. across oceans) in its gaseous state.

LNG is shipped on secure and specially designed ships with more than six feet of space between the outer hull and inner hulls.

Upon arrival at its destination, LNG is generally transferred to specially designed and secured storage tanks and then warmed to its gaseous state – a process called regasification. It is transported via pipelines to consumers, industries and power generators who rely on natural gas.

Once LNG returns to its gaseous state, it is distributed as natural gas through pipelines to consumers.

LNG Industry Costs Declining

LNG projects are among the most expensive energy projects.

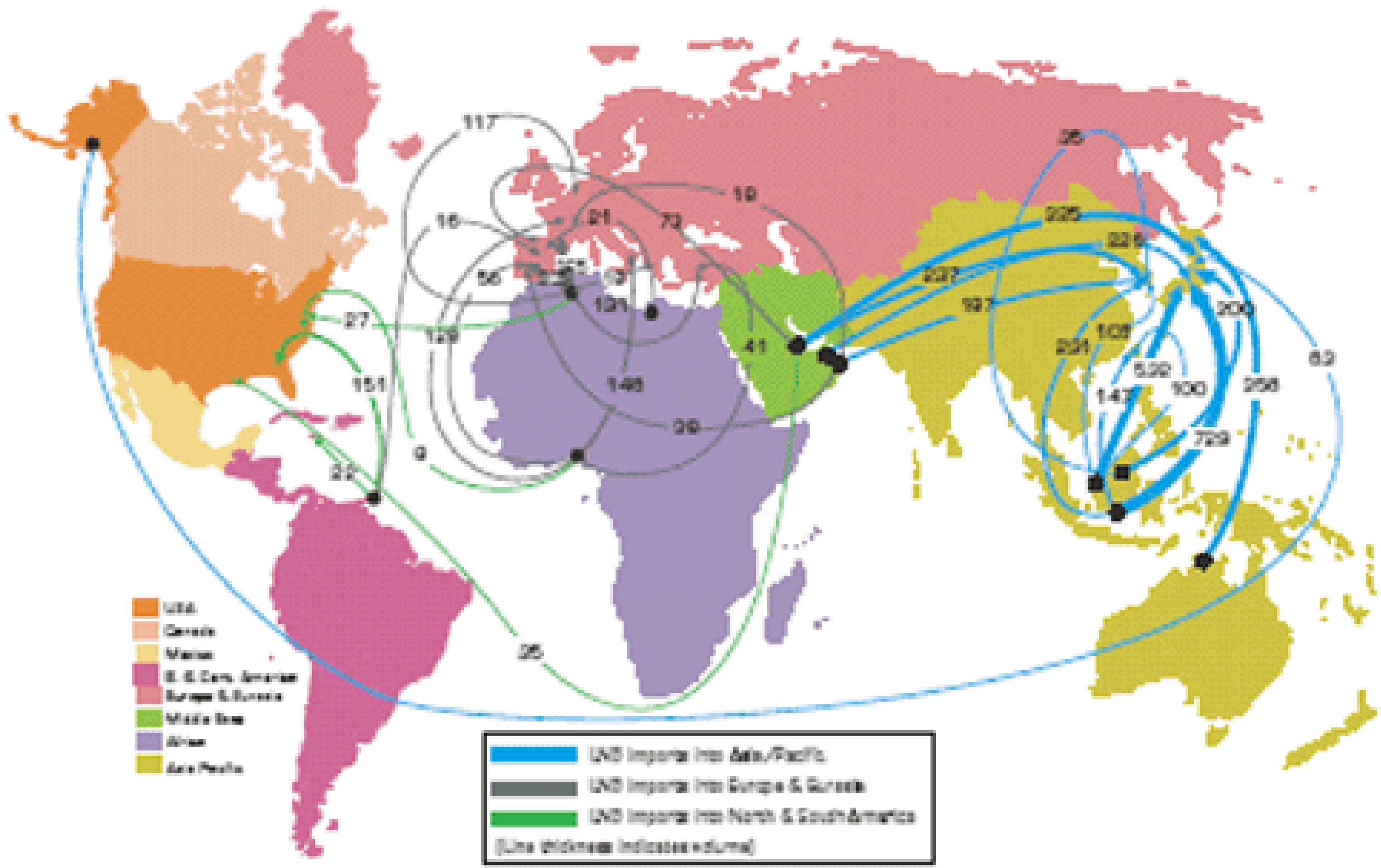
According to an independent LNG consultant, there are four main price components of an LNG project, from the gas field to the receiving terminal:

— Gas production: from the reservoir to the LNG plant, including gas processing and associated pipelines (15 to 20 percent of costs);
— LNG plant: gas treating, liquefaction, LPG and condensate recovery, LNG loading and storage (30 to 45 percent of costs);
— LNG shipping (10 to 30 percent of costs); and Receiving terminal: unloading, storage, regasification and distribution (15 to 25 percent of costs).

Source: EIA/DOE

Major LHG Movements

Major LNG Trade Movements, 2002 *(Billion cubic feet)*



Note: The map includes flows greater than 5 Bcf for imports into the United States, and flows greater than 15 Bcf for imports into all other Countries.

Source: Imports to the United States and Imports to Japan and Mexico from the United States: Energy Information Administration, *Natural Gas Monthly* (May 2003). All Other Countries: Organization for Economic Cooperation and Development, International Energy Agency, Natural Gas Information 2003 (with 2002 data).

LNG SECURITY AND SAFETY: TERMINALS

THE CENTER FOR Liquefied Natural Gas

Visit our website at www.lngfacts.org
Telephone: 202-289-2253

LNG terminals are designed to include spill containment systems, fire protection systems, multiple gas, flame, smoke and low- and high-temperature detectors and alarms, and automatic and manual shut-down systems. Each LNG tank/process area must have a thermal exclusion zone and a vapor dispersion exclusion zone within the owner's control per Federal Energy Regulatory Commission (FERC) regulations. Annually, U.S. Department of Transportation (DOT) staff inspect LNG terminals to monitor conformance with all requirements. Every two years, FERC staff inspect LNG facilities to monitor the condition of the physical plant and inspect changes from the originally approved facility design or operations.

MARINE TRANSFER (OFFLOADING) AT THE TERMINAL

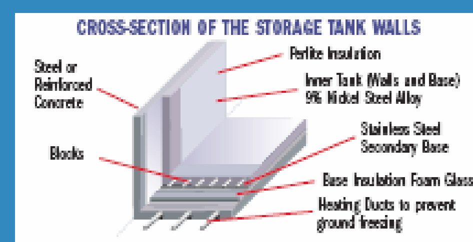
LNG marine terminals must prepare and implement security plans for deterring "transportation security incidents" to the "maximum extent practicable."

Access to marine transfer area is limited to authorized personnel.

The U.S. Coast Guard (USCG) designates the area around Marine Transfer Terminals as a Security Zone, with restricted access.

Marine transfer terminals have fixed sensors that continuously monitor for natural gas vapors. Each transfer system has an emergency shutdown system that can be activated manually or activated automatically when the fixed sensors identify LNG spills or measure dangerous levels of natural gas. Multiple fire detectors are required for the marine transfer area.

Prior to any LNG transfer commencing, the ship and terminal staff meet to ensure all aspects of safety. Regulations require facility and vessel security officers to be present. At the discretion of the USCG, USCG personnel are available to monitor the waterway, the ship, and the facility.



STORAGE TANKS

LNG is stored in special, low temperature cryogenic, non-pressurized tanks at –260 degrees Fahrenheit. LNG tanks must have a primary, secondary, and in some cases a tertiary containment system. All tanks have a nickel steel innerwall for primary containment. Some tanks have a concrete reinforced outer wall for secondary containment, some have a carbon steel outer wall with a dike or impoundment for secondary containment.

SITE SECURITY

Under the Marine Transportation Safety Act (MTSA), facilities at U.S. ports, including LNG terminals, are required to submit Facility Security Plans to the Coast Guard Captain of the Port for review and approval. The facility must designate a Facility Security Officer, conduct a facility security assessment, implement security measures to provide increasing levels of security at increasing Maritime Security (MARSEC) levels, and conduct security exercises and drills on a regular basis. In addition, the plan must include procedures for preventing unauthorized access, coordinating with local, state and federal authorities, responding to security incidents and training of personnel.

SITE SECURITY IS MAINTAINED BY A VARIETY OF MEANS INCLUDING:

- Limiting access via protective enclosures and/or perimeter fencing with each access locked and/or guarded.
- Constant monitoring (including Closed Circuit TV).
- All personnel must undergo security and fire protection training.

LNG SECURITY AND SAFETY: SHIPS

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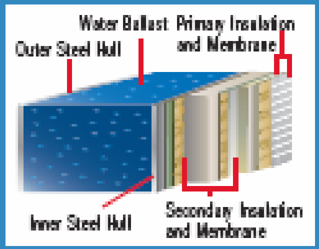
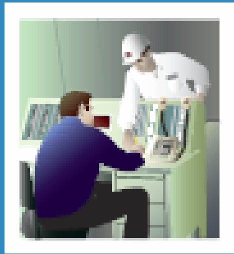
The safety record of LNG ships far exceeds any other sector of the shipping industry with more than 40,000 deliveries. Over the past 40 years, there have been no collisions, fires, explosions or hull failures resulting in a loss of containment for LNG ships in port or at sea.



LNG ships are double-hulled and specially designed so that the LNG is stored in special containment systems that are not under pressure and at about –260 degrees Fahrenheit. With more than six feet between the outer hull and the cargo, these vessels are designed to protect the cargo tanks and prevent leakage or rupture in the rare event of an accident. The International Maritime Organization (IMO) has developed international standards for the construction and operation of all ships, including LNG carriers.

Inherent in the design of these LNG ships are numerous levels of safety systems, including Ship Traffic Management schemes with radar, global positioning equipment, global maritime distress systems, gas/heat/fire detection, and ship-to-shore communication systems. The cargo transfer system can not be operated if all cargo related safety systems are not fully functioning. All the systems are designed to protect the integrity of the cargo and to ensure it is well-insulated and well-contained. Additionally, the ships are equipped with automatic identification systems that will allow ship tracking and monitoring while traveling on U.S. navigable waters.



Crews of LNG ships are highly trained, specialized and experienced personnel. They are versed in detailed contingency plans to cover even the most unlikely of incidents. Regular exercises are conducted to test their response capability. International experts (including terrorist experts) test the robustness of plans, procedures, people and training. Before entering U.S. waters, the Immigration Service validates crew identities. The ship provides crew identification 96 hours before arrival for personnel security clearance. Crews tend to be "dedicated" to a specific route and thus known to U.S. Bureau of Customs and Border Protection.

LNG SHIPPING OPERATIONS

All vessels and ports worldwide that engage in international trade comply with the International Ship and Port Facility Security Code. Foreign-flagged ships entering U.S. waterways meet the security requirements of the Maritime Transportation Security Act of 2002 (MTSA).

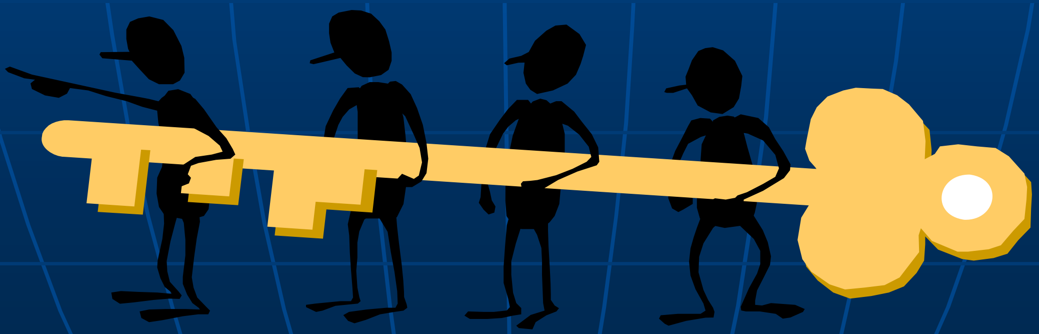
LNG ships entering U.S. waters are required by the U.S. Coast Guard (USCG) to have certified security plans that identify the person authorized to implement security actions, describe provisions for establishing and maintaining physical security, cargo security, and personnel security, and address how they would respond to emergency situations.

Operators of LNG ships adhere to LNG ship management procedures and emergency plans developed by the regional Captain of the Port USCG marine safety unit. These procedures include requirements for pre-arrival notification, harbor transit, docking operations, cargo transfer, inspection, monitoring and emergency procedures.

Companies involved in LNG shipping work with the local Pilotage Authority and the USCG to develop optimum plans for safe transit in and out of port. This coordination helps manage port shipping traffic, similar to air traffic controllers, with the aim of protecting against collisions while not adversely affecting movement of other traffic. The USCG can assign sea marshals to escort LNG ships as they transit in and out of U.S. ports to provide for harbor safety and security if warranted.

Key Concepts

- There are currently only five LNG import terminals in the US
- Natural gas consumption is projected to continue to rise
- LNG is not widely distributed in the US rather it is converted back to gas and is transported along the natural gas pipeline network



Summary

Heading For An Oil Shock

OIL	2001–2010	2011–2020	2021–2030
Exploration & Development	$689	$740	$793
Nonconventional oil	49	60	96
Refining	122	143	147
Tankers	37	79	76
Pipelines	20	23	23
TOTAL	$917	$1,045	$1,135

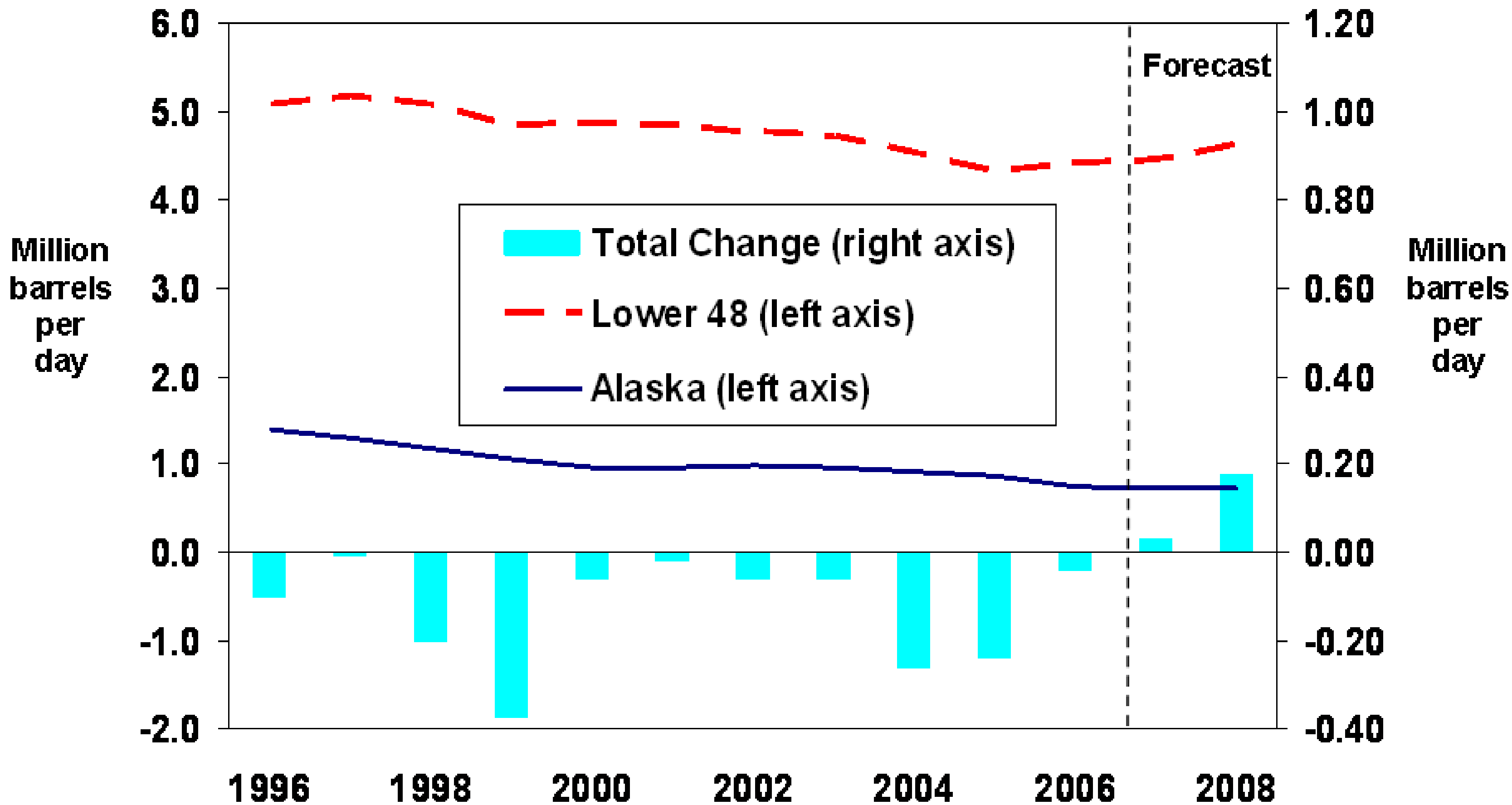
Investments needed to meet world oil-and-gas demand in the International Energy Agency's reference scenario, in billions

*LNG is liquefied natural gas
Source: International Energy Agency, Paris

Heading For An Oil Shock

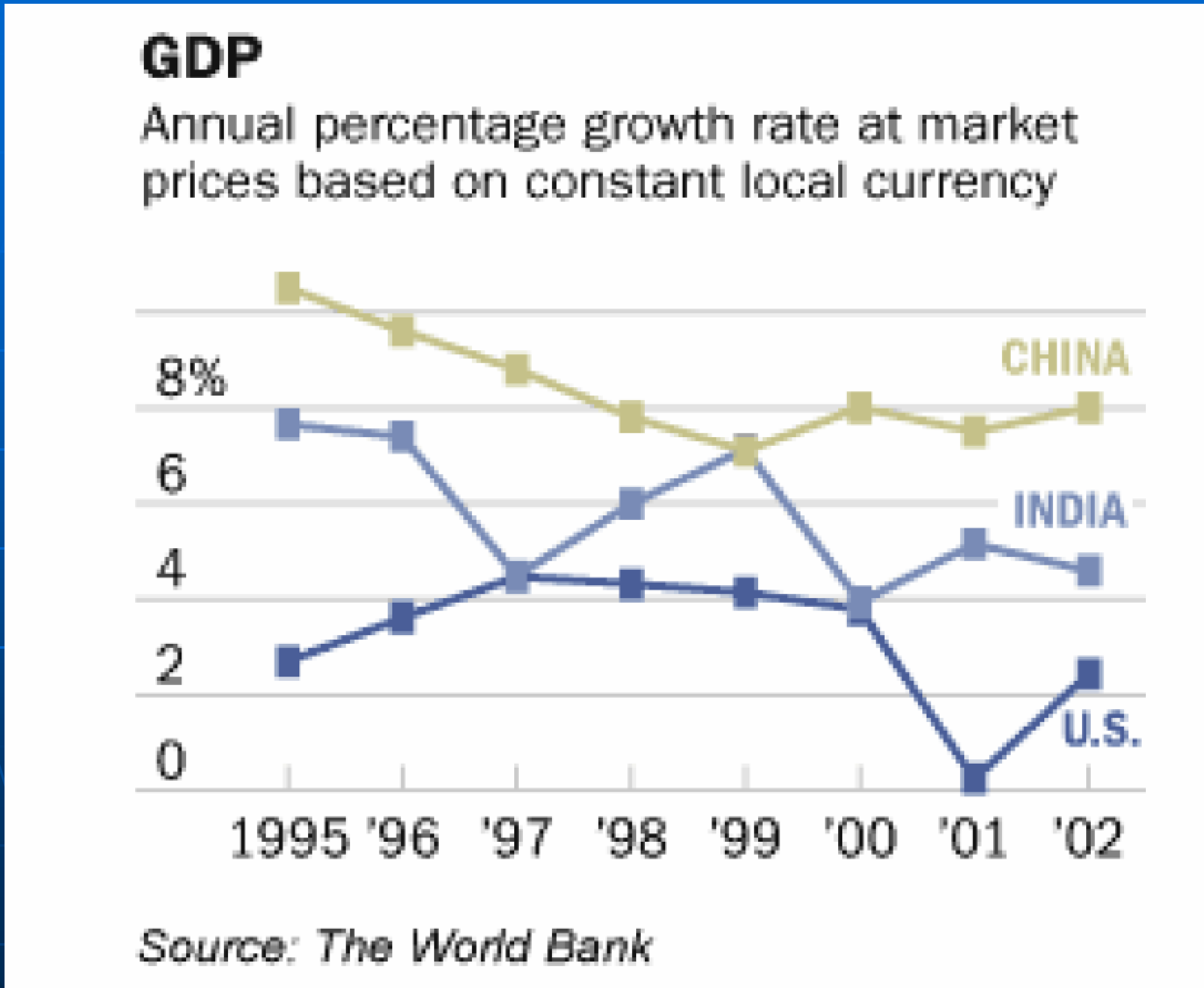
GAS	2001–2010	2011–2020	2021–2030
Exploration & Development	$478	$575	$678
LNG* liquefaction	46	32	38
LNG regasification	21	21	25
LNG ships	30	16	22
Transmission	201	196	182
Distribution	135	160	194
Underground storage	36	41	17
TOTAL	$947	$1,041	$1,156

U.S. Crude Oil Production Trends

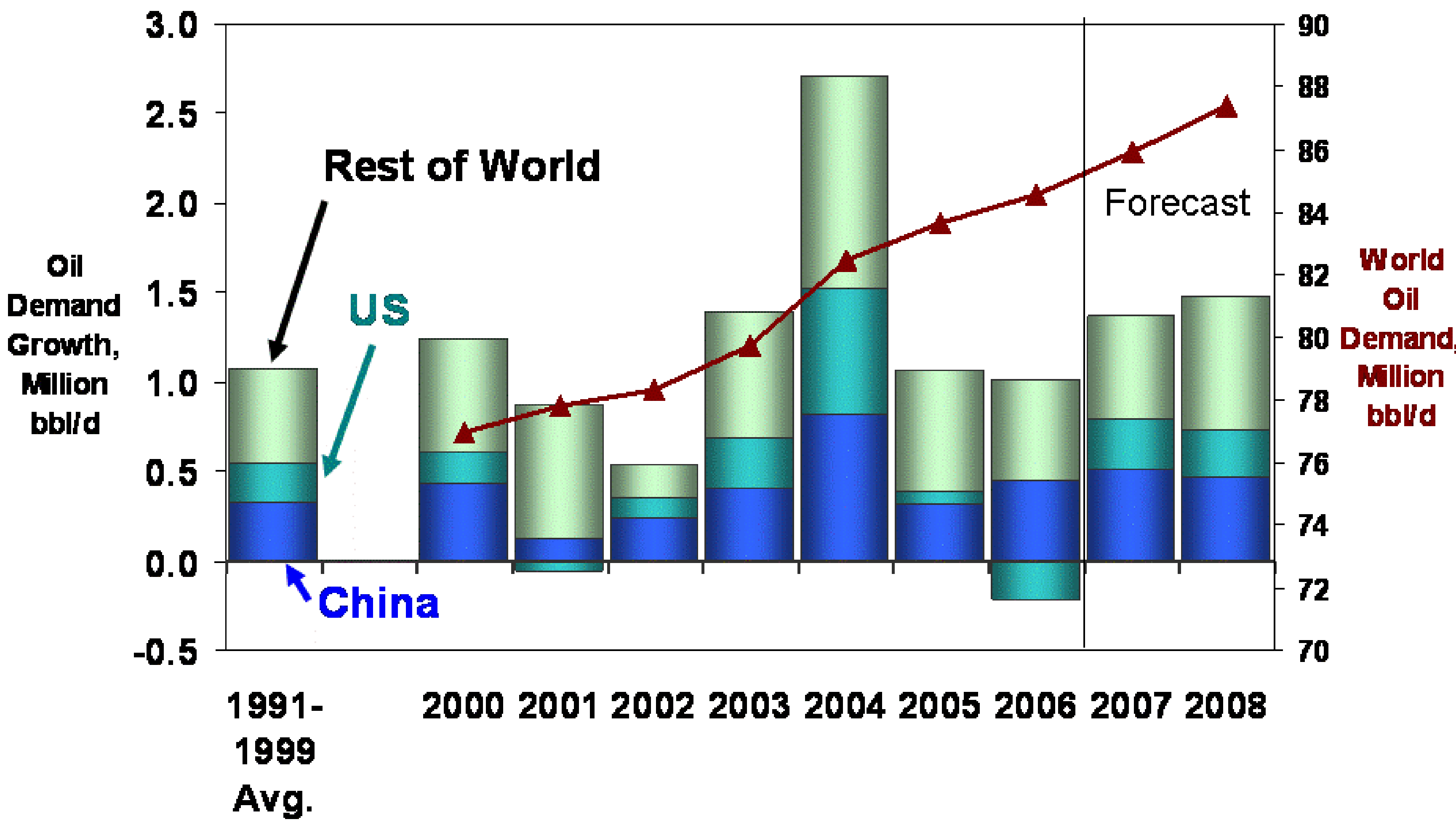


Short-Term Energy Outlook, July 2007

www.eia.doe.gov


GDP
Annual percentage growth rate at market prices based on constant local currency
8%
6
4
2
0
CHINA
INDIA
U.S.
1995 '96 '97 '98 '99 '00 '01 '02
Source: The World Bank

World Oil Consumption Growth



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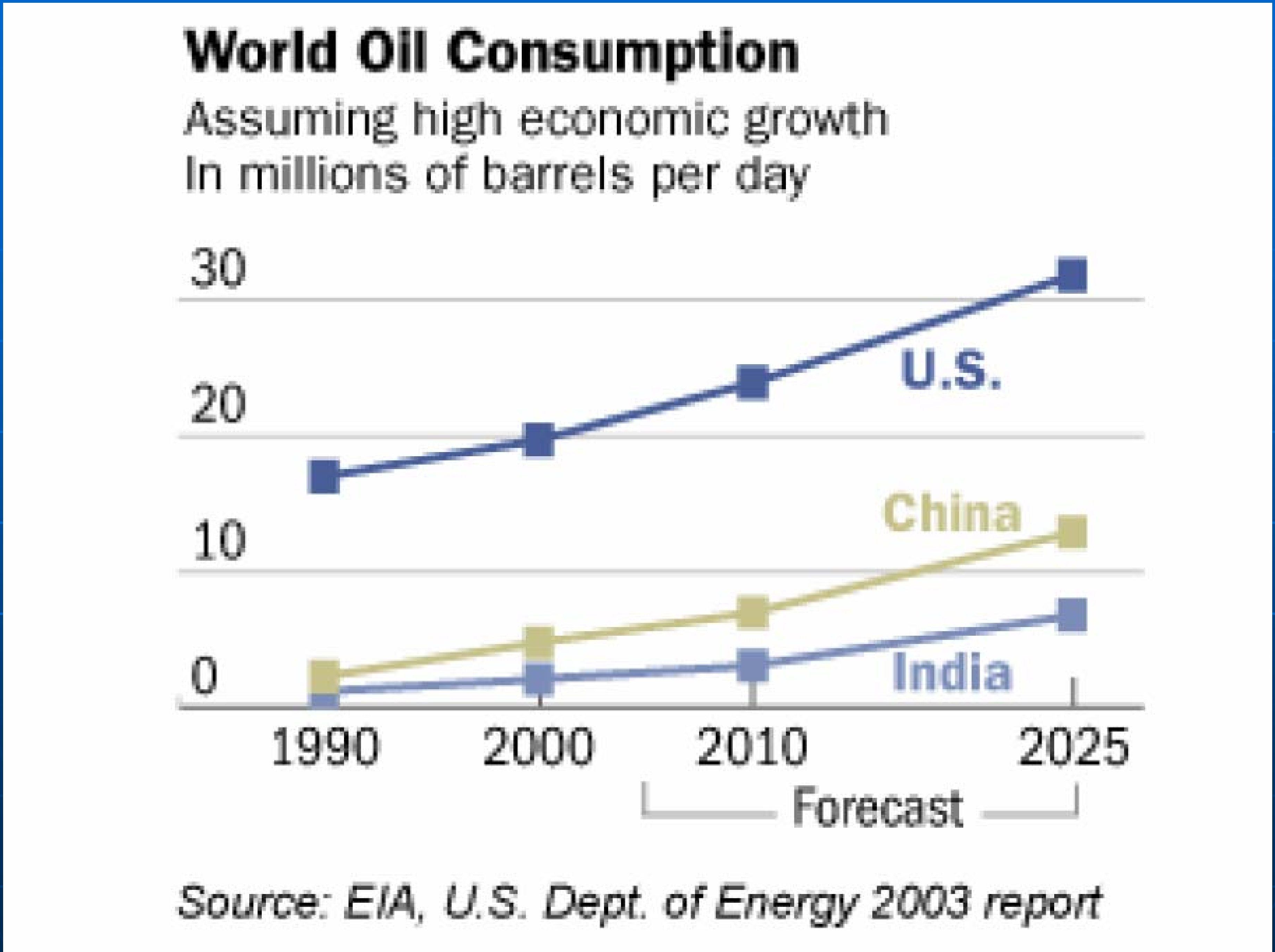

World Oil Consumption
Assuming high economic growth
In millions of barrels per day
30
20
10
0
U.S.
China
India
1990
2000
2010
2025
Forecast
Source: EIA, U.S. Dept. of Energy 2003 report

Worldwide Direction of Trends

- Consumption is projected to increase at the rate of 1.4 million barrels per day (US .2 & China .5)
- Non OPEC supply is projected to rise at a rate of .6 million barrels per day
- OPEC supply is projected to remain flat

Domestic US Trends

- Consumption is estimated to grow at the rate of 1.4 % to an average of 20.9 million barrels per day
- Crude oil production is estimated to increase at a rate of .6% to an average of 5.2 million barrels per day
- Inventories are projected to decrease by 8 million barrels to 205 million or below a 10 day supply based upon the past 5 year history

Direction of Prices

- Continued increases in the cost of crude RAC

2006	2007	2008
60.23	62.35	63.95

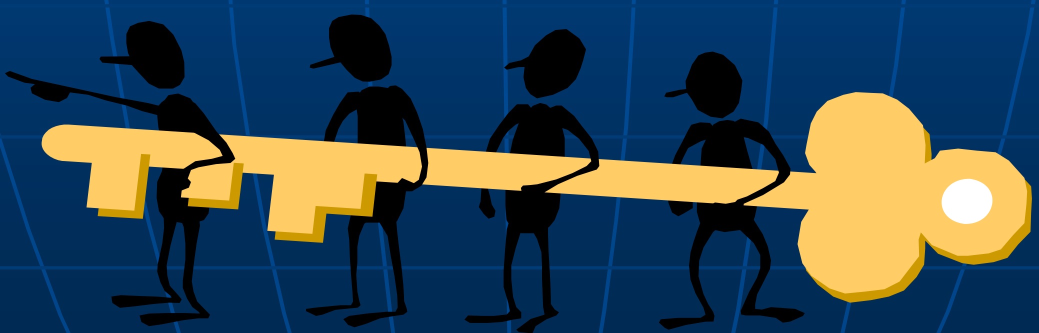
- Natural gas spot market prices will also increases on a cost mcf base

2006	2007	2008
6.93	7.91	8.39

Source: eia Energy Information Administration

Key Concepts

- Significant infrastructure investments are needed to the current petroleum network
- Strong competition for imported crude oil are anticipated from China and India
- The US's rising oil and gas consumption and needed infrastructure investments will continue price increases



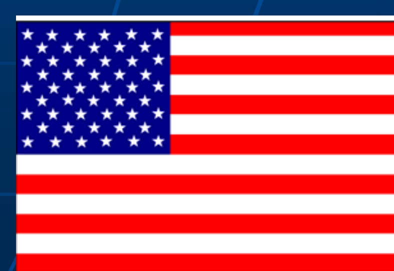
Conclusion

US vs. Brazil

- The US's petroleum networks infrastructure is more highly developed
- The US demand markets are more evenly distributed
- The US petroleum S&D system encourages product swaps, transfers and in transit sales
- The competitive petroleum transportation network is not dominated by any single player

Key Take Always

- The Transpetro network is marine and pipeline
- The US transportation network is heavily pipeline orientated
- The US network is dependent upon trades, transfers and exchanges
- US ethanol transportation is primarily rail and truck based



Questions

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