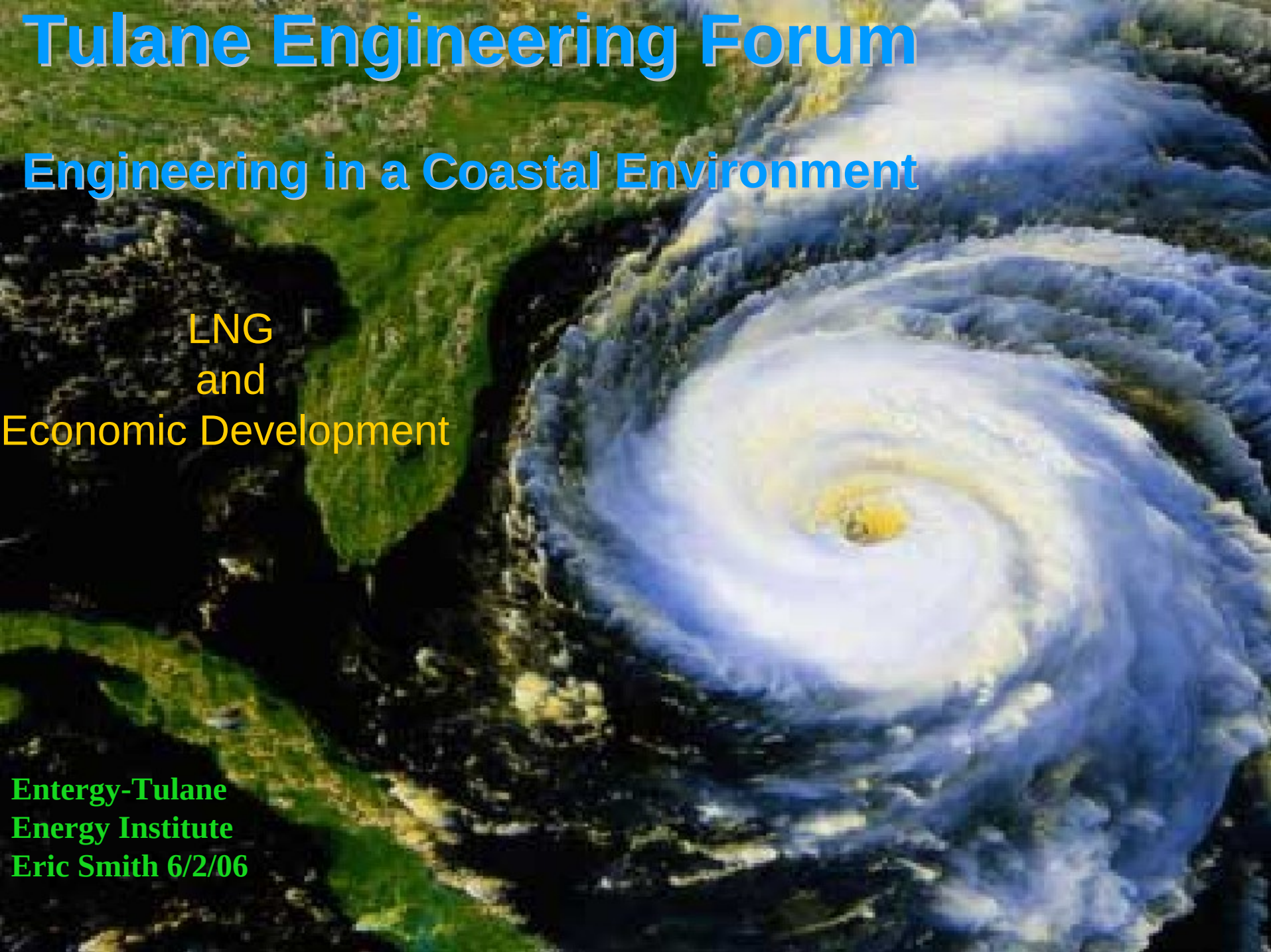
Tulane Engineering Forum

Engineering in a Coastal Environment

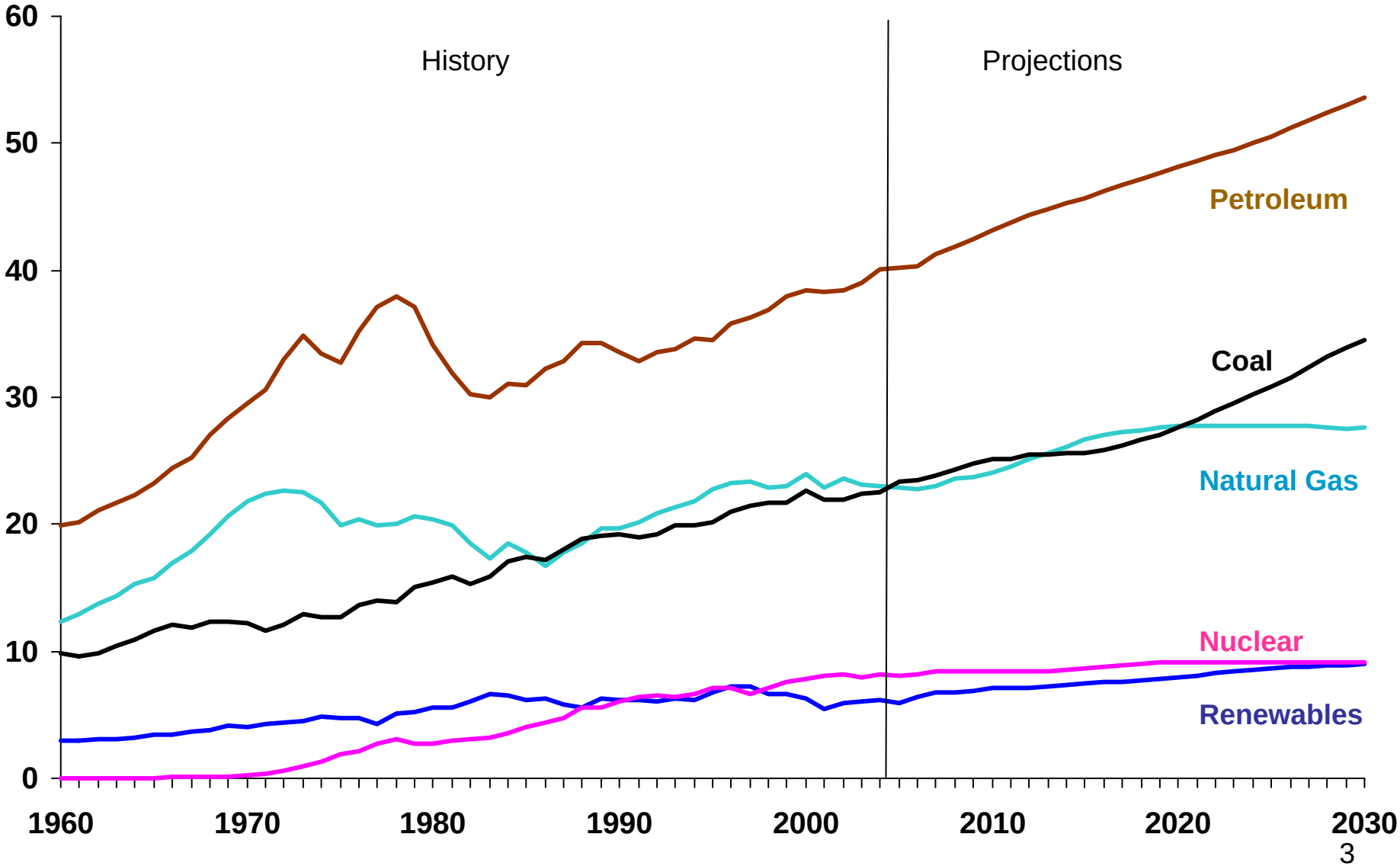
LNG
and
Economic Development



Entergy-Tulane
Energy Institute
Eric Smith 6/2/06

- U.S. Energy

U.S. Primary Energy Consumption by Fuel, 1960-2030 (quadrillion Btu)

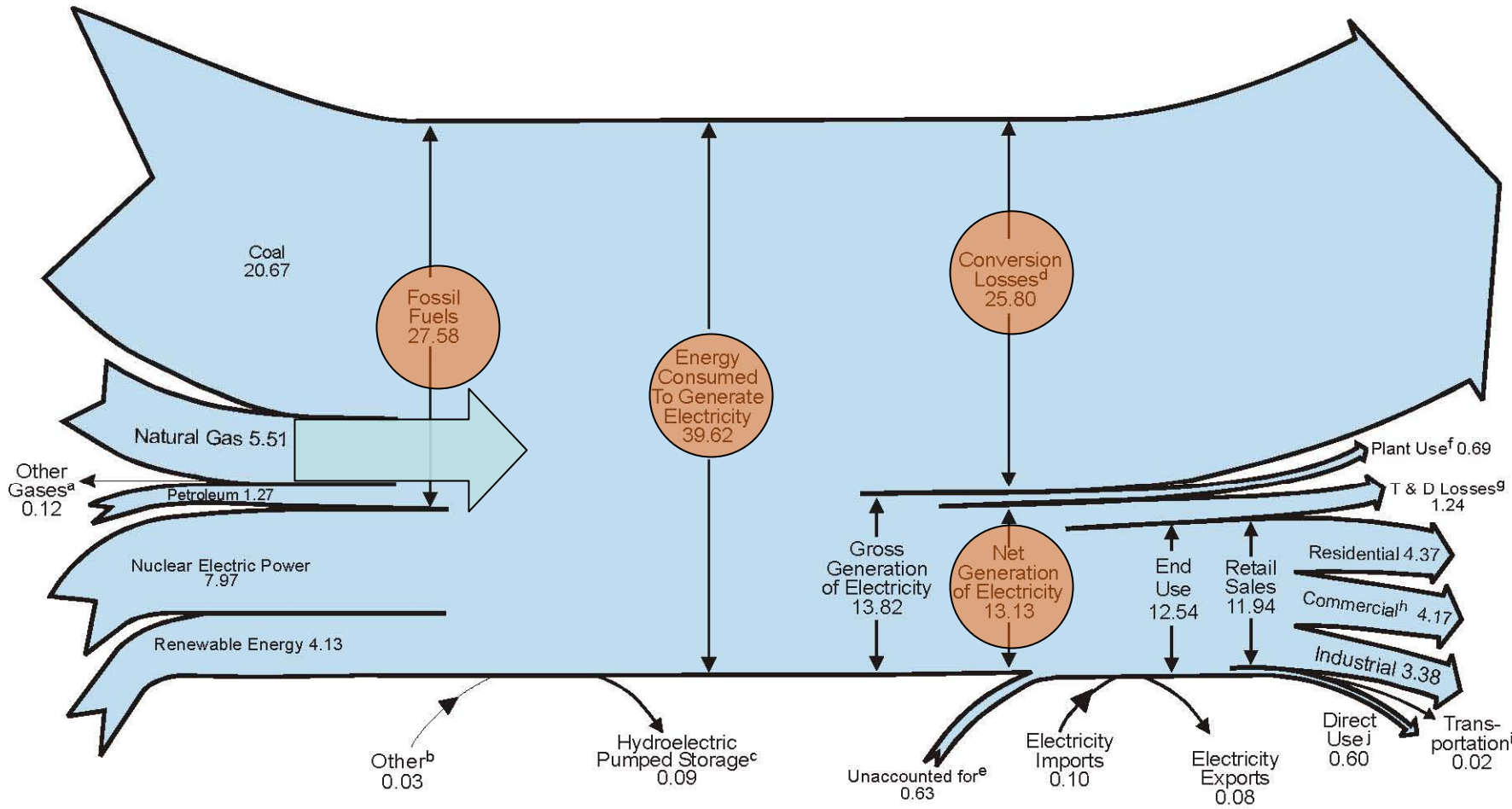


Annual Energy Outlook 2006

US Electric Power Demand drives US Gas Demand

When rationed, it will displace industrial consumption

Diagram 5. Electricity Flow, 2003
(Quadrillion Btu)



[a] Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

[b] Batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

[c] Pumped storage facility production minus energy used for pumping.

[d] Approximately two-thirds of all energy used to generate electricity. See note "Electrical System Energy Losses," at end of Section 2.

[e] Data collection frame differences and nonsampling error.

[f] Electric energy used in the operation of power plants, estimated as 5 percent of gross generation. See note "Electrical System Energy Losses," at end of Section 2.

[g] Transmission and distribution losses (electricity losses that occur between the point of generation and delivery to the customer) are estimated as 9 percent of gross generation. S note "Electrical System Energy Losses," at end of Section 2.

[h] Commercial retail sales plus approximately 95 percent of "Other" retail sales from Table

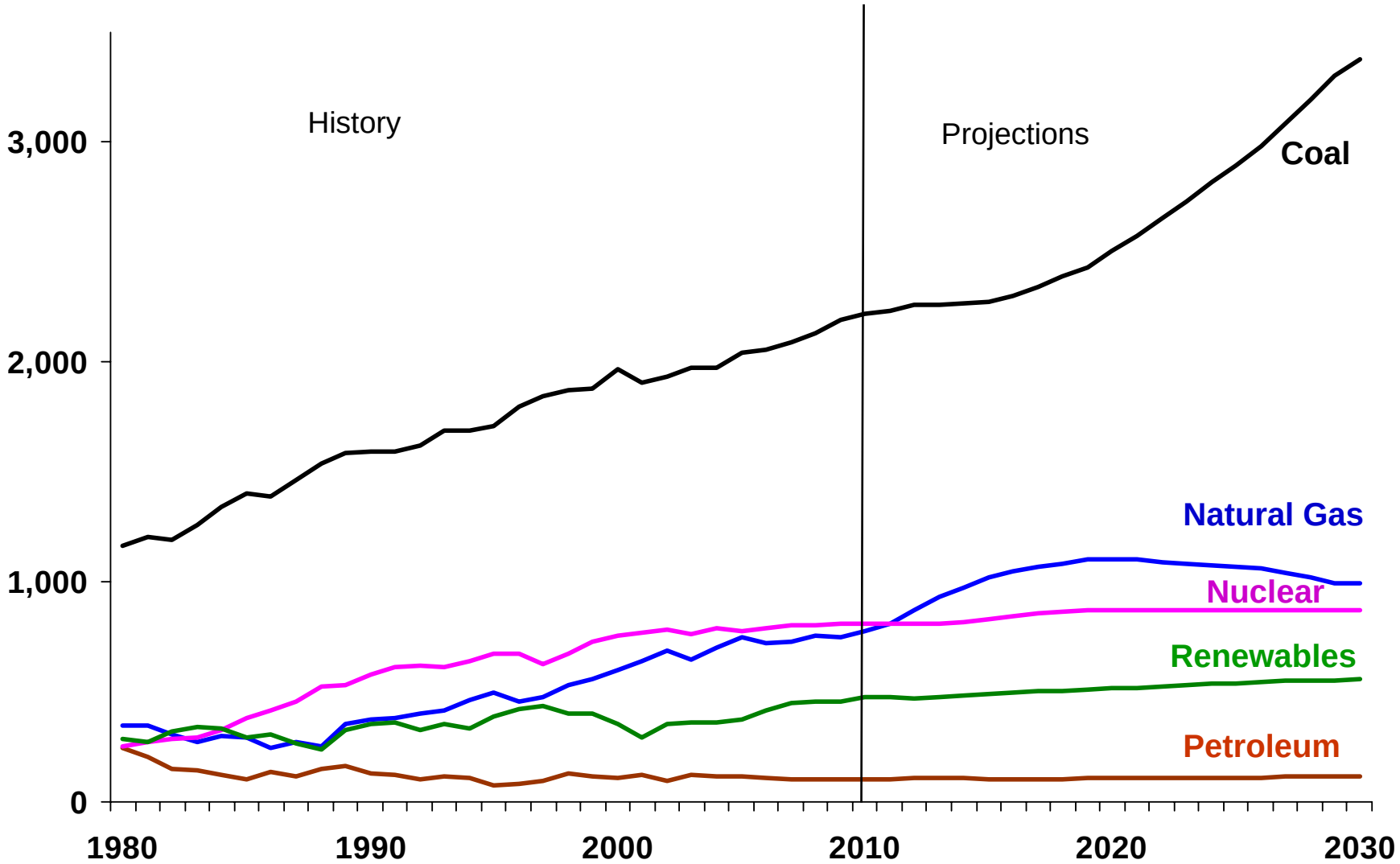
[i] Approximately 5 percent of "Other" retail sales from Table 8.9.

[j] Commercial and industrial facility use of onsite net electricity generation; and electricity among adjacent or co-located facilities for which revenue information is not available.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Tables 2.1b-2.1e, 8.1, 8.4a, and A6 (column 4).

U.S. Electricity Generation by Fuel, 1980-2030 (billion kilowatthours)



Annual Energy Outlook 2006

- U.S. Gas Profile

US Gas Supply and Disposition in 2004

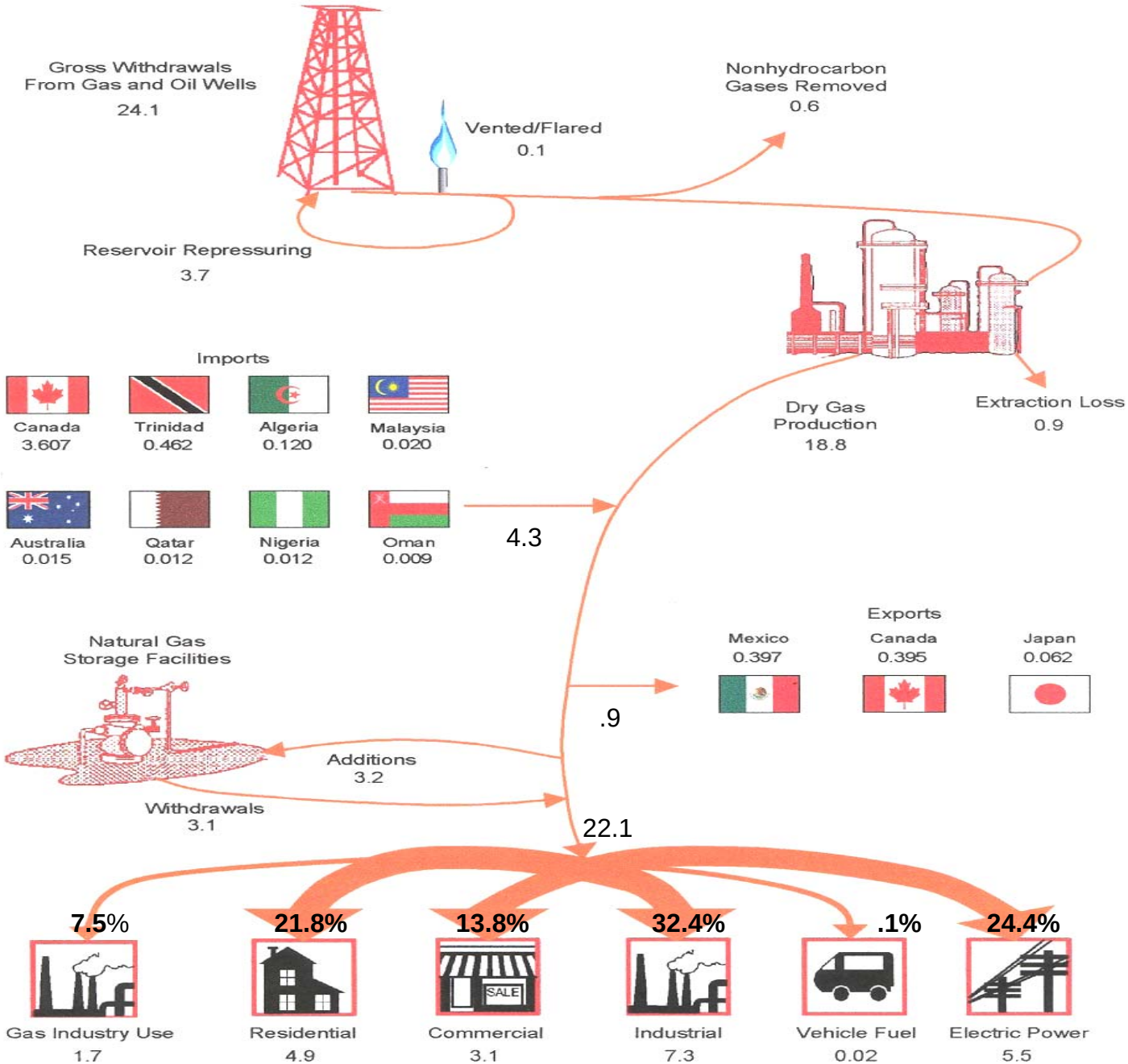
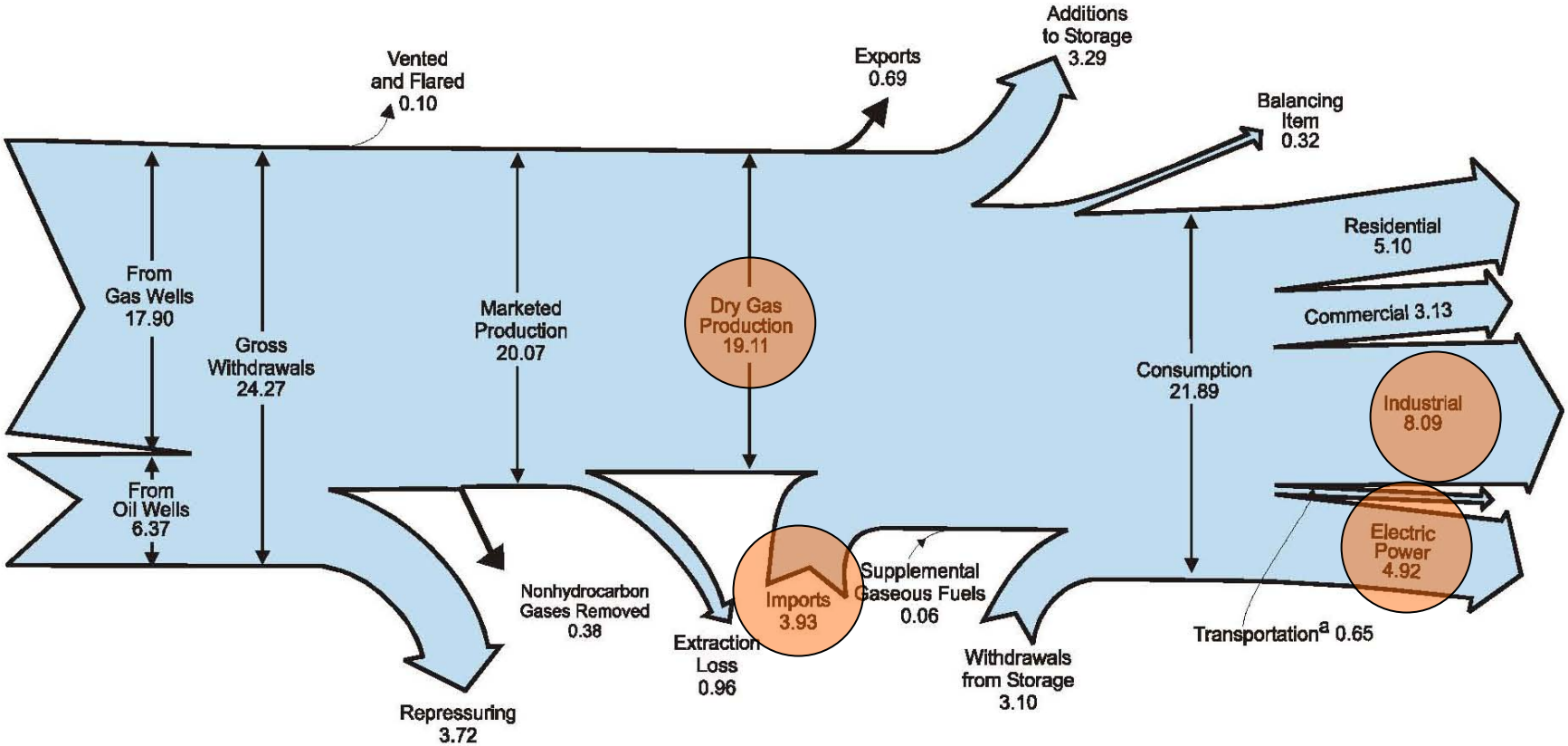


Diagram 3. Natural Gas Flow, 2003
(Trillion Cubic Feet)



[a] Natural gas consumed in the operation of pipelines, primarily in compressors, and a small quantity used as vehicle fuel.

Notes: • Data are preliminary. • Totals may not equal sum of components due to independent rounding.
Sources: Tables 6.1, 6.2, and 6.5.

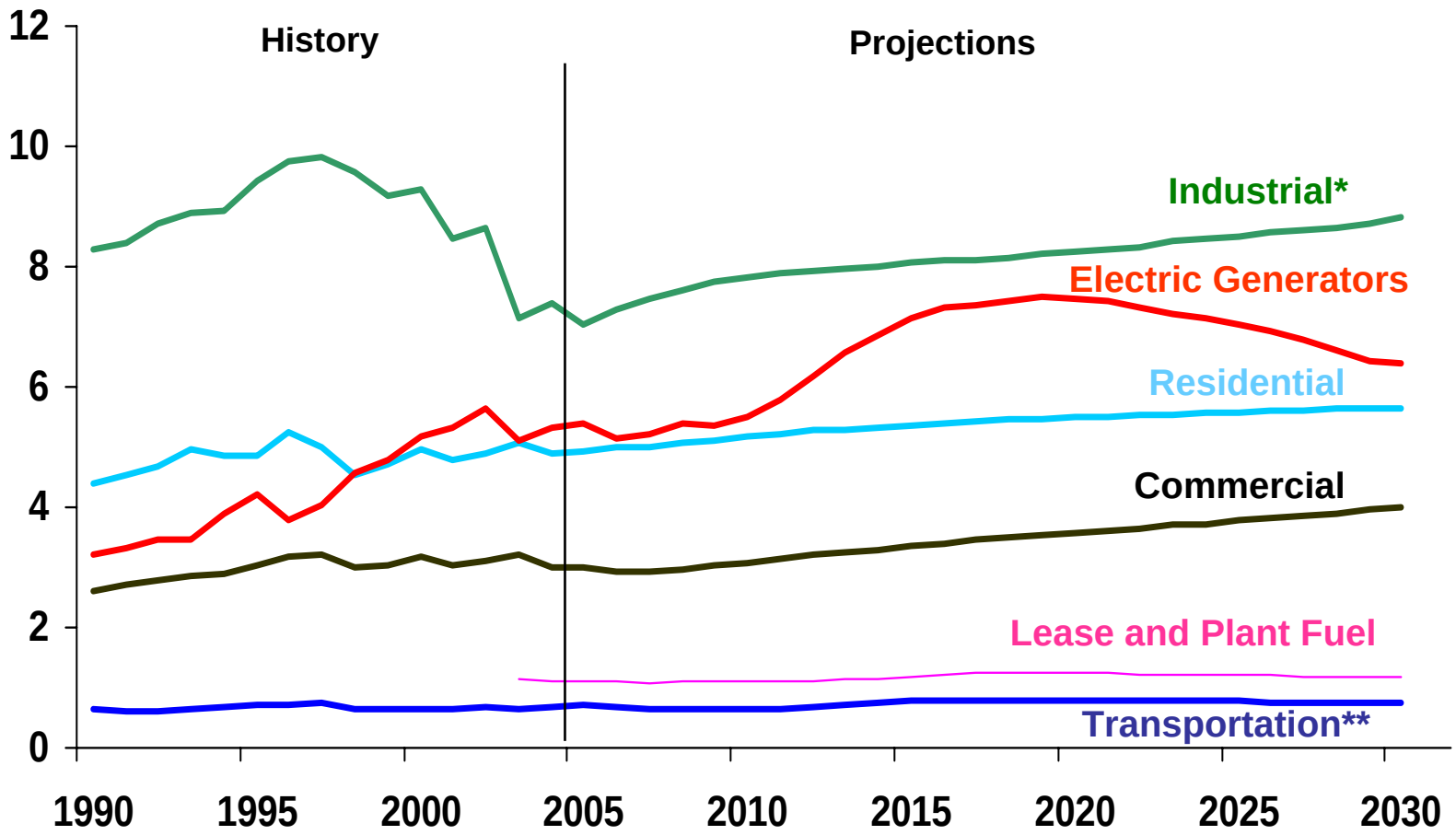
U.S. Natural Gas Demand

U.S. Natural Gas Consumption - Data Through February 2006 (Tcf)

	Residential	Commercial	Industrial	Electric	Other	Total	Avg. Daily Consumption (Bcf/day)
1995	4.85	3.03	8.58	3.20	1.92	21.58	59.1
1996	5.24	3.16	8.87	2.73	1.96	21.97	60.2
1997	4.98	3.21	8.51	4.07	1.96	22.74	62.3
1998	4.52	3.00	8.32	4.59	1.82	22.24	60.9
1999	4.73	3.05	8.08	4.82	1.74	22.41	61.4
2000	5.00	3.22	8.14	5.21	1.81	23.37	64.0
2001	4.77	3.02	7.35	5.34	1.76	22.24	60.9
2002	4.89	3.10	7.56	5.67	1.79	23.02	63.1
2003	5.08	3.21	7.14	5.14	1.80	22.36	61.3
2004	4.89	3.14	7.25	5.46	1.69	22.43	61.3
2005	4.84	3.06	6.65	5.80	1.65	21.99	60.2
2006							
January	0.71	0.41	0.57	0.31	0.15	2.14	69.1
February	0.70	0.40	0.55	0.30	0.14	2.08	74.3
2006 YTD	1.42	0.80	1.12	0.60	0.28	4.22	71.6
2005 YTD	1.65	0.89	1.24	0.71	0.31	4.80	81.3
2004 YTD	1.83	0.99	1.33	0.73	0.32	5.19	86.6
Change	-14.3%	-9.9%	-9.9%	-15.0%	-6.9%	-12.0%	-12.0%

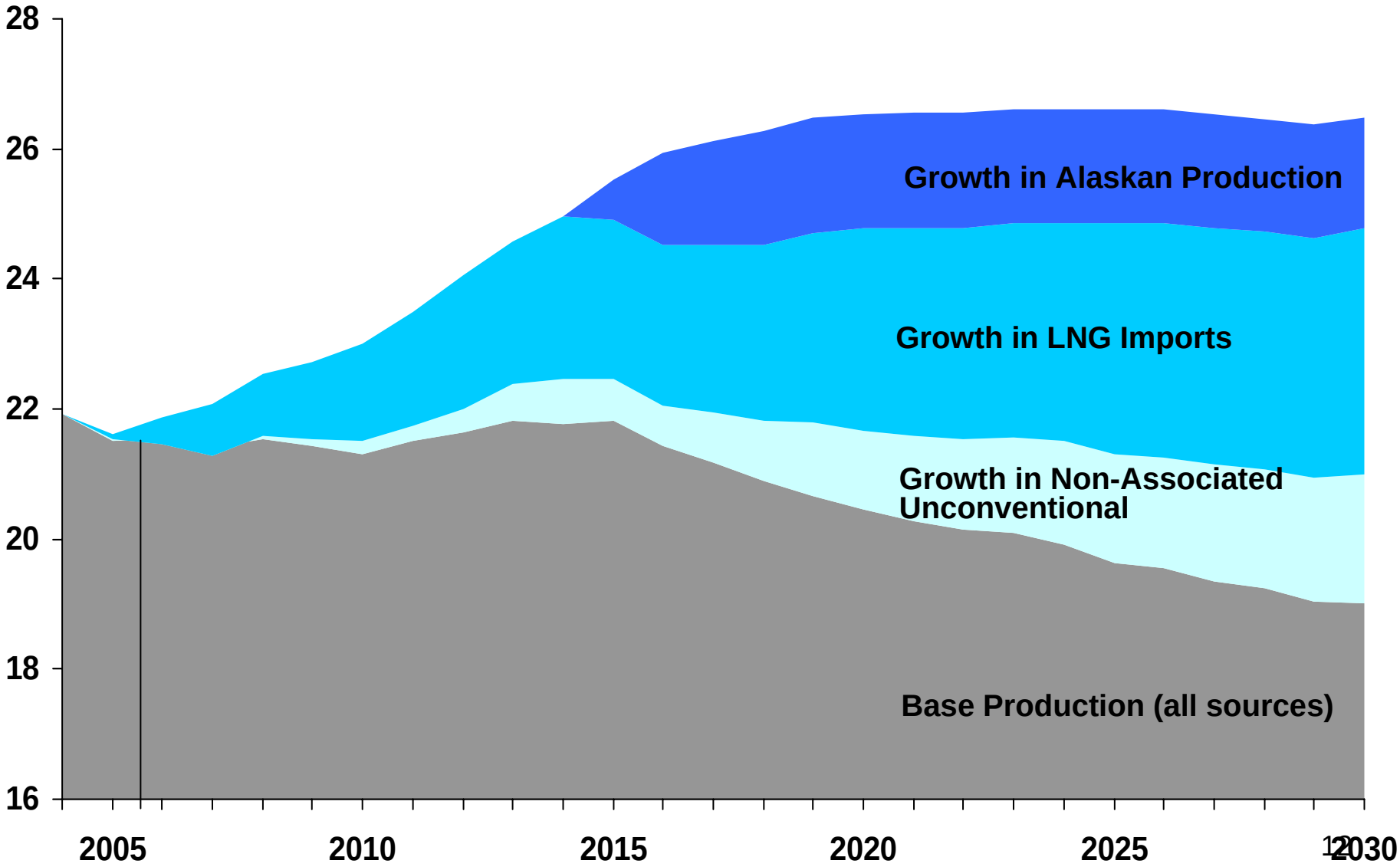
Source: DOE/EIA Via Howard Weil

U.S. Natural Gas Consumption by Sector, 1990-2030 (trillion cubic feet)



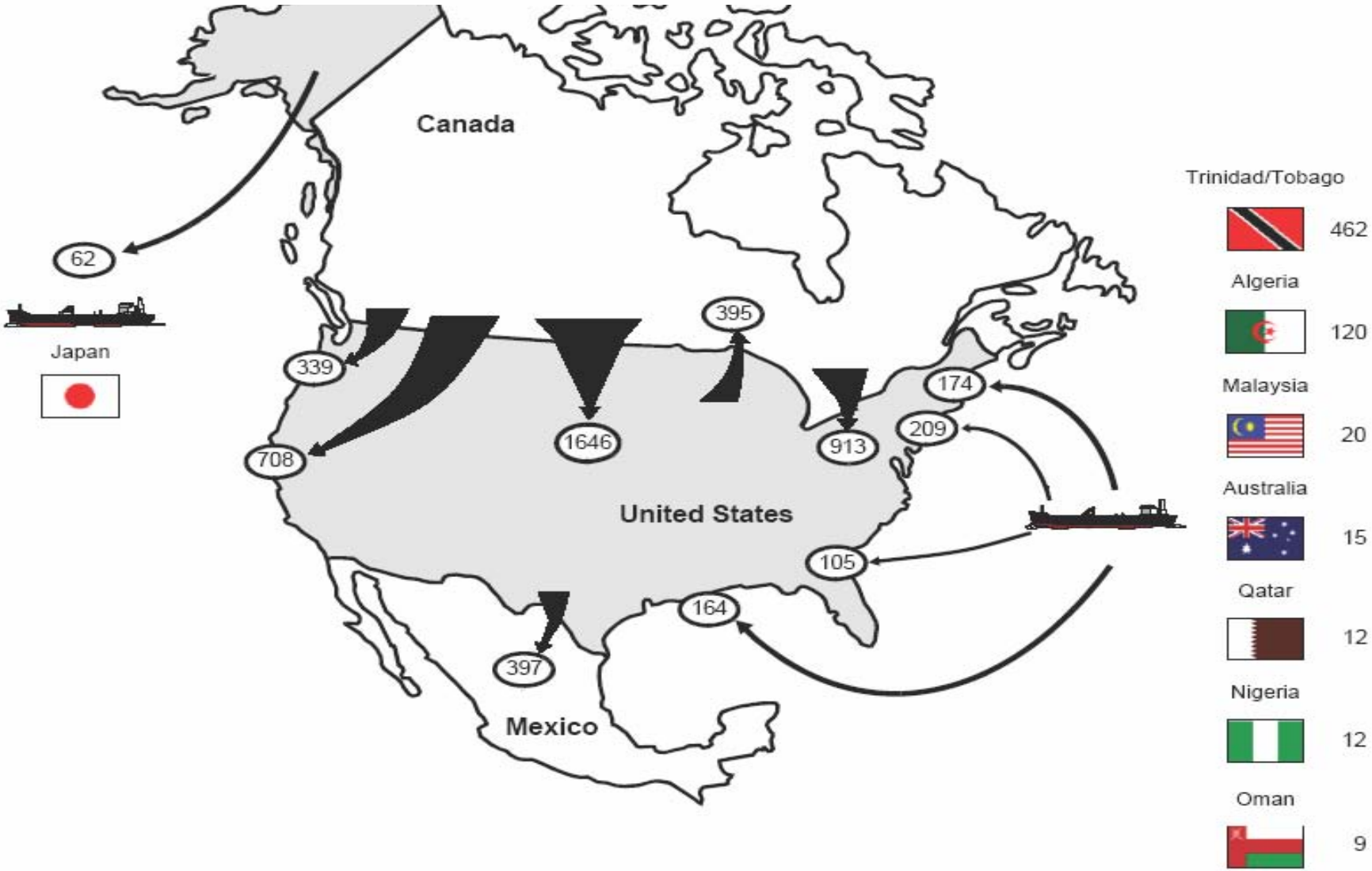
* Includes lease and plant fuel until 2002
** Includes pipeline fuel
Annual Energy Outlook 2006

Major Sources of U.S. Natural Gas Supply, 2004-2030 (trillion cubic feet)



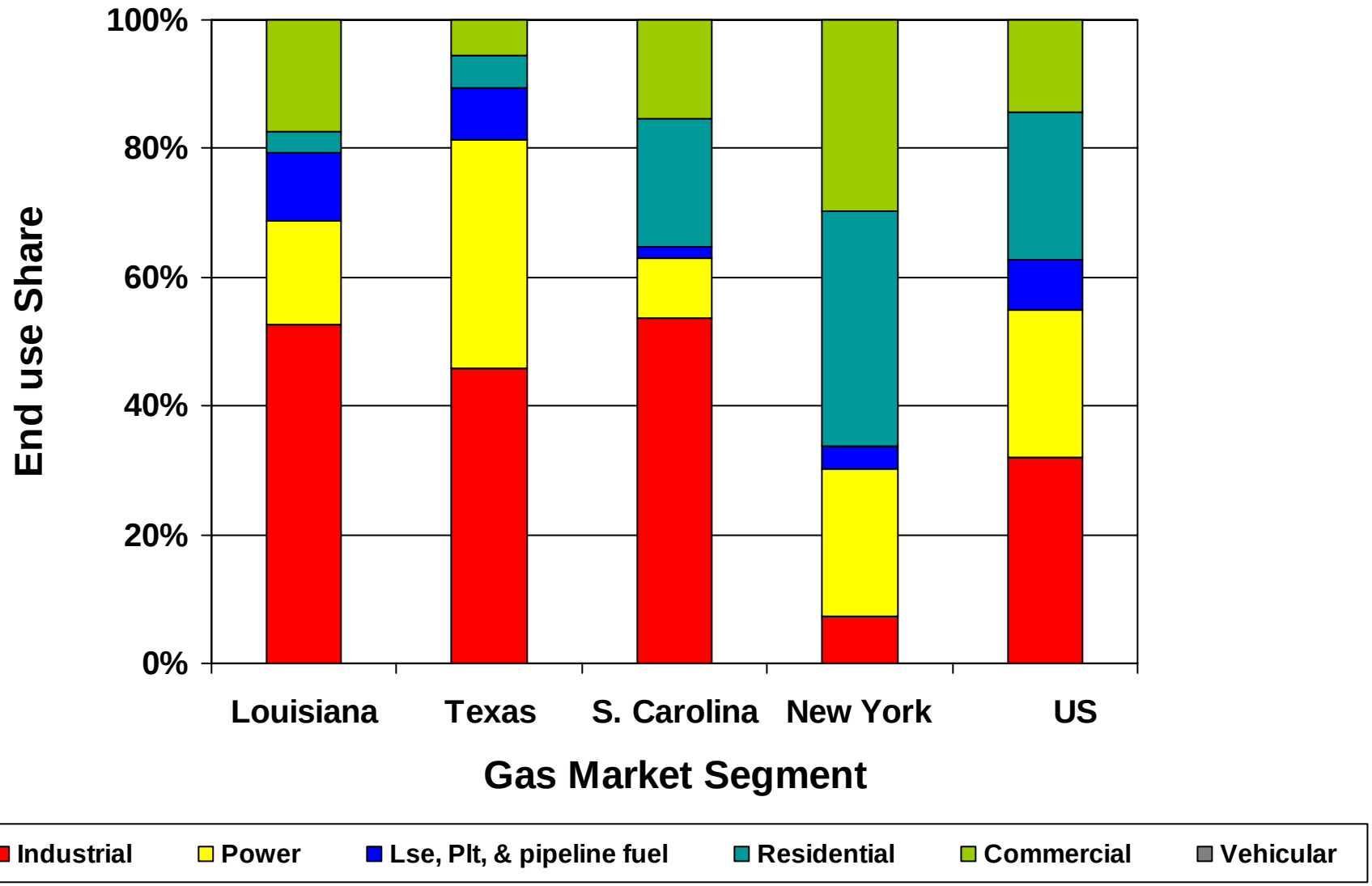
Annual Energy Outlook 2006

Flow of Natural Gas Imports and Exports, 2004
(Billion Cubic Feet)



Source: Energy Information Administration, based on data from the Office of Fossil Energy, U.S. Department of Energy, *Natural Gas Imports and Exports.*

Differences in State Consumption Profiles



EIA and ETEI

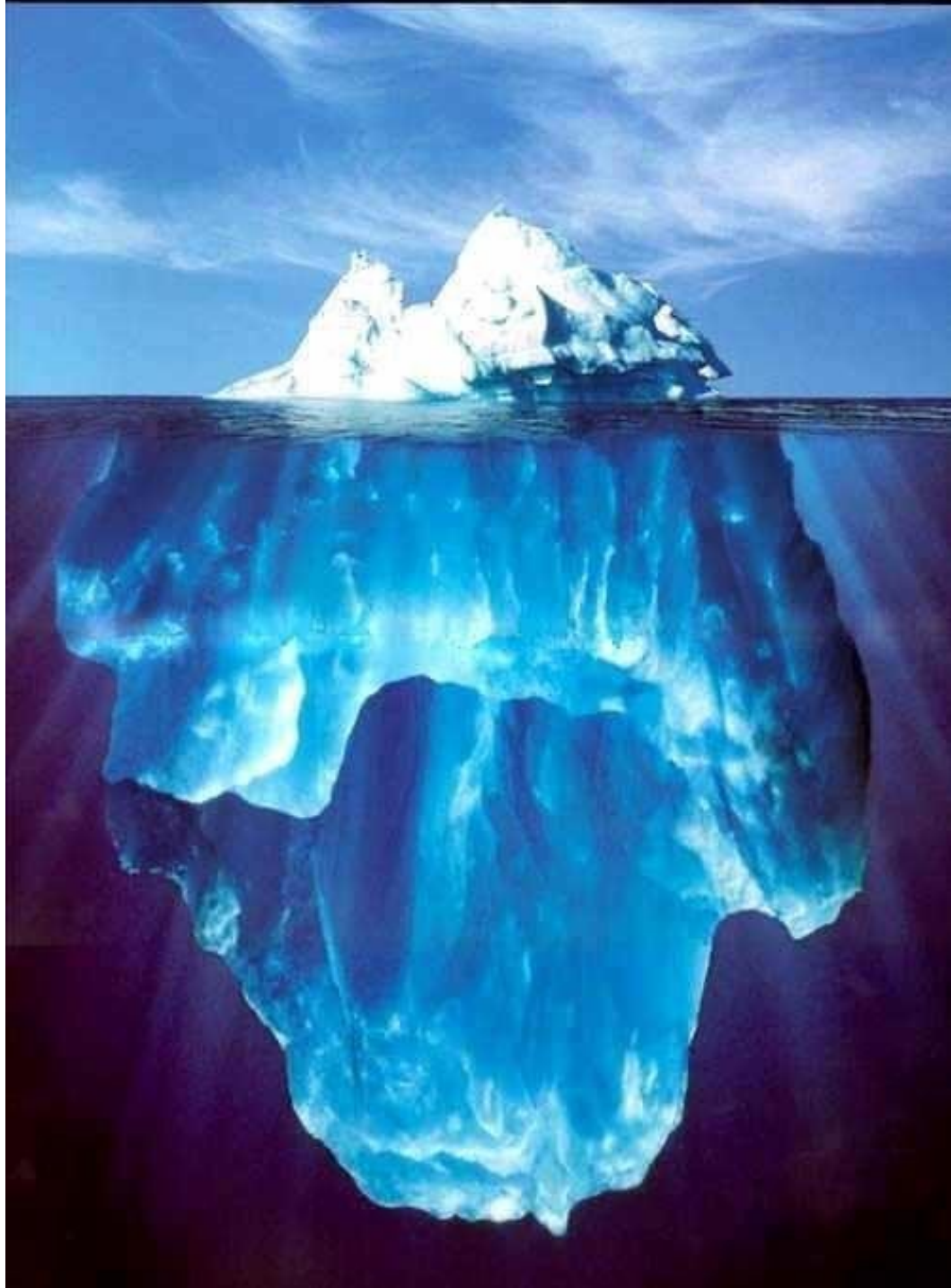
Louisiana — Natural Gas 2004

	Million Cu. Feet	Percent of National Total
Total Net Movements:	-89,452	—
Dry Production:	1,223,932	6.53
Deliveries to Consumers:		
Residential:	42,482	0.87
	3.75%	
Commercial:	24,671	0.79
	2.18%	

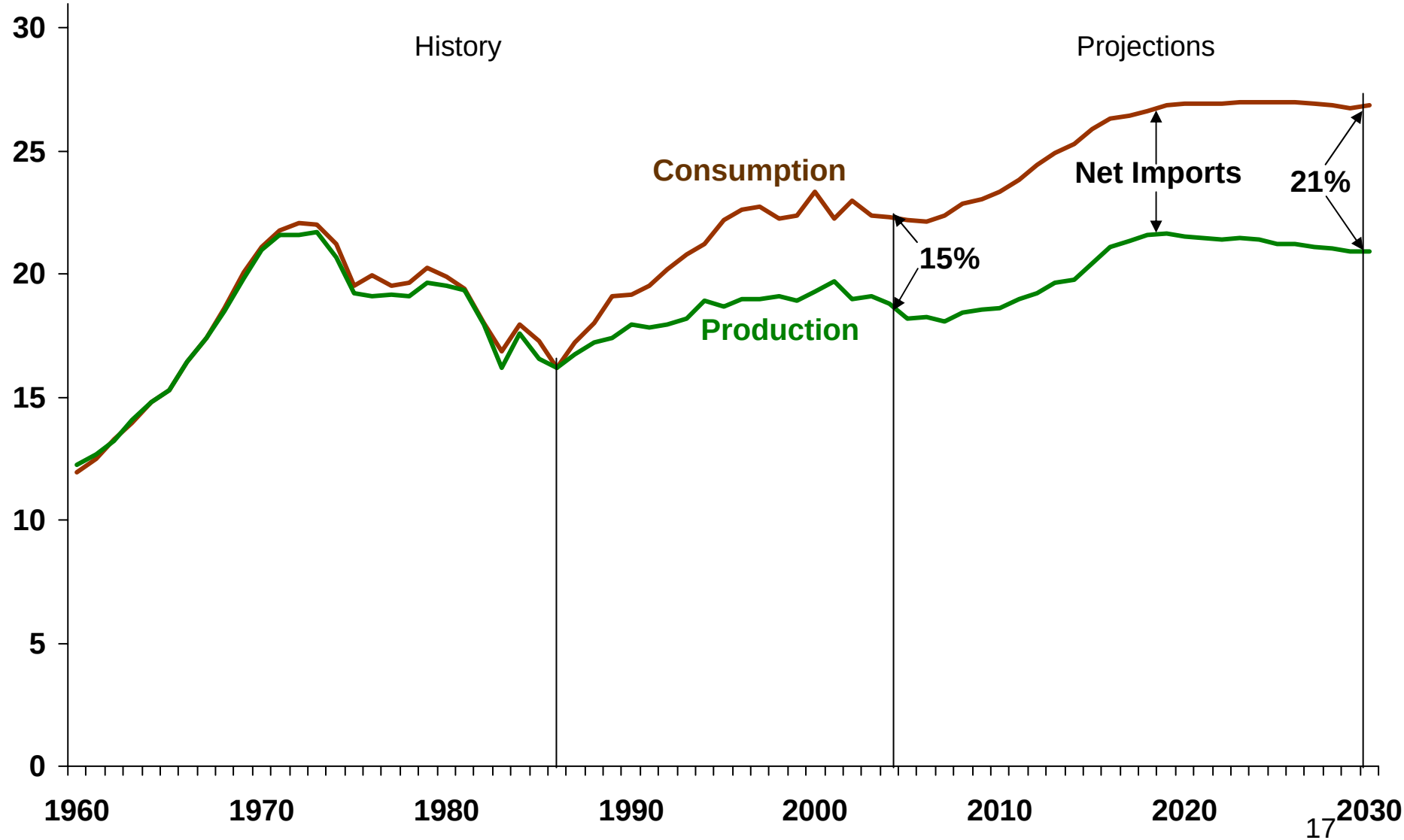
	Million Cu. Feet	Percent of National Total
Industrial:	819,248	11.30
	72.38%	
Vehicle Fuel:	133	0.65
Electric Power:	245,361	4.49
	21.68%	
Total Delivered:	1,131,895	5.45

EIA Natural Gas Annual 2004 pg 89

The Increasing Role of LNG Imports

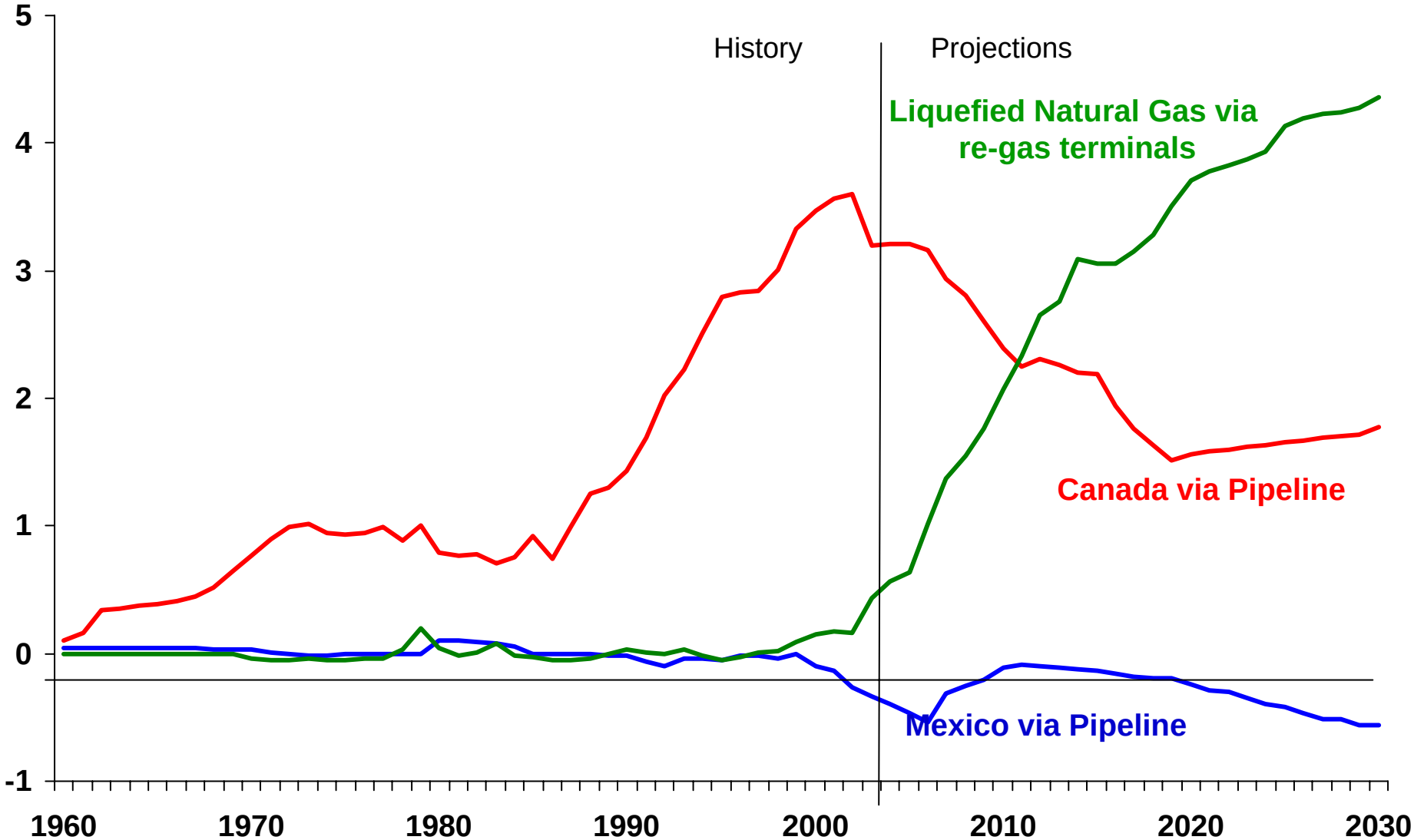


U.S. Natural Gas Production, Consumption, and Net Imports, 1960-2030 (trillion cubic feet)



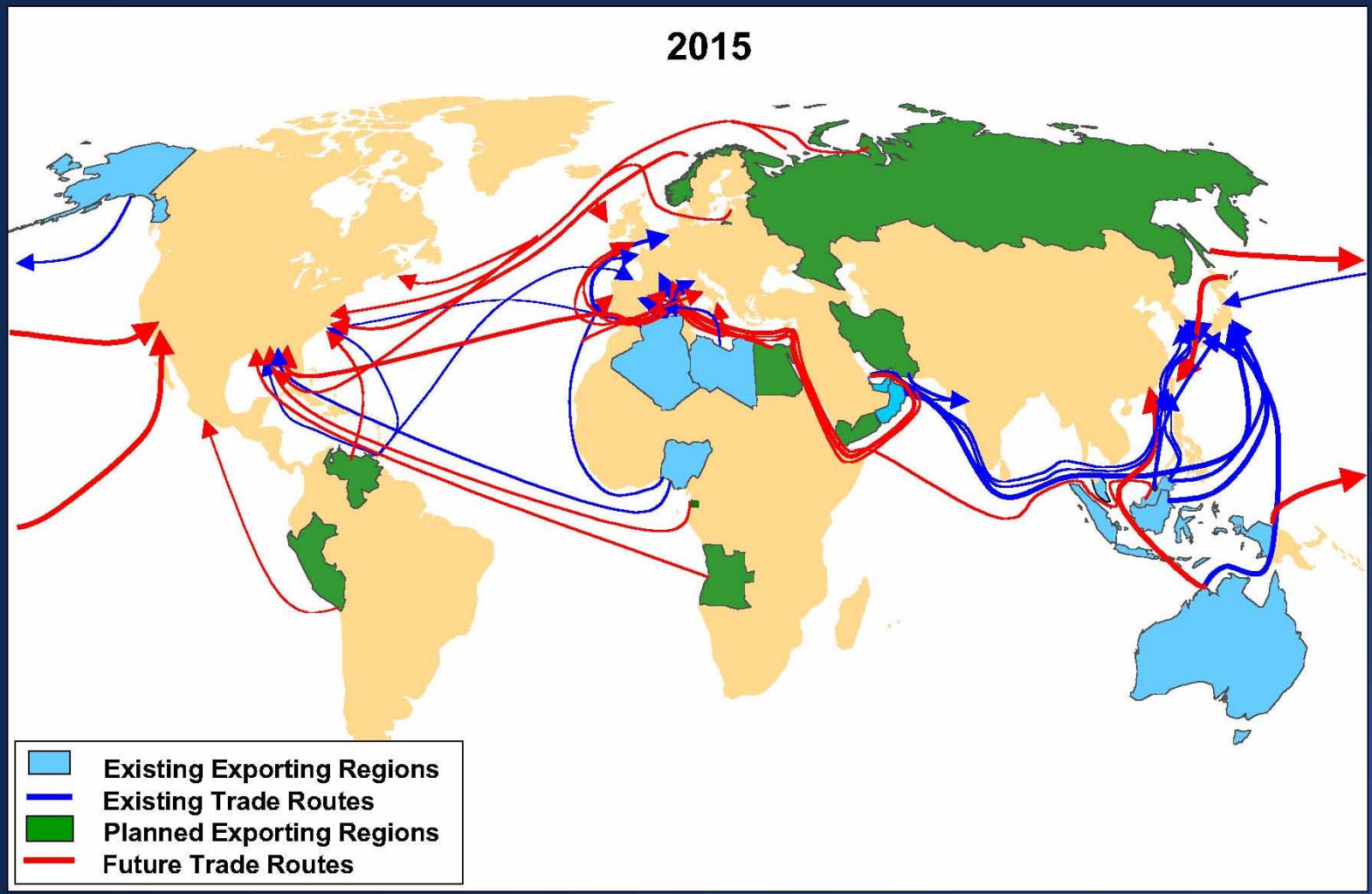
Annual Energy Outlook 2005 and 2006

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



Annual Energy Outlook 2006

Projected World LNG Trade

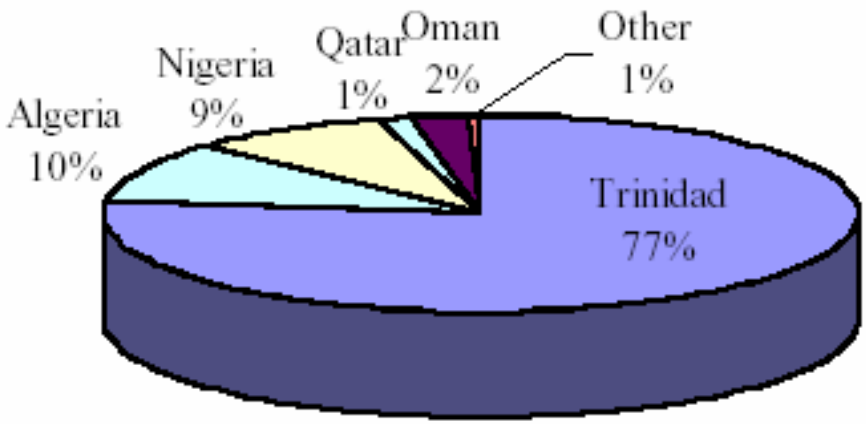


Pace Global Energy Services

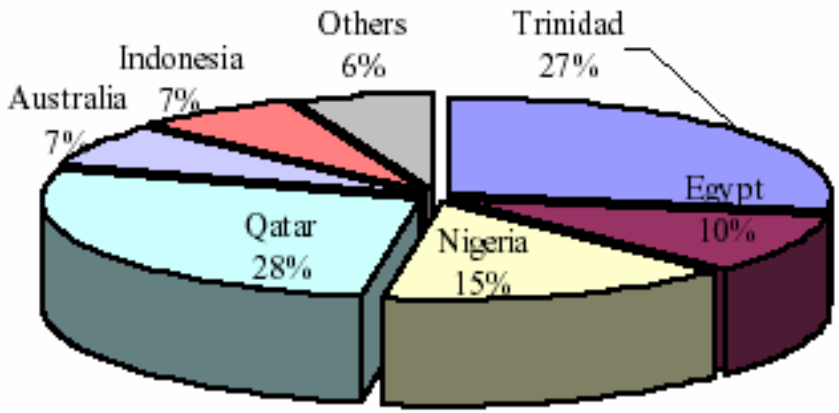
…with a diversified group of suppliers likely to target the U.S. market…

SUPPLIERS OF U.S. LNG IMPORTS

2003



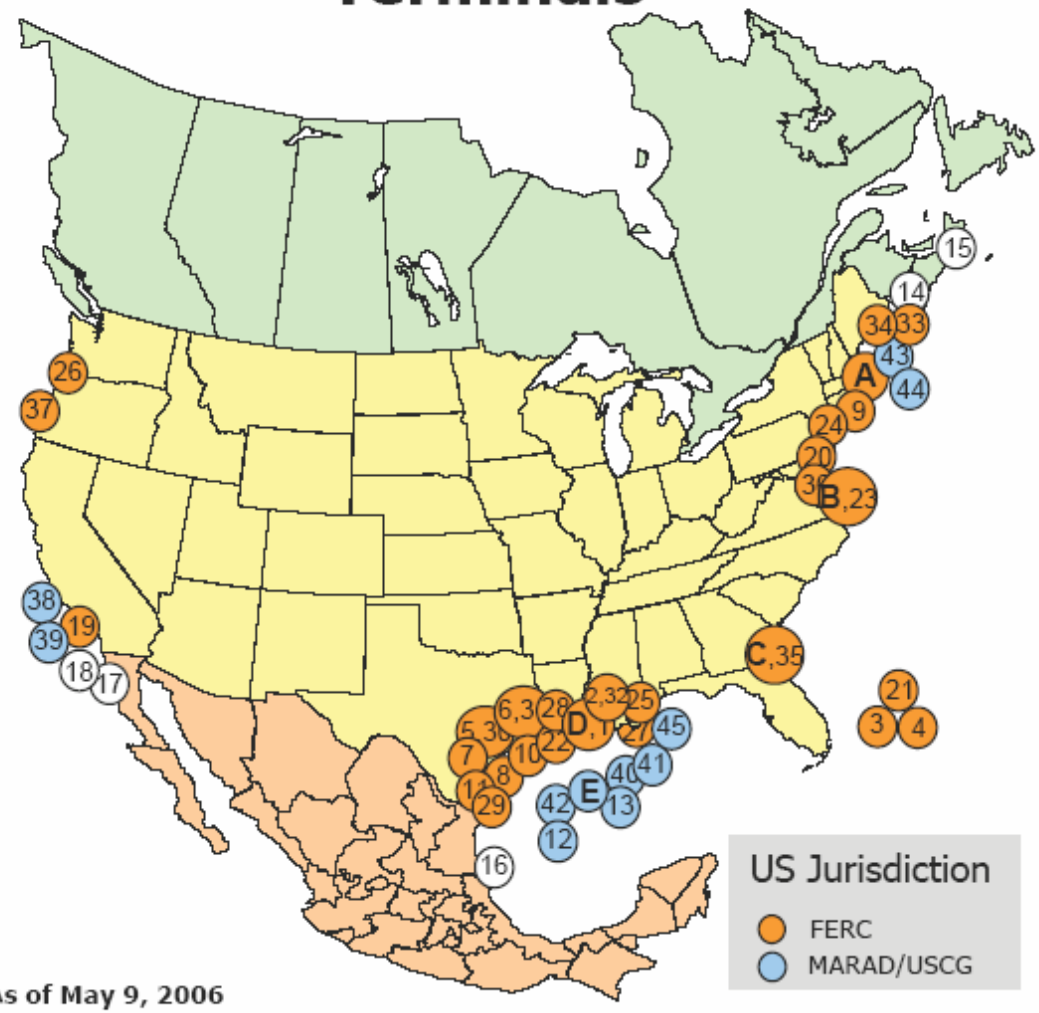
2010E



Source: Department of Energy and Banc of America Securities LLC

FERC

Existing and Proposed North American LNG Terminals



As of May 9, 2006

* *US pipeline approved; LNG terminal pending in Bahamas*

Office of Energy Projects

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 : 1.5 Bcfd (Southern Union - Trunkline LNG)
E. Gulf of Mexico: 0.5 Bcfd (Gulf Gateway Energy Bridge - Excelerate Energy)

APPROVED BY FERC
1. Lake Charles, LA: 0.6 Bcfd (Southern Union - Trunkline LNG)
2. Hackberry, LA : 1.5 Bcfd (Cameron LNG - Sempra Energy)
3. Bahamas : 0.84 Bcfd (AES Ocean Express)*
4. Bahamas : 0.83 Bcfd (Calypso Tractebel)*
5. Freeport, TX : 1.5 Bcfd (Cheniere/Freeport LNG Dev.)
6. Sabine, LA : 2.6 Bcfd (Cheniere LNG)
7. Corpus Christi, TX: 2.6 Bcfd (Cheniere LNG)
8. Corpus Christi, TX : 1.0 Bcfd (Vista Del Sol - ExxonMobil)
9. Fall River, MA : 0.8 Bcfd (Weaver's Cove Energy/Hess LNG)
10. Sabine, TX : 1.0 Bcfd (Golden Pass - ExxonMobil)
11. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)

APPROVED BY MARAD/COAST GUARD
12. Port Pelican: 1.6 Bcfd (Chevron Texaco)
13. Louisiana Offshore : 1.0 Bcfd (Gulf Landing - Shell)

CANADIAN APPROVED TERMINALS
14. St. John, NB : 1.0 Bcfd (Canaport - Irving Oil)
15. Point Tupper, NS 1.0 Bcf/d (Bear Head LNG - Anadarko)

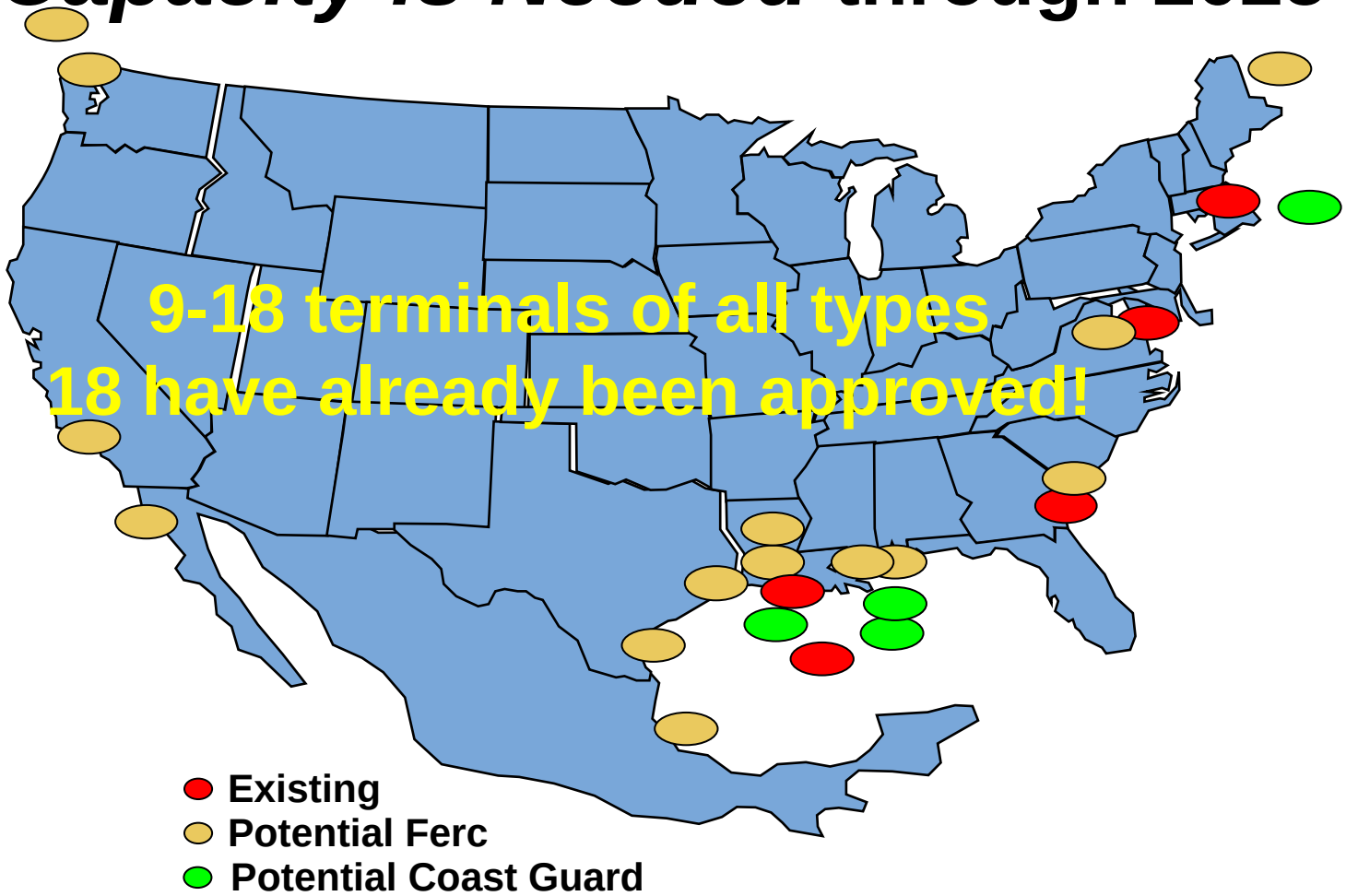
MEXICAN APPROVED TERMINALS
16. Altamira, Tamulipas : 0.7 Bcfd (Shell/Total/Mitsui)
17. Baja California, MX : 1.0 Bcfd (Energy Costa Azul - Sempra)
18. Baja California - Offshore : 1.4 Bcfd (Chevron Texaco)

PROPOSED TO FERC
19. Long Beach, CA : 0.7 Bcfd, (Mitsubishi/ConocoPhillips - Sound Energy Solutions)
20. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG - BP)
21. Bahamas : 0.5 Bcfd, (Seafarer - El Paso/FPL)
22. Port Arthur, TX: 1.5 Bcfd (Sempra)
23. Cove Point, MD : 0.8 Bcfd (Dominion)
24. LI Sound, NY: 1.0 Bcfd (Broadwater Energy - TransCanada/Shell)
25. Pascagoula, MS: 1.0 Bcfd (Gulf LNG Energy LLC)
26. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
27. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - ChevronTexaco)
28. Cameron, LA: 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
29. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
30. Freeport, TX: 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)
31. Sabine, LA: 1.4 Bcfd (Cheniere LNG - Expansion)
32. Hackberry, LA : 1.15 Bcfd (Cameron LNG - Sempra Energy - Expansion)
33. Pleasant Point, ME : 0.5 Bcfd (Quoddy Bay, LLC)
34. Robbinston, ME: 0.5 Bcfd (Downeast LNG - Kestrel Energy)
35. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG)
36. Baltimore, MD: 1.5 Bcfd (AES Sparrows Point – AES Corp.)
37. Coos Bay, OR: 1.0 Bcfd (Jordan Cove Energy Project)

PROPOSED TO MARAD/COAST GUARD
38. California Offshore: 1.5 Bcfd (Cabrillo Port - BHP Billiton)
39. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
40. Louisiana Offshore : 1.0 Bcfd (Main Pass McMoRan Exp.)
41. Gulf of Mexico: 1.0 Bcfd (Compass Port - ConocoPhillips)
42. Gulf of Mexico: 1.5 Bcfd (Beacon Port Clean Energy Terminal - ConocoPhillips)
43. Offshore Boston, MA: 0.4 Bcfd (Neptune LNG - Tractebel)
44. Offshore Boston, MA: 0.8 Bcfd (Northeast Gateway - Excelerate Energy)
45. Gulf of Mexico: 1.4 Bcfd (Bienville Offshore Energy Terminal - TORP)

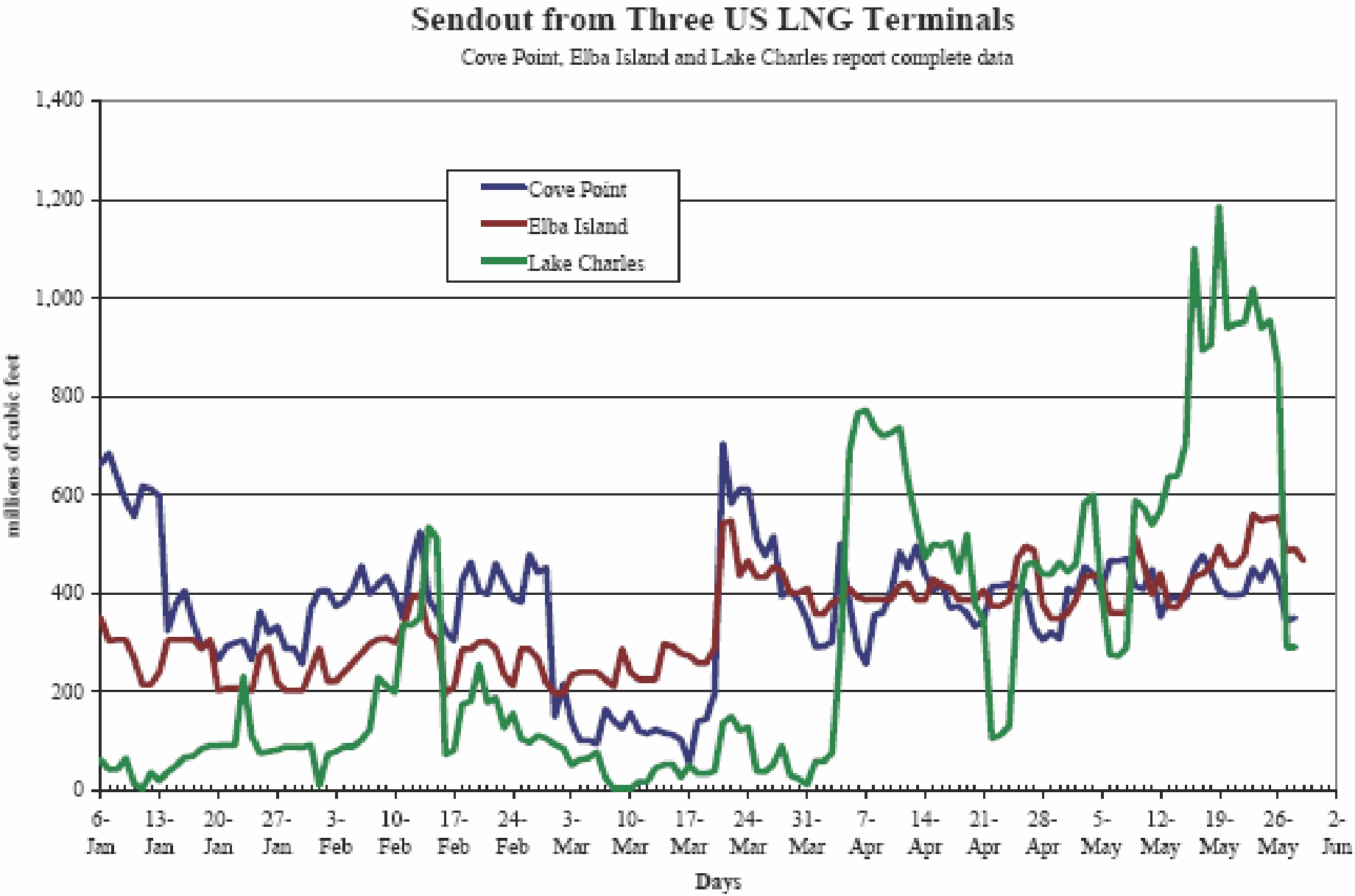
69 terminals have been proposed,
52 in the US, 8 in Canada and 9 in Mexico

Only 18 *bcf/day of new NA LNG Terminal Capacity is Needed* through 2025



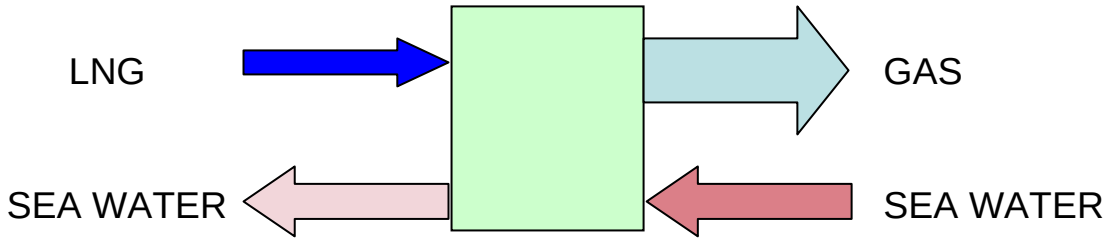
LNG Import Profile for 2004 and 2005

			2004	2005		
Distrigas Corp.	Suez	Belgium	**173.8**	**168.5**	Trinidad & Tobago	Everett
BP Energy Company	BP	UK	**80**	**81.5**	T & T, Nigeria	Cove Point
Statoil Nat. Gas, LLC	Statoil	Norway	**66**	**62.3**	T & T, Algeria	Cove Point
Shell NA LNG, LLC	Shell	Netherlands	**63.3**	**77.8**	Trinidad & Tobago	Cove Point
			209.3			
BG LNG Services, Inc.	British Gas	UK	**105.2**	**132.1**	T & T, Egypt	Elba Island
BG LNG Services, Inc.	British Gas	UK	**163.7**	**103.8**	T & T, Oman	Lake Charles
					Nigeria, Algeria	
					Malaysia, Qatar, Egypt	
Excelerate Energy		USA	**0**	**5.2**	Malaysia, Nigeria	Energy Bridge
			652.0	**631.3**		

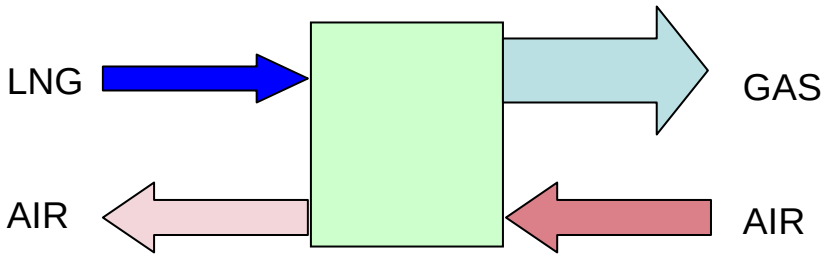

Sendout from Three US LNG Terminals
Cove Point, Elba Island and Lake Charles report complete data
millions of cubic feet
1,400
1,200
1,000
800
600
400
200
0
Cove Point
Elba Island
Lake Charles
6-Jan
13-Jan
20-Jan
27-Jan
3-Feb
10-Feb
17-Feb
24-Feb
3-Mar
10-Mar
17-Mar
24-Mar
31-Mar
7-Apr
14-Apr
21-Apr
28-Apr
5-May
12-May
19-May
26-May
2-Jun
Days

LNG Vaporizers

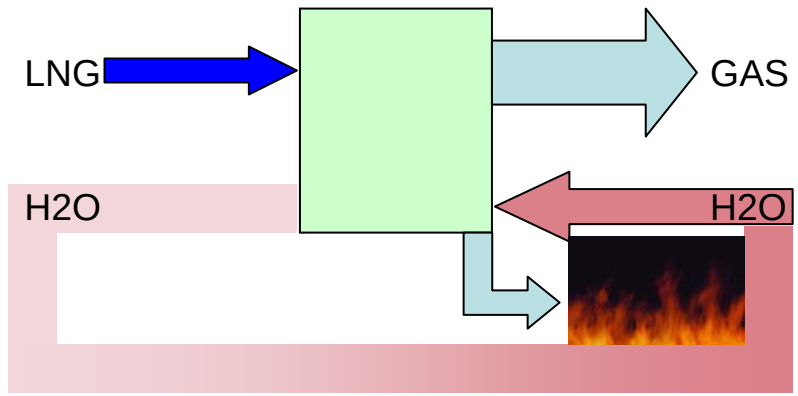
- Open Rack
  (80% of installations)



- Ambient Air



- Submerged Combustion
  aka Closed Loop
  (20% of installations)



Caveat!

Growth in international Liquefaction, not terminal capacity, will limit availability of LNG US imports

LNG Value Chain

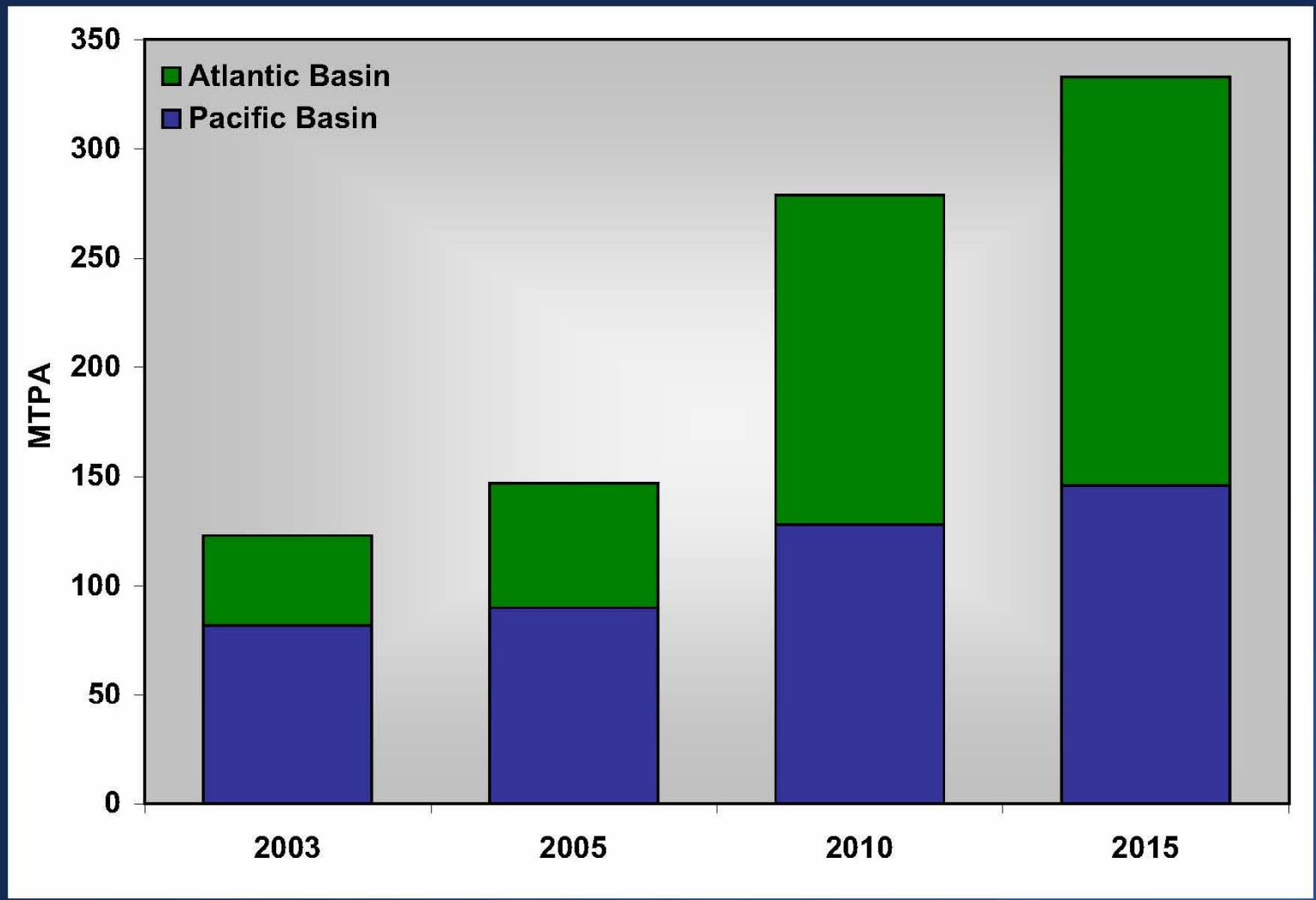
92%

8%

TOTAL	EXPLORATION & PRODUCTION	LIQUEFACTION	SHIPPING*	RE-GASIFICATION	
	Reserves: 9 Tcf Scope: $0.05B Initial drilling: $0.05B Development: $1.4B	Trains required: 2 Cost per train: $1.0B	Distance: 12,000 nm Rd. Trip Time: 30 days Ships Required: 12 Cost per ship: $0.17B	Port: $0.09B Storage: $0.16B Vaporization: .19B Engineering & Other: .06B	
$6.0 B	$1.5 B	$2.0 B	$2.0 B	$0.5 B	1 Bcf/d Scenario
$2.50 - 3.50	$.50 - 1.00	$.80 - 1.00	$.90 - 1.10	$.30 - .40	Per Unit $/Mcf
100%	25%	33%	33%	8%	% of Total

*Shipping: West Africa to U.S. Gulf Coast

Global Demand for LNG



Pace Global Energy Services

Liquefaction Capacity Additions in trillion cubic feet/year

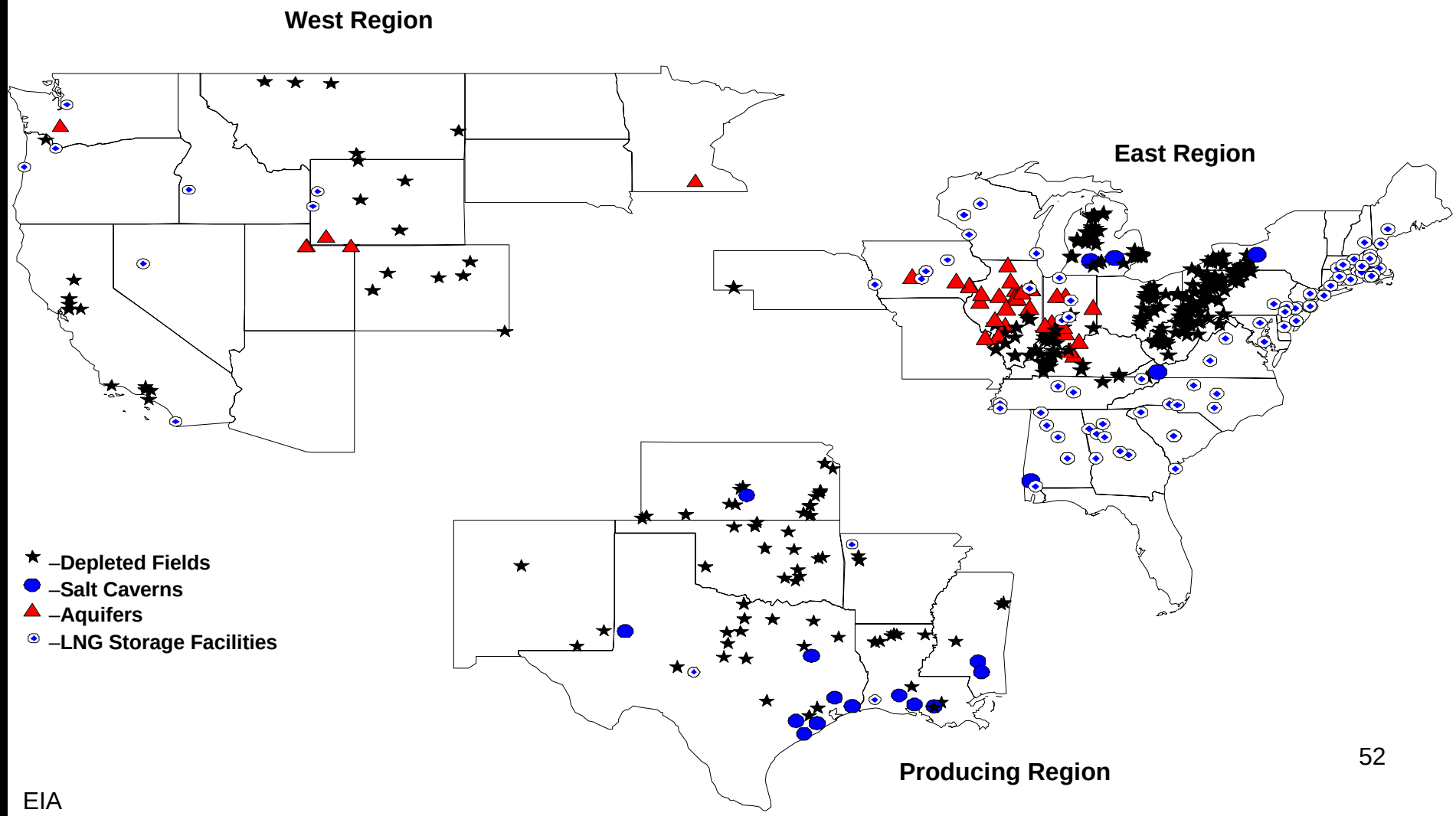
Atlantic Basin	Percent	2004	2005	2006	2007	2008	2009	2010	2011	2011*	Percent
Algeria	17.0%	1.3						0.3		1.6	8.4%
Egypt			***0.3***	***0.1***	***0.2***					***0.6***	***3.5%***
Nigeria	7.4%	0.6		0.4	0.2		0.5	0.8		2.4	12.9%
Equitorial Guinea						***0.2***				***0.2***	***0.9%***
Angola	1.6%	0.1								0.1	0.6%
Norway					***0.2***					***0.2***	***1.1%***
Russia-Shtockman								***0.2***	***1.3***	***1.5***	***7.9%***
Trinidad	6.5%	0.5		0.3						0.8	4.1%
Venezuela							***0.2***			***0.2***	***1.3%***
Total Atlantic	32.4%	2.5	0.3	0.8	0.6	0.2	0.8	1.2	1.3	7.6	40.7%
Regional Cum.		2.5	2.8	3.5	4.1	4.3	5.1	6.3	7.6	208%	
Country Count		4	5	5	6	7	8	9	9	125%	
Worldwide total	100%	7.6	0.3	1.3	1.0	1.1	2.8	2.4	2.0	18.6	100%
Cumulative		7.6	7.9	9.1	10.1	11.3	14.1	16.5	18.6	145%	
Country Count		12	13	13	14	16	19	21	21	75%	

Source Pan Eurasian Research

- The Need for new High Deliverability Gas Storage

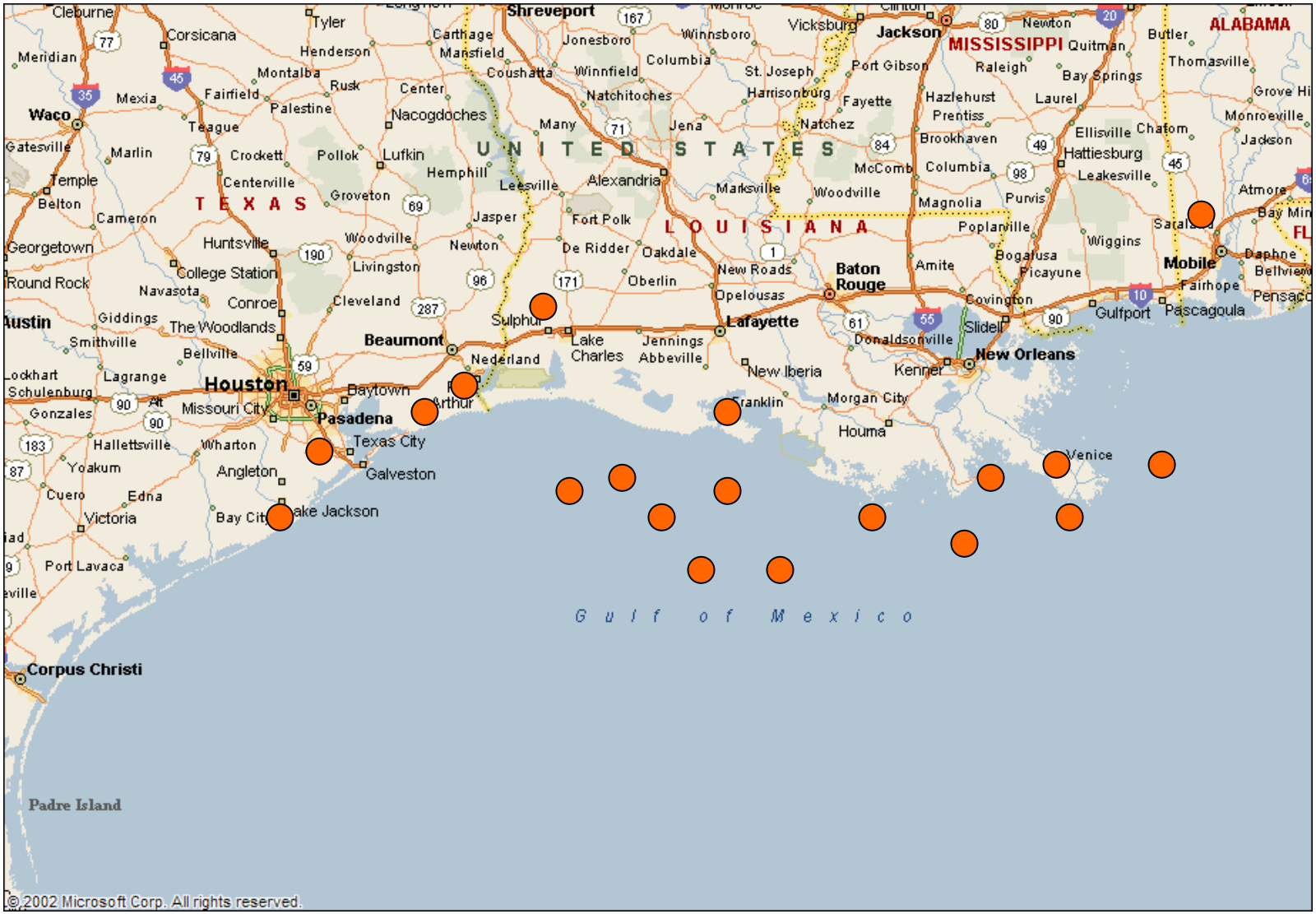
- The US Gulf Coast holds a trump card.

Natural Gas Storage in the Lower 48 States is predominantly in the North East and is mostly depleted reservoir storage



EIA

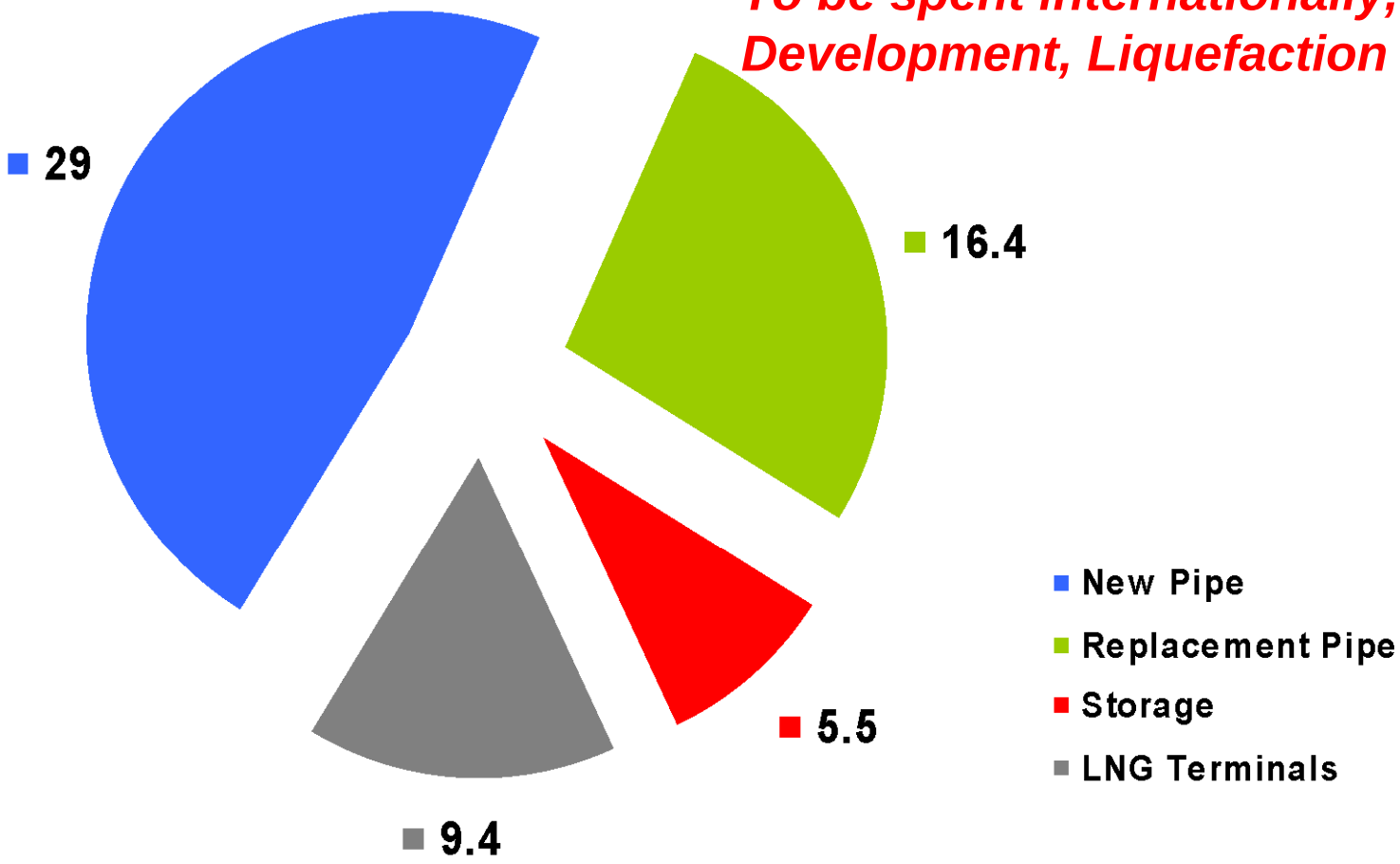
Multiple Site Potential



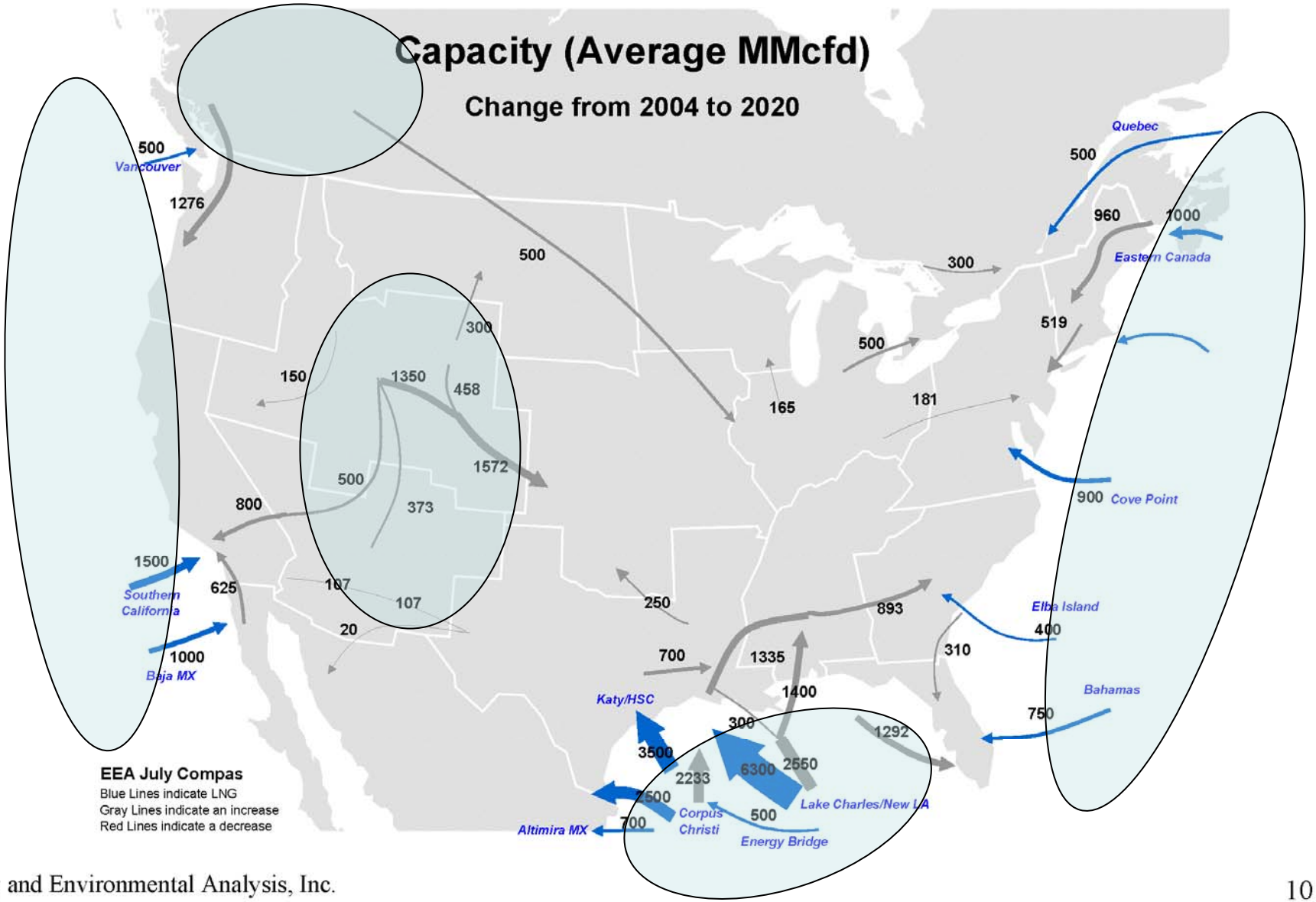
The Need for revamping North America's Gas based Pipeline Infrastructure

Infrastructure Costs to 2020: $60 billion

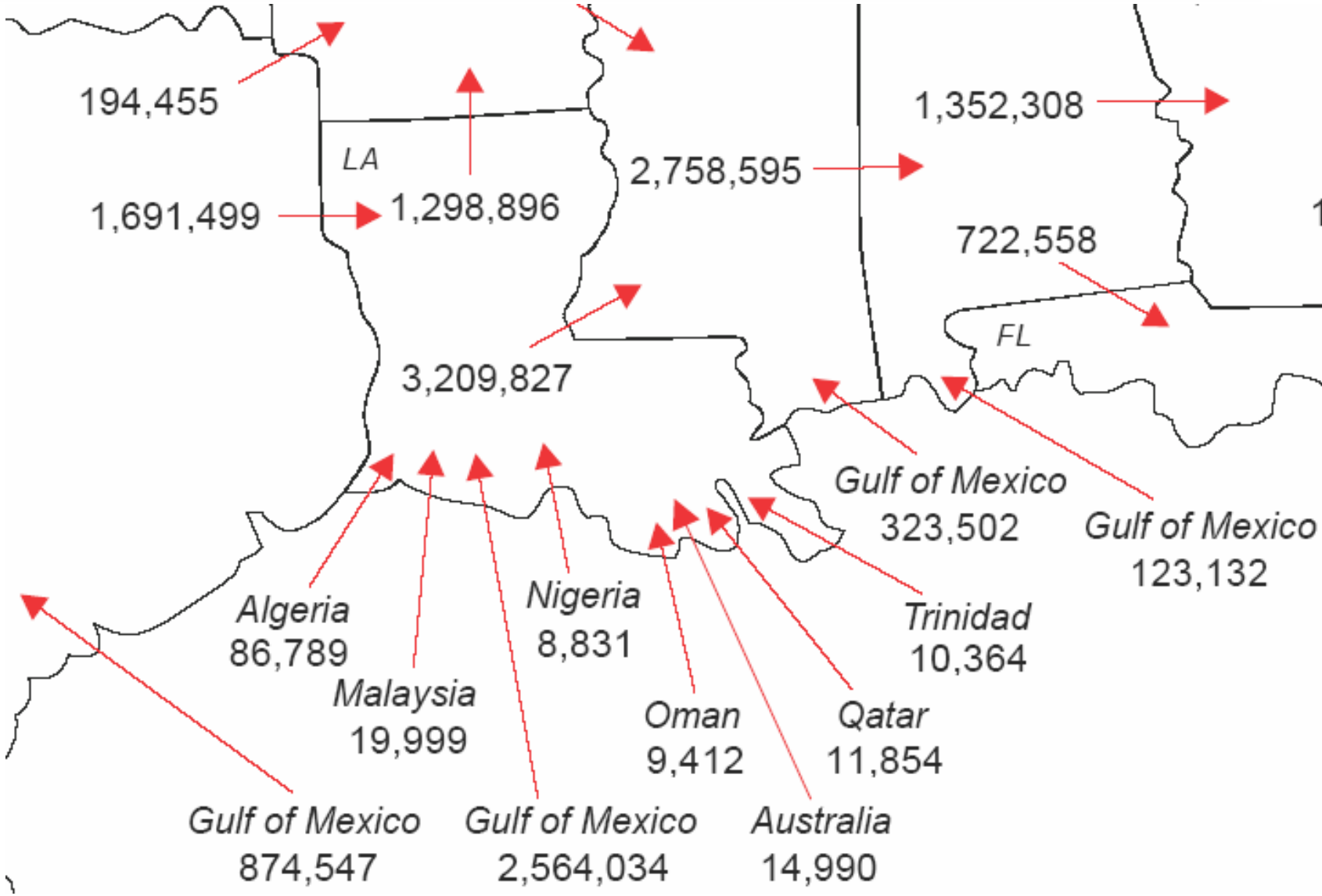
And this doesn't include ~$ 100 billion To be spent internationally, on LNG Development, Liquefaction & Shipping!



New Long Haul Pipeline Capacity

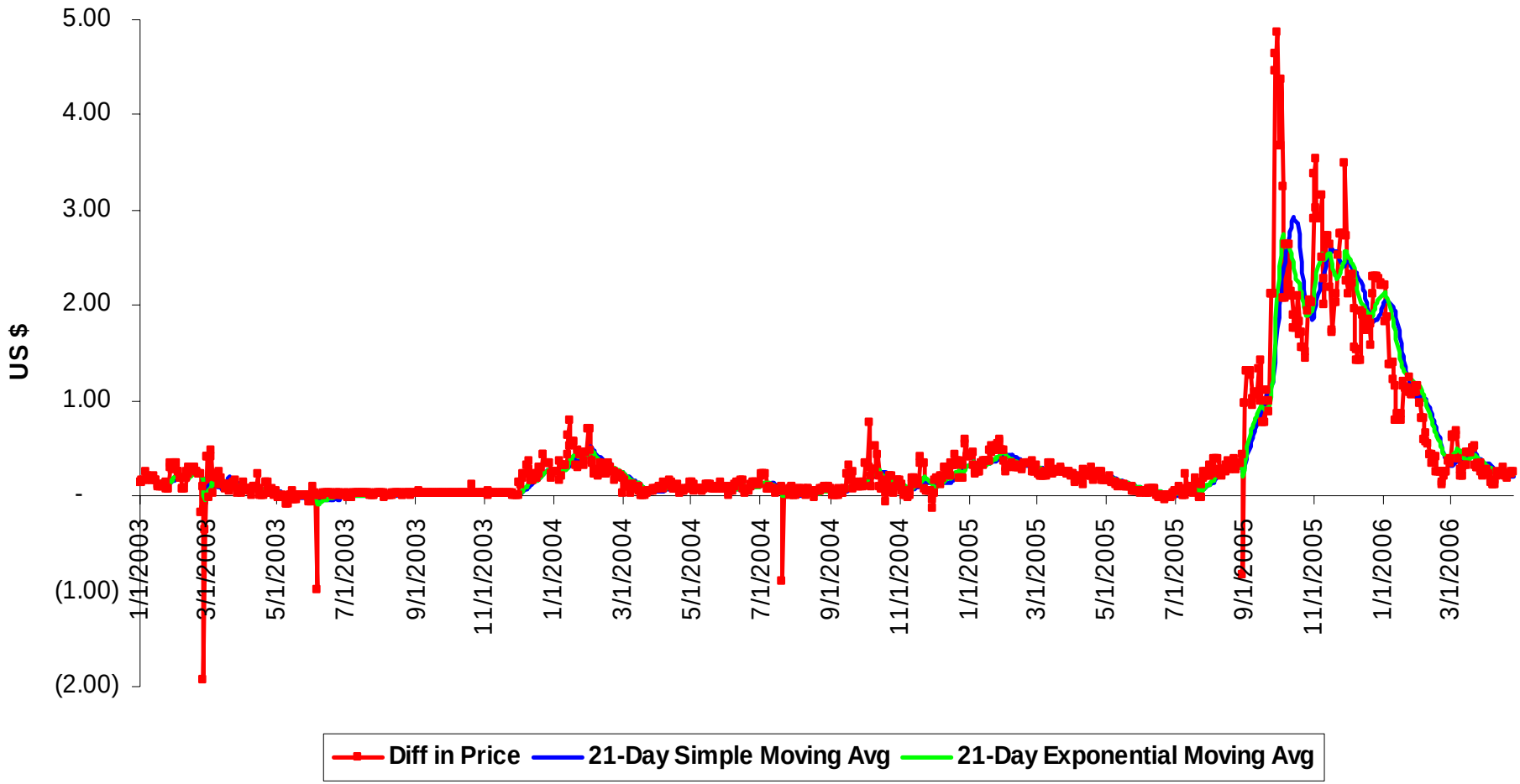


Interstate Movements of Natural Gas in the United States, 2004
(Million Cubic Feet)



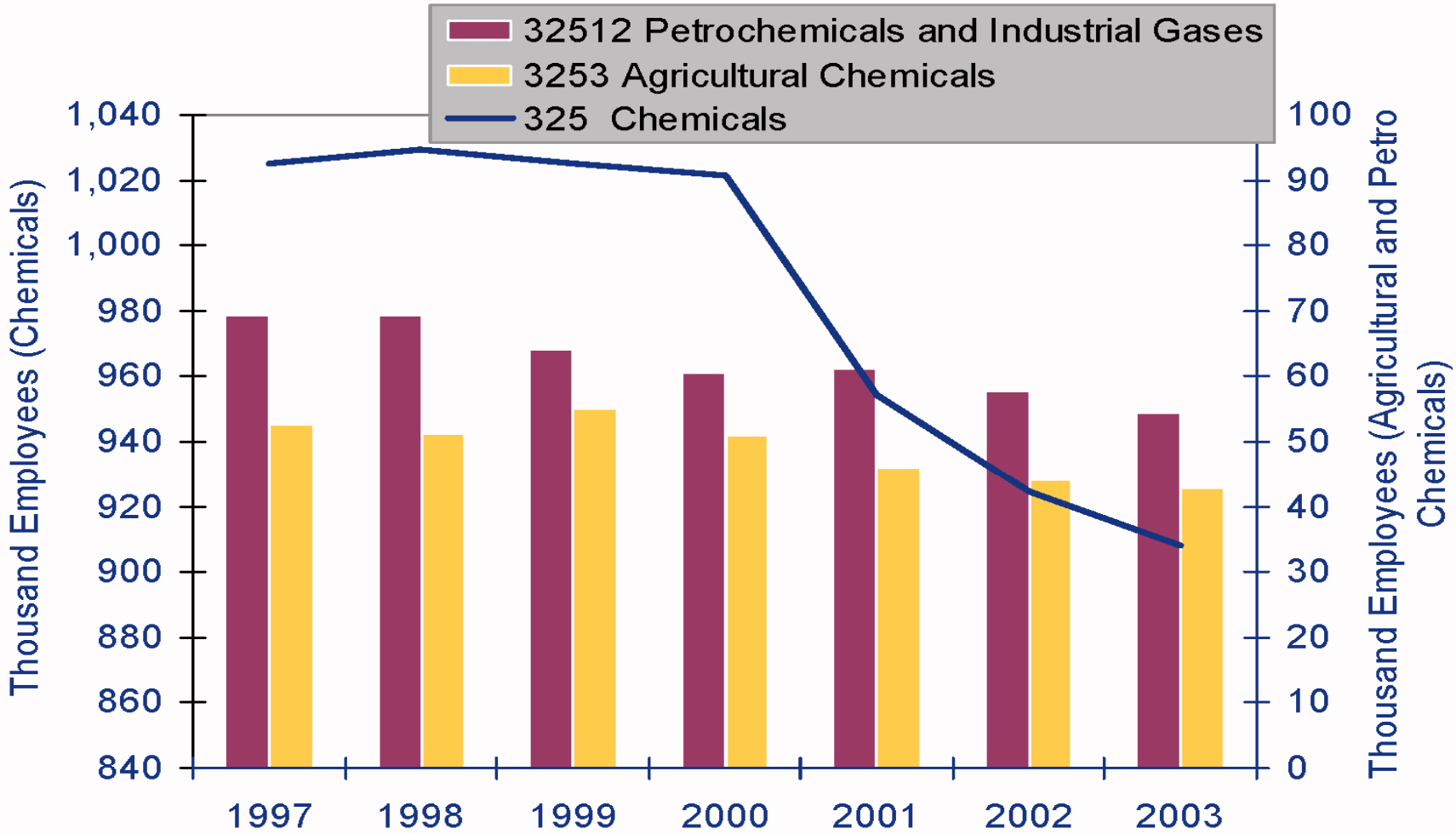
Source: Energy Information Administration (EIA), Form EIA-176, "Annual Report of Natural and Supplemental Gas Supply and Disposition."

Difference in Basis - Henry Hub vs Houston Ship Channel
2003 - 2006 ytd



Industry is vulnerable, in the US and in Louisiana/Texas

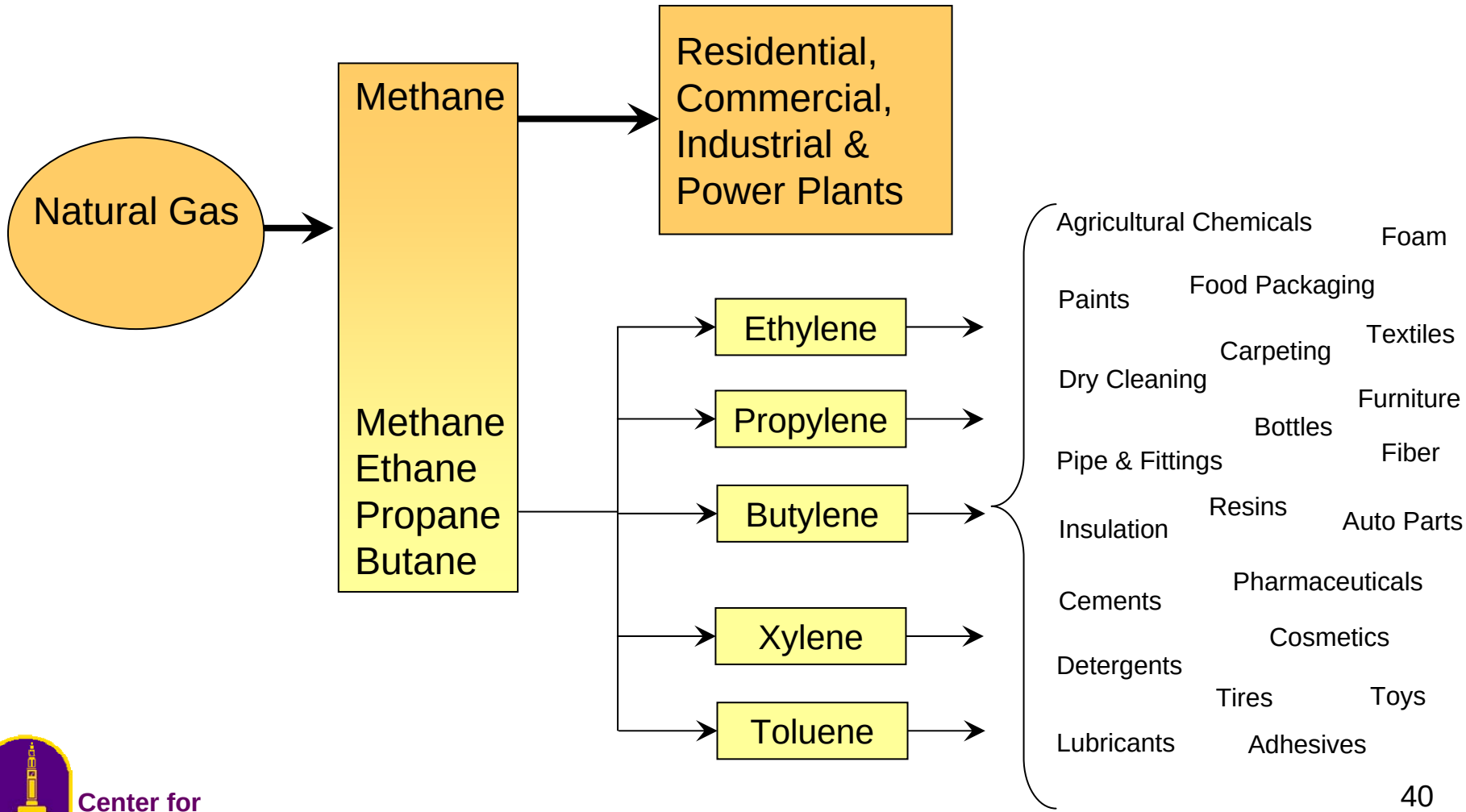
Employment Impact of Demand Destruction



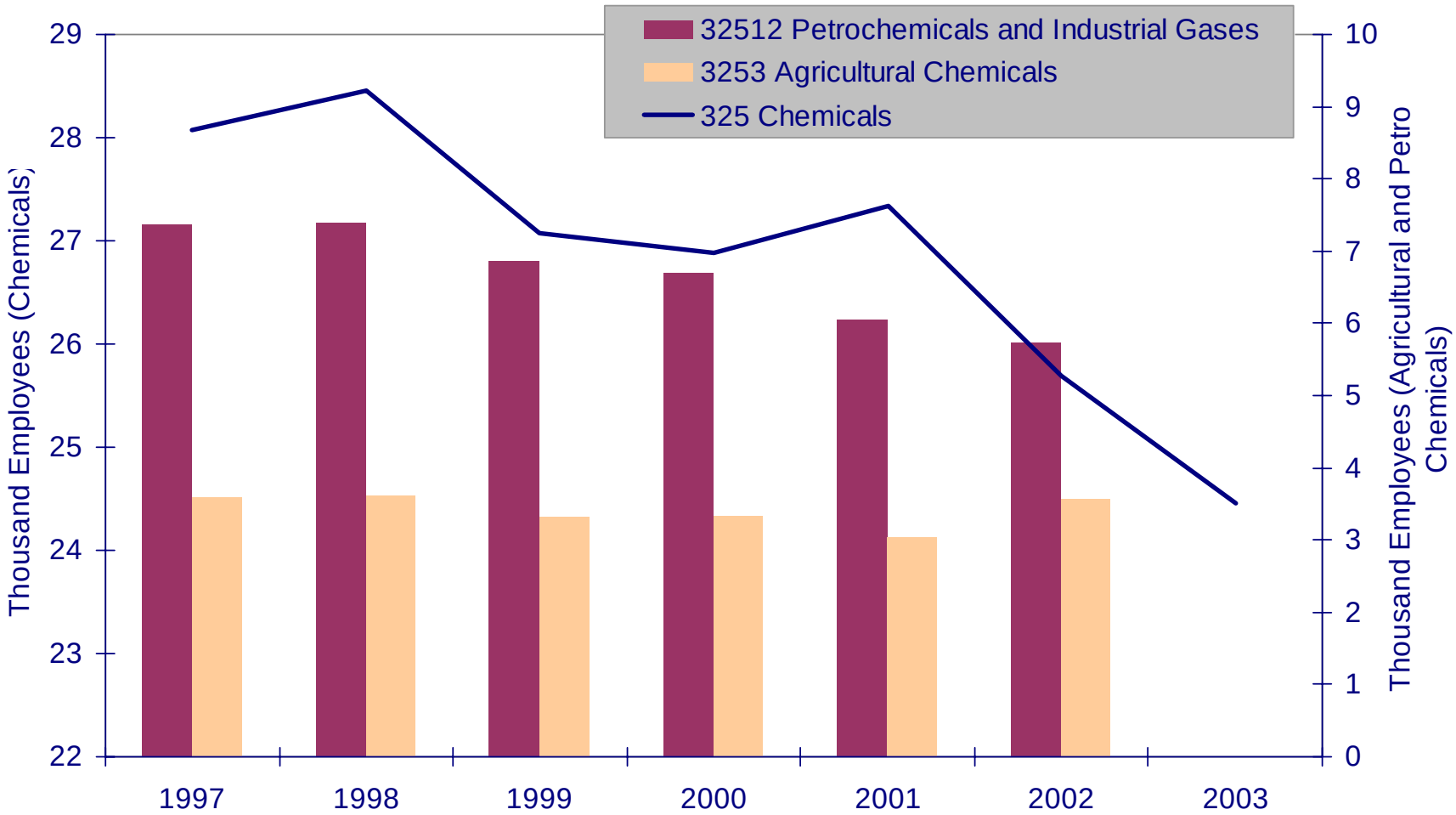
Source: Bureau of Labor Statistics, Department of Labor

Industry Employment in the U.S. (1997-2003) has experienced significant losses in chemical industry jobs since 2000 due to demand destruction. Louisiana and Texas are disproportionately effected.

Components of Natural Gas and where they end up



Employment in Chemical, Fertilizer and Petrochemical Industry in Louisiana (1997 - 2003)



The Louisiana chemical industry has been losing a significant numbers of jobs since 2001

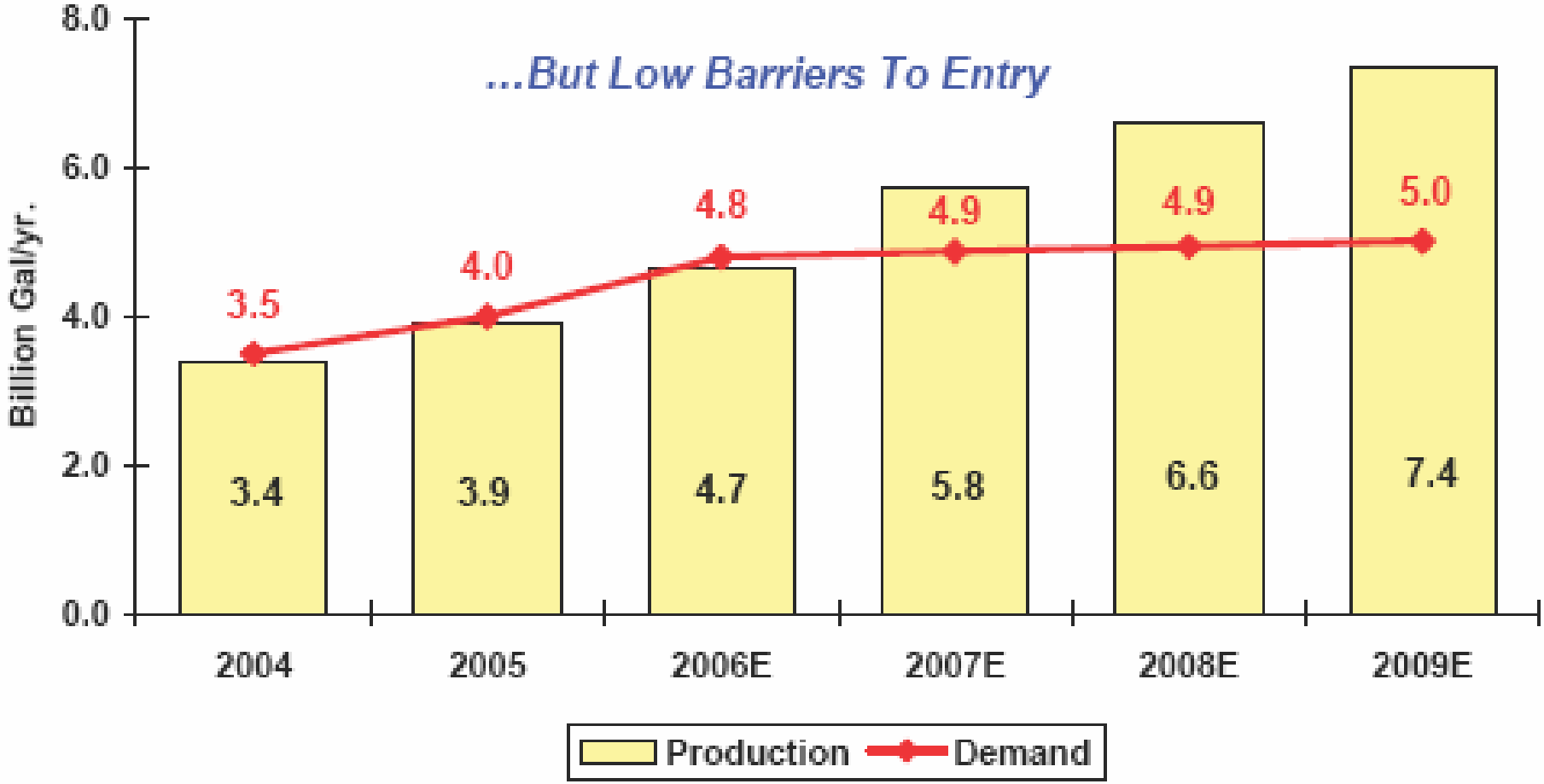
Source: Bureau of Labor Statistics, Department of Labor

Indicative Losses of US capacity during Hurricane outages

Acrylonitrile	- 55%	LDPE	-46%
Butadiene	-62%	LLDPE	-73%
Chlorine	-16%	Methyl Methacrylate	-69%
Caustic Soda	-16%	Phenol	-38%
Cyclohexane	-80%	Polybutadiene	-84%
Ethylene Glycol	-39%	Polypropylene	-55%
Ethylene Oxide	- 43%	PVC	-21%
HDPE	- 55%	Styrene-Butadiene Rubber	-55%

Fuel Ethanol: U.S. Supply/Demand Balance[1]

(Billion Gallons/Yr.)



[1] *Demand Assumptions: RFG 2005-09 CAGR = 1.5% (Oxygenate = 100% ethanol @ 10% blend level)*

Source: Oil & Gas Journal, USDA, Renewable Fuels Association, Howard Weil estimates

Conclusions

- As a State, we need both Petrochemicals and Power, not “either/or” options.
- We especially don’t need to shut down local chemical production to support out of state power production.
- LNG can help Louisiana’s Petrochemical Infrastructure to survive, but only if the terminals get built.
- We also need to encourage additional investment in pipelines that move non-conventional gas and new salt cavern storage capacity.
- Louisiana needs to coordinate its refinery and sugar industries to produce cellulosic ethanol from sugar cane.
- We need to coordinate the solution of infrastructure problems.

Potential Projects to Consider

- Pipeline Enhancements
  - Maintenance of existing system
  - New Capacity, same direction
  - New Capacity new gas sources
  - New Texas to Louisiana capability
- Salt Cavern Storage
  - Onshore
  - Offshore
- Alternate LNG Delivery Systems
  - Barges
  - Rail
  - Truck
- LNG Buyer Aggregation
  - Petrochemicals
  - Paper
  - Power
- Cellulosic Ethanol Production

Questions?

Eric N. Smith
504-865-5031
esmith11@tulane.edu