8th EU-US Energy Regulators Roundtable

Natural Gas in the U.S.: Supply and Infrastructure = Security

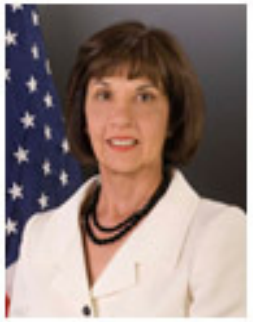
Michael J. McGehee
Director, Division of Pipeline Certificates
Office of Energy Projects
Federal Energy Regulatory Commission

Berlin, Germany **October 26 - 27, 2010**

FERC Organization Chart







Chairman
Jon Wellinghoff

Commissioner
Philip D. Moeller

Commissioner
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Commissioner
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- Energy Projects
- External Affairs
- Enforcement
- Electric Reliability
- General Counsel
- Secretary
- Administrative Litigation
- Administrative Law Judges
- Energy Market Regulation
- Executive Director
- Energy Policy & Innovation

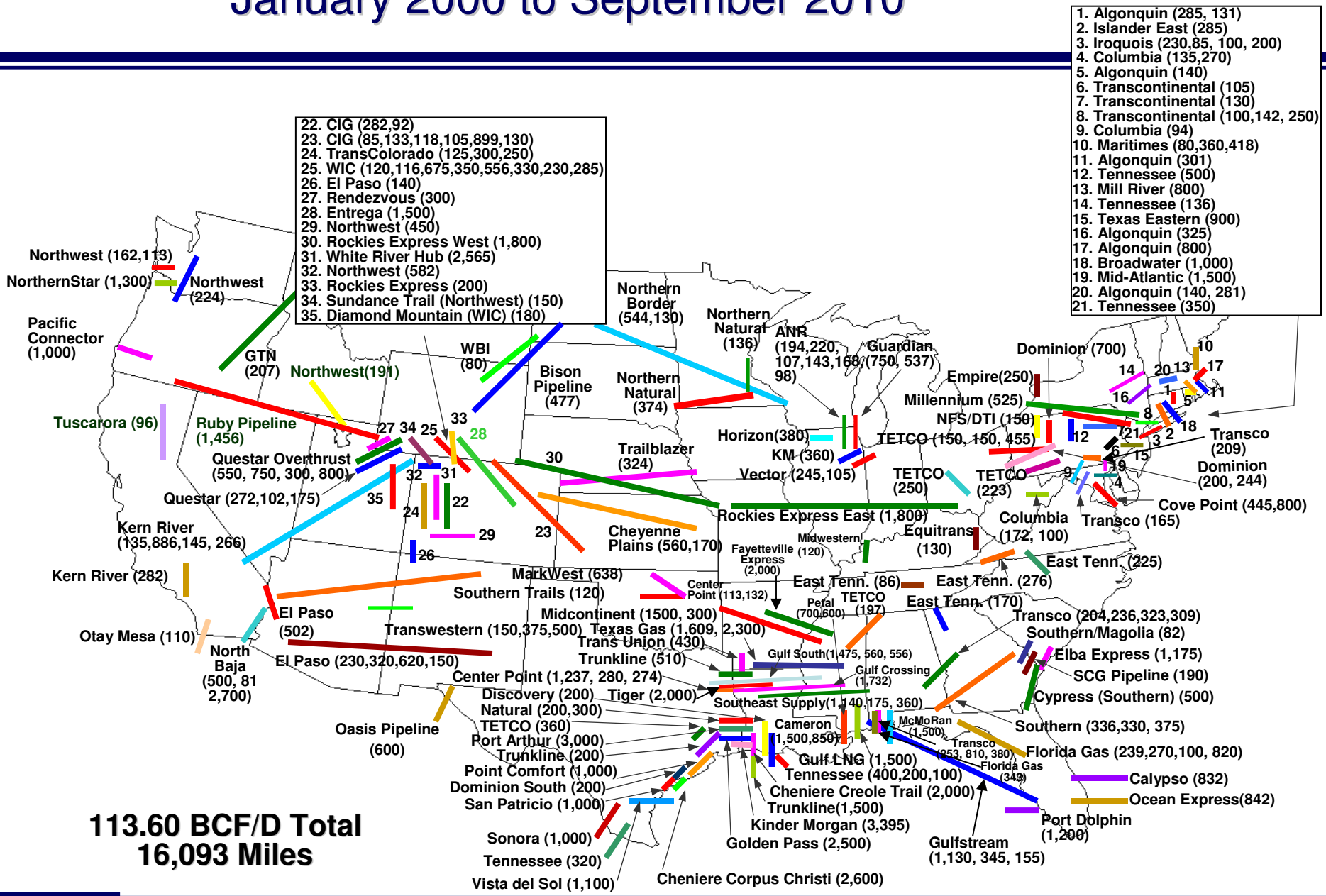
Gas Pipeline Program

- Evaluate applications for facilities to import, export, transport, store or exchange natural gas
- Authorize the construction and operation of facilities for such services
- Approve abandonment of such facilities
- Conduct environmental reviews of proposals involving construction, modification, or abandonment
- Implement the “Pre-Filing Process”
- Conduct inspections of LNG facilities and pipeline construction

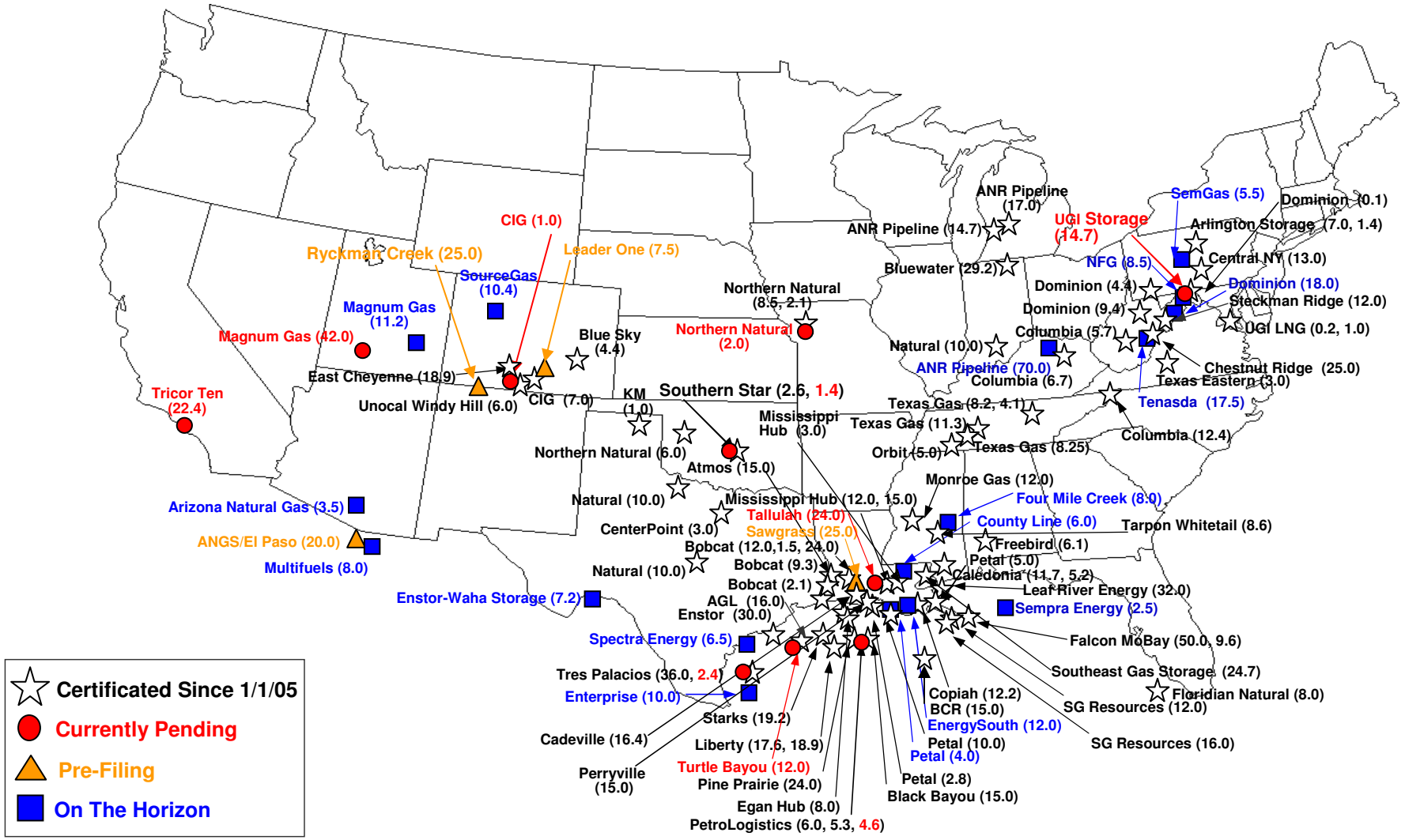
In the United States, there are approximately 217,300 miles of interstate natural gas transmission pipeline.

Source: Based on data from Ventyx Global Energy Decisions, Inc., Velocity Suite, January 2010, and EIA's Natural Gas Pipelines.

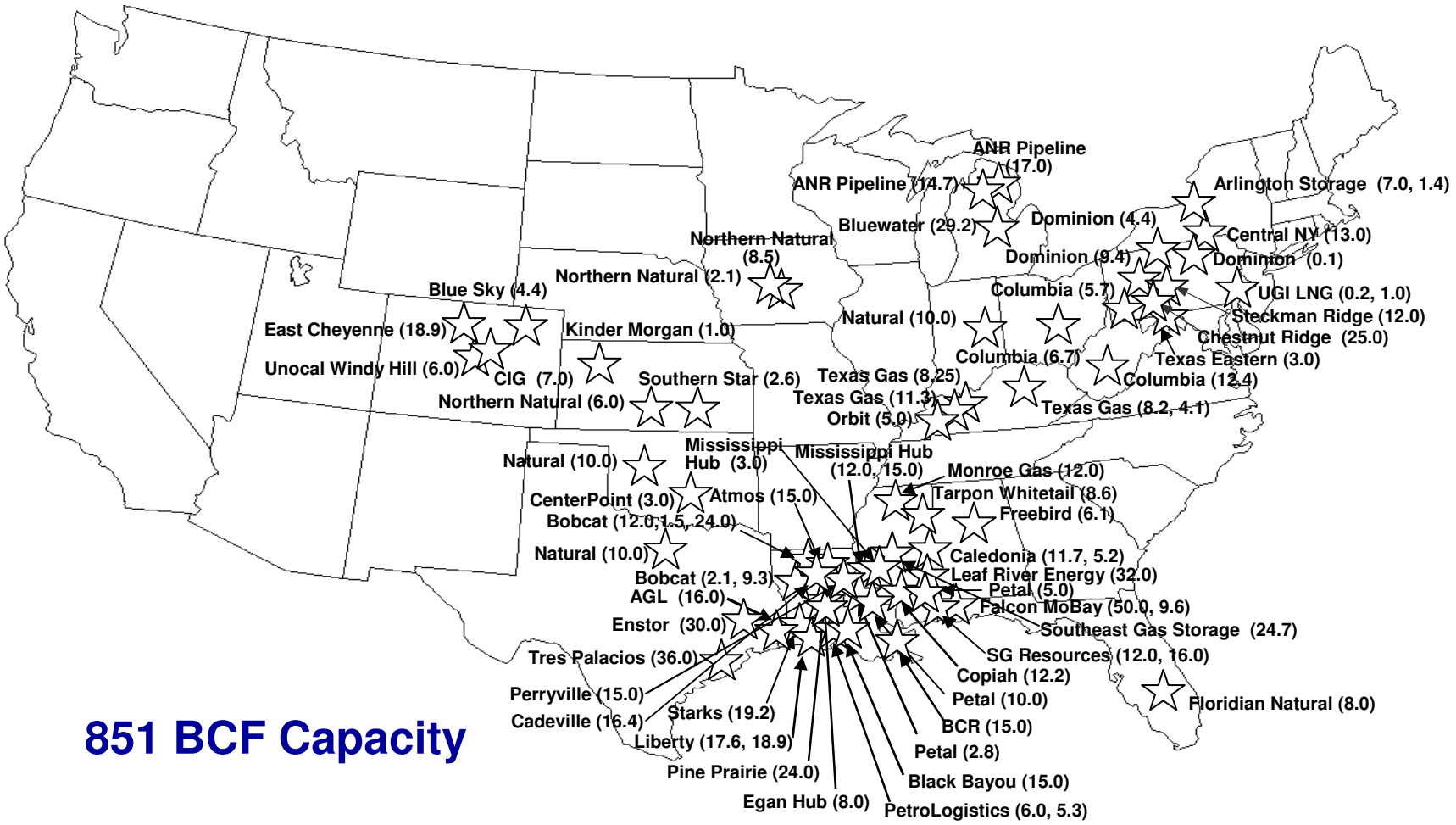
Major Pipeline Projects Certificated (MMcf/d) January 2000 to September 2010



All Storage Projects (Capacity in Bcf)



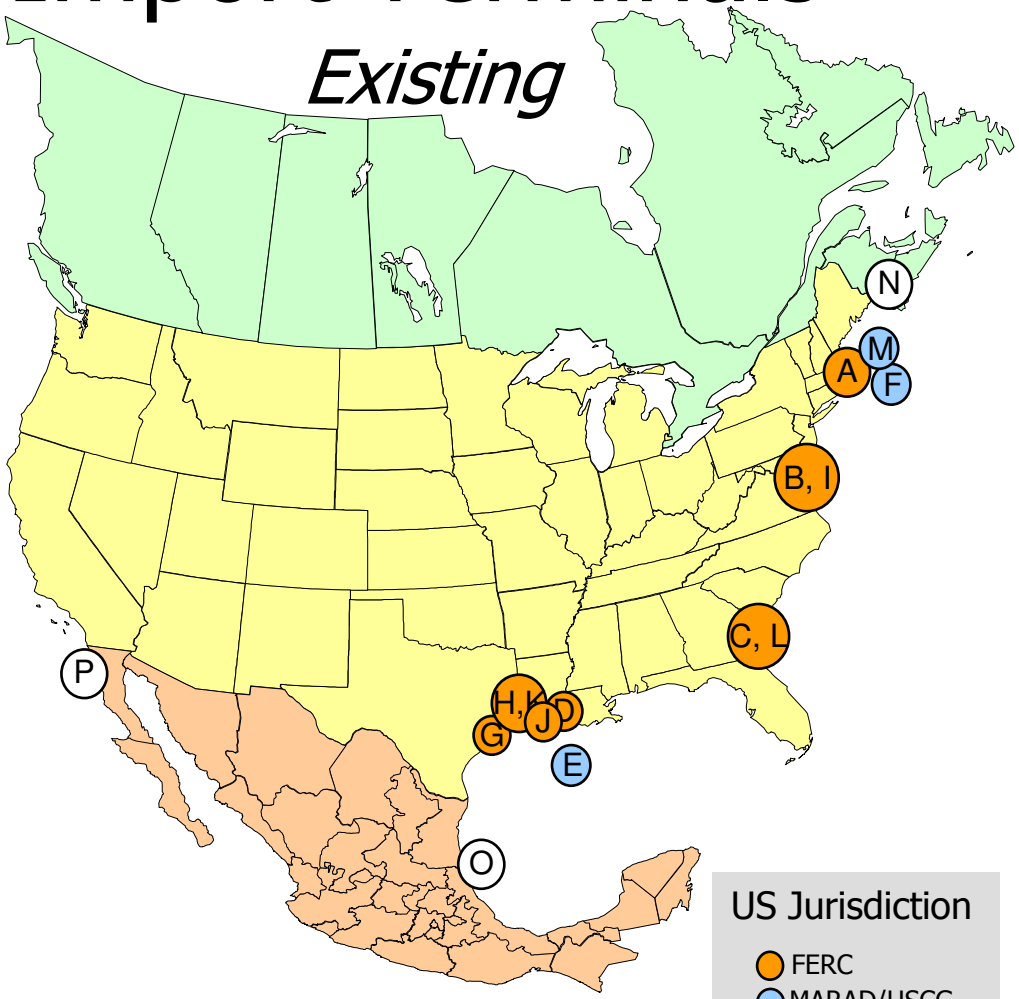
Storage Projects Certificated January 2005 through September 2010 (Capacity in Bcf)



851 BCF Capacity

North American LNG Import Terminals

Existing



As of September 7, 2010

* *Expansion of an existing facility*

U.S.

A. Everett, MA : 1.035 Bcfd (GDF SUEZ - 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, (Excelerate Energy - Gulf Gateway Energy Bridge)
F. Offshore Boston: 0.8 Bcfd, (Excelerate Energy – Northeast Gateway)
G. Freeport, TX: 1.5 Bcfd, (Cheniere/Freeport LNG Dev.)
H. Sabine, LA: 2.6 Bcfd (Cheniere/Sabine Pass LNG)
I. Cove Point, MD : 0.8 Bcfd (Dominion – Cove Point LNG - Expansion)*
J. Hackberry, LA: 1.8 Bcfd (Sempra - Cameron LNG)
K. Sabine, LA: 1.4 Bcfd (Cheniere/Sabine Pass LNG – Expansion)*
L. Elba Island, GA: 0.4 Bcfd (El Paso – Southern LNG –Phase A Expansion)*
M. Offshore Boston, MA : 0.4 Bcfd (GDF SUEZ – Neptune LNG)

Canada

N. Saint John, NB: 1.0 Bcfd, (Repsol/Fort Reliance - Canaport LNG)

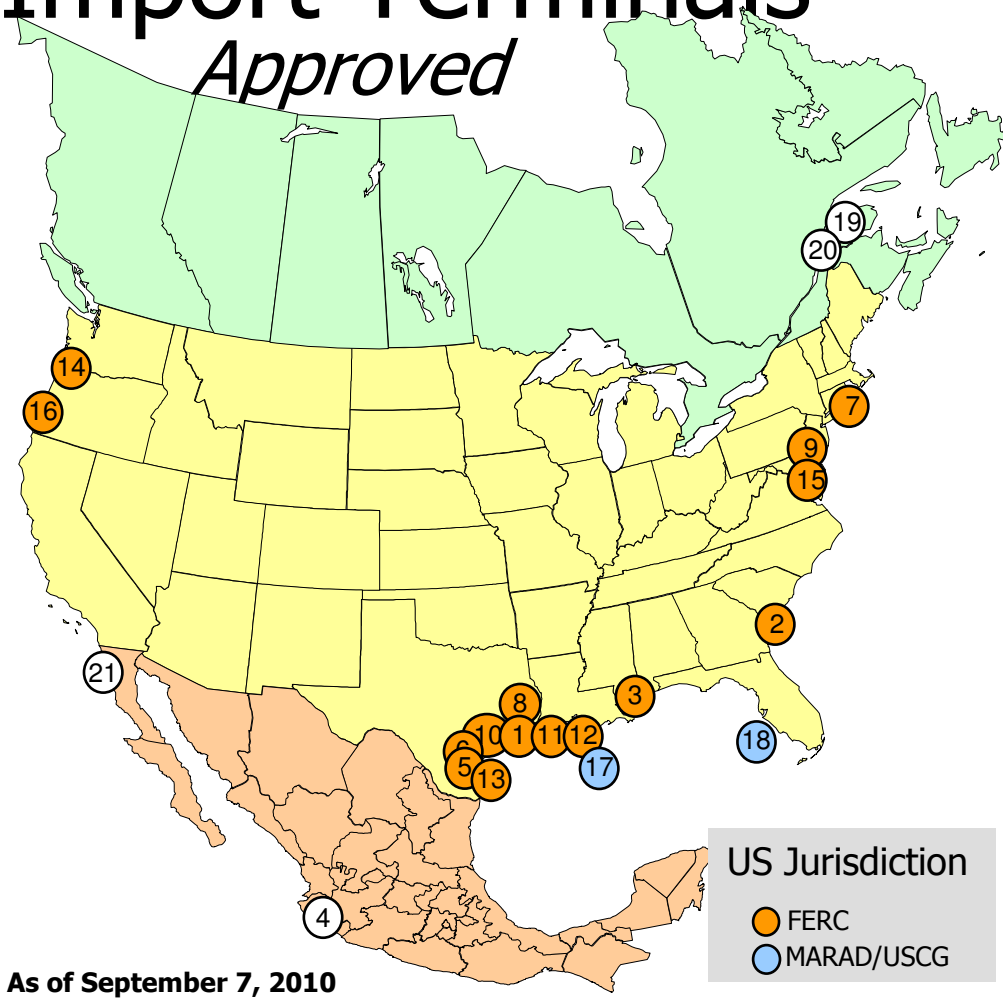
Mexico

O. Altamira, Tamulipas: 0.7 Bcfd, (Shell/Total/Mitsui – Altamira LNG)
P. Baja California, MX: 1.0 Bcfd, (Sempra – Energia Costa Azul)

FERC

North American LNG Import Terminals

Approved



As of September 7, 2010

* *Expansion of an existing facility*

APPROVED - UNDER CONSTRUCTION
U.S.

1. **Sabine, TX:** 2.0 Bcfd (ExxonMobil - Golden Pass)
2. **Elba Island, GA:** 0.5 Bcfd (El Paso - Southern LNG Expansion)*
3. **Pascagoula, MS:** 1.5 Bcfd (El Paso/Crest/Sonangol - Gulf LNG Energy LLC)

APPROVED - UNDER CONSTRUCTION
Mexico

4. **Manzanillo, MX:** 0.5 Bcfd (KMS GNL de Manzanillo)

APPROVED - NOT UNDER CONSTRUCTION
U.S. - FERC

5. **Corpus Christi, TX**: 1.0 Bcfd (Occidental Energy Ventures – Ingleside Energy)
6. **Corpus Christi, TX:** 2.6 Bcfd, (Cheniere – Corpus Christi LNG)
7. **Fall River, MA :** 0.8 Bcfd, (Hess LNG/Weaver's Cove Energy)
8. **Port Arthur, TX:** 3.0 Bcfd (Sempra)
9. **Logan Township, NJ :** 1.2 Bcfd (Hess LNG - Crown Landing LNG)
10. **Cameron, LA:** 3.3 Bcfd (Cheniere - Creole Trail LNG)
11. **Freeport, TX:** 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)*
12. **Hackberry, LA:** 0.85 Bcfd (Sempra - Cameron LNG - Expansion)*
13. **Port Lavaca, TX:** 1.0 Bcfd (Gulf Coast LNG Partners – Calhoun LNG)
14. **Bradwood, OR**: 1.0 Bcfd (Northern Star Natural Gas LLC – Northern Star LNG)
15. **Baltimore, MD:** 1.5 Bcfd (AES Corporation – AES Sparrows Point)
16. **Coos Bay, OR:** 1.0 Bcfd (Jordan Cove Energy Project)

U.S. - MARAD/Coast Guard

17. **Gulf of Mexico:** 1.0 Bcfd (Main Pass McMoRan Exp.)
18. **Offshore Florida:** 1.2 Bcfd (Hoëgh LNG - Port Dolphin Energy)

Canada

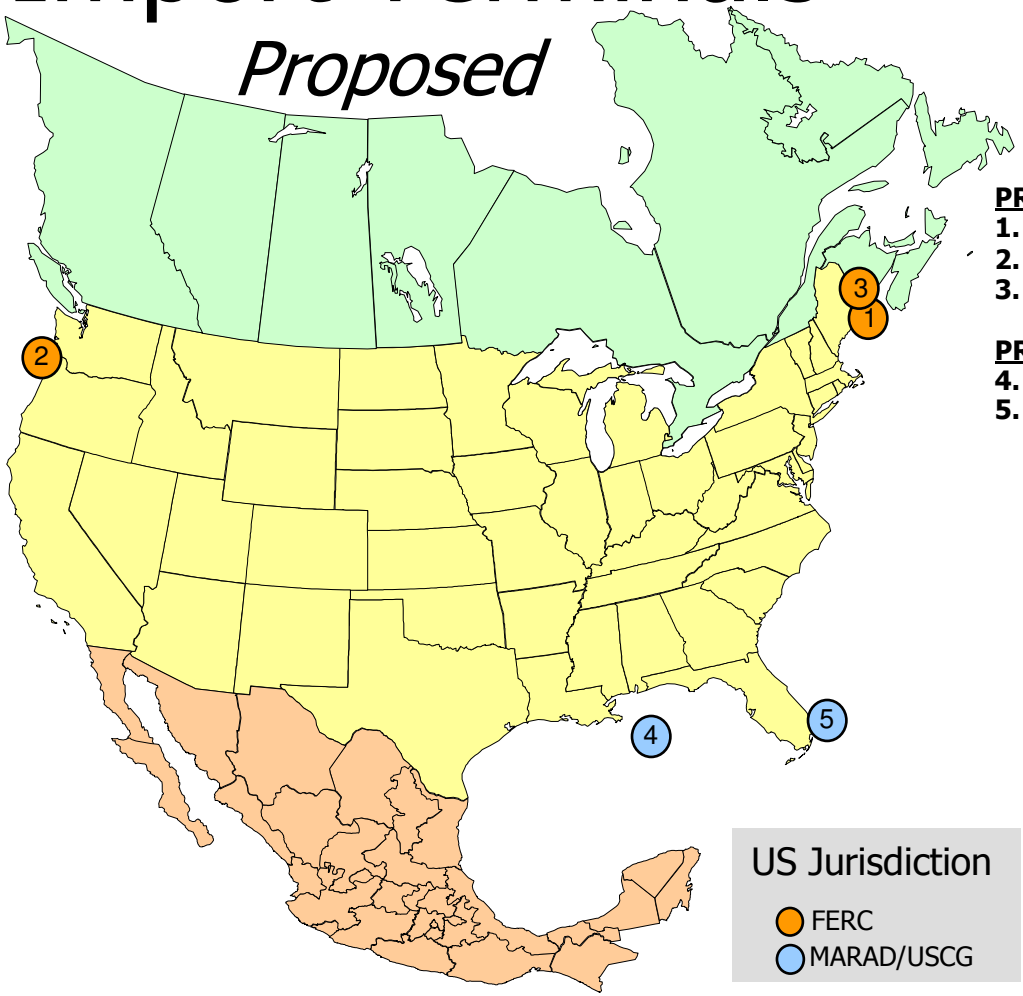
19. **Rivière-du- Loup, QC:** 0.5 Bcfd (Cacouna Energy - TransCanada/PetroCanada)
20. **Quebec City, QC :** 0.5 Bcfd (Project Rabaska - Enbridge/Gaz Met/Gaz de France)

Mexico

21. **Baja California, MX :** 1.5 Bcfd (Sempra - Energia Costa Azul - Expansion)

North American LNG Import Terminals

Proposed



As of September 7, 2010

PROPOSED TO FERC

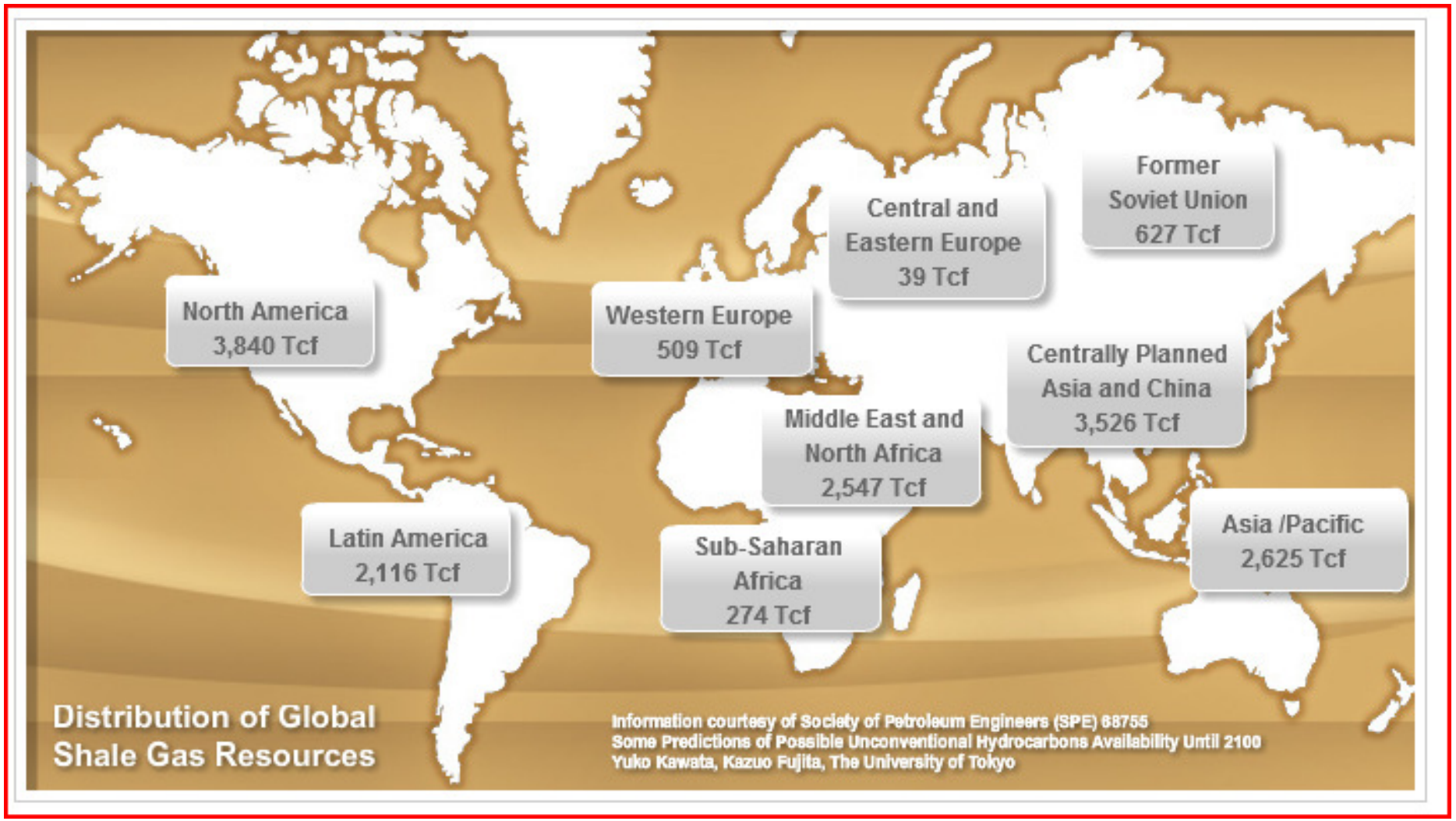
1. **Robbinston, ME:** 0.5 Bcfd (Kestrel Energy - Downeast LNG)
2. **Astoria, OR:** 1.5 Bcfd (Oregon LNG)
3. **Calais, ME:** 1.2 Bcfd (BP Consulting LLC)

PROPOSED TO MARAD/COAST GUARD

4. **Gulf of Mexico:** 1.4 Bcfd (TORP Technology - Bienville LNG)
5. **Offshore Florida:** 1.9 Bcfd (GDF SUEZ - Calypso LNG)

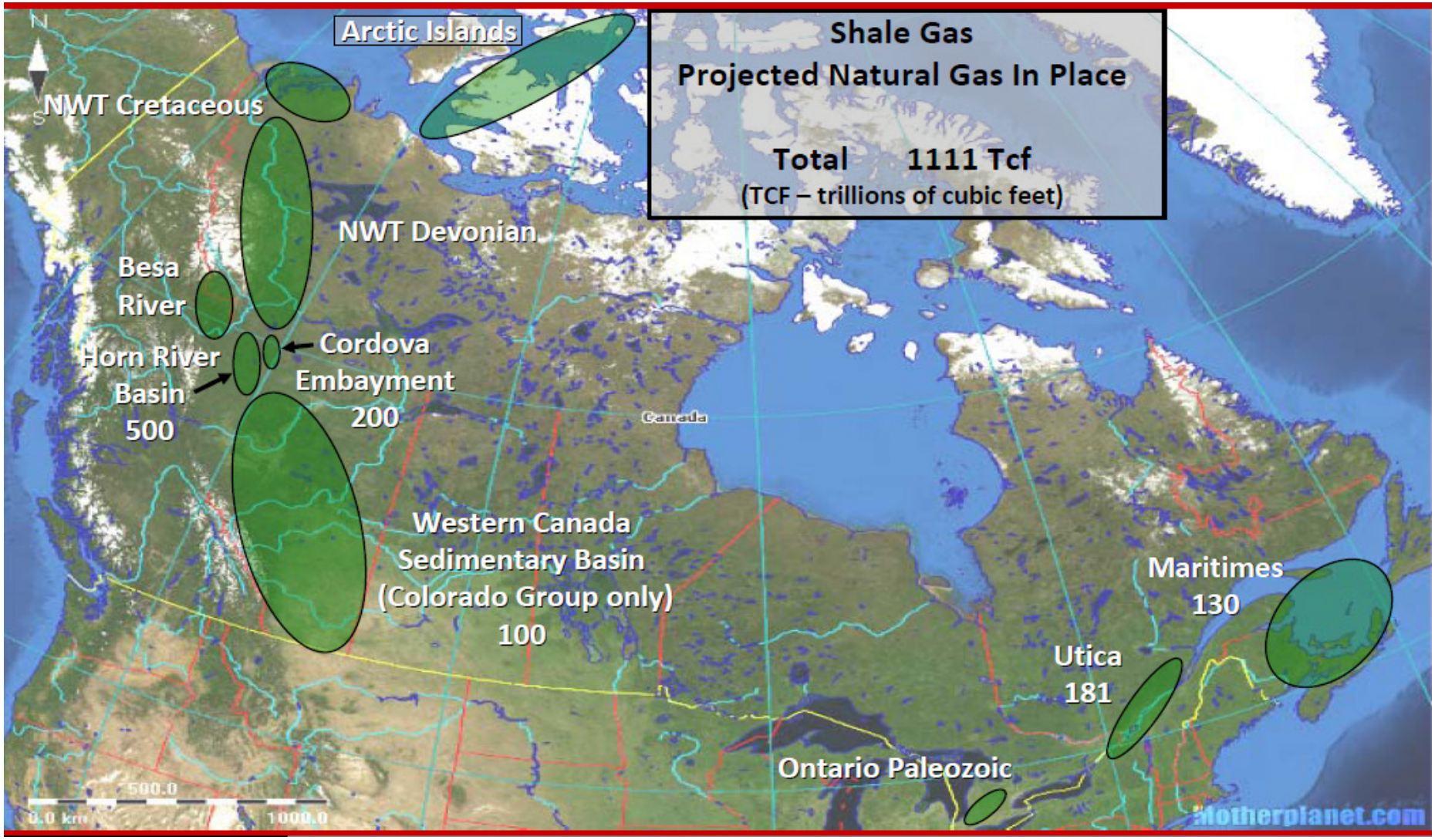
Impact of Shale Gas

Global Shale Gas



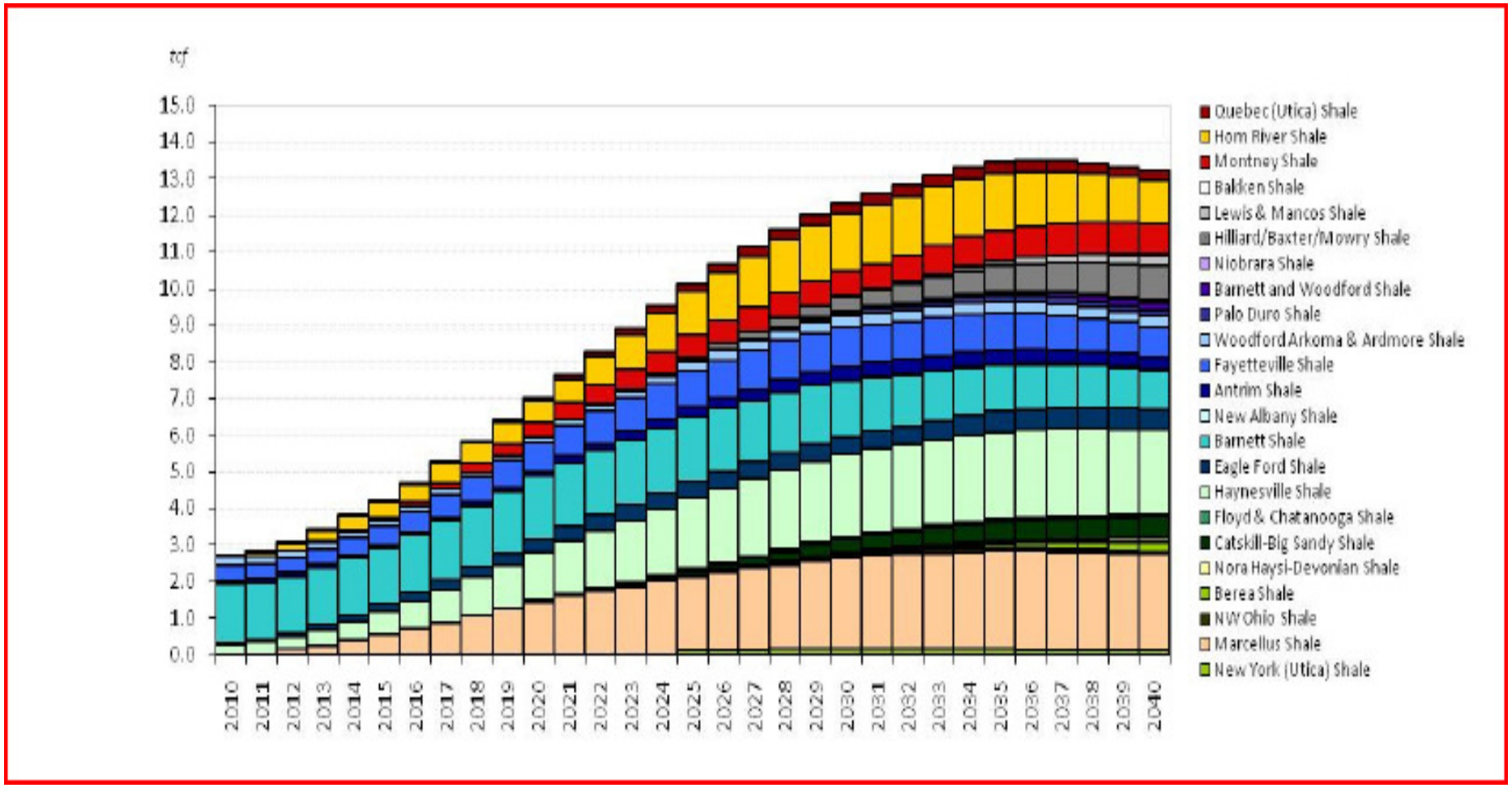
Source: Halliburton.Com

Canada's Shale Gas



Source: Canadian Society for Unconventional Gas, CSUG Technical Luncheon, May12, 2010

North American Shale Production



Source: Figure 39 of Energy Market Consequences of an Emerging U.S. Carbon Management Policy – Peter R. Hartley, Ph.d., and Kenneth B. Medlock III, Ph.D.

North American Natural Gas Resource Base Could Support Current Levels of Gas Use for Almost 140 Years

U.S. and Canada Natural Gas Resource Base

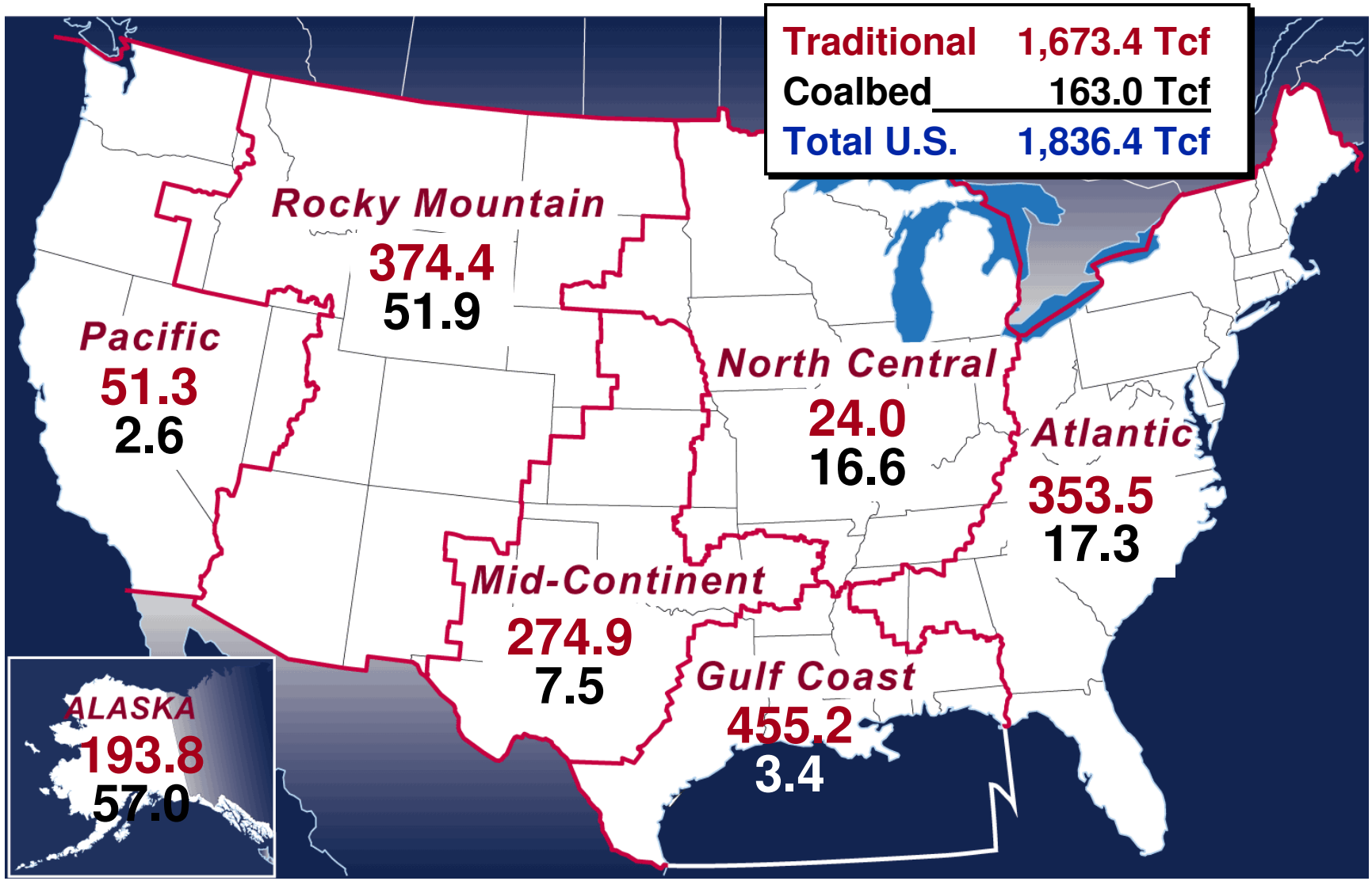
(Tcf of Economically Recoverable Resource, Assuming Current E&P Technologies)

	Proven Reserves	Unproved Plus Discovered Undeveloped	Total Remaining Resource	Shale Resource[1]
Alaska	7.7	153.6	161.3	0.0
West Coast Onshore	2.3	24.6	27.0	0.3
Rockies & Great Basin	66.7	388.3	454.9	37.9
West Texas	27.6	47.7	75.3	17.5
Gulf Coast Onshore	70.1	684.7	754.8	476.9
Mid-continent	37.0	205.0	241.9	133.9
Eastern Interior [2]	18.6	795.7	814.3	728.1
Gulf of Mexico	14.0	238.6	252.5	0.0
U.S. Atlantic Offshore	0.0	32.8	32.8	0.0
U.S. Pacific Offshore	0.8	31.7	32.5	0.0
WCSB	60.4	664.0	724.4	508.8
Arctic Canada	0.4	45.0	45.4	0.0
Eastern Canada Onshore	0.0	12.8	12.8	0.0
Eastern Canada Offshore	0.5	71.8	72.3	0.0
Western British Columbia	0.0	10.9	10.9	0.0
US Total	**244.7**	**2,602.6**	**2,847.3**	**1,394.5**
Canada Total	**61.3**	**804.5**	**865.8**	**508.8**
US and Canada Total	**306.0**	**3,407.1**	**3,713.0**	**1,903.3**

1 . Shale Resource is a subset of Total Remaining Resource
2. Reference case assumes drilling levels are constant at today's level over time, reflecting restricted access to the full resource development.

Source: ICF International's Compass Report for July 2010.

Regional Resource Assessment



Source: Report of the Potential Gas Committee (December 31, 2008) "Potential Supply of Natural Gas in the United States" June 18, 2009

Technically Recoverable Gas in the U.S.

Natural Gas Resource Assessment of the Potential Gas Committee, 2008 (mean values)

Traditional Resources	1,673.4 Tcf
Coalbed Gas Resources	163.0 Tcf
Total U.S. Resources	1,836.4 Tcf
Proved Reserves (EIA)	237.7 Tcf*
Future Gas Supply	2,074.1 Tcf

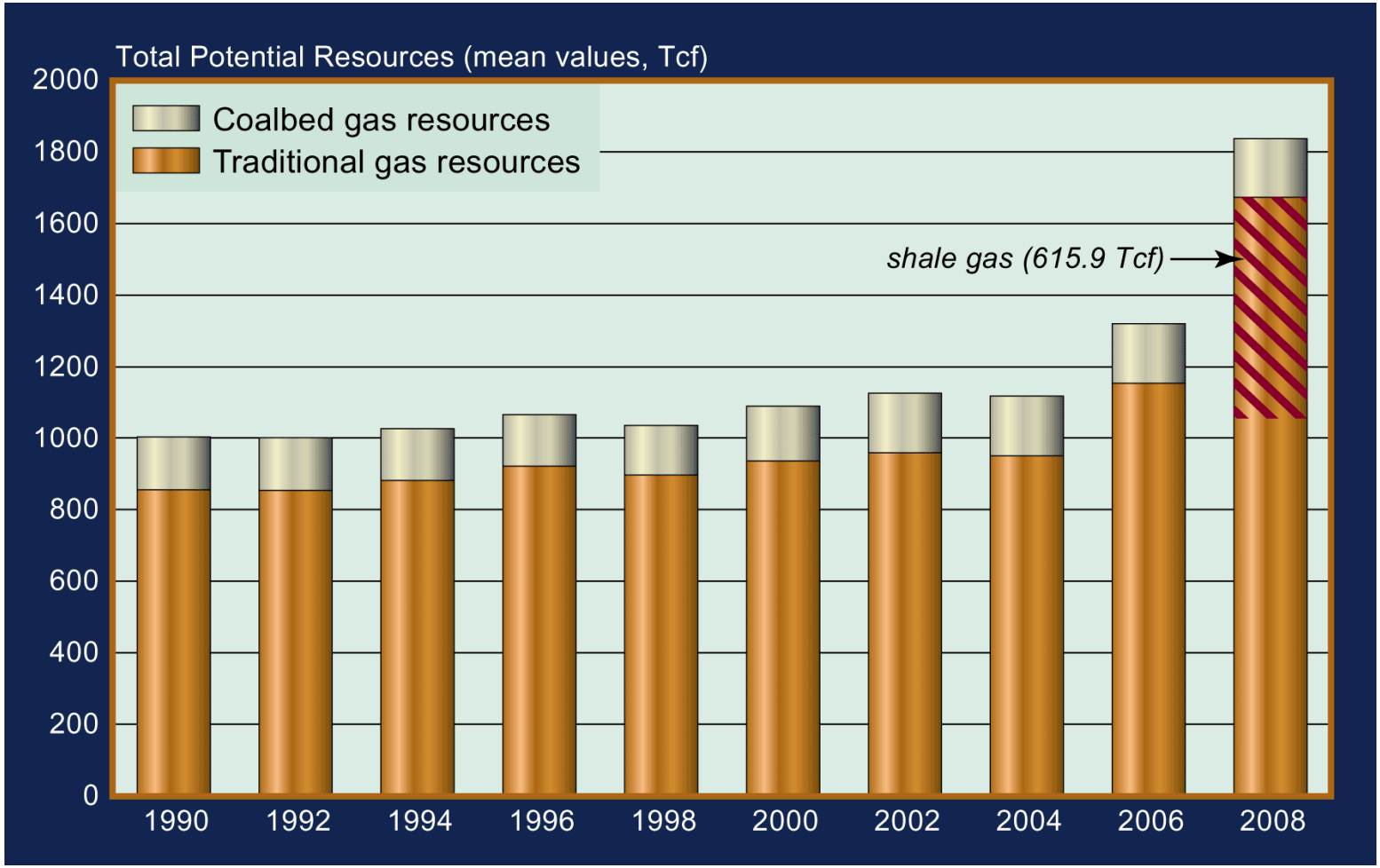
* Value as of year-end 2007

Source: Report of the Potential Gas Committee (December 31, 2008) "Potential Supply of Natural Gas in the United States" June 18, 2009

The growing importance of shale gas is substantiated by the fact that, of the 1,836 Tcf of total potential resources, shale gas accounts for 616 Tcf (33%).

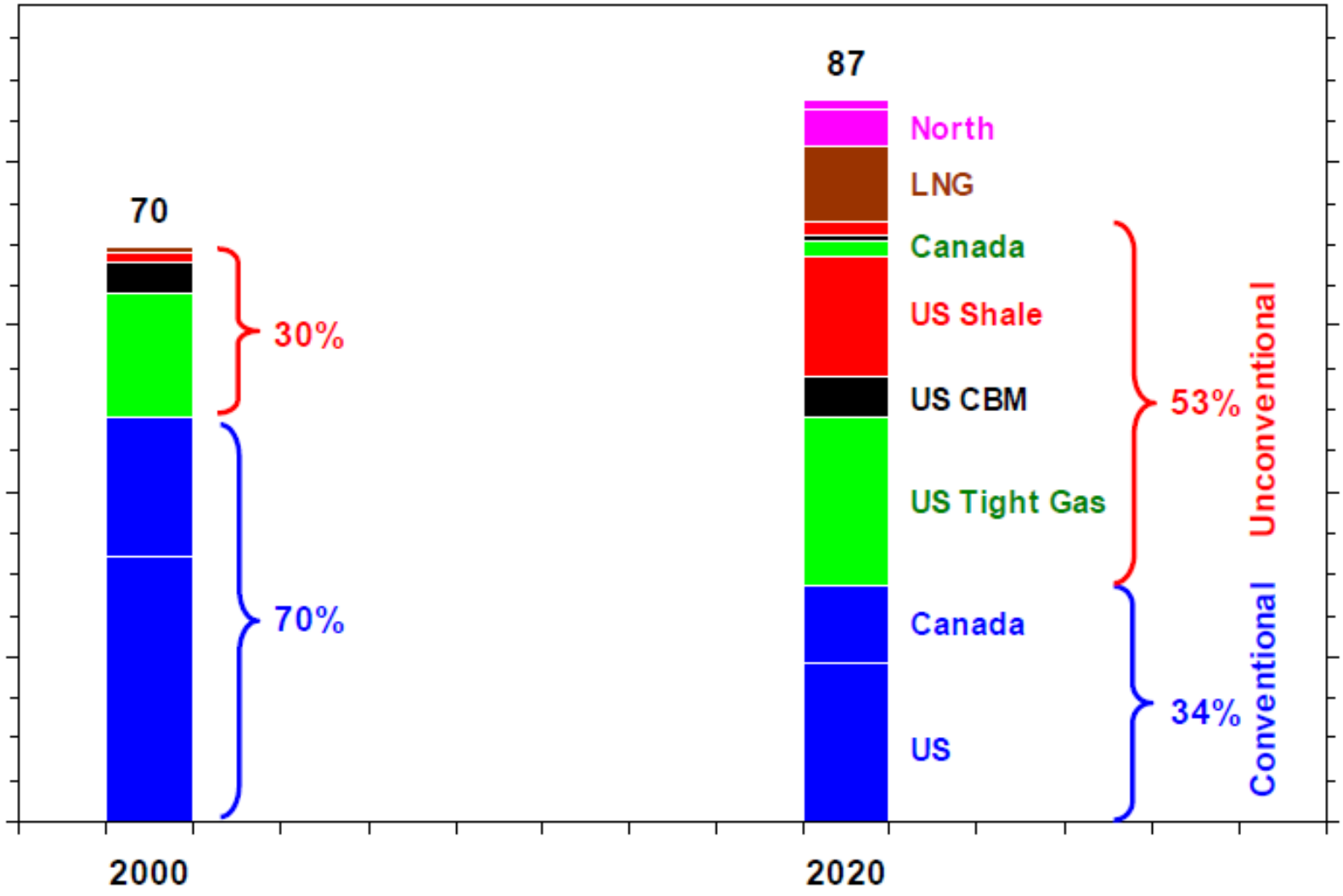
PGC Resource Assessments, 1990-2008

Total Potential Gas Resources (mean values)



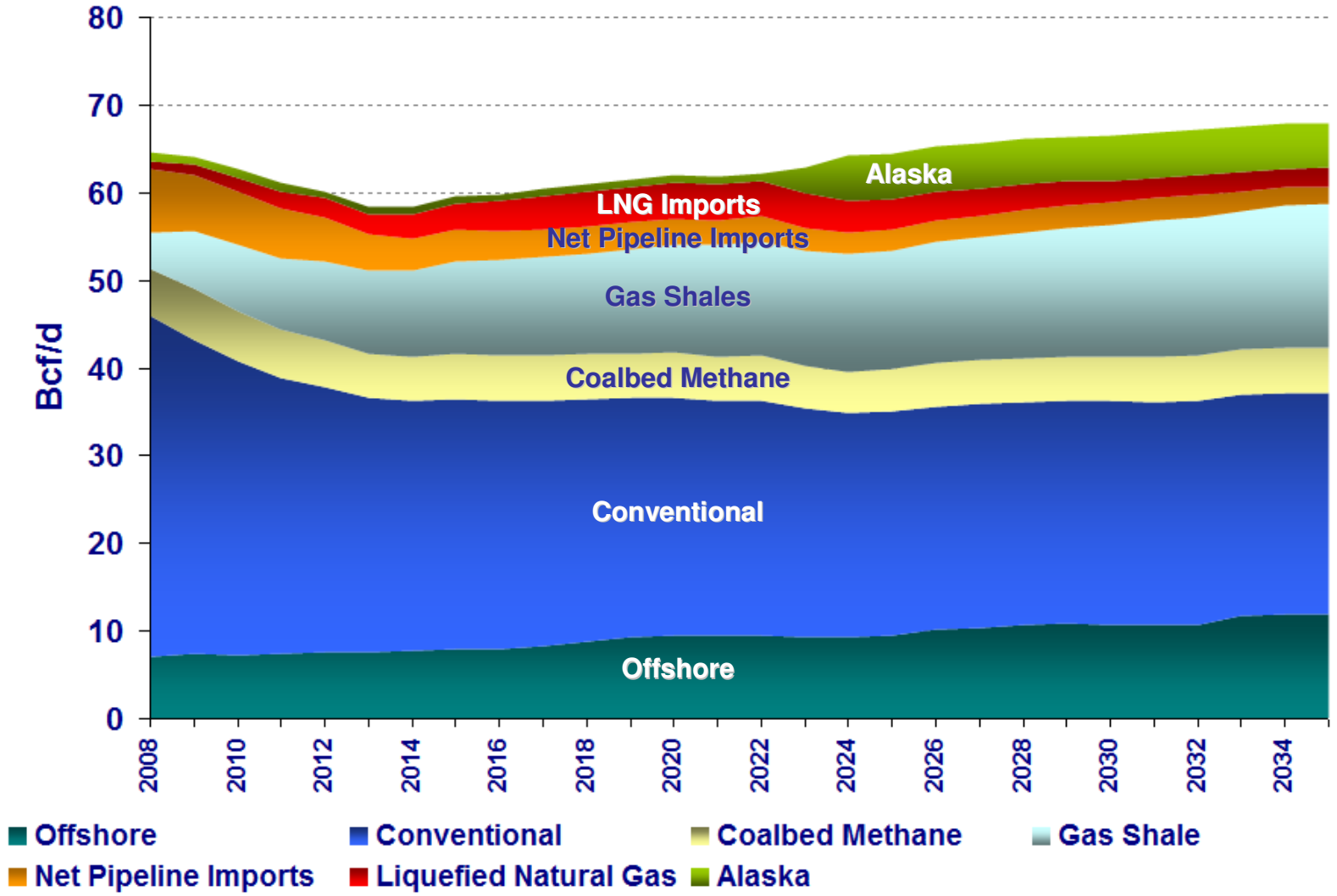
Source: Report of the Potential Gas Committee (December 31, 2008) "Potential Supply of Natural Gas in the United States" June 18, 2009

North American Unconventional Gas Growth, Bcf/d



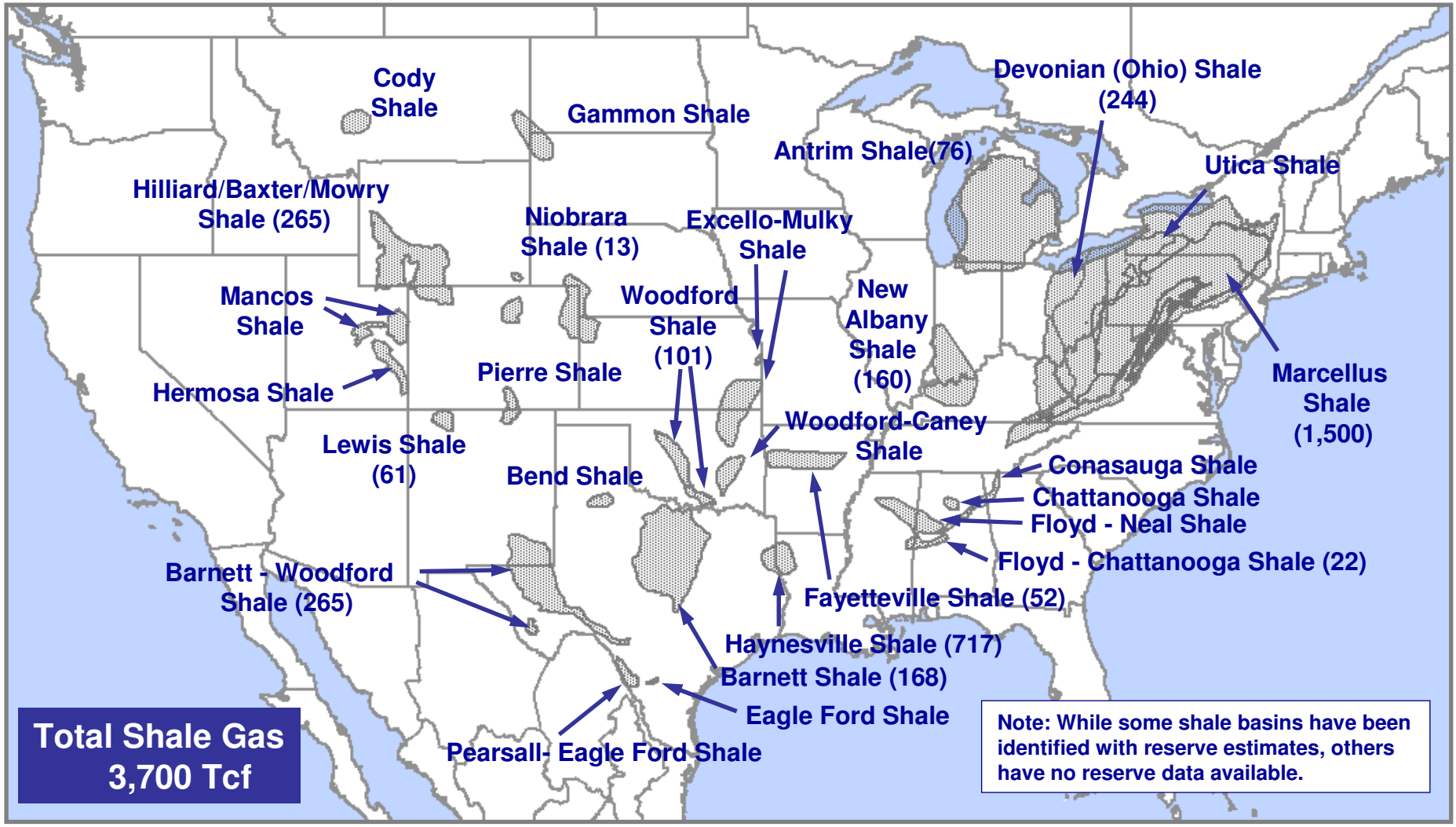
Source: Ziff Energy Group "Shale Gas Outlook to 2020" April 8, 2009

Future U.S. Gas Supply



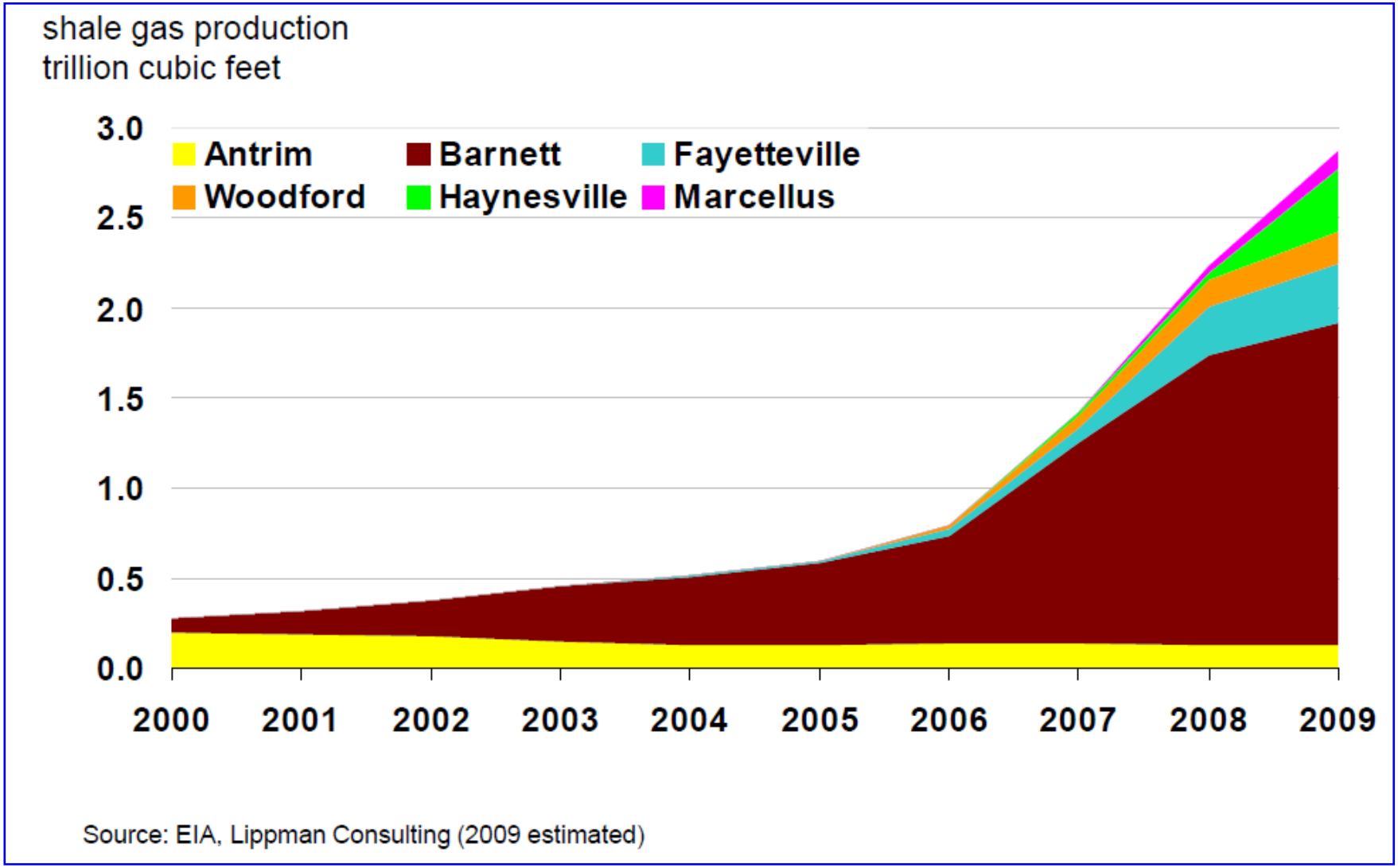
Source: EIA Annual Energy Outlook 2010 and EIA spreadsheets.

United States Shale Basins
Maximum Reported Gas-in-Place (in Tcf)



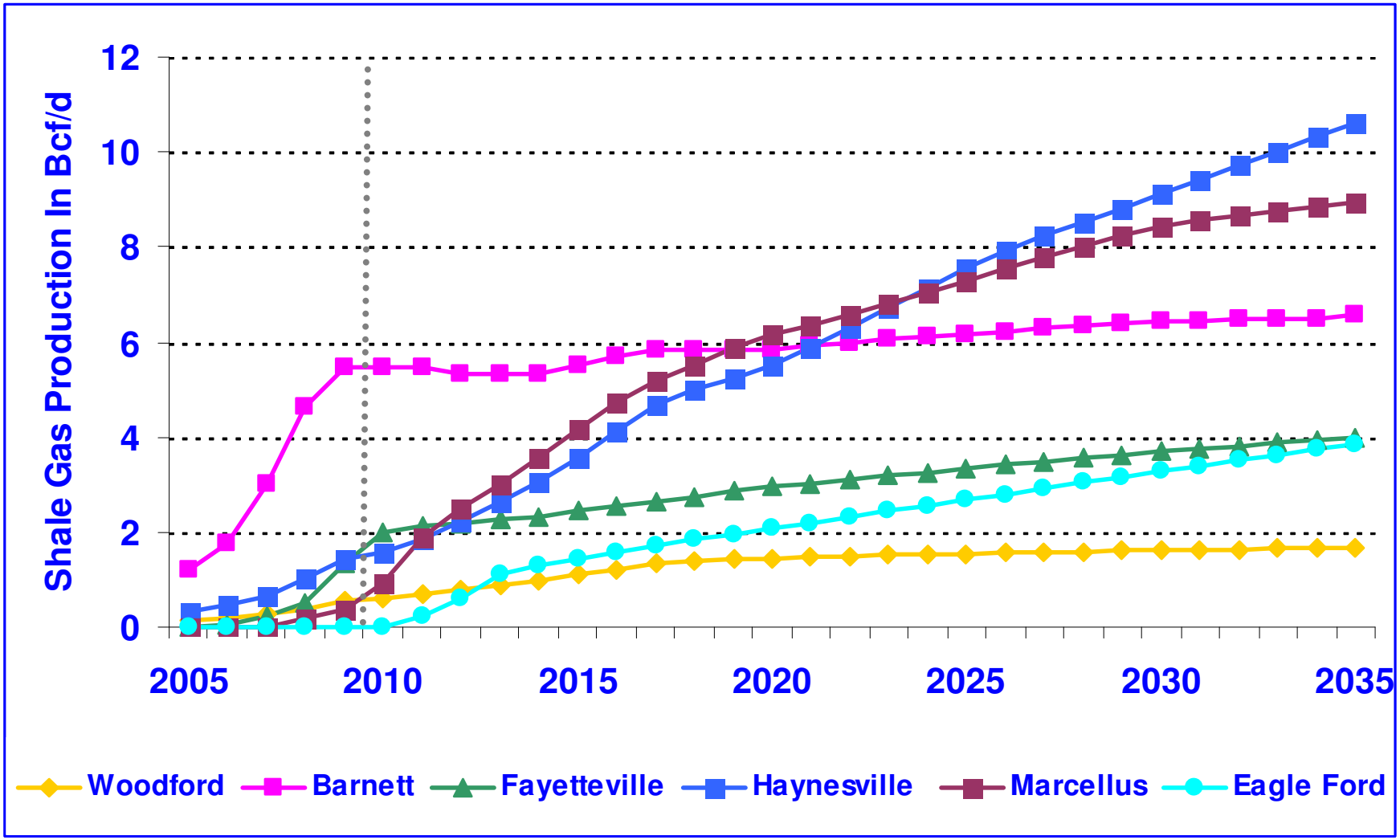
Source: Ventyx Velocity Suite 2010 and Navigant Consulting's North American Natural Gas Supply Assessment – July 4, 2008

Shale Gas Production



Source: Glen Sweetnam, EIA, April 7, 2010 at 2010 Energy Conference.

Shale Gas Estimates



Source: ICF International Data Base and Compass Report July 2010

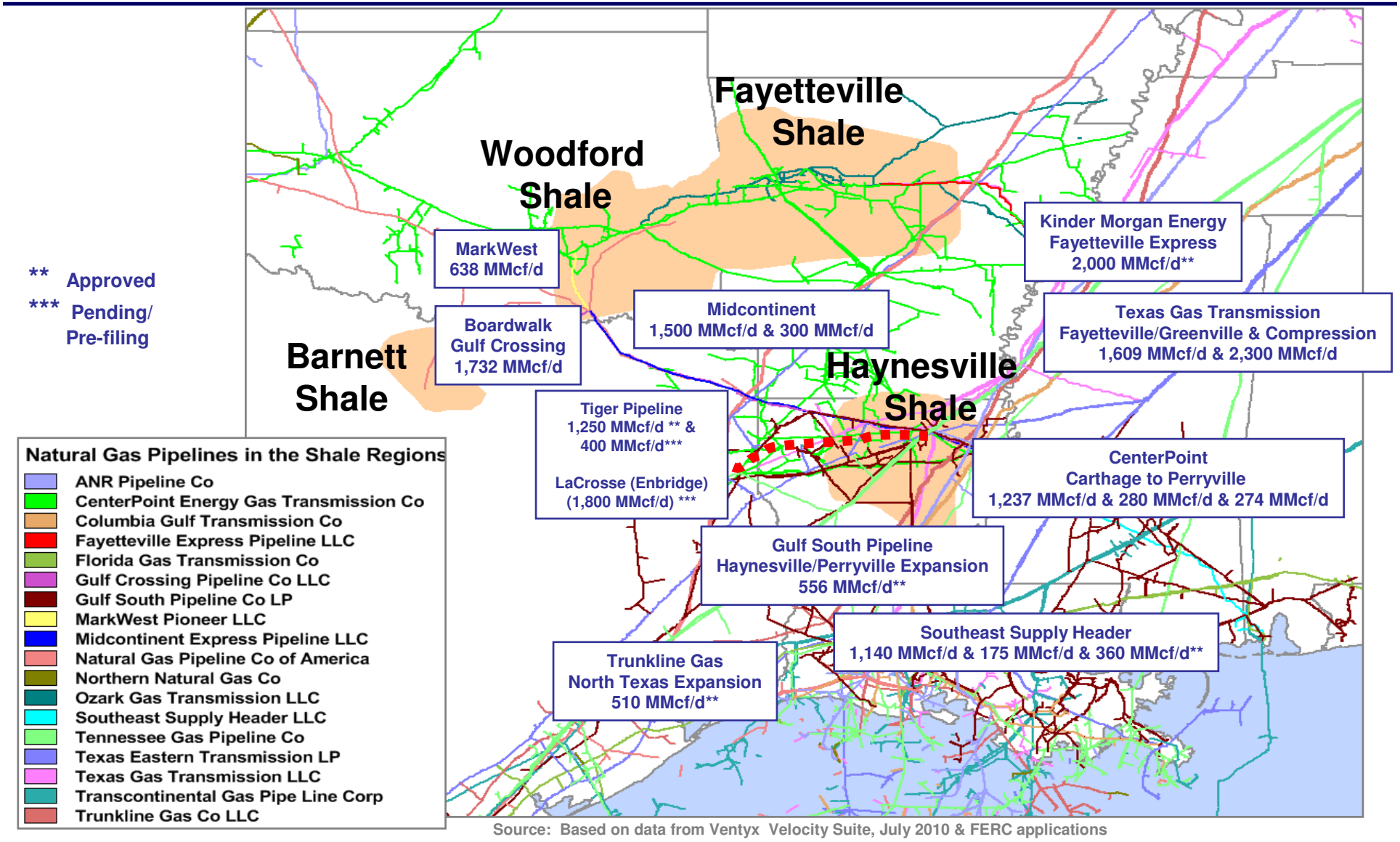
Summary of FERC Related Projects and Potential Projects Impacting the Shale Basins

FERC Natural Gas Basin	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)	Cost (Millions)
Total Barnett	2,027	230	91,940	$602
Total Barnett, Wooford &	3,532	877	290,070	$3,517
Total Fayetteville	5,979	448	122,107	$2,240
Total Woodford	638	50	19,500	$134
Total Haynesville	2,230	196	229,716	$1,425
Total Marcellus	6,132	650	369,692	$2,319
Total Various Supplies	5,710	978	328,334	$2,168
Grand Total	26,248	3,429	1,451,359	$12,405

Potential Natural Gas Basin	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)
Total Barnett	2,139	40	9,500
Total Barnett & Woodford	1,800	175	70,000
Total Fayetteville	1,100	346	100,000
Total Bakken	130	100	0
Total Haynesville	1,100	0	20,260
Total Marcellus	6,108	993	0
Grand Total	12,377	1,654	199,760

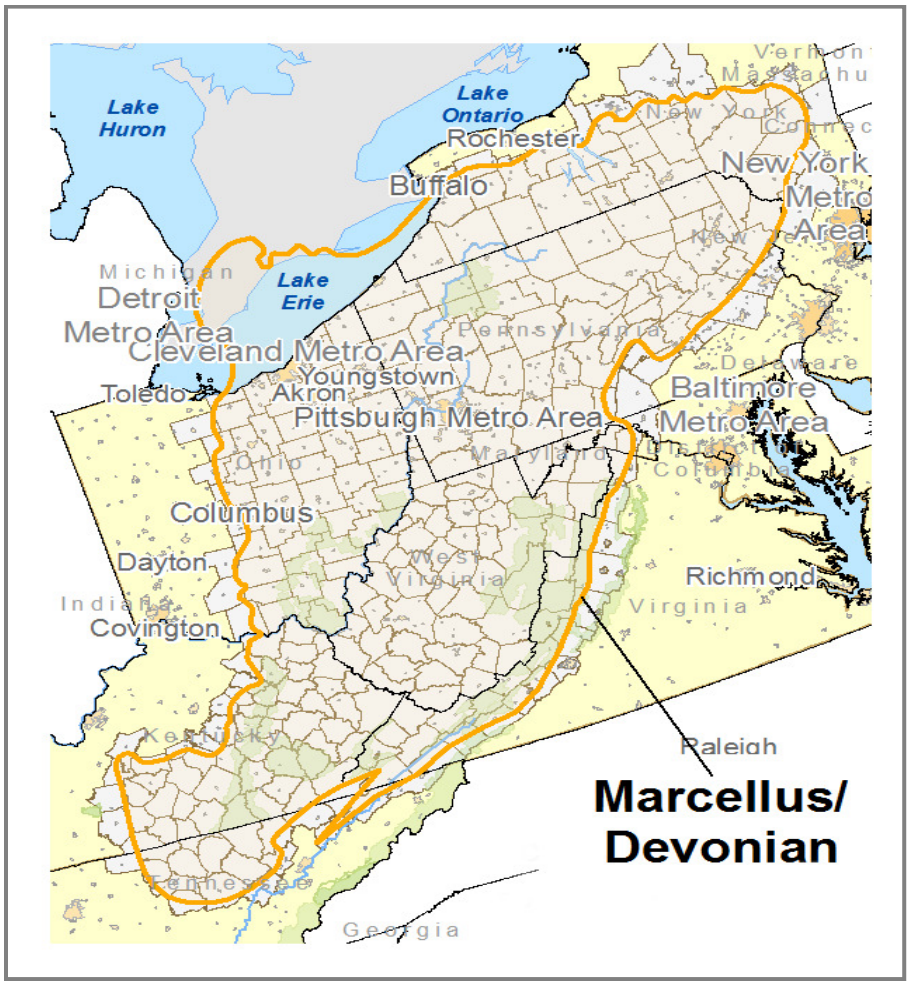
Source: FERC

Major Projects to move shale gas out of East Texas and Arkansas.



Source: Based on data from Ventyx Velocity Suite, July 2010 & FERC applications

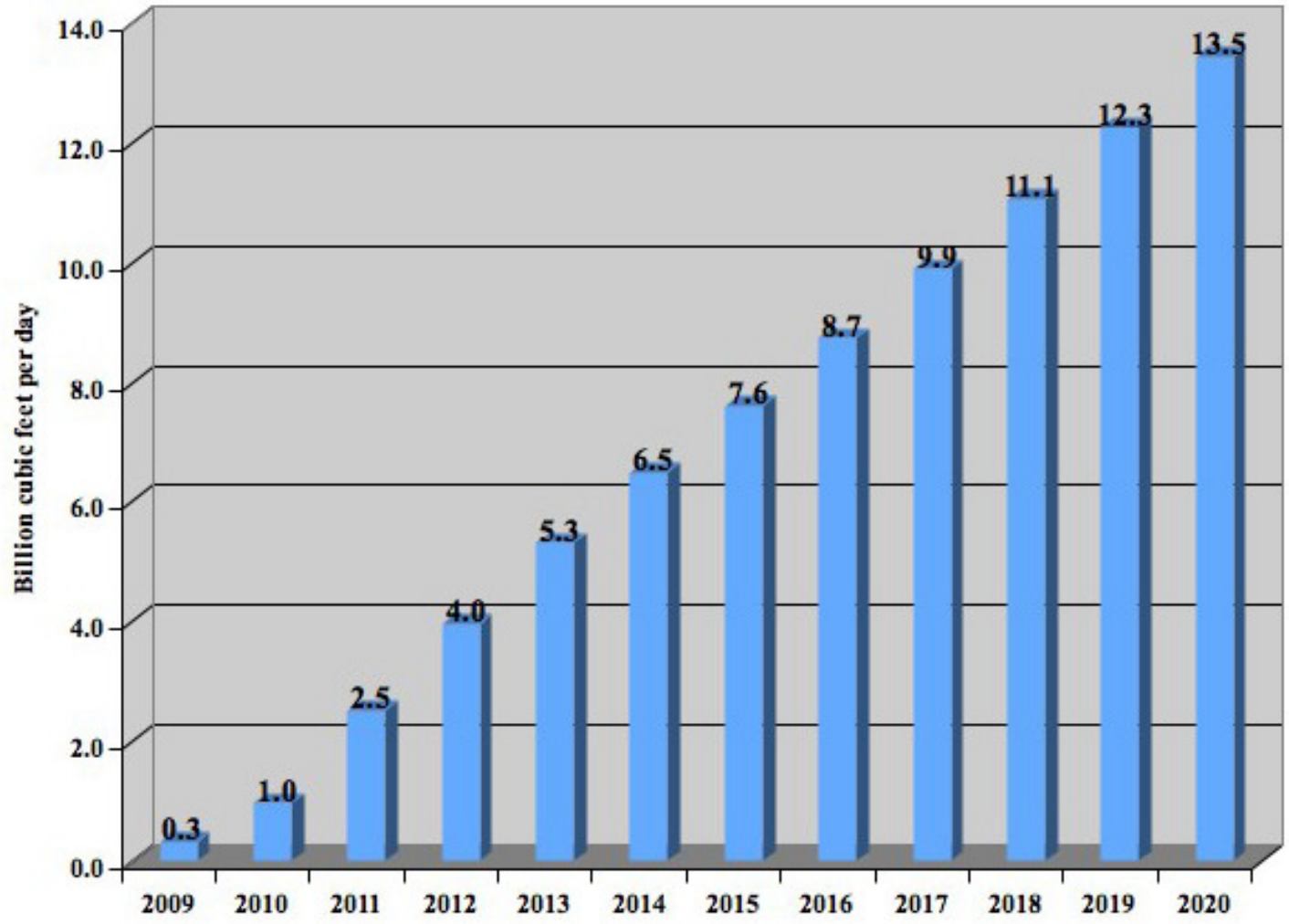
Marcellus Shale in the Appalachian Basin



- The Marcellus Shale spans six states in the northeastern U.S.
- Covers an area of 95,000 square miles at an average thickness of 50 ft to 200 ft
- Estimated depth of production is between 4,000 ft and 8,500 ft
- As of September 2008, there were a total of 518 wells permitted in Pennsylvania and 277 of the approved wells have been drilled
- The average well spacing is 40 to 160 acres per well
- The technically recoverable resources is estimated to be 262 Tcf
- The amount of gas in place is estimated to be up to 1,500 Tcf

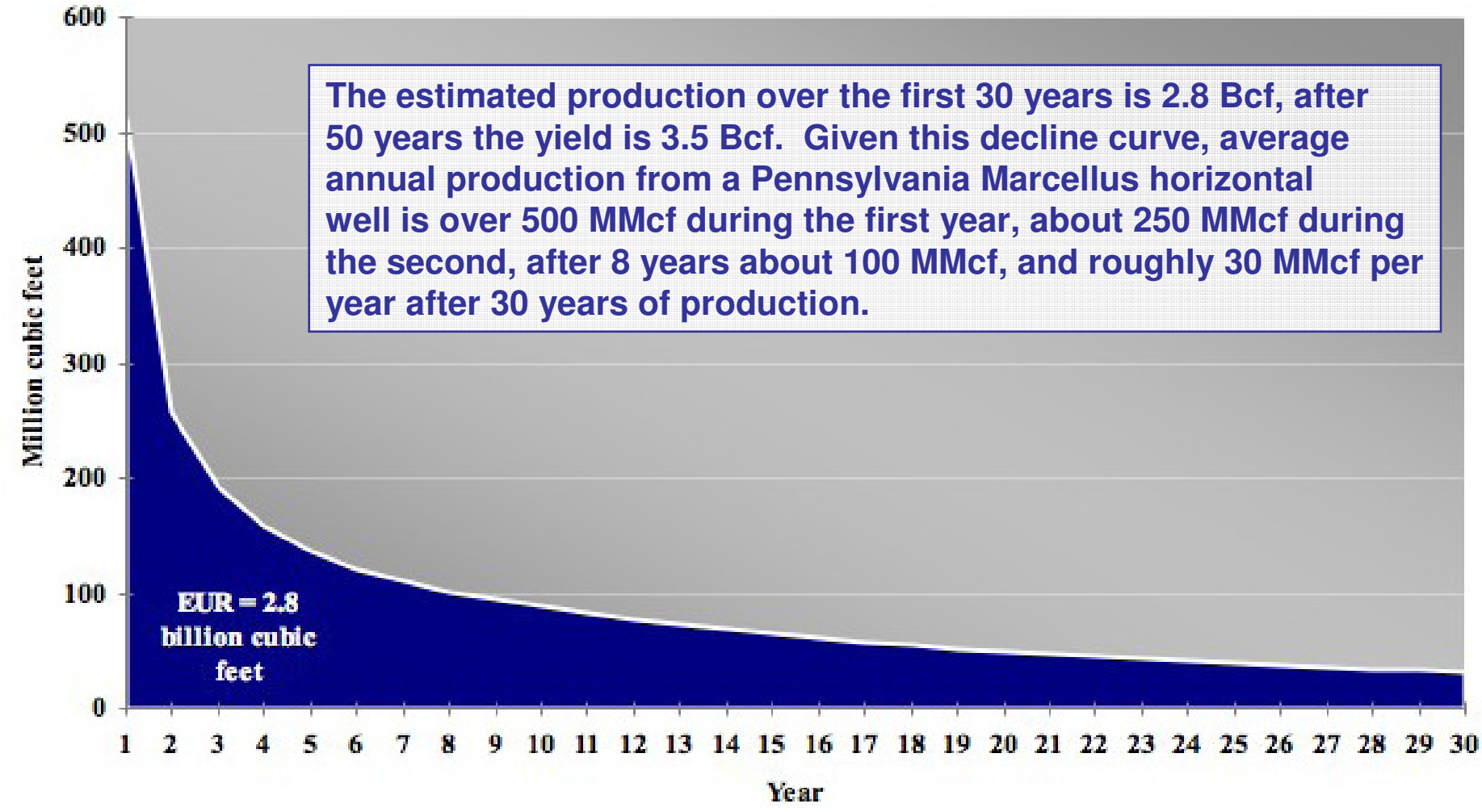
Source: Exhibit 19 and text - Marcellus Shale in the Appalachian Basin, DOE's Modern Shale Gas Development in the United States; A Primer, dated April 2009

Forecast for Marcellus Natural Gas Production in Pennsylvania, 2010 - 2020



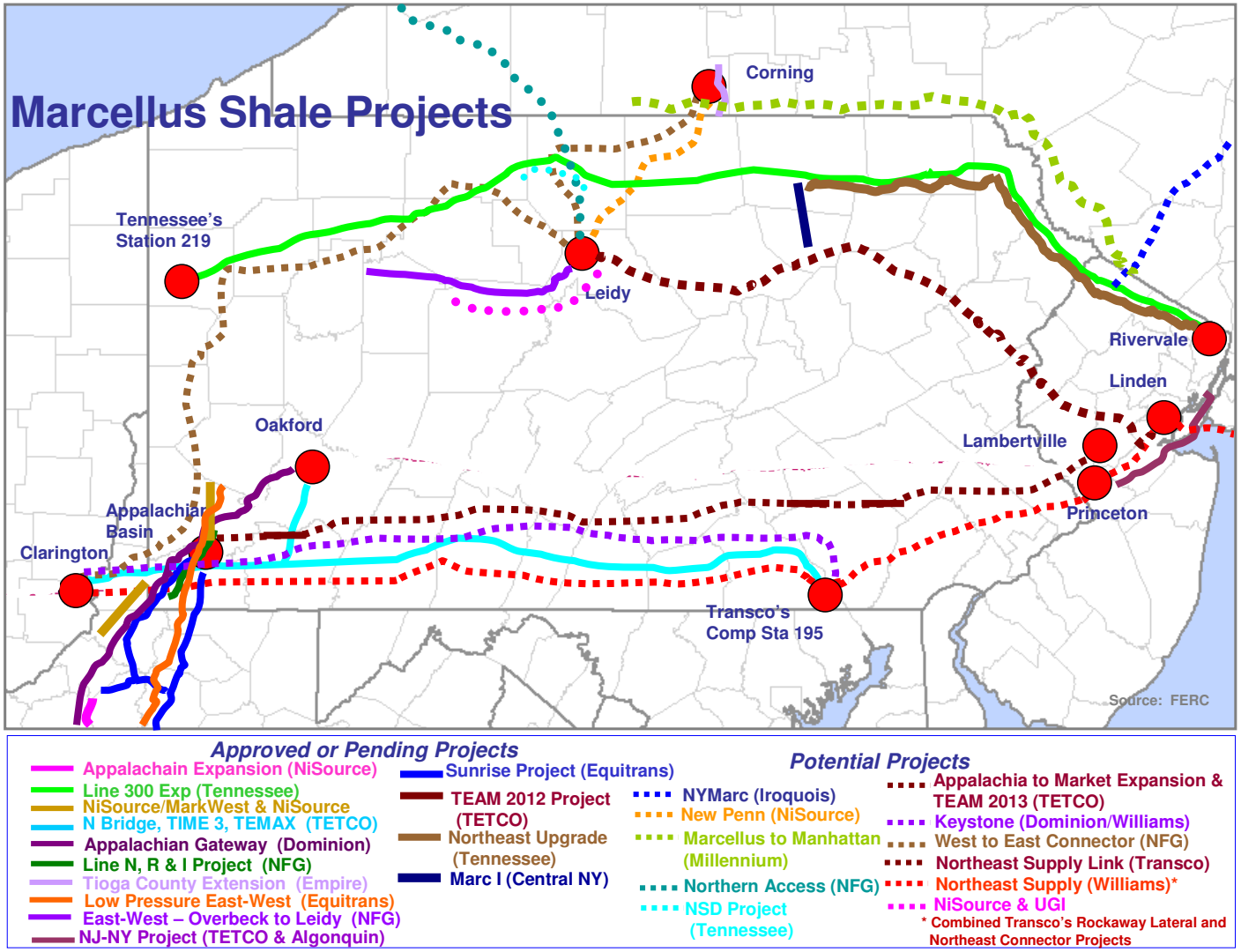
Source: Figure 8 of The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play: An Update by Timothy J. Considine, Ph.D., Robert Watson, Ph.D, P.E., and Seth Blumsack, Ph.D. PennState May 24, 2010

Annual Production Decline Curve for Typical Marcellus Horzontal Well



Source: Figure 6 of The Economic Impacts of the Pennsylvania Marcellus Shale Natural Gas Play: An Update by Timothy J. Considine, Ph.D., Robert Watson, Ph.D, P.E., and Seth Blumsack, Ph.D. PennState May 24, 2010

Marcellus Shale Projects



Source: FERC

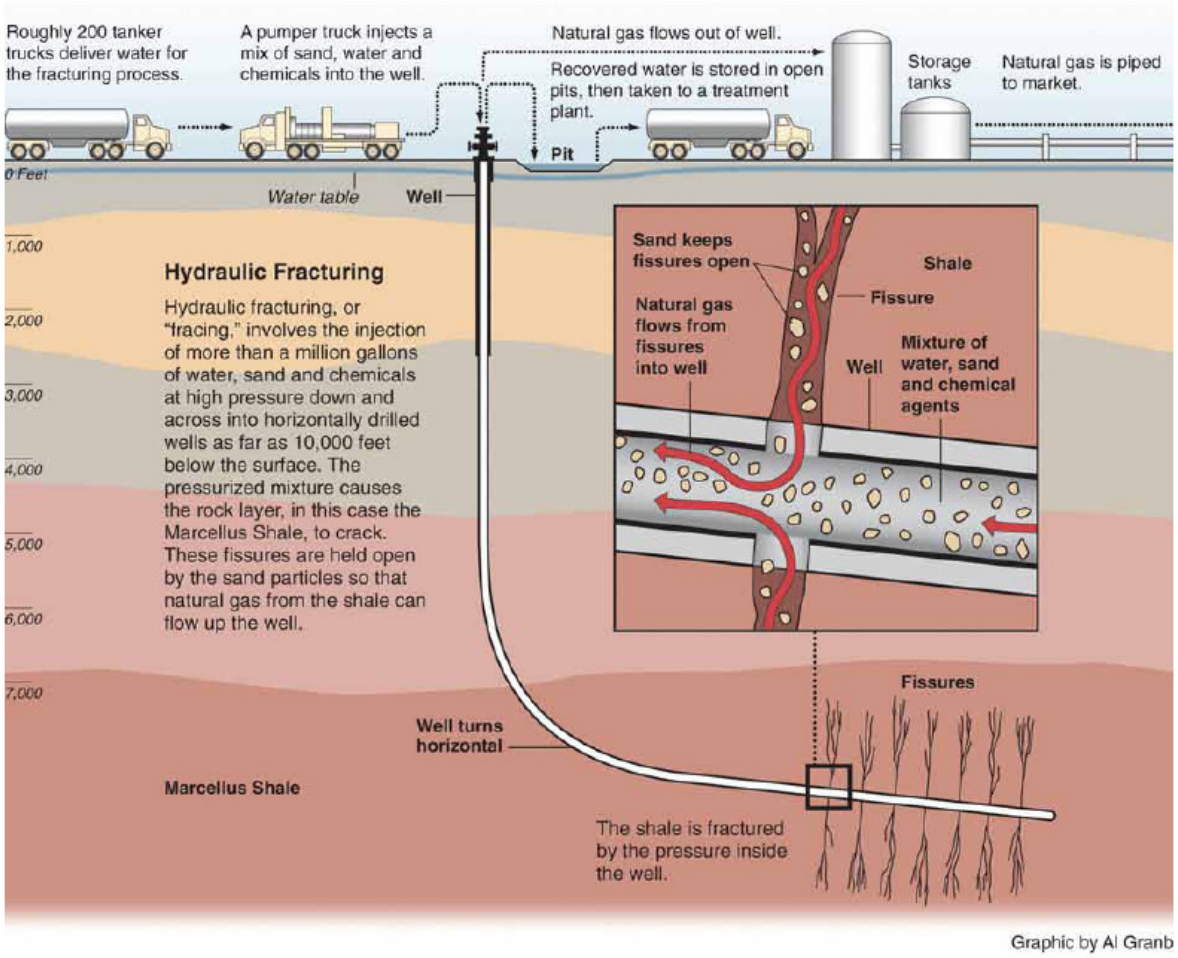
Summary of Natural Gas Facilities Impacting the Marcellus Shale Basin

Natural Gas Basin	Status	Company/Project	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)
Marcellus	Approved	Texas Eastern Transmission, LP (TEMAX and TIME III projects)	455	62	84,433
Marcellus	Approved	Texas Eastern Transmission, LP (Northern Bridge Project)	150	0	10,666
Marcellus	Approved	Columbia Gas Transmission, LLC (Appalachian Expansion Project)	100	0	9,470
Marcellus	Approved	Tennessee Gas Pipeline Company (Line 300 Expansion)	350	129	59,158
Marcellus	Prior-Notice	Columbia Gas Transmission, LLC (Majorsville Compressor/MarkWest Upgrade)	250	4	0
Marcellus	Prior-Notice	Columbia Gas Transmission, LLC	150	6	0
Marcellus	Prior-Notice	Equitrans, LP (Low Pressure East and West Upgrade Project)	92	0	0
Marcellus	Pending	Dominion Transmission, Inc. (Appalachian Gateway Project)	484	107	17,965
Marcellus	Pending	Central New York Oil and Gas Company (MARC I Project)	550	39	31,660
Marcellus	Pre-Filing	National Fuel Gas Supply Corporation (Line N R & I Project)	150	18	5,000
Marcellus	Pre-Filing	National Fuel Gas Supply Corporation (East to West/Overbeck to Leidy)	425	82	25,000
Marcellus	Pre-Filing	Texas Eastern Transmission & Algonquin Gas Transmission (NJ-NY Project	800	16	0
Marcellus	Pre-Filing	Equitrans, LP (Sunrise Project)	1,000	112	85,000
Marcellus	Pre-Filing	Texas Eastern Transmission, LLC (TEAM 2012 Project)	190	22	20,720
Marcellus	Pre-Filing	Tennessee Gas Pipeline Company (Northeast Upgrade Project)	636	37	20,620
Marcellus	Pending	Empire Pipeline, Inc (Tioga County Extension)	350	16	0
Total			6,132	650	369,692

Natural Gas Basin	Status	Company/Project	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)
Marcellus	Potential	Nisource (New Penn)	500	82	
Marcellus	Potential	TETCO (Appalachia to Market Expansion- TEAM)	500		
Marcellus	Potential	Dominion/Williams (Keystone Connector)	1,000	240	
Marcellus	Potential	Williams (Northeast Supply)	688	250	
Marcellus	Potential	NFG (West to East Connector)	625	324	
Marcellus	Potential	Iroquois Gas Transmission System LP (NYMarc System Project)	500	66	0
Marcellus	Potential	Millennium Pipeline (Marcellus to Manhattan)	675	0	0
Marcellus	Potential	National Fuel Gas Supply Company (Northern Access Expansion)	450	0	0
Marcellus	Potential	Tennessee Gas Pipeline Company (Northeast Supply Diversification Project)	250	7	0
Marcellus	Potential	NiSource Gas Transmission and Storage & UGI Corporation	500	0	0
Marcellus	Potential	Transcontinental Gas Pipe Line Corporation (Northeast Supply Link)	420	24	0
Total			6,108	993	0

Source: FERC

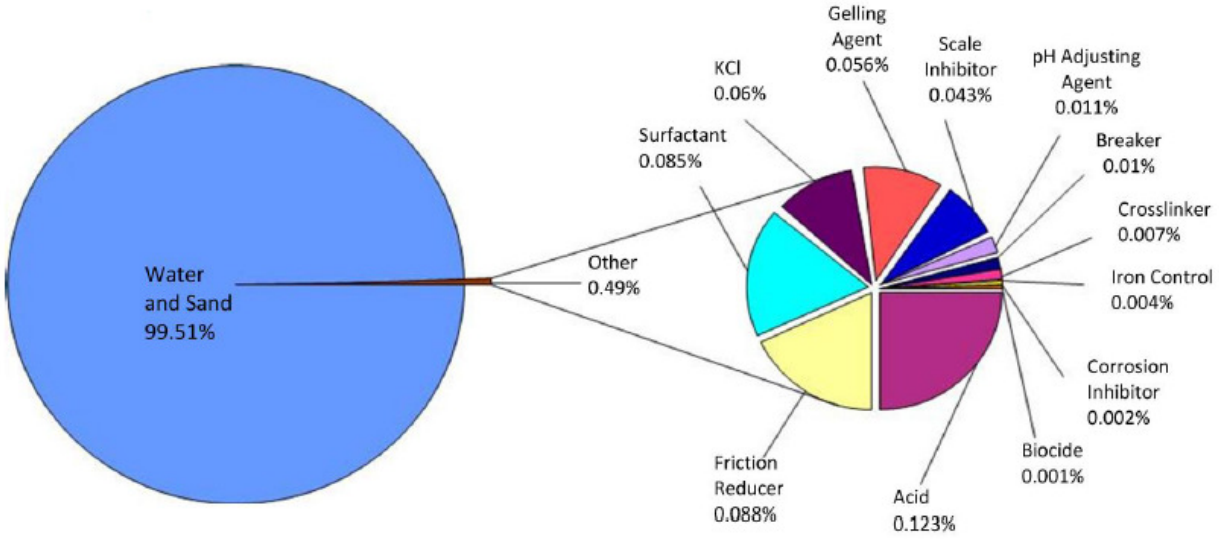
Hydraulic Fracturing in Shale



- In order to produce shale gas, new drilling technologies have been developed.
- Hydraulic fracturing and horizontal drilling have allowed previously unrecoverable sources of gas to be developed economically and environmentally safe manner.
- CERA – 2 to 4 million gallons of water is required to drill and complete a well.
- CERA – Fracturing generally takes place below drinking water aquifers with impermeable formations in between.

Source: Environmental America Research and Policy Center – Toxic Chemicals on Tap – November 2009, and CERA's Friction Over Fraccing

Volumetric Composition of a Fracture Fluid

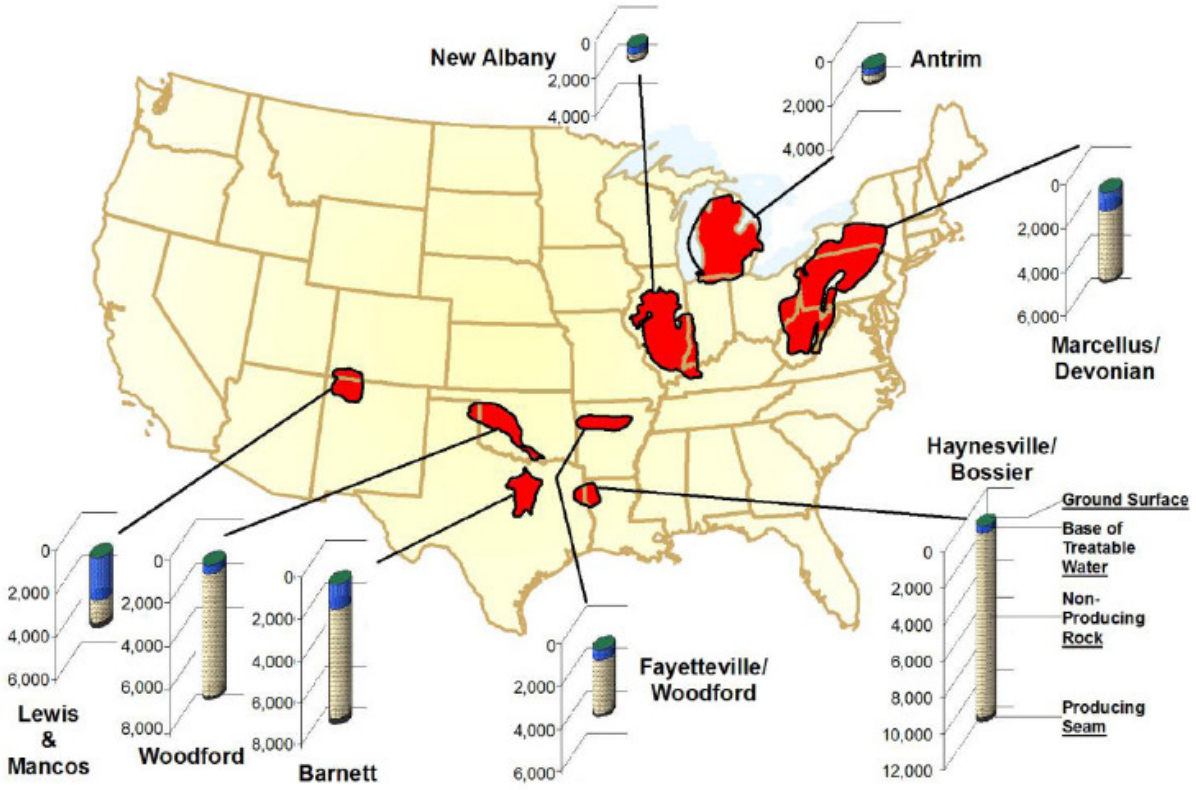


Source: ALL Consulting based on data from a fracture operation in the Fayetteville Shale, 2008

- Hydraulic fracturing used for a nine-stage hydraulic fracturing treatment of a Fayetteville Shale horizontal well
- Make-up of fracturing fluid varies from one geologic basin or formation to another
- Additives represent less than 0.5% of the total fluid volume
- Overall the concentration of additives in most slickwater fracturing fluids is a relatively consistent 0.5% to 2% with water making up 98% to 99.5%

Source: DOE's Modern Shale Gas Development in the United States: A Primer April 2009

Volumetric Composition of a Fracture Fluid



Source: Compiled from Various Data Sources

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- **Hydraulic fracturing used for a nine-stage hydraulic fracturing treatment of a Fayetteville Shale horizontal well**
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Estimated Water Needs for Drilling and Fracturing in Selected Shale Gas Plays

The drilling and hydraulic fracturing of a horizontal shale gas well may typically require 2 to 4 million gallons of water, with about 3 million gallons being the most common.

Shale Gas Play	Volume of Drilling Water per well (gal)	Volume of Fracturing Water per well (gal)	Total Volumes of Water per well (gal)
Barnett Shale	400,000	2,300,000	2,700,000
Fayetteville Shale	60,000*	2,900,000	3,060,000
Haynesville Shale	1,000,000	2,700,000	3,700,000
Marcellus Shale	80,000*	3,800,000	3,880,000

* Drilling performed with an air "mist" and/or water-based or oil-based muds for deep horizontal well completions.

Note: These volumes are approximate and may vary substantially between wells.

Source: ALL Consulting from discussions with various operators, 2008

Source: DOE's Modern Shale Gas Development in the United States: A Primer April 2009

Re-Exports of LNG

- Freeport LNG Development LP – CP03-75-003, Order May 6, 2009 authorized re-exports of imported LNG
- Cheniere Sabine Pass LNG – CP04-47-001, Order May 29, 2009 also authorized re-exports of imported LNG
- Cameron LNG, LLC – CP10-496-000, September 3, 2010 filing seeking same re-export authority
- Approximately 9.7 Bcf has been re-exported to South Korea, Spain and Japan.

Sabine Pass Liquefaction Project

- Docket No. PF10-24-000 - Sabine Pass Liquefaction, LLC and Sabine Pass LNG
- Proposed project to liquefy surplus supplies of domestic natural gas for export to foreign markets
- Four LNG liquefaction trains designed to process an average of 2.4 Bcf/d delivered to Sabine Pass terminal through Cheniere Creole Trail Pipeline
- Application with FERC 2/2011; anticipate Order by 12/2011; start construction 1/2012; liquefaction in service 2015

Sabine Pass Liquefaction Project

- On 9/7/2010, DOE granted Sabine long-term authority to export LNG from its Sabine Pass terminal to free trade nations
- 800 Bcf per year for 30 years starting no later than 10 years from authorization, i.e., 9/7/2020
- Must have one or more long-term (greater than two years) export contracts with third parties for up to 30 years by 9/7/2020
- export LNG to Australia, Bahrain, Singapore, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Chile, Morocco, Canada, Mexico, Oman, Peru, Singapore, Jordan, and to any nation that later enters into a free-trade agreement with the US covering natural gas

Market Knows Best

- FERC is not the market
- FERC will present a “menu” of infrastructure solutions that are:
  - In the public interest
  - Will cause the least environmental impact
  - Will be safe
- The market is in the best position to select the infrastructure projects that get built

Conclusions

- The Commission process has benefited all stakeholders in natural gas projects
- More needs to be done
  - Turn opposition into understanding
  - Continue to refine the siting process
- More infrastructure is coming
  - Alaska
  - Pipes from non-traditional sources
  - Hydrokinetics
  - Electric transmission

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