Advances in Domestic Oil Recovery

American Petroleum Institute
www.api.org

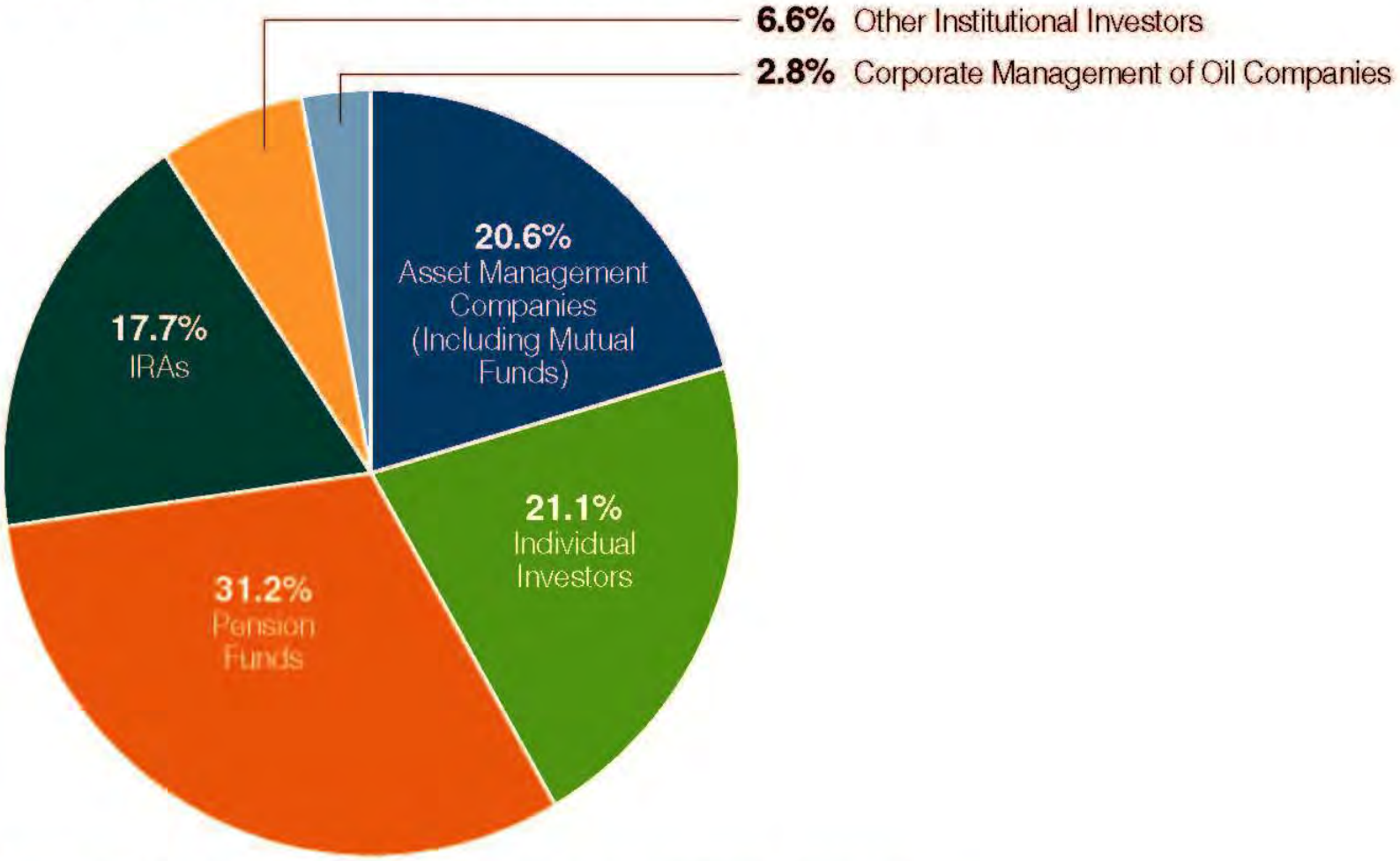
Table E-1. Total Impacts of the Oil and Natural Gas Industry's Operations and Capital Investments on the U.S. Economy, 2009

Item	Amount	Percent of U.S. Total
Operational Impact		
Employment*	7,978,636	4.6%
Labor Income ($ millions)**	$466,869	5.3%
Value Added ($ millions)	$966,324	6.8%
Capital Investment Impact		
Employment*	1,181,930	0.7%
Labor Income ($ millions)**	$66,679	0.8%
Value Added ($ millions)	$115,377	0.8%
Total Impacts		
Employment*	9,160,566	5.3%
Labor Income ($ millions)**	$533,548	6.0%
Value Added ($ millions)	$1,081,701	7.7%

Source: PwC calculations using the IMPLAN modeling system (2009 database).
Details may not add to totals due to rounding.

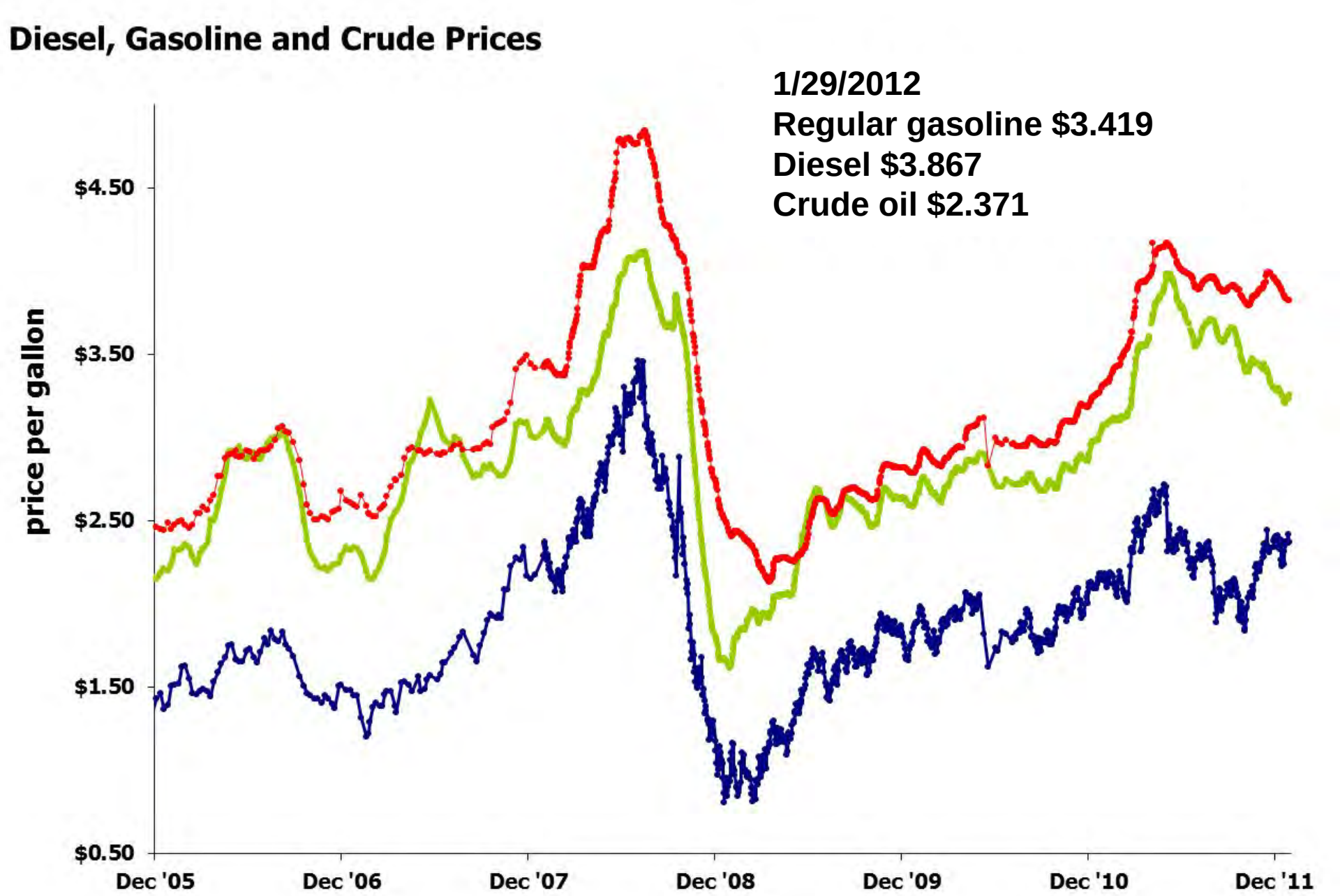
* Employment is defined as the number of payroll and self-employed jobs, including part-time jobs.
** Labor income is defined as wages and salaries and benefits as well as proprietors' income.

Who Owns "Big Oil?" (Holdings of Oil Stocks, 2011)



Source: *Who Owns America's Oil and Natural Gas Companies*, SONECON, October 2011.

Diesel, Gasoline and Crude Prices

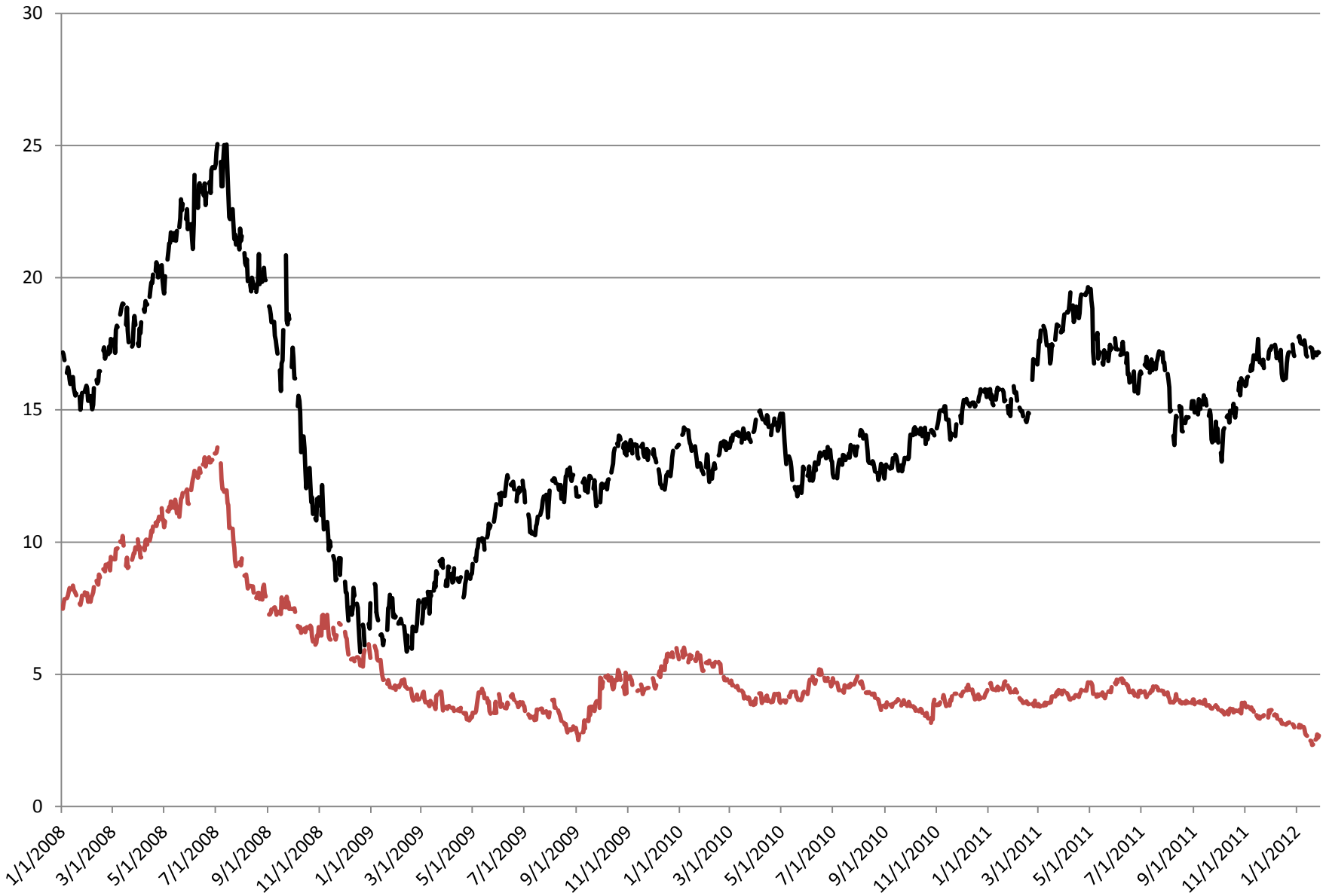


Source: NYMEX (WTI crude oil) and AAA (gasoline and diesel)

Oil prices relate to many uncertain factors

U.S. Energy Information Administration

NYMEX Prices for Crude oil and Natural Gas



Gentlemen, we can rebuild him. **We have the technology**.

Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

Table 1. INTEK estimates of undeveloped technically recoverable shale gas and shale oil resources remaining in discovered shale plays as of January 1, 2009

Onshore Lower-48 Oil and Gas Supply Submodule region	Shale play	Shale gas resources (trillion cubic feet)	Shale oil resources (billion barrels)
Northeast	Marcellus	410	--
	Antrim	20	--
	Devonian Low Thermal Maturity	14	--
	New Albany	11	--
	Greater Sittstone	8	--
	Big Sandy	7	--
	Cincinnati Arch*	1	--
Subtotal		472	--
Percent of total		63%	--
	Haynesville	75	--
	Eagle Ford	21	3
	Floyd-Neal & Conasauga	4	--
Subtotal		100	3
Percent of total		13%	14%
Mid-Continent	Fayetteville	32	--
	Woodford	22	--
	Cana Woodford	6	--
Subtotal		60	--
Percent of total		8%	--

Table 1. INTEK estimates of undeveloped technically recoverable shale gas and shale oil resources remaining in discovered shale plays as of January 1, 2009

Southwest	Barnett	43	--
	Barnett-Woodford	32	--
	Avalon & Bone Springs	--	2
Subtotal		76	2
Percent of total		10%	7%
Rocky Mountain	Mancos	21	--
	Lewis	12	--
	Williston-Shallow Niobraran*	7	--
	Hilliard-Baxter-Mancos	4	--
	Bakken	--	4
Subtotal		43	4
Percent of total		6%	15%
West Coast	Monterey/Santos	--	15
Subtotal		--	15
Percent of total		--	64%
Total onshore Lower-48 States		750	24

Table i U.S. Shale Gas Unproved Discovered Technically Recoverable Resources Summary

Play	Technically Recoverable Resource		Area (sq. miles)		Average EUR	
	Gas (Tcf)	Oil (BBO)	Leased	Unleased	Gas (Bcf/ well)	Oil (MBO/ well)
Marcellus	410.34	…	10,622	84,271	1.18	…
Big Sandy	7.40	…	8,675	1,994	0.33	…
Low Thermal Maturity	13.53	…	45,844		0.30	…
Greater Siltstone	8.46	…	12,914		0.19	…
New Albany	10.95	…	1,600	41,900	1.10	…
Antrim	19.93	…	12,000		0.28	…
Cincinnati Arch*	1.44	…	NA		0.12	…
Total Northeast	**472.05**	…	**101,655**	**128,272**	**0.74**	…
Haynesville	74.71	…	3,574	5,426	3.57	…
Eagle Ford	20.81	…	1,090		5.00	…
Floyd-Neal & Conasauga	4.37	…	2,429		0.90	…
Total Gulf Coast	**99.99**	…	**7,093**	**5,426**	**2.99**	…
Fayetteville	31.96	…	9,000		2.07	…
Woodford	22.21	…	4,700		2.98	…
Cana Woodford	5.72	…	688		5.20	…
Total Mid-Continent	**59.88**	…	**14,388**		**2.45**	…
Barnett	43.38	…	4,075	2,383	1.42	…
Barnett Woodford	32.15	…	2,691		3.07	…
Total Southwest	**75.52**	…	**6,766**	**2,383**	**1.85**	…
Hilliard-Baxter-Mancos	3.77	…	16,416		0.18	…
Lewis	11.63	…	7,506		1.30	…
Williston-Shallow Niobraran*	6.61	…	NA		0.45	…
Mancos	21.02	…	6,589		1.00	…
Total Rocky Mountain	**43.03**	…	**30,511**		**0.69**	…
Total Lower 48 U.S.	**750.38**	…	**160,413**	**136,081**	**1.02**	…

Table ü U.S. Technically Recoverable Shale Oil Resources Summary

Play	Technically Recoverable Resource		Area (sq. miles)		Average EUR	
	Gas (Tcf)	Oil (BBO)	Leased	Unleased	Gas (Bcf/ well)	Oil (MBO/ well)
Eagle Ford	…	3.35	3,323		…	300
Total Gulf Coast	**…**	**3.35**	**3,323**		**…**	**300**
Avalon & Bone Springs	…	1.58	1,313		…	300
Total Southwest	**…**	**1.58**	**1,313**		**…**	**300**
Bakken	…	3.59	6,522		…	550
Total Rocky Mountain	**…**	**3.59**	**6,522**		**…**	**550**
Monterey/Santos	…	15.42	1,752		…	550
Total West Coast	**…**	**15.42**	**1,752**		**…**	**550**
Total Lower 48 U.S.	**…**	**23.94**	**12,910**		**…**	**460**

Figure 1 Northeast Shale Gas and Shale Oil Resources

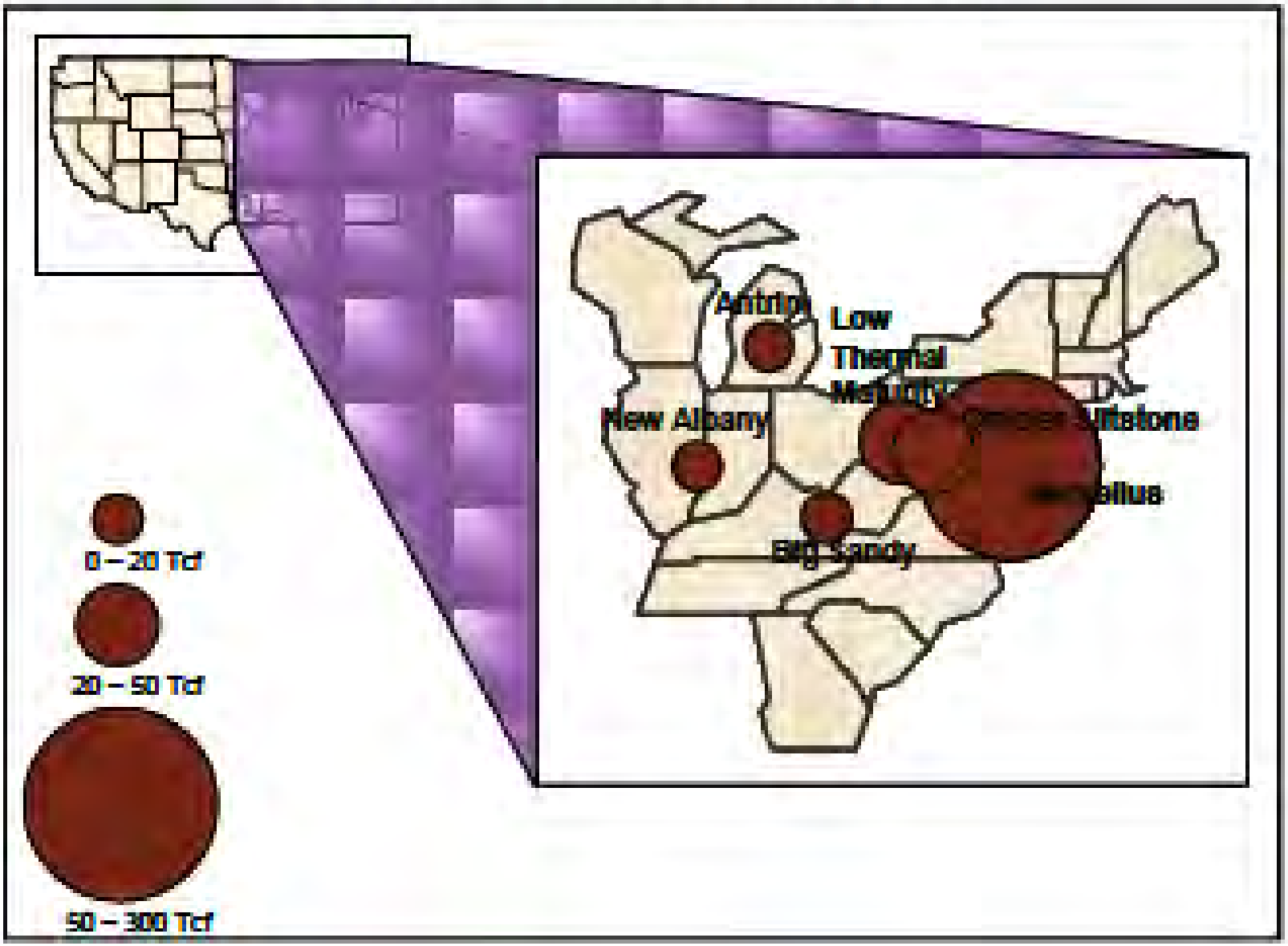
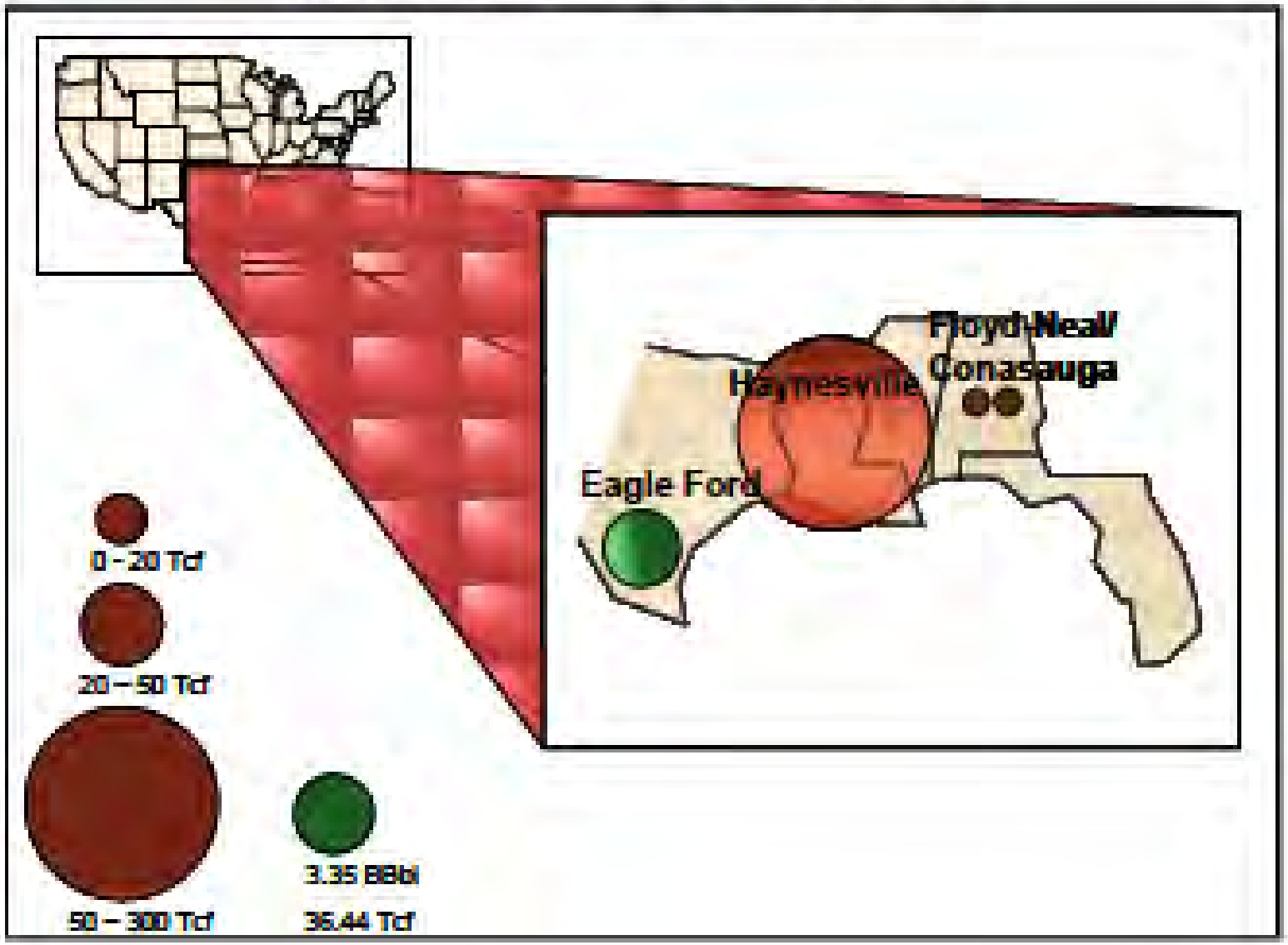


Figure 8 Gulf Coast Shale Gas and Shale Oil Resources



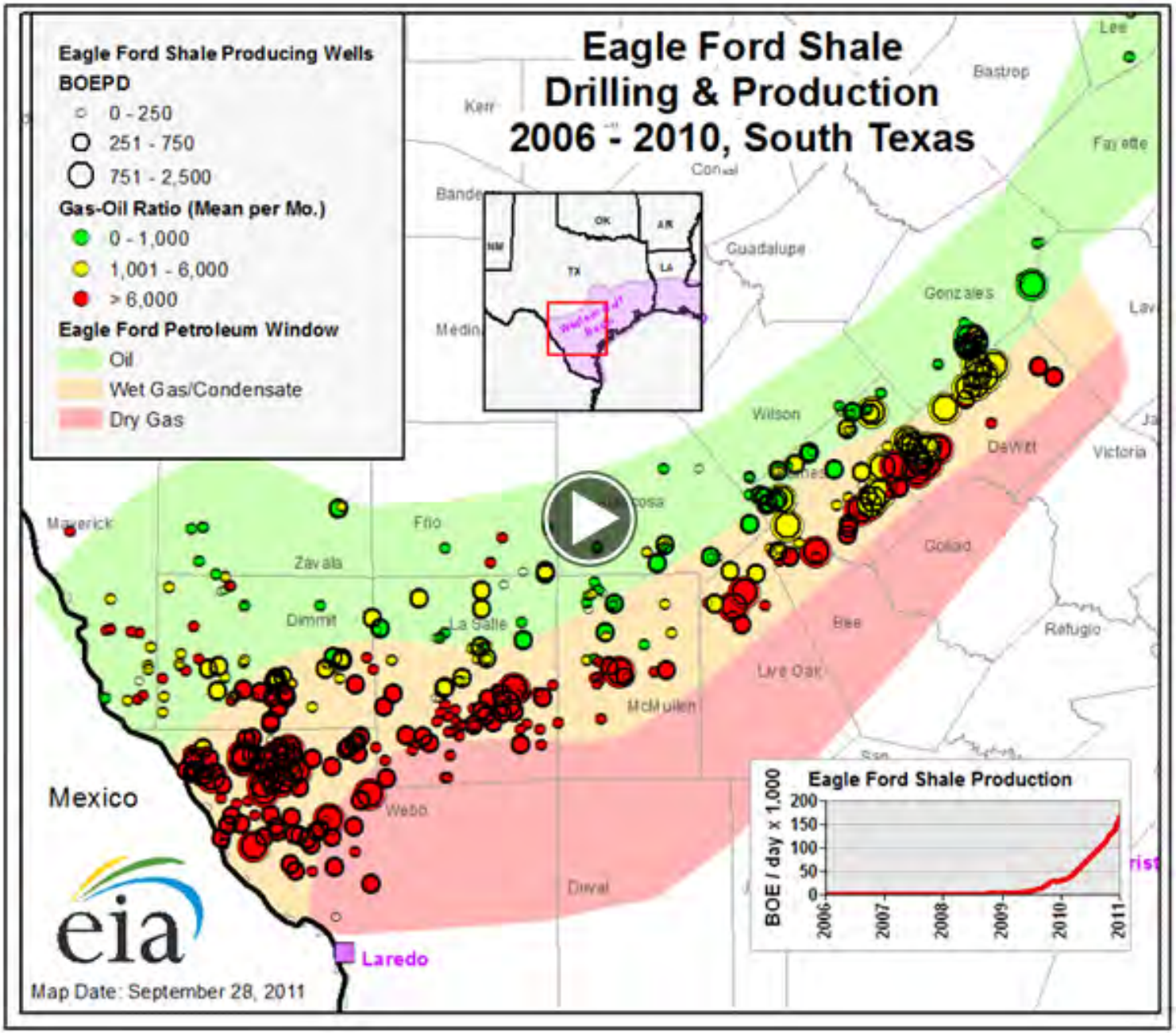

Eagle Ford Shale
Drilling & Production
2006 - 2010, South Texas
Eagle Ford Shale Producing Wells
BOEPD
0 - 250
251 - 750
751 - 2,500
Gas-Oil Ratio (Mean per Mo.)
0 - 1,000
1,001 - 6,000
> 6,000
Eagle Ford Petroleum Window
Oil
Wet Gas/Condensate
Dry Gas
Mexico
Laredo
Map Date: September 28, 2011
eia
Eagle Ford Shale Production
BOE / day x 1,000
200
150
100
50
0
2006
2007
2008
2009
2010
2011
Lee
Bastrop
Fayette
Kerr
Bandera
Guadalupe
Gonzales
Wilson
DeWitt
Victoria
Goliad
Refugio
Bee
Live Oak
McMullen
La Salle
Dimmit
Maverick
Zavala
Frio
Webb
Duval
OK
AR
NM
TX
LA

Figure 14 Mid-Continent Shale Gas and Shale Oil Resources

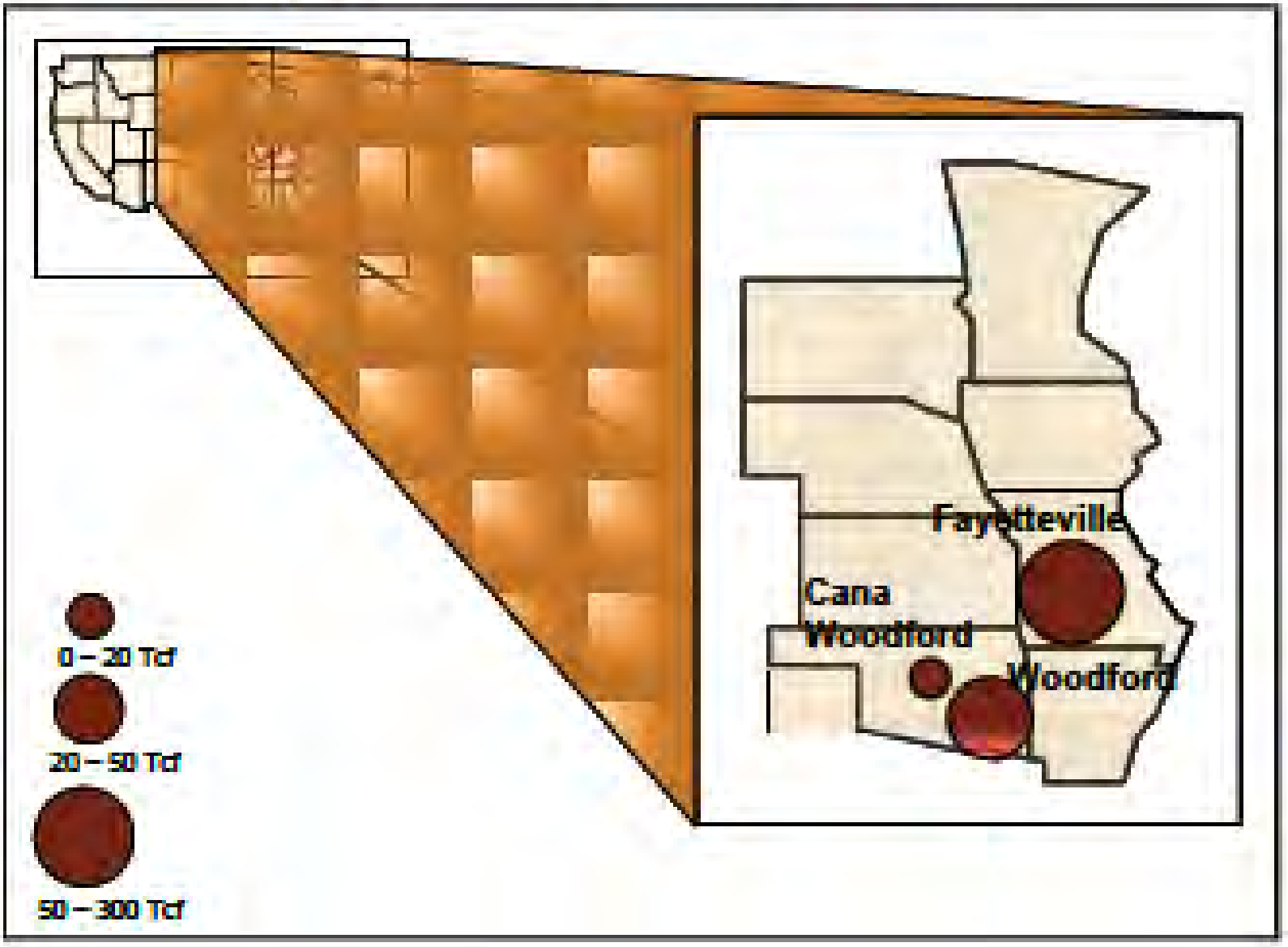


Figure 20 Southwest Shale Gas and Shale Oil Resources

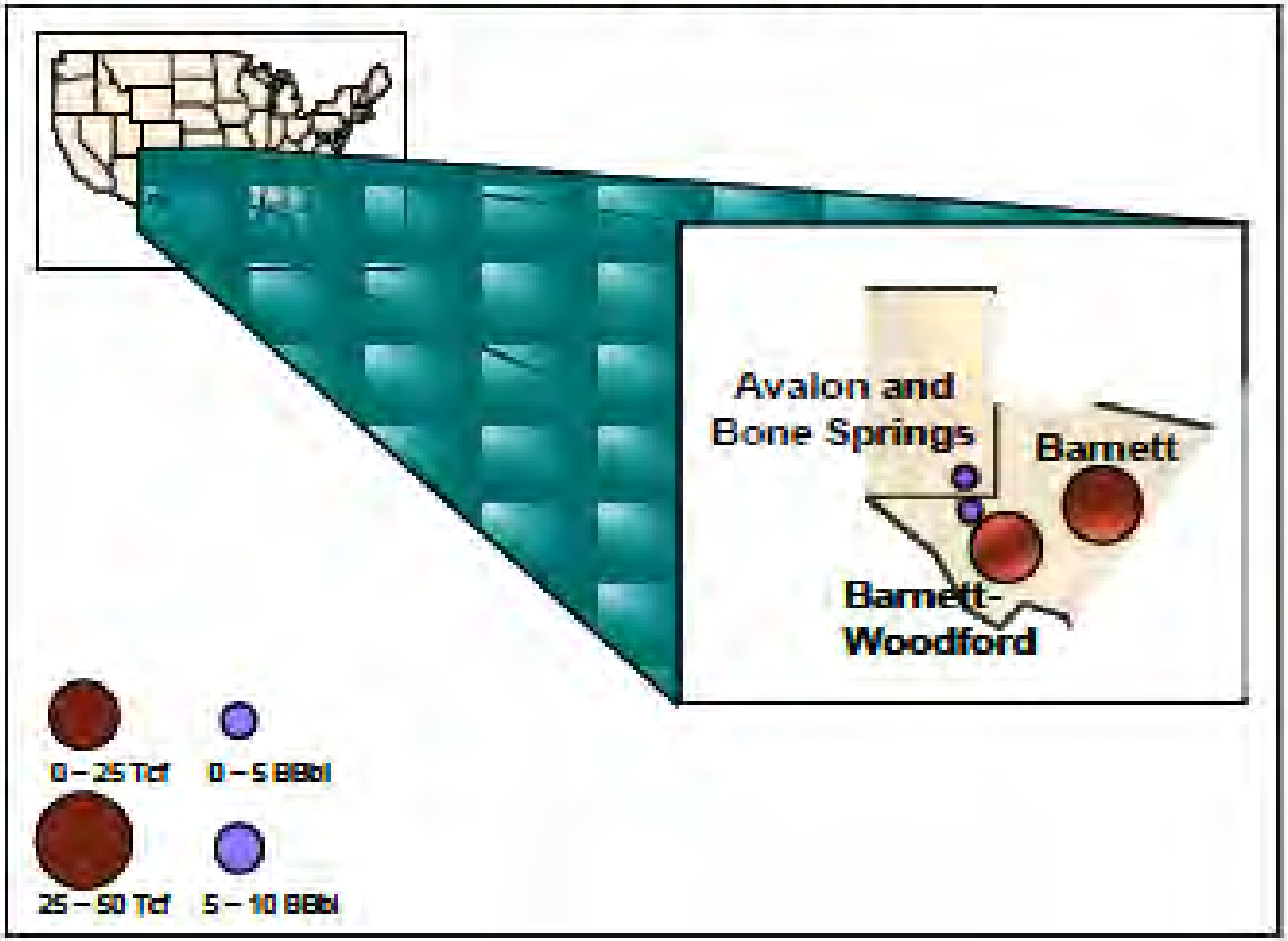


Figure 1 Northeast Shale Gas and Shale Oil Resources

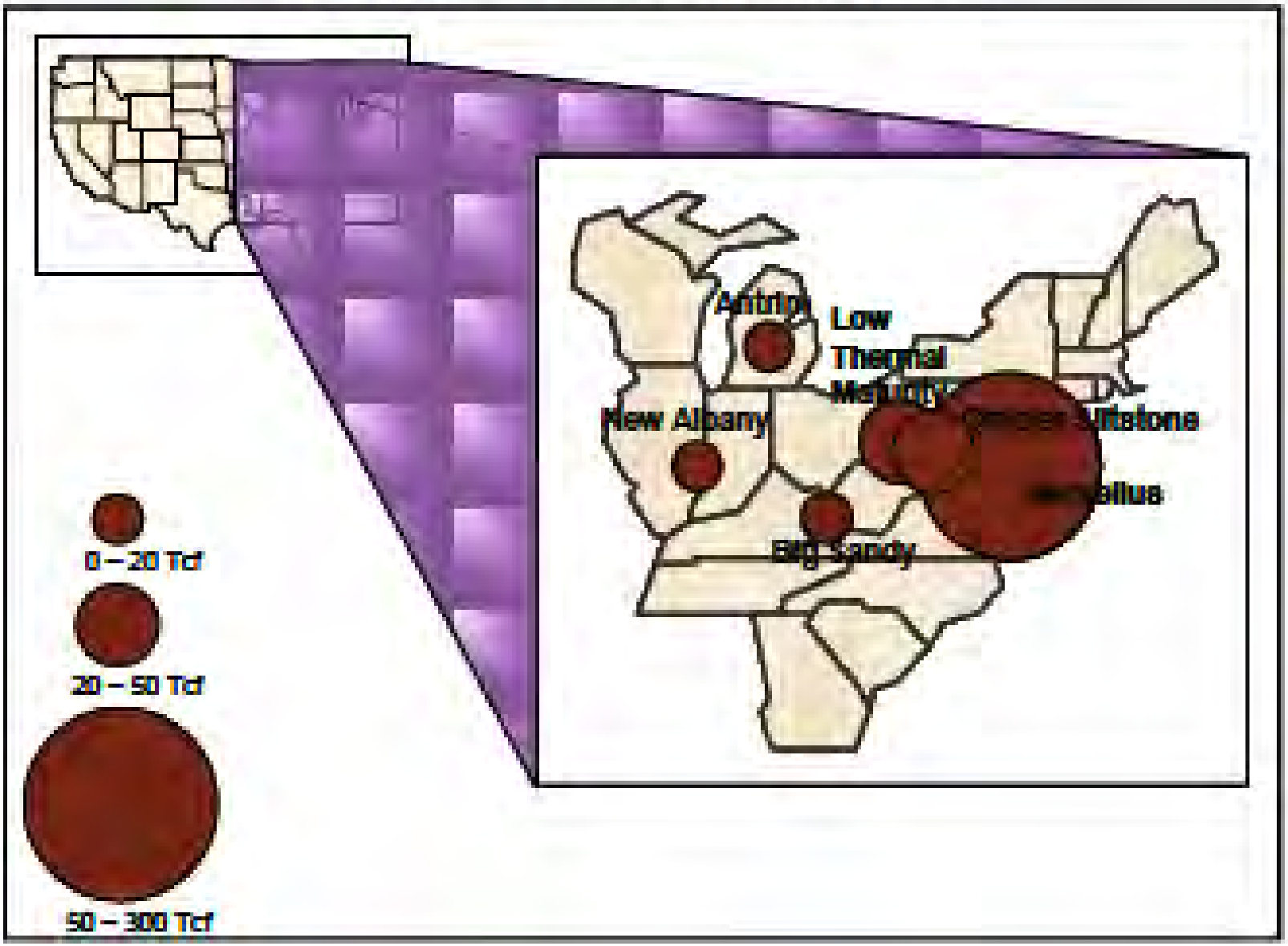
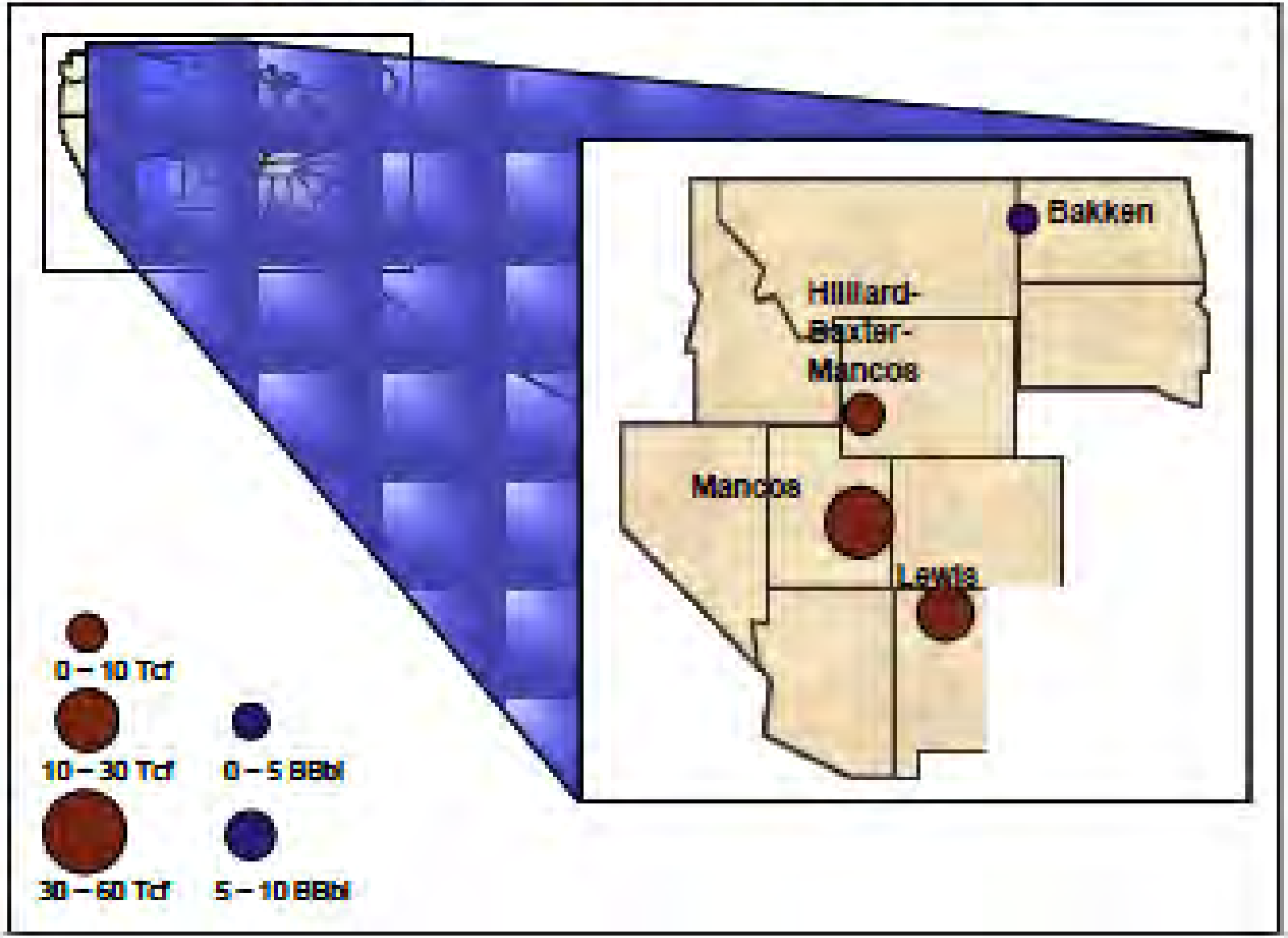
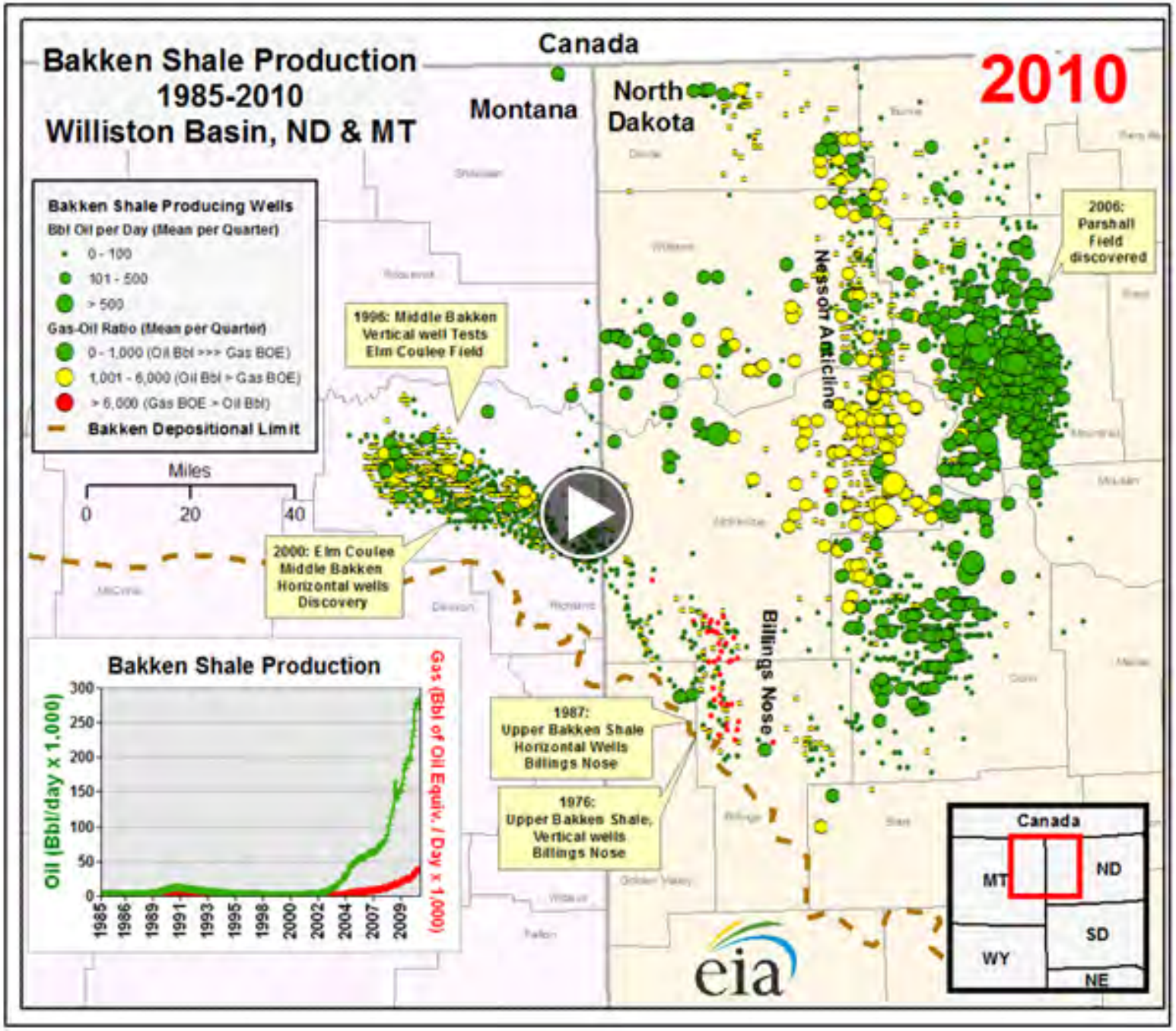


Figure 25 Rocky Mountains: Shale Gas and Shale Oil Resources:




Bakken Shale Production
1985-2010
Williston Basin, ND & MT
Canada
Montana
North Dakota
2010
Bakken Shale Producing Wells
Bbl Oil per Day (Mean per Quarter)
0 - 100
101 - 500
> 500
Gas-Oil Ratio (Mean per Quarter)
0 - 1,000 (Oil Bbl >>> Gas BOE)
1,001 - 6,000 (Oil Bbl > Gas BOE)
> 6,000 (Gas BOE > Oil Bbl)
Bakken Depositional Limit
Miles
0
20
40
1996: Middle Bakken Vertical well Tests Elm Coulee Field
2000: Elm Coulee Middle Bakken Horizontal wells Discovery
2006: Parshall Field discovered
Nesson Anticline
Billings Nose
1987: Upper Bakken Shale Horizontal Wells Billings Nose
1976: Upper Bakken Shale, Vertical wells Billings Nose
Bakken Shale Production
Oil (Bbl/day x 1,000)
Gas (Bbl of Oil Equiv. / Day x 1,000)
300
250
200
150
100
50
0
1985
1986
1989
1991
1993
1995
1998
2000
2002
2004
2007
2009
Canada
MT
ND
SD
WY
NE
eia

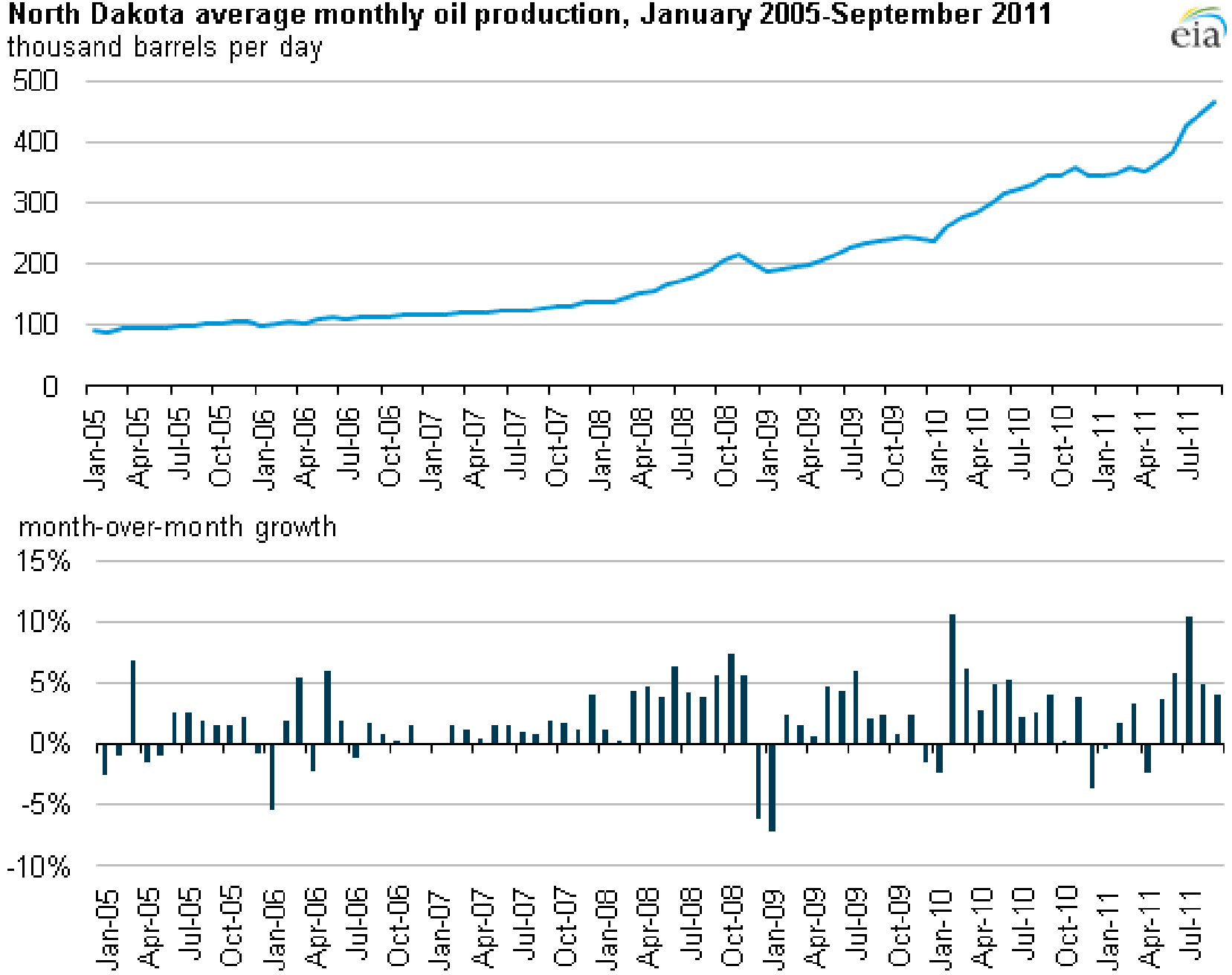
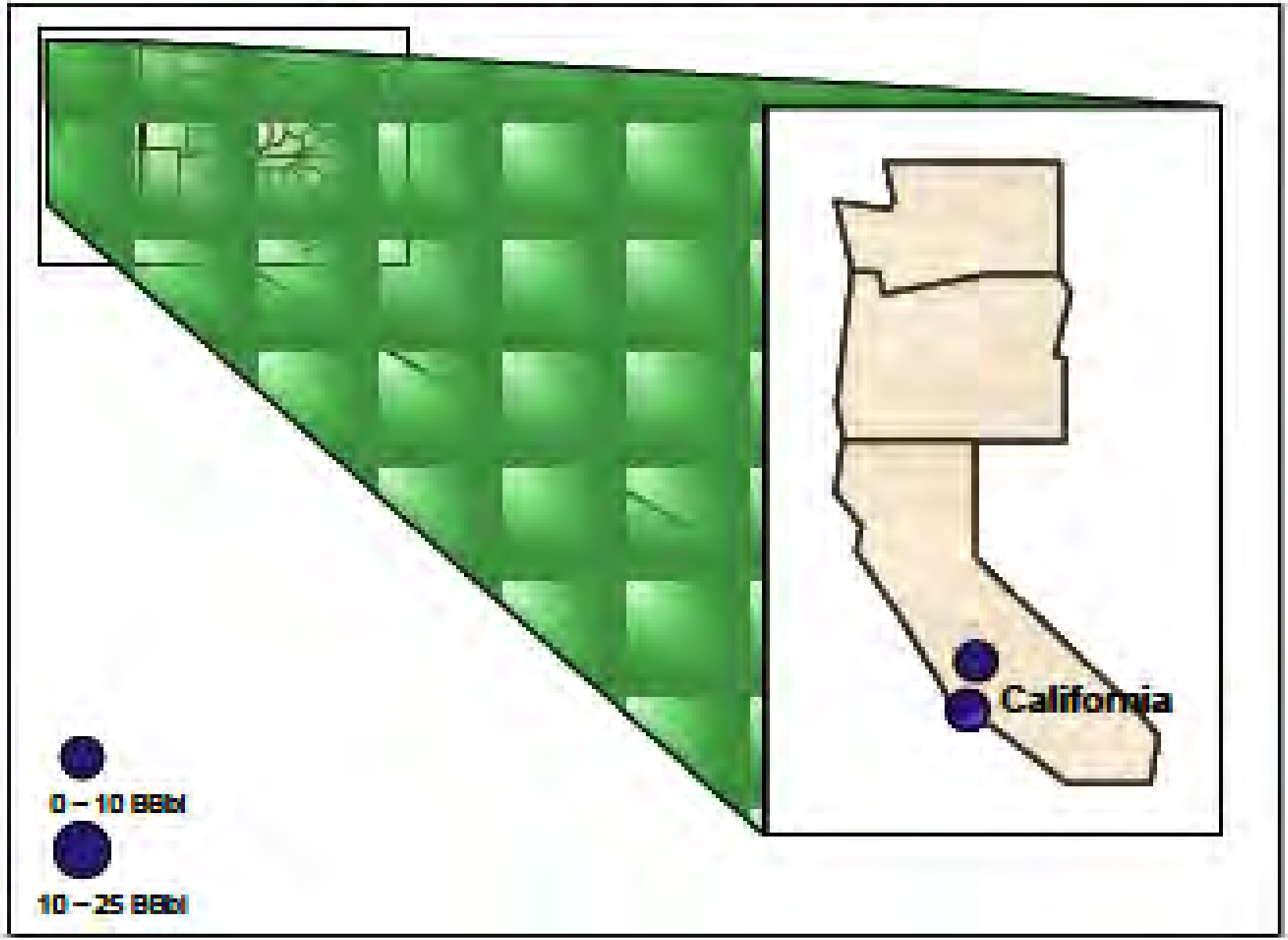
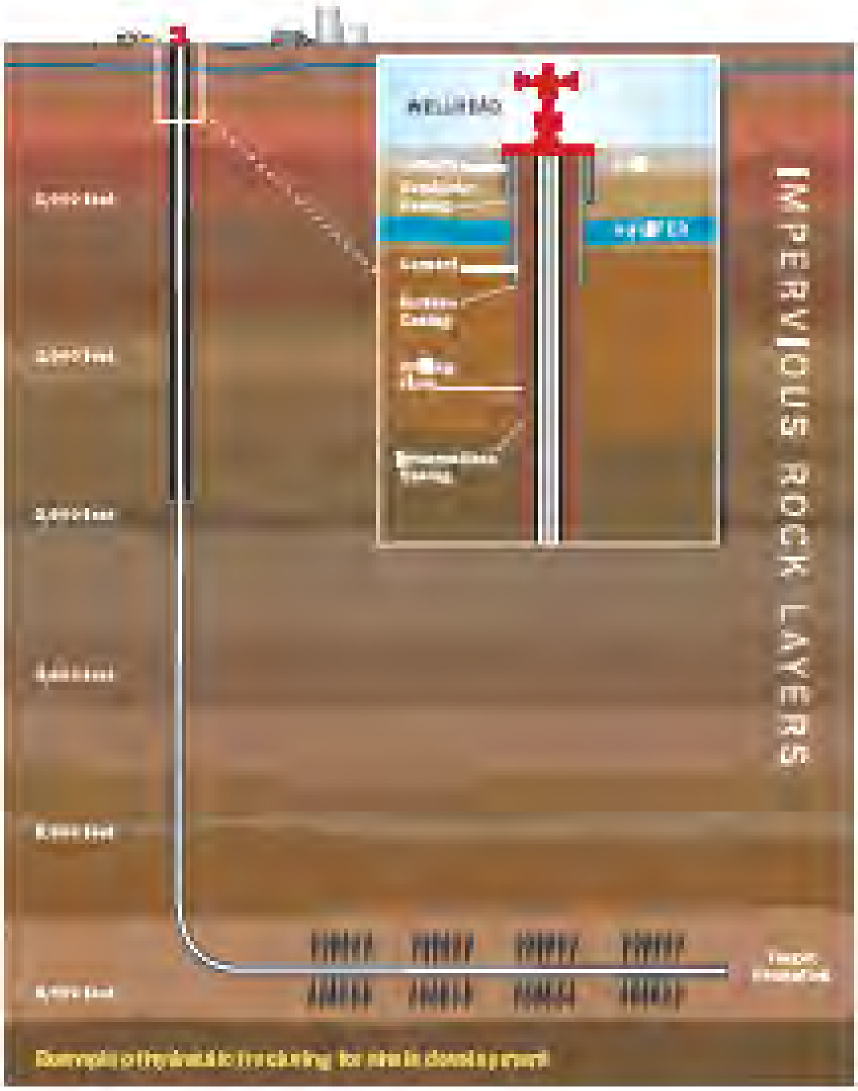

North Dakota average monthly oil production, January 2005-September 2011
thousand barrels per day
eia
500
400
300
200
100
0
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
month-over-month growth
15%
10%
5%
0%
-5%
-10%
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11

Figure 31 West Coast Shale Gas and Shale Oil Resources



Proper well construction provides groundwater protection.



Typically, steel pipe known as surface casing is cemented into place at the uppermost portion of a well for the explicit purpose of protecting the groundwater. The depth of the surface casing is generally determined based on groundwater protection, among other factors. As the well is drilled deeper, additional casing is installed to isolate the formation(s) from which oil or natural gas is to be produced, which further protects groundwater from the producing formations in the well.

Casing and cementing are critical parts of the well construction that not only protect any water zones but are also important to successful oil or natural gas production from hydrocarbon bearing zones.

Industry well design practices protect sources of drinking water from the other geologic zones of an oil and natural gas well with multiple layers of impervious rock[1]

1. Industry has developed equipment/specifications and operating practices for safe drilling and production [illegible]

Typical Chemical Additives Used in Frac Water

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring

Source: DOE, GWPC Modern Gas Shale Development in the United States: A Primer (2009).

Hydraulic Fracturing is Well Regulated

Hydraulic fracturing is **well regulated** by multiple federal, state and local authorities addressing environmental protection during natural gas operations, covering such items as well permitting, well materials and construction, **safe disposition of** used hydraulic fracturing **fluids, water testing, and chemical recordkeeping and reporting.** These rules and industry practices **effectively protect underground sources of drinking water.**

Overview of Industry Guidance/Best Practices on Hydraulic Fracturing (HF)

HF1 – *Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines,* 1st Edition, October 2009, (API)

- Highlights industry practices for well construction and integrity for wells that will be hydraulically fractured.
- The guidance identifies actions to protect shallow groundwater aquifers, while also enabling economically viable development of oil and natural gas resources.

HF2 – *Water Management Associated with Hydraulic Fracturing,* 1st Edition, June 2010, (API)

- Identifies best practices used to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing.
- Focuses primarily on issues associated with hydraulic fracturing pursued in deep shale gas development, but also describes the important distinctions related to hydraulic fracturing in other applications.

HF3 – *Practices for Mitigating Surface Impacts Associated with Hydraulic Fracturing,* 1st Edition, February 2011, (API)

- Identifies the best practices for minimizing surface environmental impacts associated with hydraulic fracturing operations.
- Focused on protecting surface water, soils, wildlife, other surface ecosystems, and nearby communities.
- Includes API's policy on chemical disclosure:
  - API supports transparency regarding the disclosure of the chemical ingredients;
  - States are the proper authority to determine reporting requirements and formatting of reporting and public disclosure;
  - Proprietary information should be protected; and
  - Hydraulic fracturing is effectively regulated by numerous federal, state and local requirements. Hydraulic fracturing should not be placed exclusively under the purview of the Safe Drinking Water Act (SDWA) or any other federal statute.

Overview of Industry Guidance/Best Practices on Hydraulic Fracturing (HF)

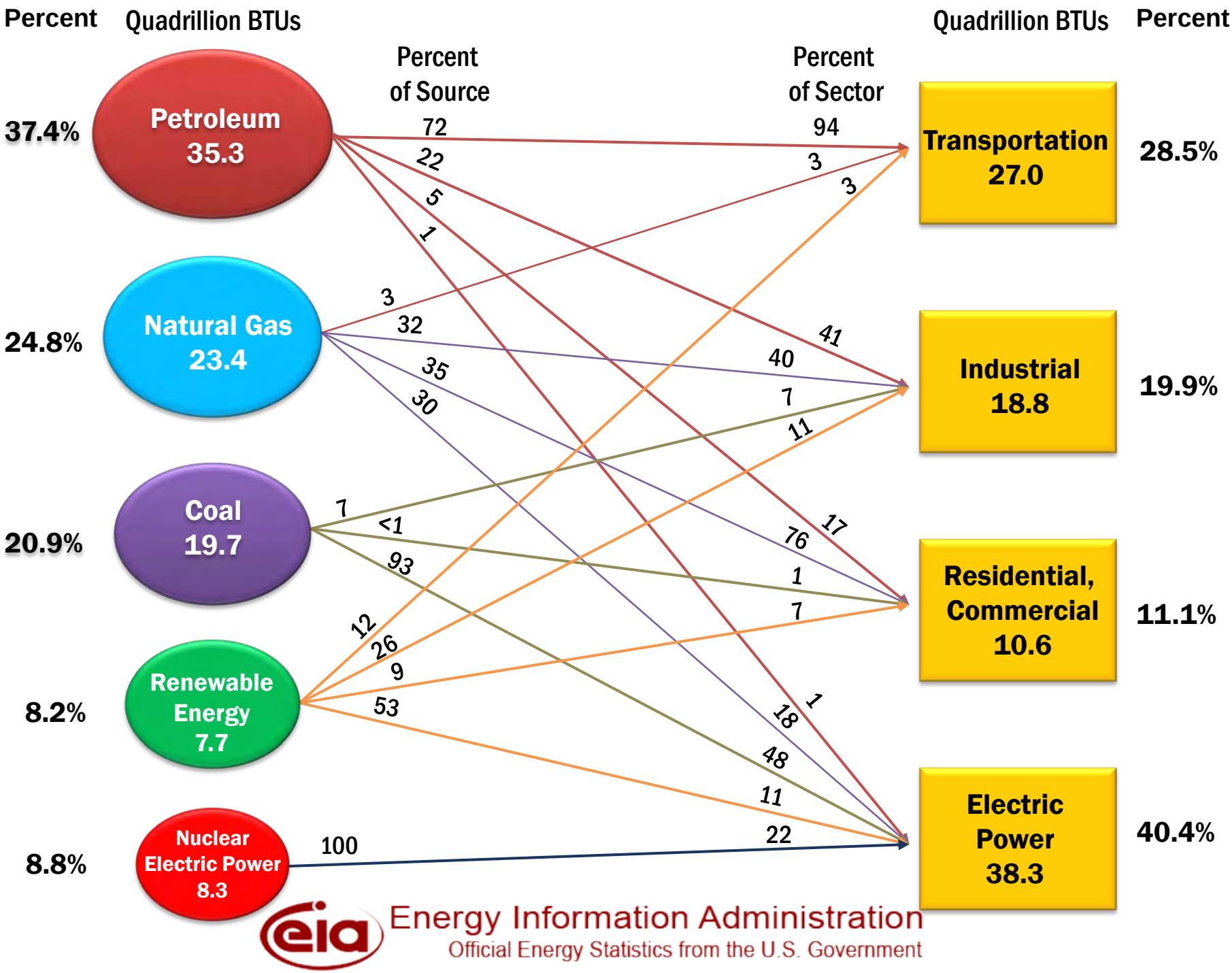
Std 65 Part 2 – *Isolating Potential Flow Zones During Well Construction*, 2nd Edition, December 2010, (API)

- Identifies best practices used to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing.
- Focuses primarily on issues associated with hydraulic fracturing pursued in deep shale gas development, but also describes the important distinctions related to hydraulic fracturing in other applications.

RP 51R – *Environmental Protection for Onshore Oil and Gas Production Operations and Leases*, 1st Edition, July 2009, (API)

- Provides environmentally sound practices for domestic onshore oil and gas production operations, including fracturing. Applies to all production facilities, including produced water handling facilities. Operational coverage begins with the design and construction of access roads and well locations, and includes reclamation, abandonment, and restoration operations.
- **Annex A provides guidance for a company to consider as a "Good Neighbor."**

Figure 14: Natural Gas Development Activities and Local Beneficiaries


Percent
Quadrillion BTUs
Percent of Source
Percent of Sector
Quadrillion BTUs
Percent
37.4%
Petroleum 35.3
24.8%
Natural Gas 23.4
20.9%
Coal 19.7
8.2%
Renewable Energy 7.7
8.8%
Nuclear Electric Power 8.3
Transportation 27.0
28.5%
Industrial 18.8
19.9%
Residential, Commercial 10.6
11.1%
Electric Power 38.3
40.4%
72
22
5
1
3
32
35
30
7
<1
93
12
26
9
53
100
94
3
3
41
40
7
11
17
76
1
7
1
18
48
11
22
Energy Information Administration
Official Energy Statistics from the U.S. Government

Thank You

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