

# **“The Strategic Impact of Unconventional Energy Resources in the American South.”**

**Michael E. Moore  
Executive Director  
NACCSA**

**VP Energy Commodities and Advisory Services  
FearnOil, Inc. a division of Astrup-Fearnleys**

**September 30, 2014 SSEB Annual Meeting-Mobile, AL.**

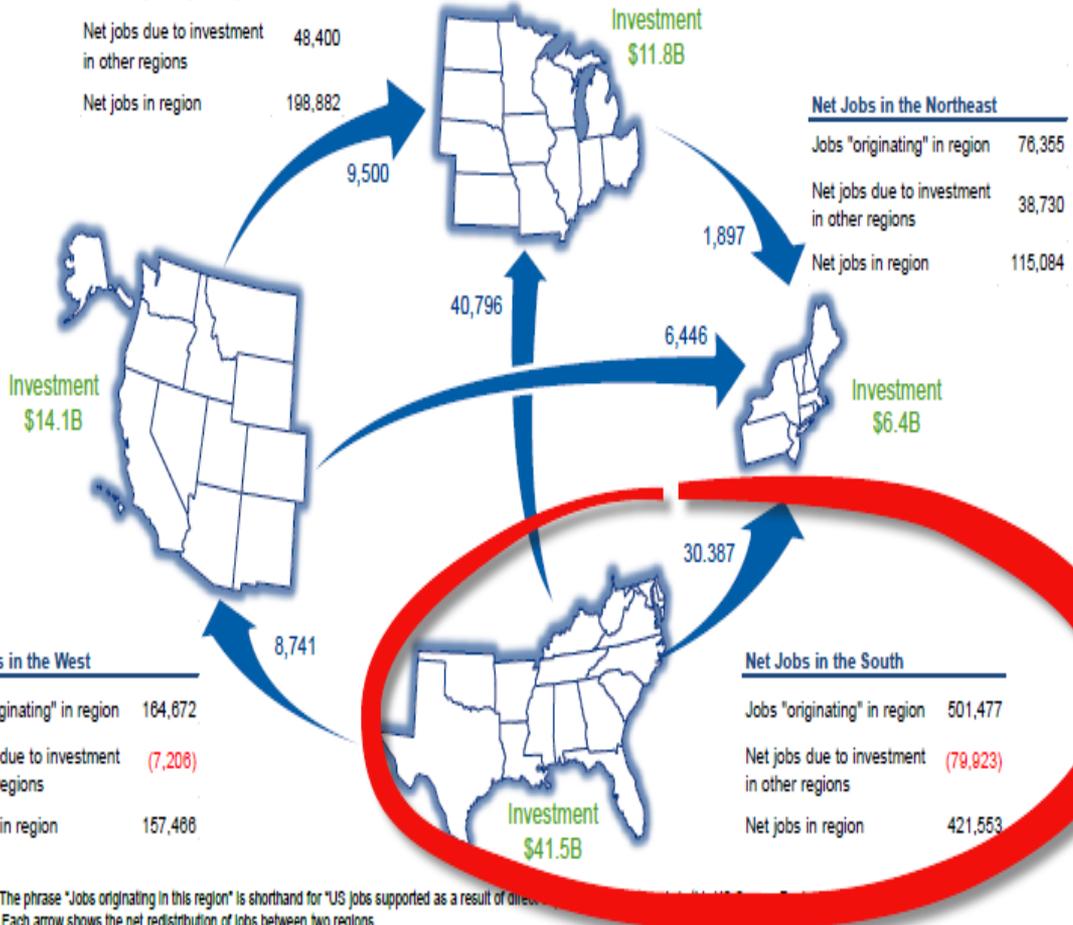


# Unconventional Impact!

## Investment and Job Distribution by US Census Region, Base Case

### Net Jobs in the Midwest

Jobs "originating" in region	150,482
Net jobs due to investment in other regions	48,400
Net jobs in region	198,882



### Net Jobs in the Northeast

Jobs "originating" in region	76,355
Net jobs due to investment in other regions	38,730
Net jobs in region	115,084

### Net Jobs in the South

Jobs "originating" in region	501,477
Net jobs due to investment in other regions	(79,923)
Net jobs in region	421,553

### Net Jobs in the West

Jobs "originating" in region	164,672
Net jobs due to investment in other regions	(7,208)
Net jobs in region	157,468

Notes: 1. The phrase "Jobs originating in this region" is shorthand for "US jobs supported as a result of direct investment in this region."  
2. Each arrow shows the net redistribution of jobs between two regions

Over the past five years, unconventional oil and gas activity has thrust the nation into an unexpected position. The U.S. is now the global growth leader in crude oil production capacity growth, adding nearly 1.2 million barrels per day (mbd) of capacity over the 2008 – 2012 time period<sup>1</sup>. In addition, the U.S. is now the largest natural gas producer, at 65 billion cubic feet (Bcf) per day<sup>2</sup>. At the same time, unconventional activity is spurring the growth of natural gas liquids (NGLs) production, adding over 500,000 barrels of oil equivalent (boe) per day since 2008<sup>3</sup>. This has brought the total increase in liquids production capacity to some 1.7 mbd since 2008.

Driven by growth in U.S. natural gas, natural gas liquids, and crude oil, the past 2 years have witnessed rapid growth in direct capital investment toward oil and gas infrastructure assets. IHS estimates that capital spending in oil and gas midstream and downstream infrastructure has increased by 60 percent, from \$56.3 billion in 2010 to \$89.6 billion in 2013. This increase in capital spending has provided both an economic stimulus and an incisive data point into how shale driven oil and gas production is reshaping the U.S. oil and gas infrastructure landscape.

Source: IHS 2013

"Oil & Natural Gas Transportation & Storage Infrastructure: Status, Trends, & Economic Benefits" done by IHS for API 12-2013  
<http://www.api.org/~media/Files/Policy/SOAE-2014/API-Infrastructure-Investment-Study.pdf>

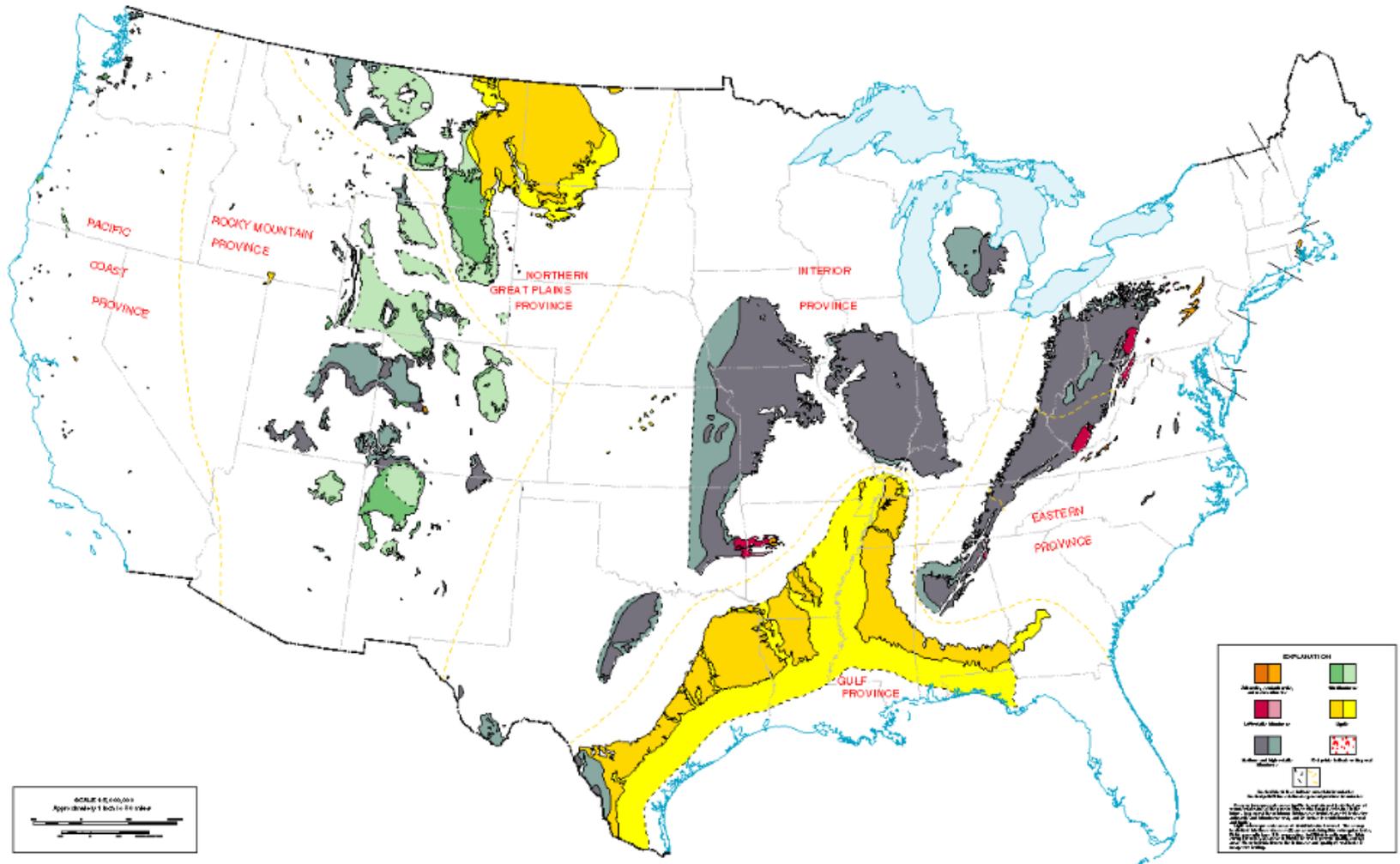
# Areas to be Covered

- Coal-CCUS-CO2 EOR
- Unconventional Oil/Gas
- Changing US Power Generation
- Petrochem and Refining
- Infrastructure
- Some Things to Think About

# Coal-CCUS-CO<sub>2</sub> EOR

# US Coal Resources

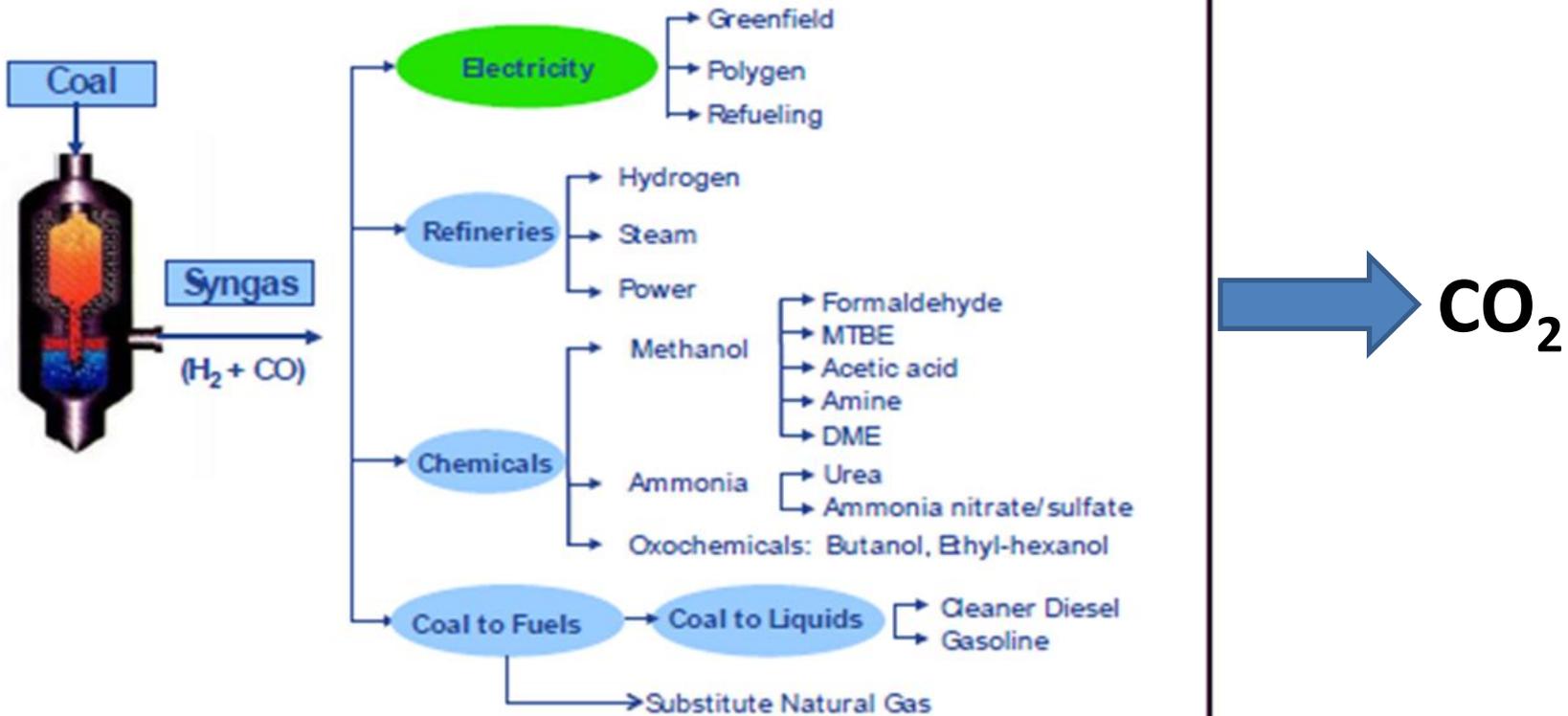
Source: <http://pubs.usgs.gov/of/1996/of96-092/Comp/main.gif>



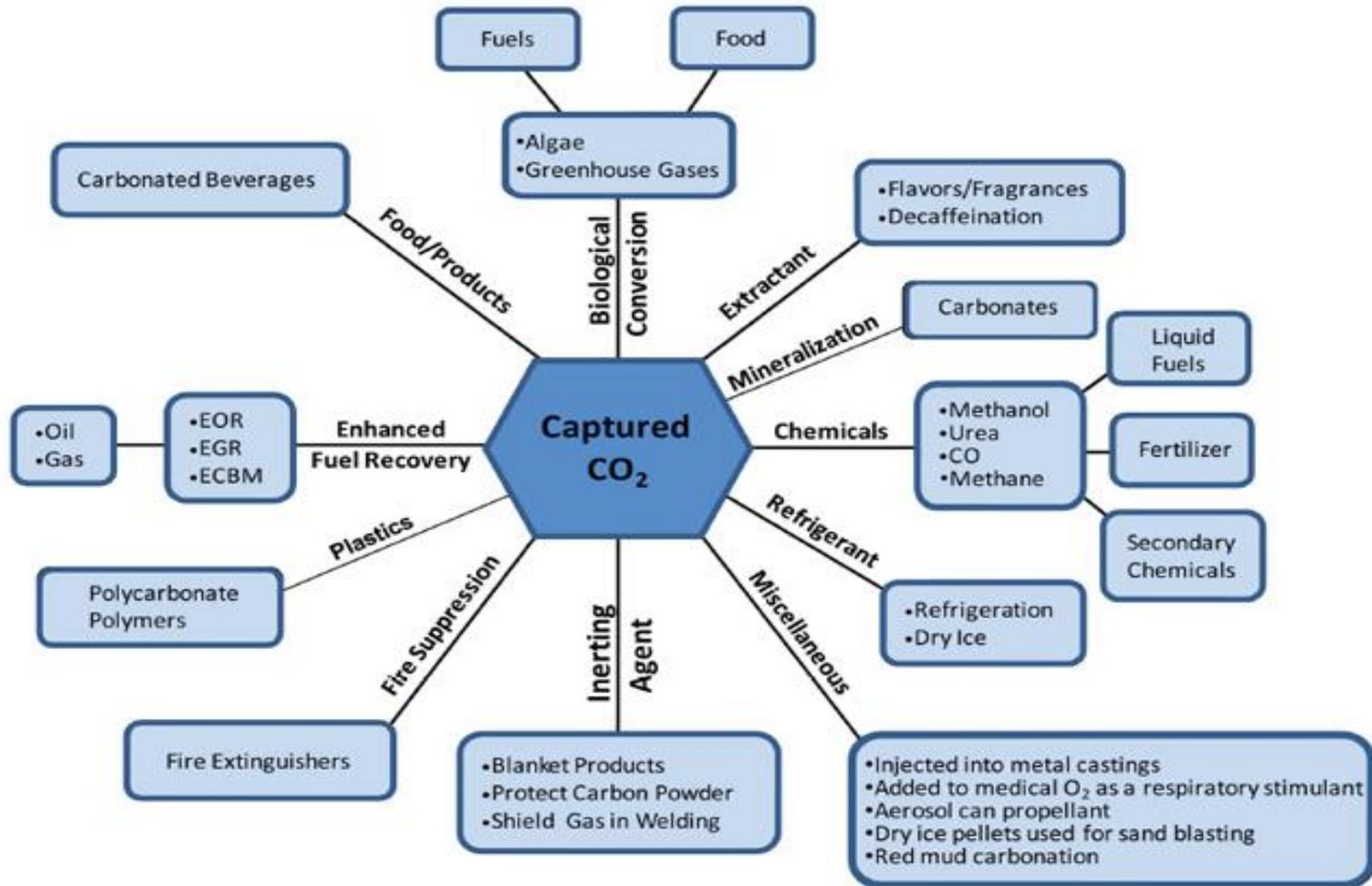
# Coal Utilization

Potential product slate from coal gasification

## Coal Flexibility



# CO<sub>2</sub> Utilization



# Mississippi Power Kemper IGCC Project

[http://www.mississippipower.com/kemper/docs/Q4\\_2013KemperProgressReport.pdf](http://www.mississippipower.com/kemper/docs/Q4_2013KemperProgressReport.pdf)



Aerial view of the facility taken in October 2013.



Tord Lien (left), Norweigan Energy Minister, meets Southern Company President and CEO Tom Fanning (right) and Mississippi Power President and CEO Ed Holland.



- 582-megawatt integrated gasification combined-cycle (IGCC) power plant in Kemper County uses lignite
- Nearly complete-only commercial scale CCUS power project in the US
- CO<sub>2</sub> going to Denbury and Tellus for EOR and utilization
- Visited on January 22<sup>nd</sup> the power block was operational and running delivering power to the grid in Mississippi

# SSEB Role

## Plant Ratcliffe –

### “Kemper County Energy Facility”

- First MS Power baseload plant in 30 years
- Plant: 582-MW TRIG™ IGCC
- Location: Kemper County, MS
- Fuel: Mine-Mouth Lignite, ~4M tons/yr
- CO<sub>2</sub> Capture: 65%
- By-Products: CO<sub>2</sub>, Sulfuric Acid, & Ammonia: \$50 Million annually
- CO<sub>2</sub> for EOR 61 mile pipeline



## Southeast Regional Carbon Sequestration Partnership Demonstration Projects

SECARB Early Test  
Cranfield, MS



SECARB Anthropogenic Test  
Plant Barry



## CO<sub>2</sub> Capture

### Southern Company's CCS Commercialization Program Goals

- Deploy integrated CCS demo to understand the integration of capture plant and injection field
- Advance capture technology performance to preserve the new and retrofit PC coal option
- “Learn by doing” to create competitive advantage and maintain leadership position in technology development
- 25 MW demo is key step to support this process

### Plant Barry

- Southern Company Services & Mitsubishi Heavy Industries collaboration with partners
- KM-CDR capture technology (500 TPD)



## SECARB Anthropogenic Test

### Project Schedule and Milestones



The CO<sub>2</sub> capture unit at Alabama Power's (Southern Co.) Plant Barry became **operational in 2011**.

A newly built 12 mile CO<sub>2</sub> pipeline from Plant Barry to the Citronelle Dome was also **completed in 2011**.

A characterization well was drilled to **confirm geology**.

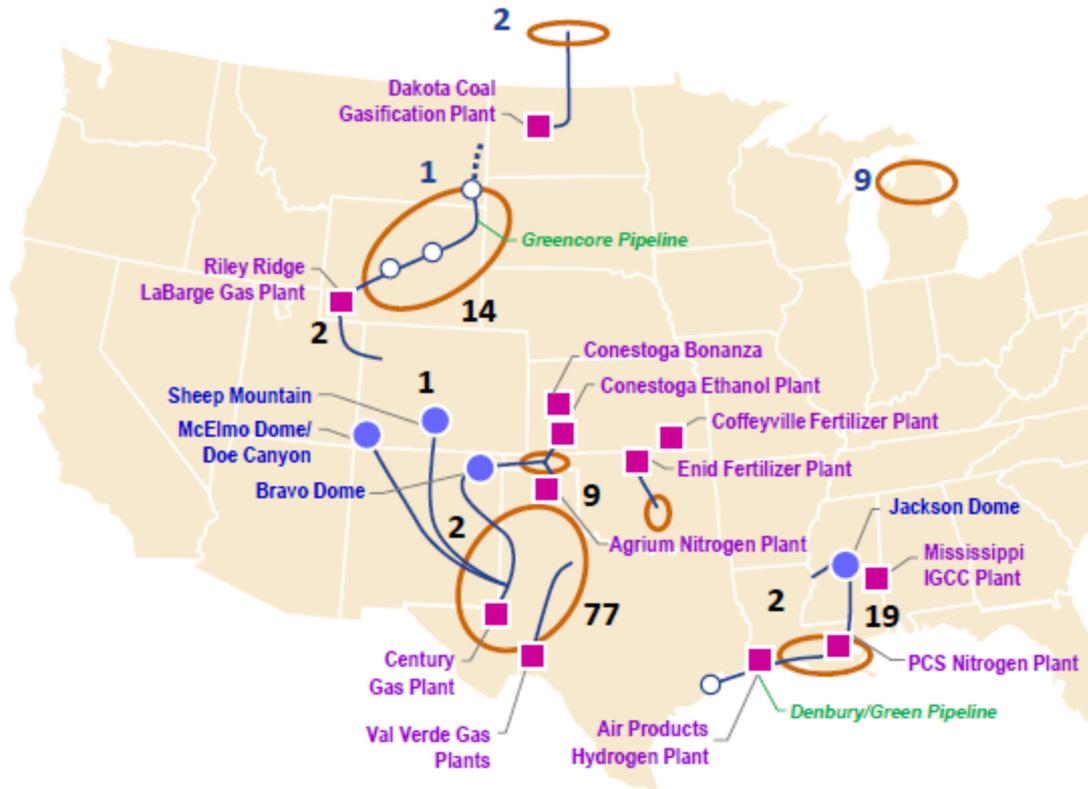
Injection wells were drilled in **2011**.

100k – 300k metric tons of CO<sub>2</sub> injected into a saline formation **beginning 2012**.

**3 years of post-injection monitoring.**

# Current CO<sub>2</sub>-EOR Operations and CO<sub>2</sub> Sources (2014)

Currently, CO<sub>2</sub>-EOR provides 300,000 B/D of oil using 3.5 Bcfd of CO<sub>2</sub>.



Oil Production (2014)	
CO <sub>2</sub> -EOR Projects	136
Oil Production (MBbl/d)	300
CO <sub>2</sub> Supplies (2014)	
Number of Sources	17
▪ Natural	5
▪ Industrial	12
CO <sub>2</sub> Supply (Bcfd)	3.5
▪ Natural	2.8
▪ Industrial	0.7

<b>136</b>	No. of U.S. CO <sub>2</sub> -EOR Projects
●	Natural CO <sub>2</sub> Source
■	Industrial CO <sub>2</sub> Source
—	CO <sub>2</sub> Pipeline
-----	CO <sub>2</sub> Proposed Pipeline

Source: Advanced Resources International, Inc., based on Oil and Gas Journal, 2014 and other sources.

- Source: The CO<sub>2</sub>-EOR Oil Recovery and CO<sub>2</sub> Utilization "Prize". Prepared for: Global Technology Exchange Session: Subsurface and EOR Task Area Challenge
- Prepared By: Mr. Vello A. Kuuskraa, President, Advanced Resources International, Inc.
- April 2014

# Size of the CO<sub>2</sub>-EOR Prize

Our field by field analysis shows that the economically viable\* oil recovery and CO<sub>2</sub> demand potentials is large.<sup>(1)(2)</sup>

- Note: Current work is going on to quantify the areas **NOT below oilfield – but rather in the fairways-or “greenfields”**.
- A study expected out this fall covers only **four counties in Texas—estimates are 100 billion bbls of OOIP additional oil** not in previous studies of the ROZ.

CO <sub>2</sub> -EOR Technology Status	Economic* Oil Recovery/CO <sub>2</sub> Demand - - Lower-48 Onshore		
	Economic Oil Fields	Crude Oil	CO <sub>2</sub> Demand**
	(No. of Fields)	(Billion Barrels)	(Gt)
Current Technology	458	19.0	7.5
“Next Generation” Technology***	948	59.6	15.2

Existing Markets	Current CO <sub>2</sub> -EOR Technology		“Next Generation” CO <sub>2</sub> -EOR Technology	
	Industrial CO <sub>2</sub> Demand (Gt)	GW Size Coal-Fired Plants** (#)	Industrial CO <sub>2</sub> Demand (Gt)	GW Size Coal-Fired Plants** (#)
Lower-48 Onshore*	4.8	40	12.5	104
Lower-48 Offshore	0.3	2	3.9	32
Alaska	3.1	26	4.4	37
Residual Oil Zone				
• Below Oil Fields	7.0	58	7.0	58
• Fairways	-	-	n/a	n/a
TOTAL	15.2	126	27.8	231

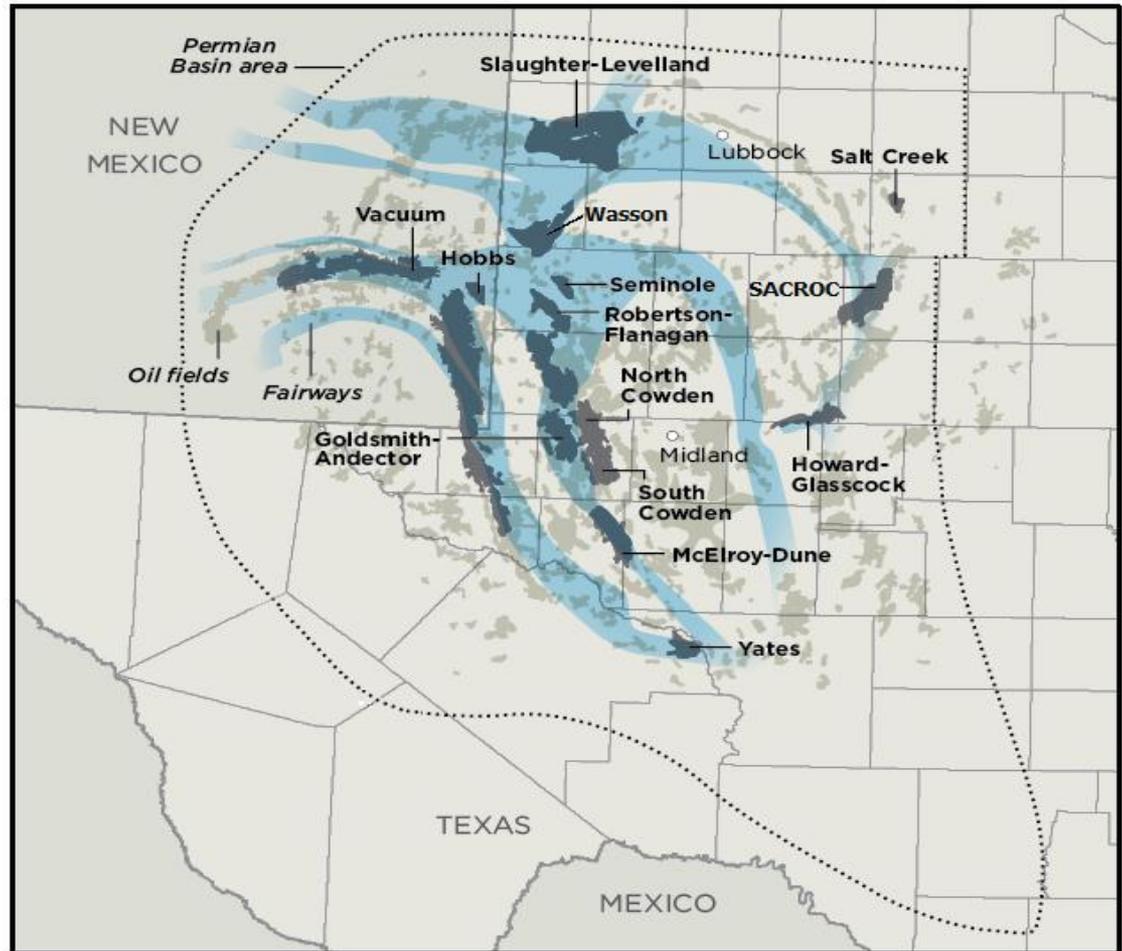
\*Excludes 2.7 Gt of natural CO<sub>2</sub> supply.

\*\*Assuming the 1,100 pounds per MWh standard for existing coal-fired power plants, one GW of capacity requires capture of 120 MMmt of CO<sub>2</sub> (over 40 years).

Note: Current coal-fired power generation capacity is about 300 GWs.

# Residual Oil Zone (“ROZ”)

- Current “quick look” indicates that over 100 billion barrels of oil may be in-place in the ROZ “Fairway”.
- So far current work in just four counties in Texas indicate 100 billion bbls.... work is required to establish its recoverability, economic feasibility and CO2 requirements. (Study should be out this fall)
- So far ROZ also present in: Saudi Arabia, North Sea, Wyoming..
- The catch-CO<sub>2</sub> is needed to produce the oil.



Research Sponsored by  
The Research Partnership to Secure Energy for America

# Next Frontier for CO<sub>2</sub>-EOR -- Shale Oil/Bakken---and Globally?

## Ultimate Impact to North Dakota

### Technologic & Economic Impact

- ND Dept. of Mineral Resources estimates that OOIP for the Bakken and Three Forks combined in North Dakota is approximately 170 billion barrels (Bbbls).

★ If the application of CO<sub>2</sub> for EOR can improve recovery by just 1.1%, that improvement would translate to an additional 1.87 Bbbls of oil production.

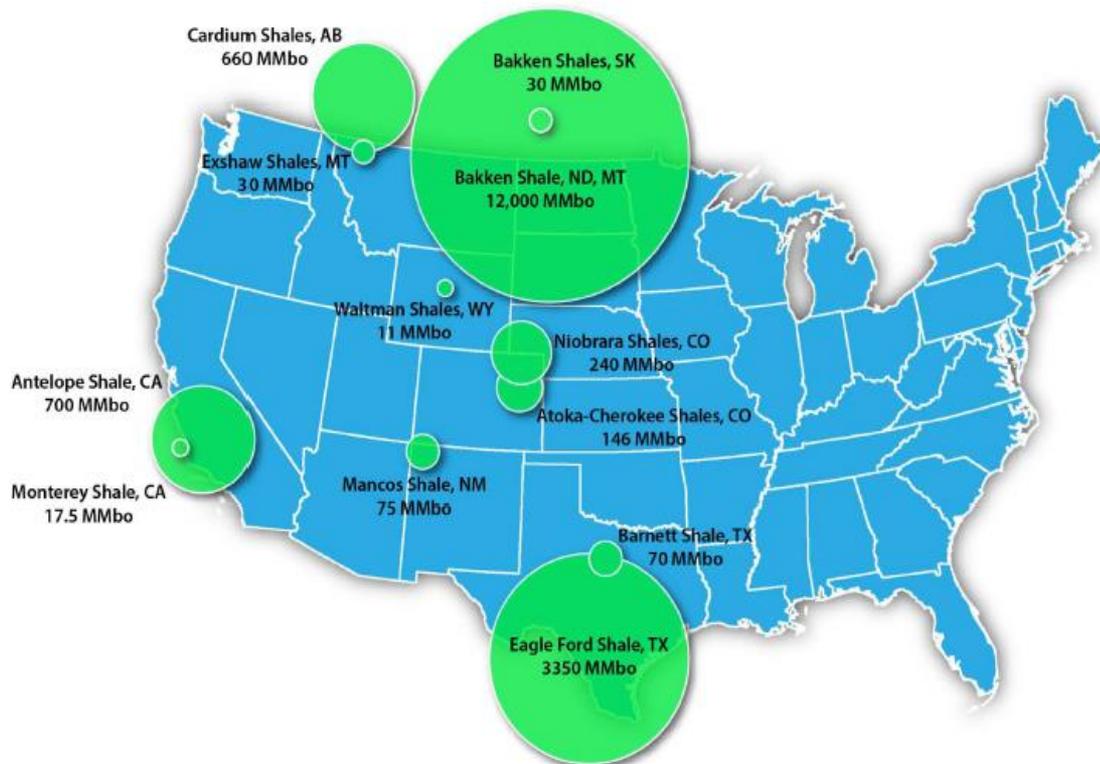
★ Assuming an average oil price of \$80/bbl, this would equate to approximately \$150 billion worth of oil.

- CO<sub>2</sub> EOR could prolong the life of the Bakken oil fields by decades.

★ Results may be applicable to tight oil plays across the United States in Texas, Montana, California, Mississippi, Ohio, etc.

★ Global shale oil only just now being explored but likely CO<sub>2</sub>-EOR opportunity there too.

### How Many More Bakken's ?

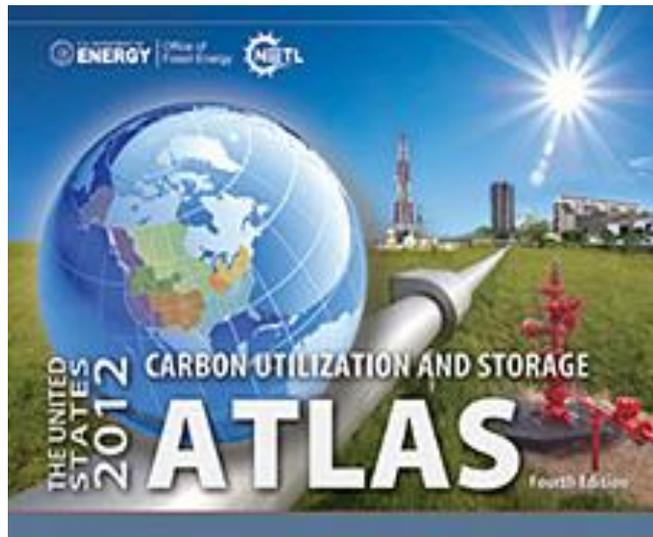


# US 2012 Carbon Capture Utilization Storage Atlas (Atlas IV)

[http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/atlasIV/index.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIV/index.html)

\*The United States has at least 2,400 billion metric tons of possible carbon dioxide (CO<sub>2</sub>) storage resource in saline formations, oil and gas reservoirs, and unmineable coal seams, according the U.S. Department of Energy (DOE) publication.

\*Enhanced Oil and Gas Recovery Offers Key Near Term Strategy for Storage



# DOE/NETL Best GS Practice Manuals

[http://www.netl.doe.gov/technologies/carbon\\_seq/refshelf/refshelf.html](http://www.netl.doe.gov/technologies/carbon_seq/refshelf/refshelf.html)

DOE/NETL has developed a series of “Best Practice Manuals”:

- \*Risk Analysis and Simulation for Geologic Storage of CO<sub>2</sub>
- \*Regional Carbon Sequestration Partnerships’ Simulation and Risk Assessment Case Histories
- \*Geologic Storage Formation Classifications
- \*Site Screening, Selection, and Initial Characterization for Storage of CO<sub>2</sub> in Deep Geologic Formations
- \*Monitoring, Verification, and Accounting of CO<sub>2</sub> Found in Deep Geologic Formations
- \*Public Outreach and Education for Carbon Storage Projects.



the ENERGY lab

BEST PRACTICES for:

Carbon Storage Systems and Well Management Activities



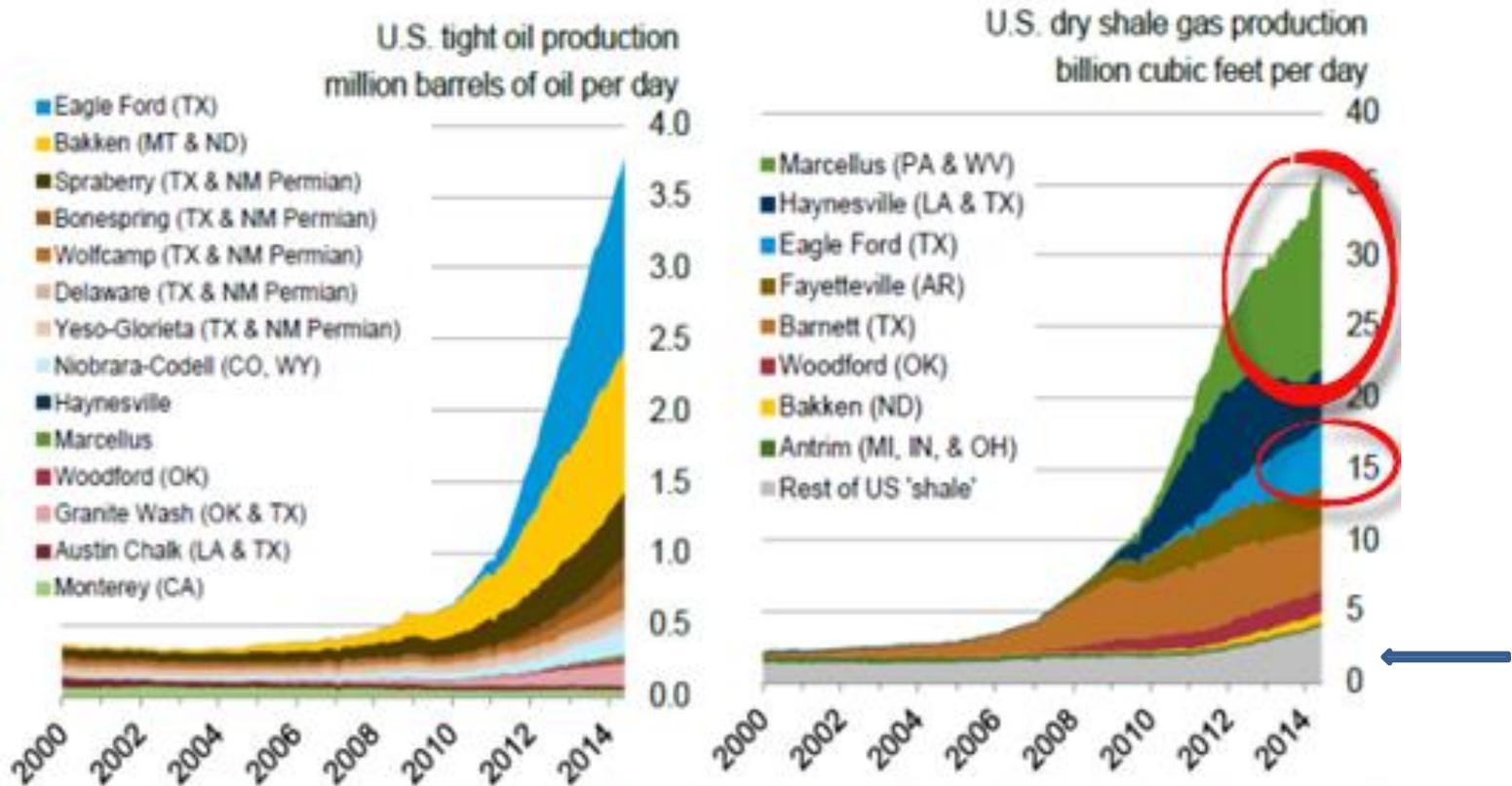
April 2012

# Unconventional Oil/Gas



# US Shale Oil/Gas Production by Region

<http://cbcapitalresearch.com/author/cbcapitalresearch/>

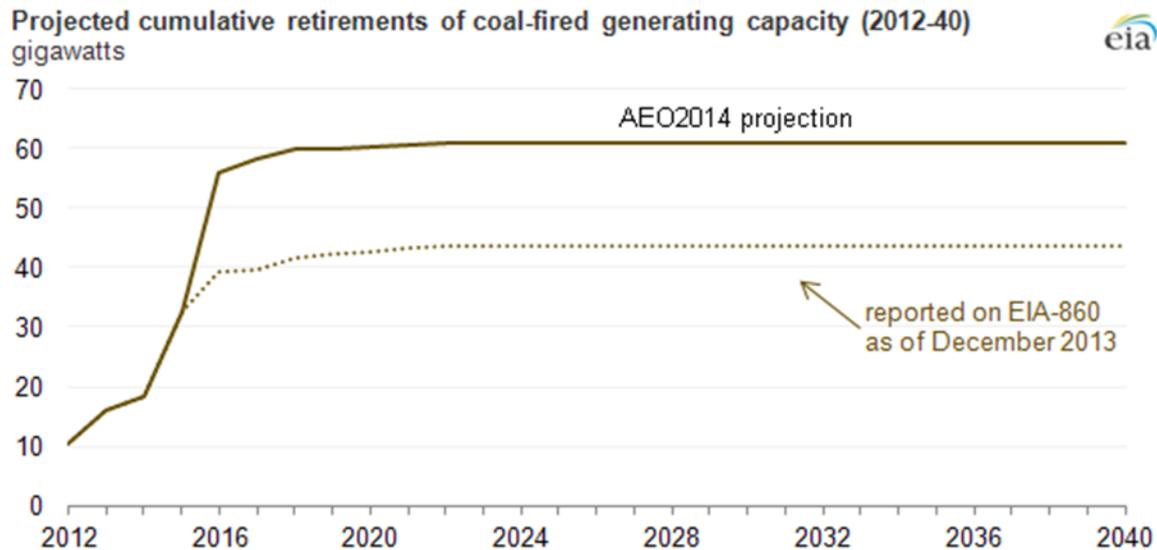


Sources: EIA derived from state administrative data collected by Drillinginfo Inc. Data are through June 2014 and represent EIA's official tight oil & shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).

# Changing US Power Generation

# AEO2014 Projects More Coal-Fired Power Plant Retirements By 2016 Than Have Been Scheduled

<http://www.eia.gov/todayinenergy/detail.cfm?id=15031#> February 14, 2014



Coal-fired power plants in the United States have been under significant economic pressure in recent years because of low natural gas prices and slow electricity demand growth. The Annual Energy Outlook 2014 (AEO2014) Reference Case projects that a total of 60 gigawatts (GW) of capacity will retire by 2020, which includes the retirements that have already been reported to the U.S. Energy Information Administration.

Coal-fired power plants are subject to the Mercury and Air Toxics Standards (MATS), which require significant reductions in emissions of mercury, acid gases, and toxic metals. The standards are scheduled to take effect in April 2015, a deadline that is conditionally allowed to be extended by up to one year by state environmental permitting agencies. Projected retirements of coal-fired generating capacity in the AEO2014 include retirements above and beyond those reported to EIA as planned by power plant owners and operators. In these projections, 90% of the coal-fired capacity retirements occur by 2016, coinciding with the first year of enforcement for the Mercury and Air Toxics Standards.

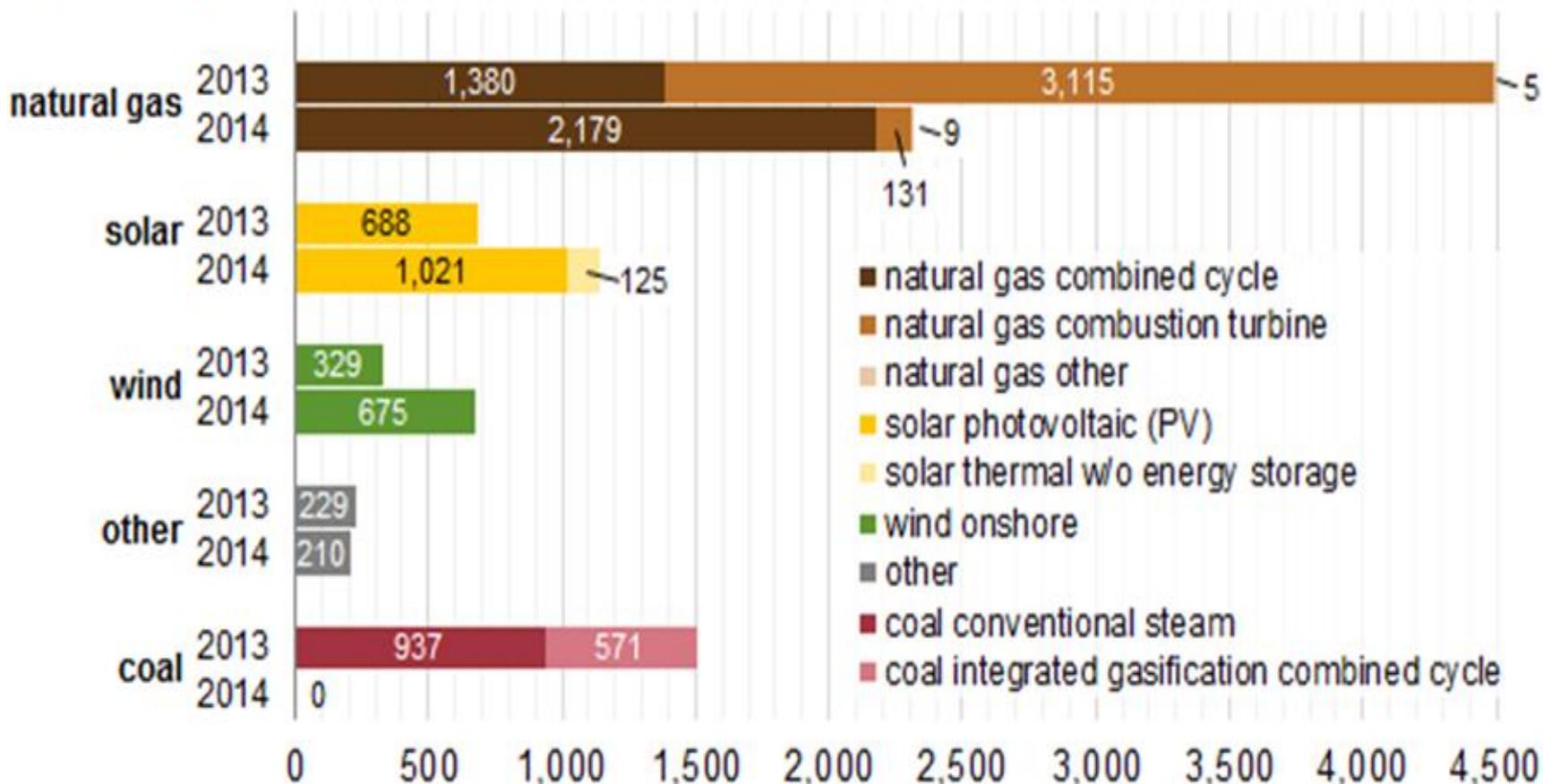
To comply with MATS, it is assumed that all coal-fired plants have flue gas desulfurization equipment (scrubbers) or dry sorbent injection systems installed by 2016. Retirement decisions are based on the relative economics and regulatory environment of the electricity markets. A plant may retire if higher coal prices, lower wholesale electricity prices (often tied to natural gas prices), or reduced utilization make investment in equipment like scrubbers uneconomical. The Reference case projections shown in the graph above reflect EIA's baseline for comparing a number of different sensitivity cases exploring variations on these factors. The full Annual Energy Outlook 2014 including all sensitivity cases will be released in the spring.

At the end of 2012 there were 1,308 coal-fired generating units in the United States, totaling 310 GW of capacity. In 2012 alone, 10.2 GW of coal-fired capacity was retired, representing 3.2% of the 2011 total. The table below shows the progression of coal-fired generating unit retirements between 2010 and 2012. Units that retired in 2010, 2011, or 2012 were small, with an average size of 97 megawatts (MW), and inefficient, with an average tested heat rate of about 10,695 British thermal units per kilowatt-hour (Btu/kWh). In contrast, units scheduled for retirement over the next 10 years are larger and more efficient: at 145 MW, the average size is 50% larger than recent retirements, with an average tested heat rate of 10,398 Btu/kWh.

# US New Power Generation

U.S. power plant capacity additions, Jan-Jun 2014 vs. Jan-Jun 2013

megawatts (MW)

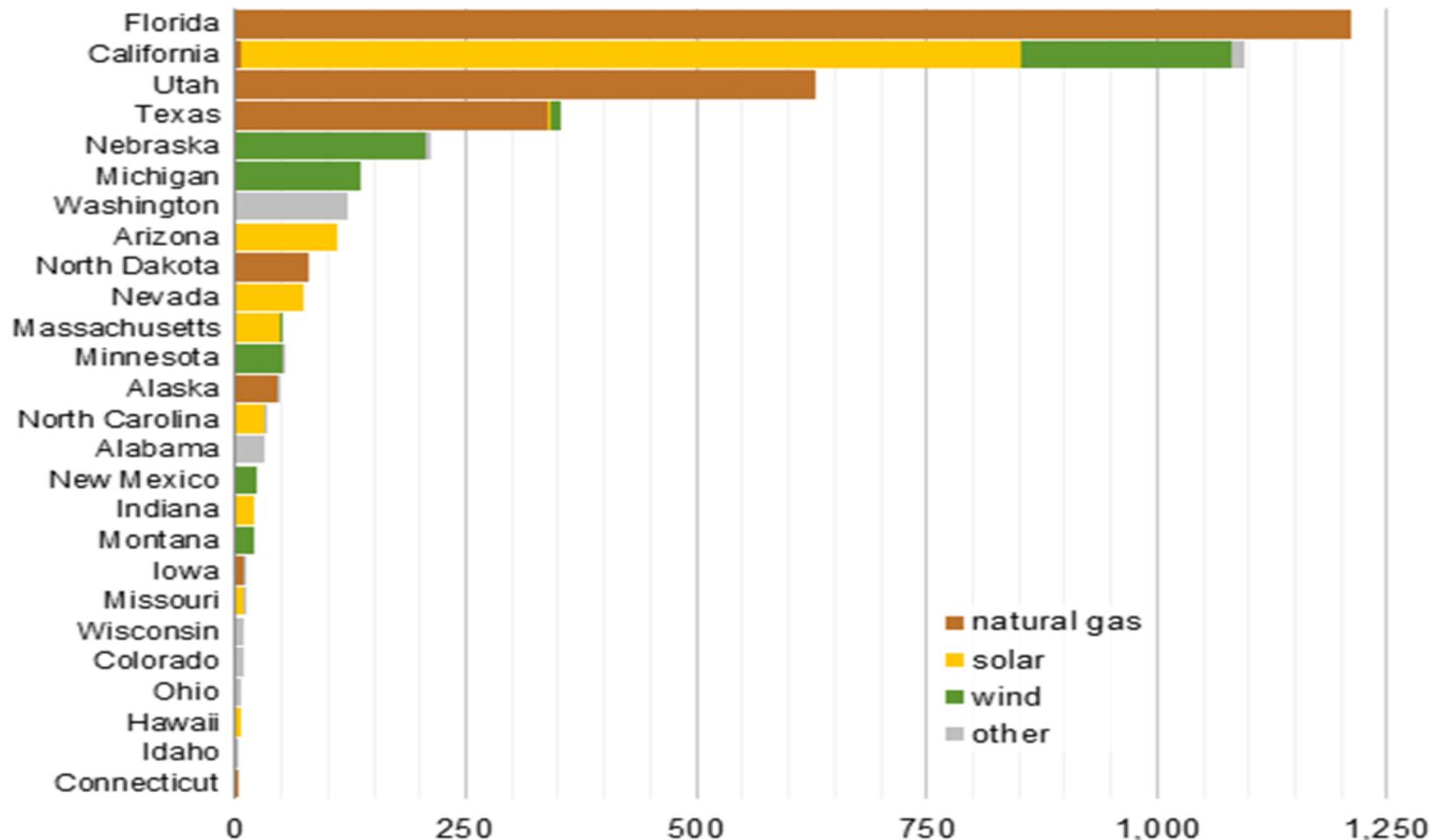


**Source:** U.S. Energy Information Administration, [Electric Power Monthly](http://www.eia.gov/todayinenergy/detail.cfm?id=17891), August 2014 edition with June 2014 data

**Note:** Data include facilities with a net summer capacity of 1 MW and above only.

# US New Power Generation

U.S. power plant capacity additions Jan-Jun 2014 by state  
megawatts (MW)

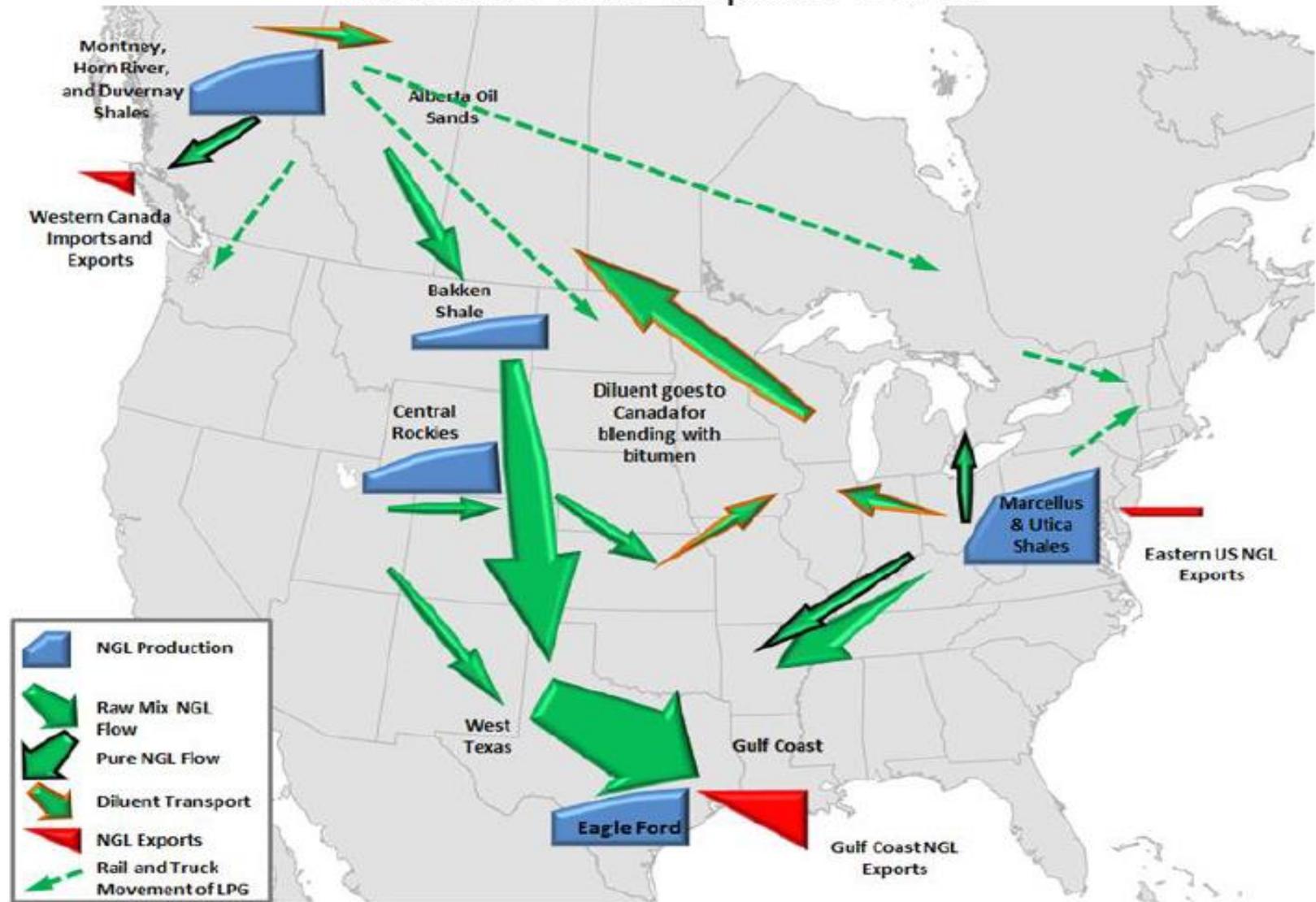


**Source:** U.S. Energy Information Administration, [Electric Power Monthly](http://www.eia.gov/electric/power/monthly), August 2014 edition with June 2014 data [www.eia.gov/todayinenergy/detail.cfm?id=17891](http://www.eia.gov/todayinenergy/detail.cfm?id=17891)

**Note:** Data include facilities with a net summer capacity of 1 MW and above only.

# Petchem and Refining

# Natural Gas Liquids Flow



Source: INGAA's "North American Midstream Infrastructure through 2035: Capitalizing on Our Energy Abundance" 3-2014 [www.ingaa.org/File.aspx?id=21498](http://www.ingaa.org/File.aspx?id=21498)

# US Shale (Gas) Impacts

Natural gas spurring 77 major industrial projects  
2012-2019

## 45 NEW PROJECTS

25 Petrochemical  
12 Steel  
6 Fertilizer  
2 Gas-to-liquids

## 23 EXPANSIONS

14 Petrochemical  
7 Fertilizer  
2 Steel

## 9 RESTARTS

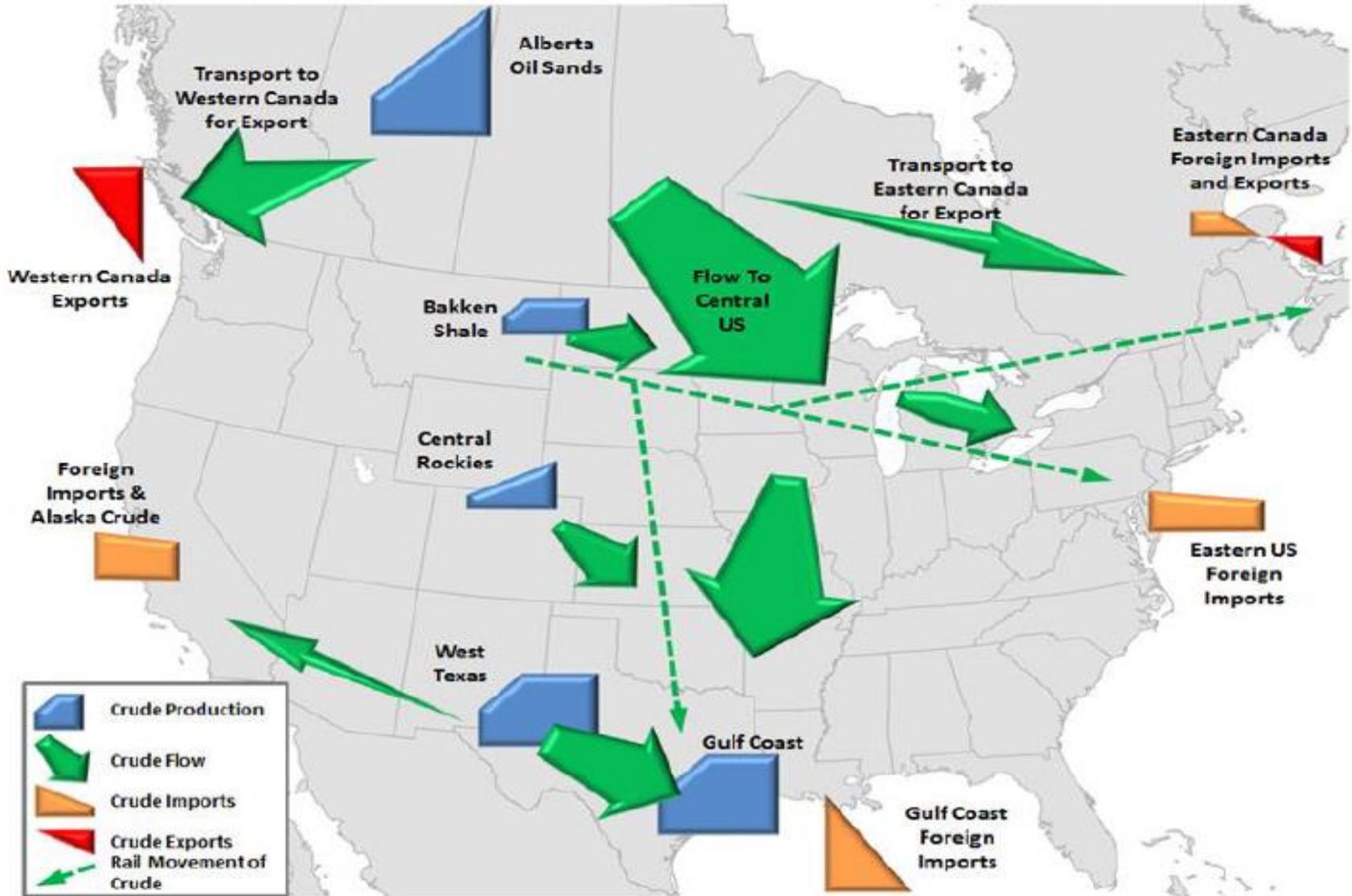
4 Fertilizer  
5 Petrochemical

(Increase of 33 from 2012)



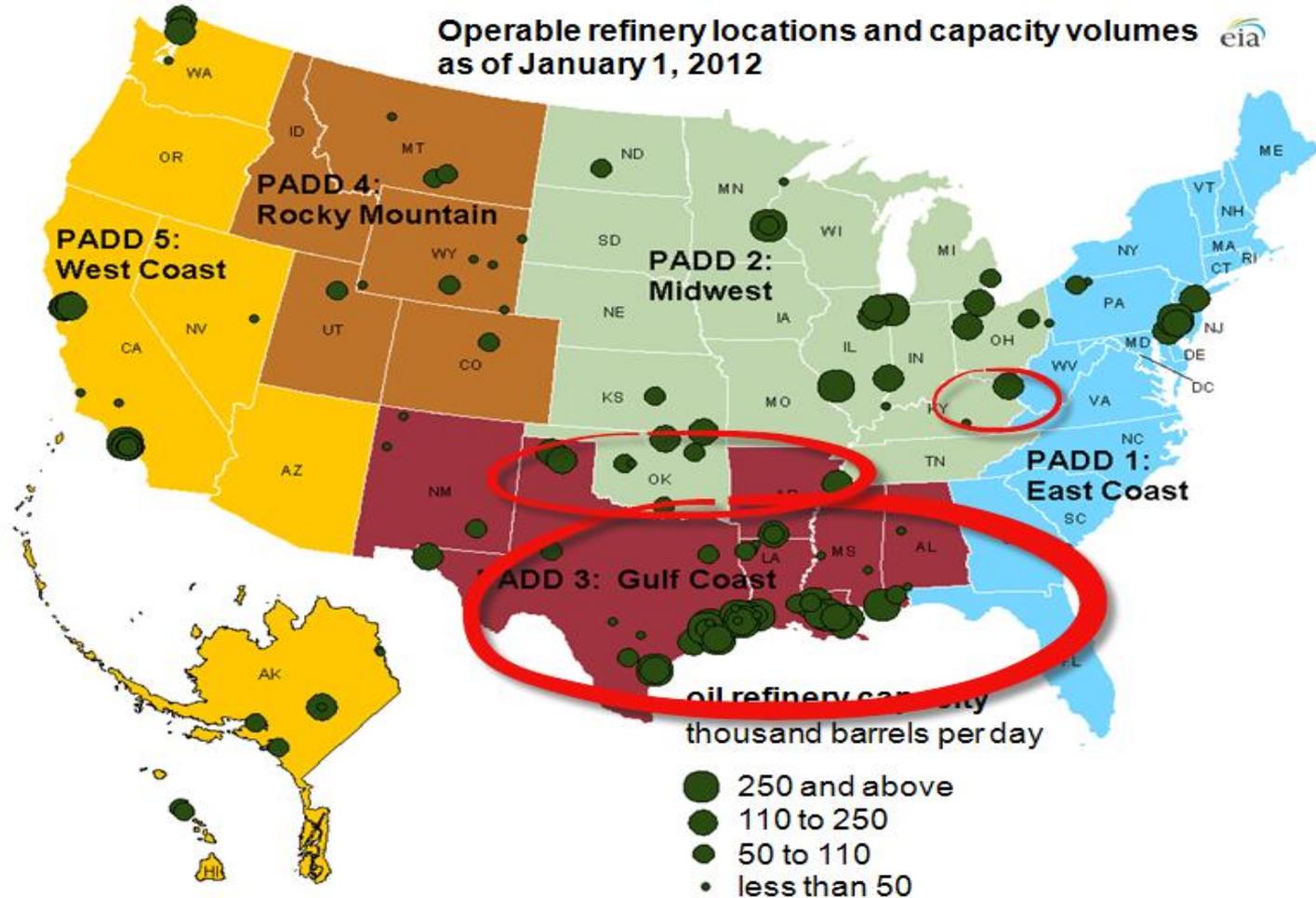
Data source: EVA

# Crude Oil and Lease Condensate Flow

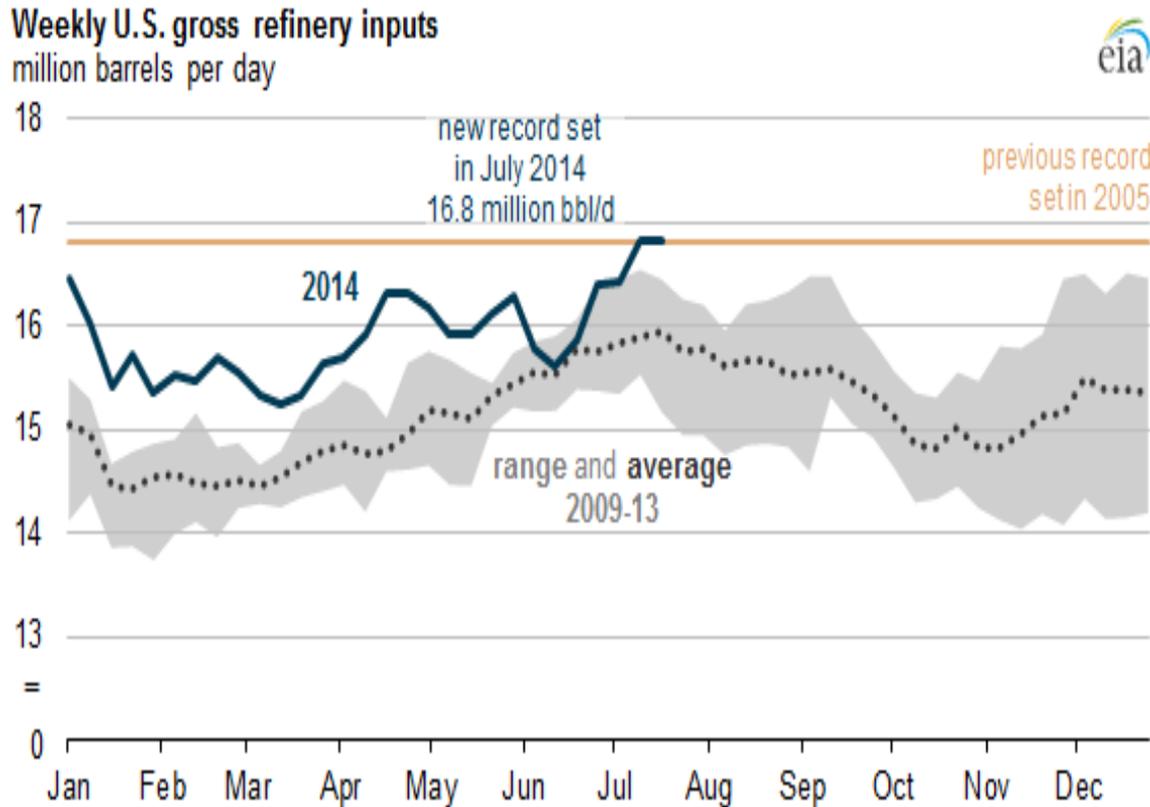


Source: INGAA's "North American Midstream Infrastructure through 2035: Capitalizing on Our Energy Abundance" 3-2014 [www.ingaa.org/File.aspx?id=21498](http://www.ingaa.org/File.aspx?id=21498)

# Southern States Refining Capacity



# US Refinery Utilization



Source: U.S. Energy Information Administration, [Weekly Petroleum Status Report](#)

U.S. refineries have been processing record volumes of oil recently. Refinery inputs hit a record-high 16.8 million barrels per day (bbl./d) in each of the past two weeks, exceeding the previous record from summer 2005. Refineries in the Midwest and Gulf Coast in particular pushed the total U.S. input volume upward, as these refiners' access to lower-cost crude oil, expansions of refining capacity, and increases in both domestic demand and exports contributed to higher refinery runs.

# US Exports...

- February 2012 US Exported More Refined Products than Imported-Not Seen Since 1949. <http://content.usatoday.com/communities/ondeadline/post/2012/02/us-exported-more-gasoline-than-imported-last-year/1>
- April 15, 2014 US becomes world class LPG exporter. A near-doubling of US propane exports occurred from 2012 to 2013. This paradigm shift looks likely to continue. At least 77 projects to build or expand LPG processing capacity are in the works, Ms. Anderson said. These projects will bring online 13 billion cubic feet per day (Bcfd) of additional capacity in US by the end of 2015. <http://www.hydrocarbonprocessing.com/Article/3331124/GPA-14-US-exports-of-LPG-poised-to-skyrocket.html>
- April 22, 2014 Enterprise plans to reduce an oversupply of ethane by exporting the plastics ingredient from the Texas coast. It will have the capacity to load 240,000 barrels a day, making it the largest such facility in the world, the company said. <http://www.bloomberg.com/news/2014-04-22/enterprise-building-ethane-export-terminal-to-cut-glut.html>
- June 25, 2014 Commerce Department issued a private letter ruling allowing Pioneer Natural Resources and Enterprise Products Partners to export unrefined crude oil that comes from the Eagle Ford geological region of Texas. <http://www.washingtonpost.com/blogs/wonkblog/wp/2014/06/25/did-the-obama-administration-just-lift-the-ban-on-u-s-crude-oil-exports/>
- **Note: Most of these new exports will leave from the USGC**

# Infrastructure

# Coal Export Terminals

<http://www.platts.com/news-feature/2012/coal/coalexports/map>



Map by Platts Cartography

Continent and Country of Destination	January - March 2012
<b>North America Total</b> .....	<b>1,761,872</b>
Canada <sup>1</sup> .....	1,074,532
Dominican Republic .....	188,021
Honduras .....	33,963
Jamaica .....	33,585
Mexico .....	430,314
Panama .....	904
Other <sup>2</sup> .....	553
<b>South America Total</b> .....	<b>2,337,667</b>
Argentina .....	50,408
Brazil .....	1,862,332
Chile .....	421,675
Peru .....	109
Other <sup>2</sup> .....	3,143
<b>Europe Total</b> .....	<b>16,359,777</b>
Austria .....	163,956
Belgium .....	737,842
Croatia .....	153,010
Denmark .....	-
Finland .....	50,468
France .....	954,416
Germany, Federal Republic of .....	1,542,714
Iceland .....	15,547
Ireland .....	229
Italy .....	2,533,242
Latvia .....	310,425
Netherlands .....	3,909,058
Norway .....	11,427
Poland .....	324,864
Portugal .....	322,092
Romania .....	334,120
Slovakia .....	118,333
Slovenia .....	201,634
Spain .....	378,837
Sweden .....	44,959
Switzerland .....	93,891
Turkey .....	1,100,967
Ukraine .....	1,002,580
United Kingdom .....	2,054,919
Other <sup>2</sup> .....	247

# Where US Coal Goes

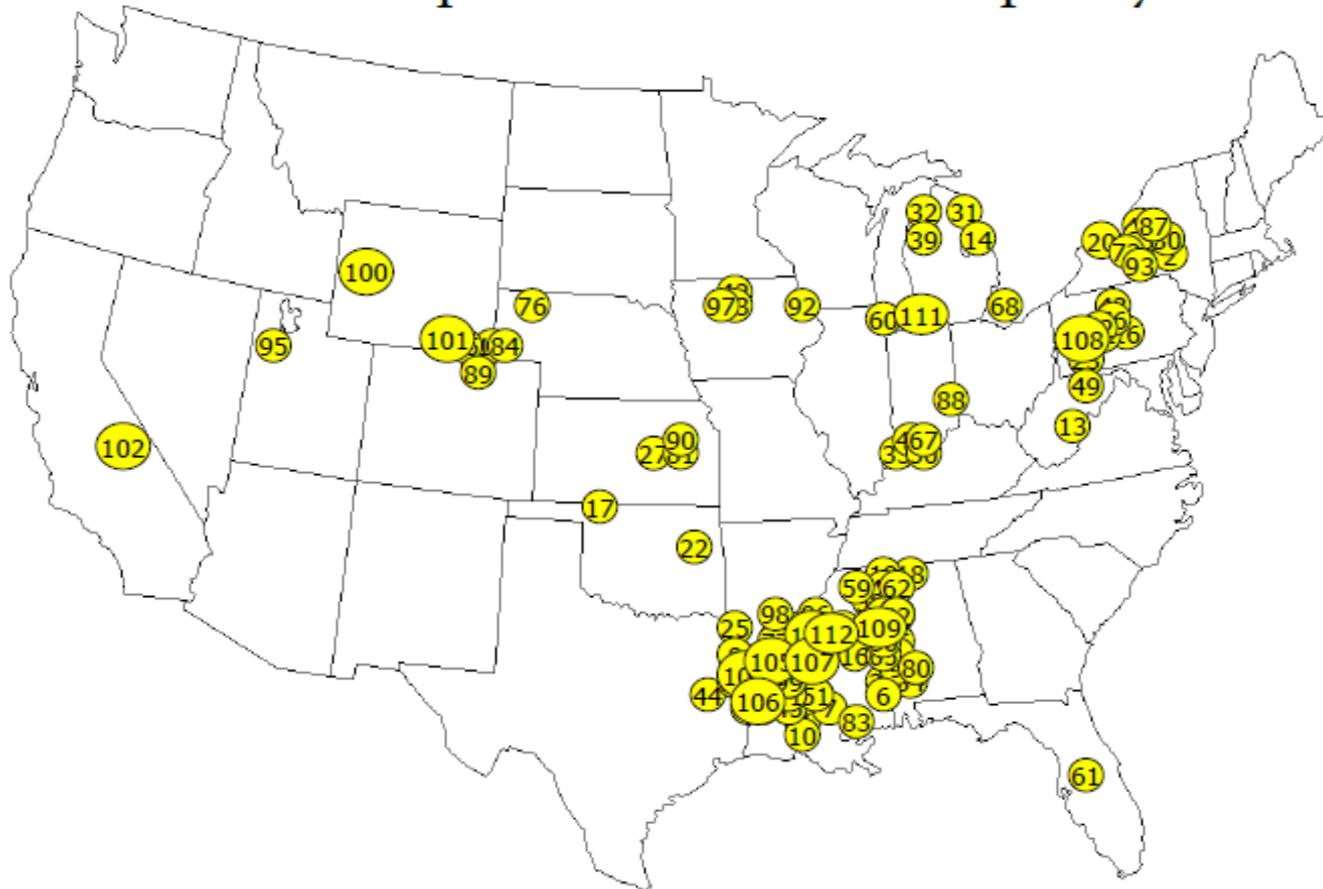
[http://democrats.naturalresources.house.gov/sites/democrats.naturalresources.house.gov/files/documents/Our Pain Their Gain1.pdf](http://democrats.naturalresources.house.gov/sites/democrats.naturalresources.house.gov/files/documents/Our_Pain_Their_Gain1.pdf)

<b>Asia Total</b> .....	<b>7,020,668</b>
China .....	2,001,035
India .....	1,474,171
Japan .....	1,429,807
Korea, South .....	1,847,310
Saudi Arabia .....	35,864
Other <sup>2</sup> .....	232,481
<b>Australia and Oceania Total</b> .....	<b>545</b>
Australia .....	545
<b>Africa Total</b> .....	<b>1,161,169</b>
Egypt .....	164,863
Morocco .....	846,358
South Africa .....	149,723
Other <sup>2</sup> .....	225
<b>Total</b> .....	<b>28,641,698</b>



FERC

## Certificated Storage Projects Since 2000 for Expansion of or New Capacity

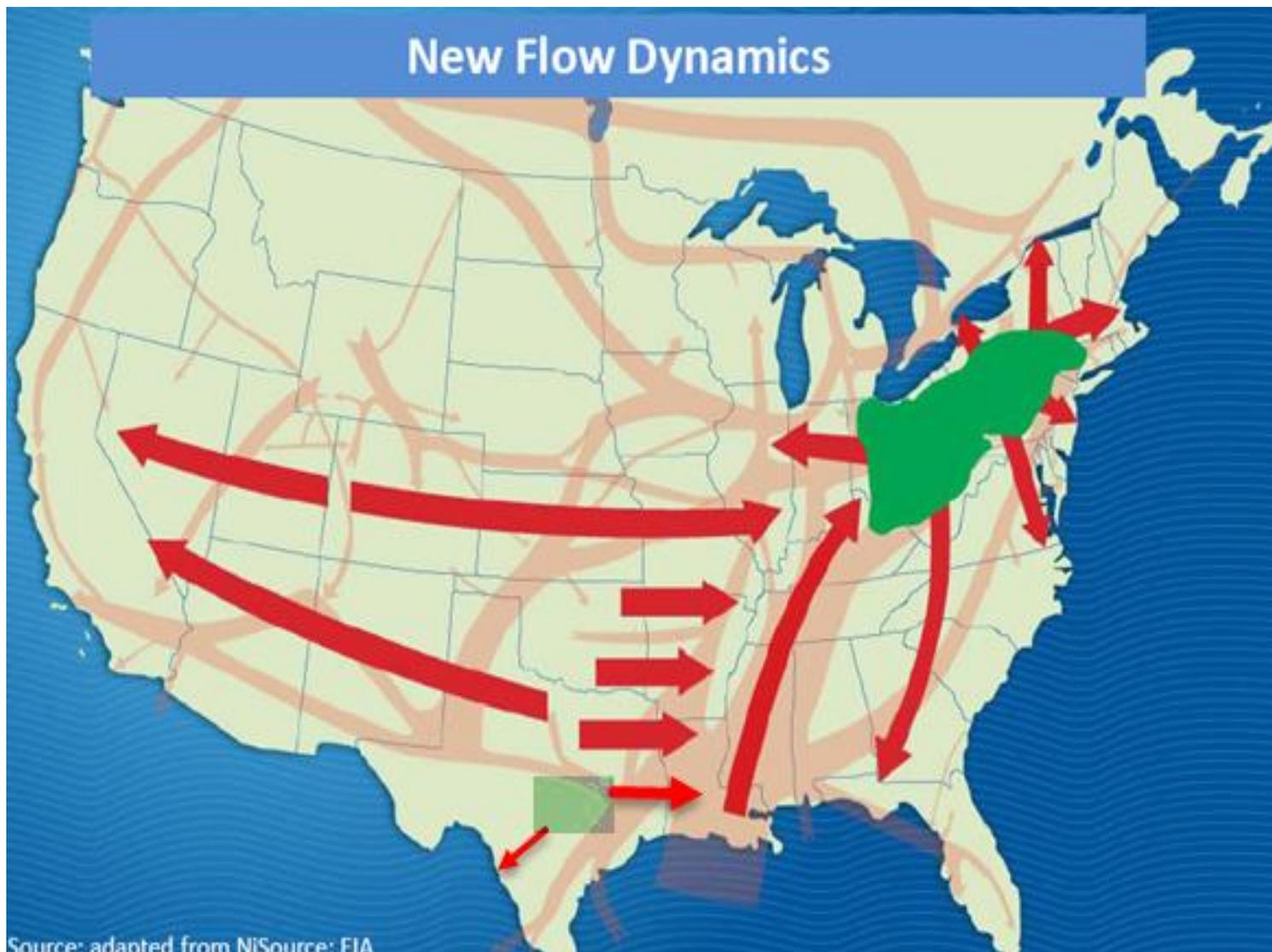


May 1, 2014

Office of Energy Projects

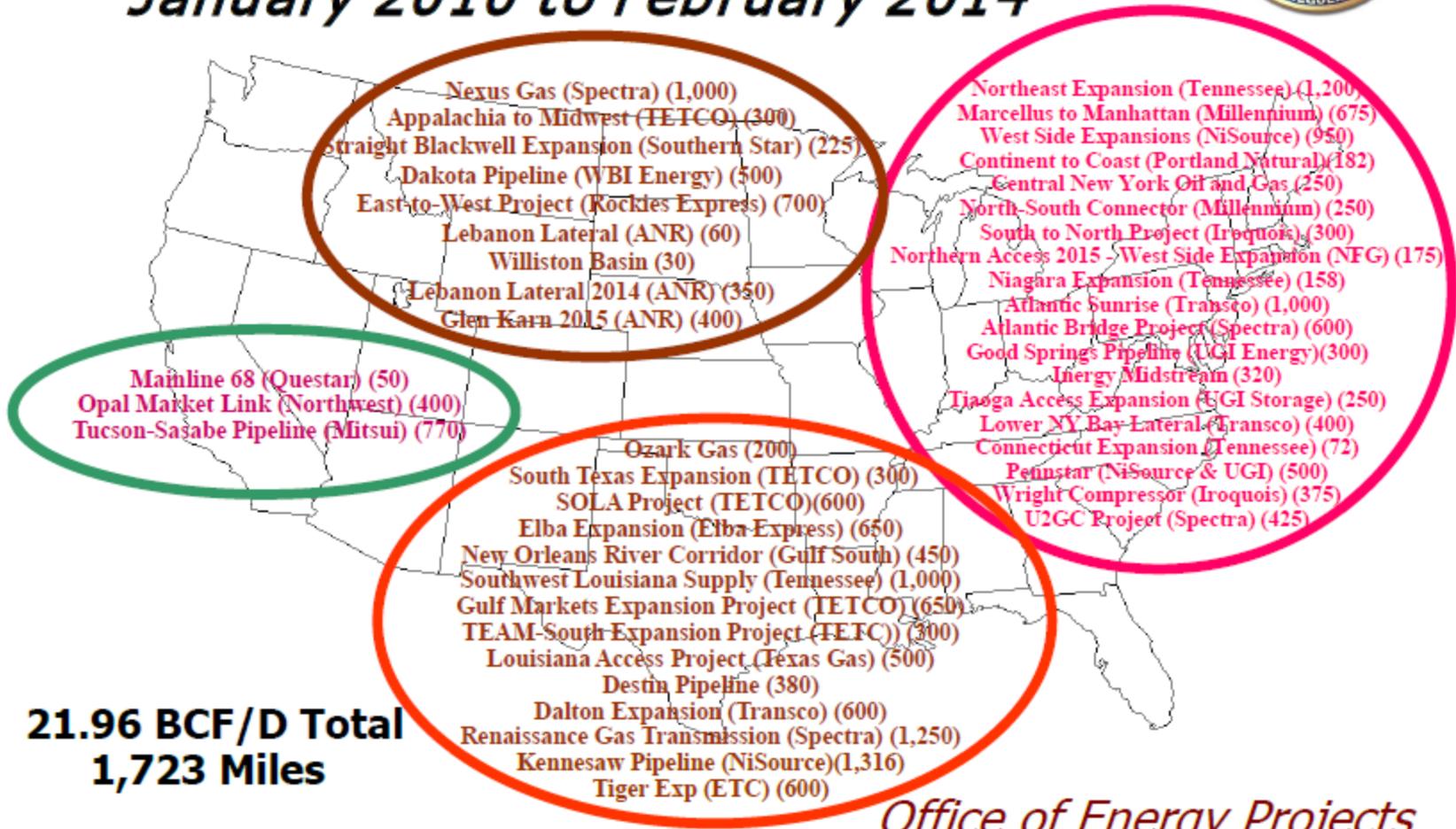
**Note: Total working natgas storage currently stands at ~4.2 tcf**  
[www.ferc.gov/industries/gas/indus-act/storage/certificated.pdf](http://www.ferc.gov/industries/gas/indus-act/storage/certificated.pdf)

# New Gas Flow Dynamics-Shale Gas



# Major Pipeline Projects On The Horizon (MMcf/d)

January 2010 to February 2014



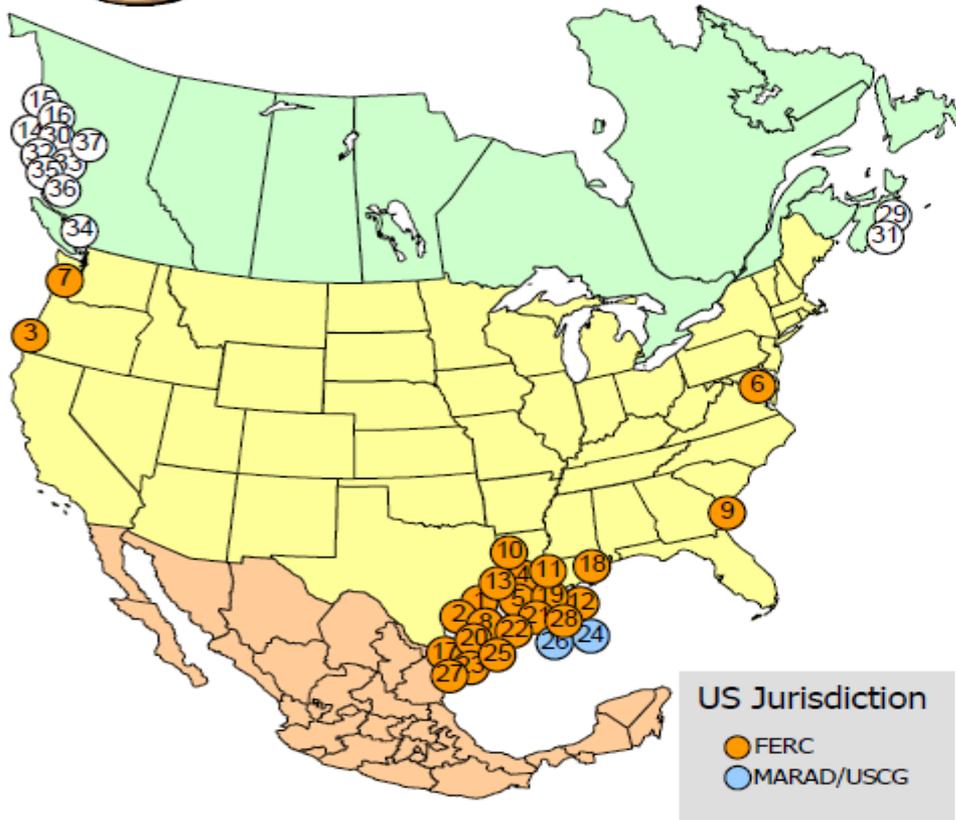
**21.96 BCF/D Total**  
**1,723 Miles**

*Office of Energy Projects*



# North American LNG Export Terminals

## *Proposed/Potential*



### Export Terminal PROPOSED TO FERC

1. **Freeport, TX:** 1.8 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction)\*
2. **Corpus Christi, TX:** 2.1 Bcfd (Cheniere – Corpus Christi LNG)\*
3. **Coos Bay, OR:** 0.9 Bcfd (Jordan Cove Energy Project)\*
4. **Lake Charles, LA:** 2.4 Bcfd (Southern Union - Trunkline LNG)
5. **Hackberry, LA:** 1.7 Bcfd (Sempra – Cameron LNG)\*
6. **Cove Point, MD:** 0.82 Bcfd (Dominion – Cove Point LNG)\*
7. **Astoria, OR:** 1.25 Bcfd (Oregon LNG)\*
8. **Lavaca Bay, TX:** 1.38 Bcfd (Accelerate Liquefaction)\*
9. **Elba Island, GA:** 0.35 Bcfd (Southern LNG Company)
10. **Sabine Pass, LA:** 1.96 Bcfd (Sabine Pass Liquefaction)\*
11. **Lake Charles, LA:** 1.07 Bcfd (Magnolia LNG)
12. **Plaquemines Parish, LA:** 1.07 Bcfd (CE FLNG)
13. **Sabine Pass, TX:** 2.1 Bcfd (ExxonMobil – Golden Pass)

### PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

14. **Kitimat, BC:** 1.28 Bcfd (Apache Canada Ltd.)
15. **Douglas Island, BC:** 0.23 Bcfd (BC LNG Export Cooperative)
16. **Kitimat, BC:** 3.23 Bcfd (LNG Canada)

### POTENTIAL U.S. SITES IDENTIFIED BY PROJECT SPONSORS

17. **Brownsville, TX:** 2.8 Bcfd (Gulf Coast LNG Export)
18. **Pascagoula, MS:** 1.5 Bcfd (Gulf LNG Liquefaction)
19. **Cameron Parish, LA:** 0.16 Bcfd (Waller LNG Services)
20. **Ingleside, TX:** 1.09 Bcfd (Pangea LNG (North America))
21. **Cameron Parish, LA:** 0.20 Bcfd (Gasfin Development)
22. **Cameron Parish, LA:** 0.67 Bcfd (Venture Global)
23. **Brownsville, TX:** 3.2 Bcfd (Eos LNG & Barca LNG)
24. **Gulf of Mexico:** 3.22 Bcfd (Main Pass - Freeport-McMoRan)
25. **Brownsville, TX:** 0.94 Bcfd (Annova LNG)
26. **Gulf of Mexico:** 1.8 Bcfd (Delfin LNG)
27. **Brownsville, TX:** 0.27 Bcfd (Texas LNG)
28. **Plaquemines Parish, LA:** 0.27 Bcfd (Louisiana LNG)

### POTENTIAL CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

29. **Goldboro, NS:** 1.4 Bcfd (Pieridae Energy Canada)
30. **Prince Rupert Island, BC:** 2.91 Bcfd (BG Group)
31. **Melford, NS:** 1.8 Bcfd (H-Energy)
32. **Prince Rupert Island, BC:** 2.74 Bcfd (Pacific Northwest LNG)
33. **Prince Rupert Island, BC:** 4.0 Bcfd (ExxonMobil – Imperial)
34. **Squamish, BC:** 0.29 Bcfd (Woodfibre LNG Export)
35. **Kitimat/Prince Rupert, BC:** 0.32 Bcfd (Triton LNG)
36. **Prince Rupert, BC:** 3.12 Bcfd (Aurora LNG)
37. **Kitsault, BC:** 2.6 Bcfd (Kitsault Energy)

As of February 18, 2014

\* Filed Certificate Application

*Office of Energy Projects*

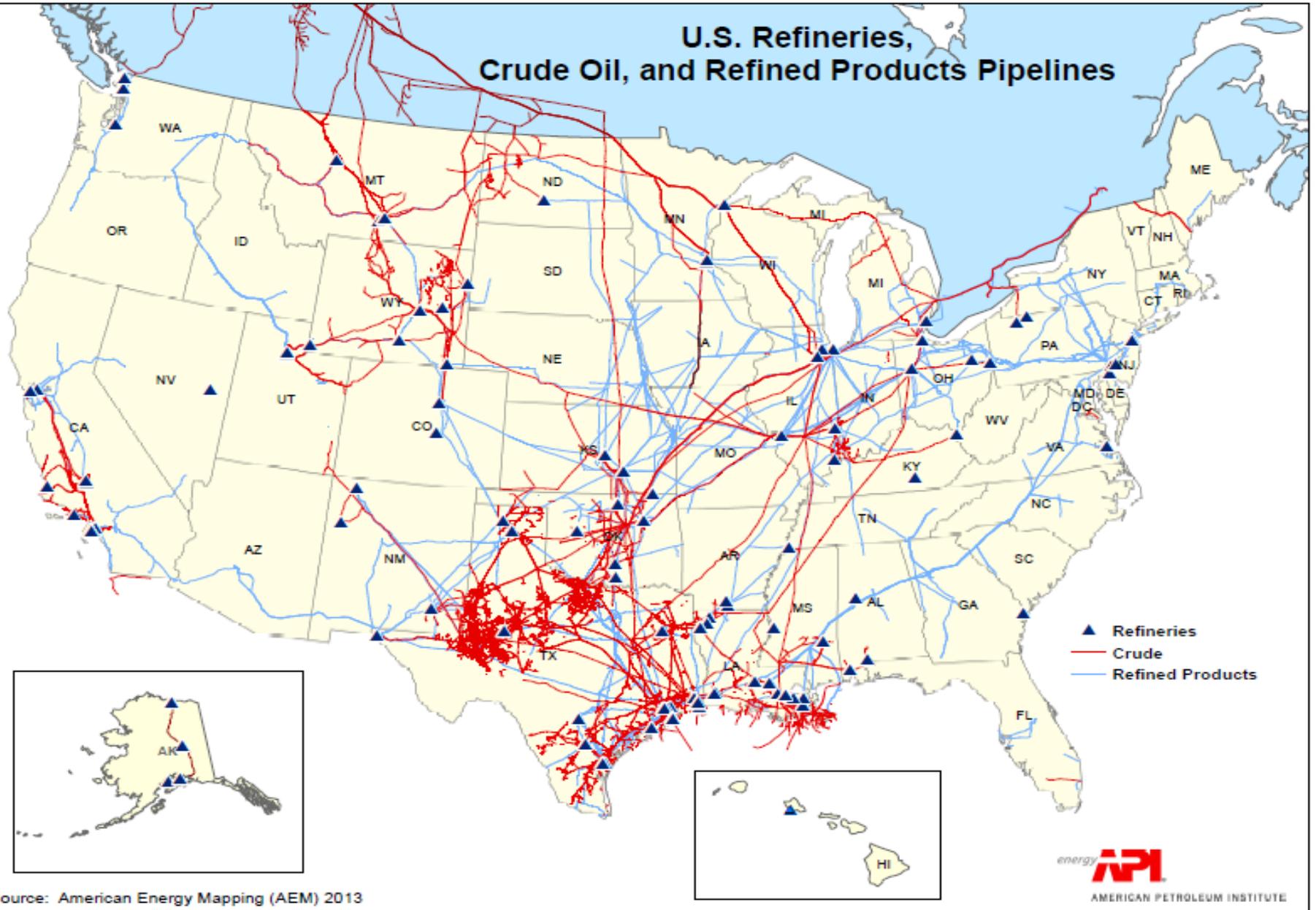
**Note: Per DOE-as Jan 22, 2014 six export facilities approved for non-FTA with 24 more pending. 32 approved for FTA exports with 6 more pending. Total FTA export capacity approved/pending 38.5 bcf**

<http://energy.gov/sites/prod/files/2014/02/f8/Summary%20of%20LNG%20Export%20Applications.pdf>

<https://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-potential-export.pdf>



# U.S. Refineries, Crude Oil, and Refined Products Pipelines



Source: American Energy Mapping (AEM) 2013

energy **API**  
AMERICAN PETROLEUM INSTITUTE

[www.api.org/oil-and-natural-gas-overview/transporting-oil-and-natural-gas/pipeline/~media/Files/Oil-and-Natural-Gas/pipeline/US-Pipeline-Map-API-Website3.pdf](http://www.api.org/oil-and-natural-gas-overview/transporting-oil-and-natural-gas/pipeline/~media/Files/Oil-and-Natural-Gas/pipeline/US-Pipeline-Map-API-Website3.pdf)

# Refinery Crude and Condensate Additions

- 17 additions planned or already operational between 2014 and 2016
- Adds ~590,000 b/day of new capacity

# Changing Crude Oil Pipelines

## Key Pipelines: Distribution Lags Production



# Crude Oil by Rail

- USGC 24 operating and planned crude by rail terminals by end of 2015
- ~1.5 million b/day of capacity

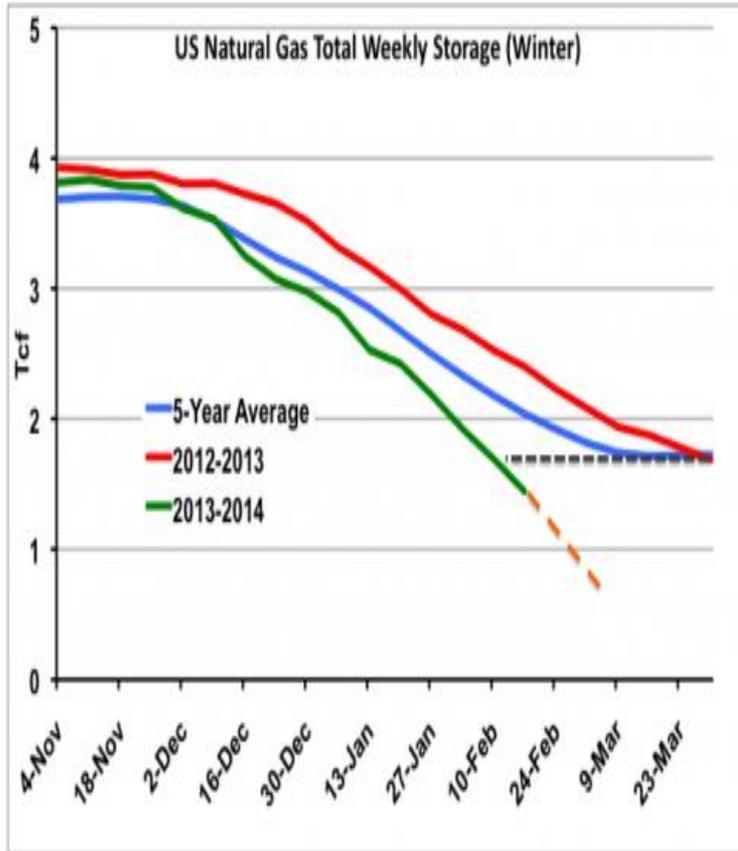
# Panama Canal Expansion and It's Impacts

It could be the single biggest game changer for the export of US energy and related commodities to the Far East.

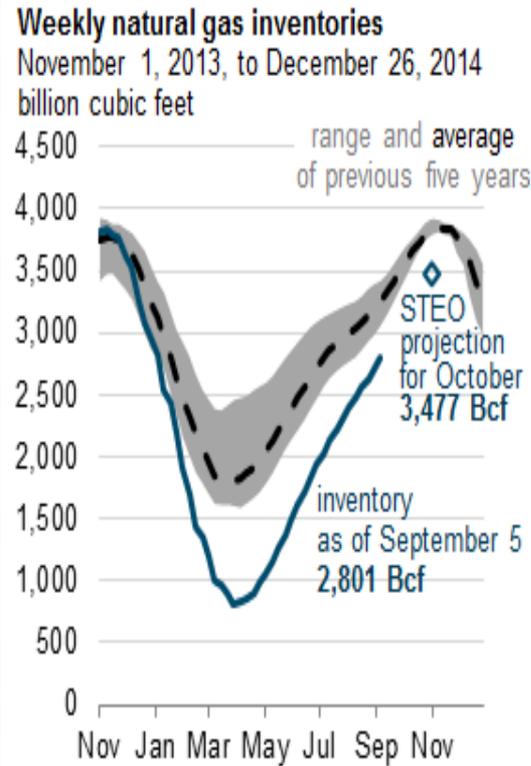
- LNG Exports –first US export facility online in 2015. Canal will be able to provide passage for up to 80% of global shipping of liquefied natural gas (LNG). It currently allows passage of only a small percentage of LNG shipping and only shipping by the smallest of LNG tankers.
- Coal Exports – major expansions of GC terminals
- NGL Exports – long term export contracts
- Transportation Fuels Exports-from foreign/US crude, GTL and CTL projects
- Crude Oil Exports – talk to open up lower 48 export restrictions-- ship size moves from 400,000-550,000 bbls to up to 680,000 bbls
- Petrochemical Exports – world scale export facilities and expansions underway in the GC

# **Some Things to Think About**

# US Natgas Storage Hit Hard



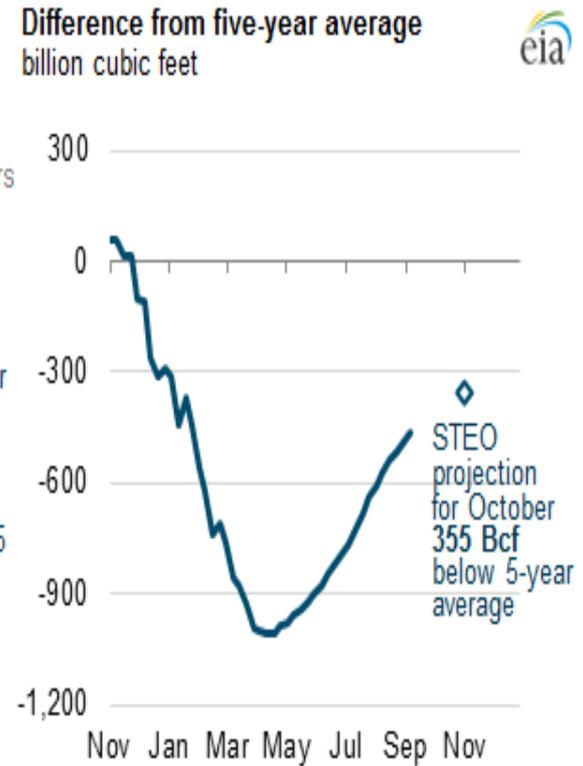
EIA Feb 14th 2014



Source: U.S. Energy Information Administration, *Weekly Natural Gas Storage Report (WNGSR)* and *Short-Term Energy Outlook (STEO)*

EIA Sept 12, 2014

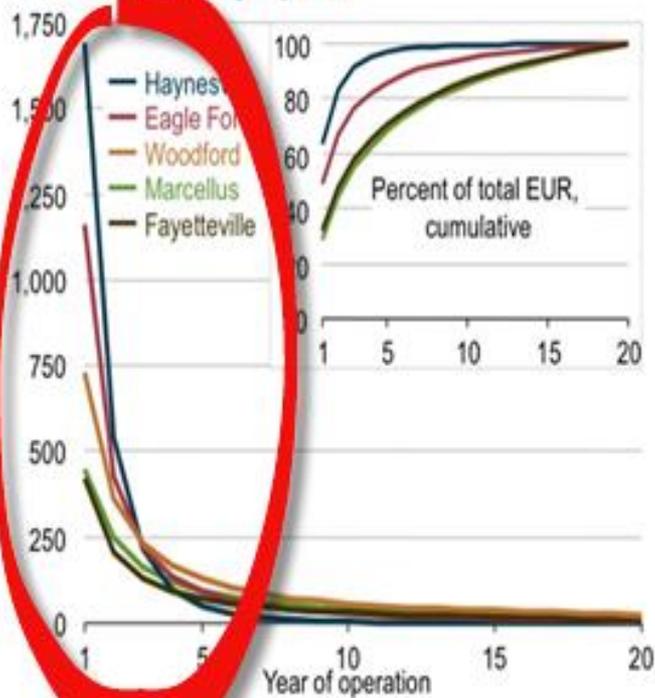
[www.eia.gov/todayinenergy/detail.cfm?id=17951](http://www.eia.gov/todayinenergy/detail.cfm?id=17951)



*“If the cold weather continues and withdrawals maintain their recent pace of 200 + Bcf/week then storage could easily fall below 1 Tcf by the end of March, for the first time since 2003.”* (orange dashed projection on the chart). RBN 2-24-14

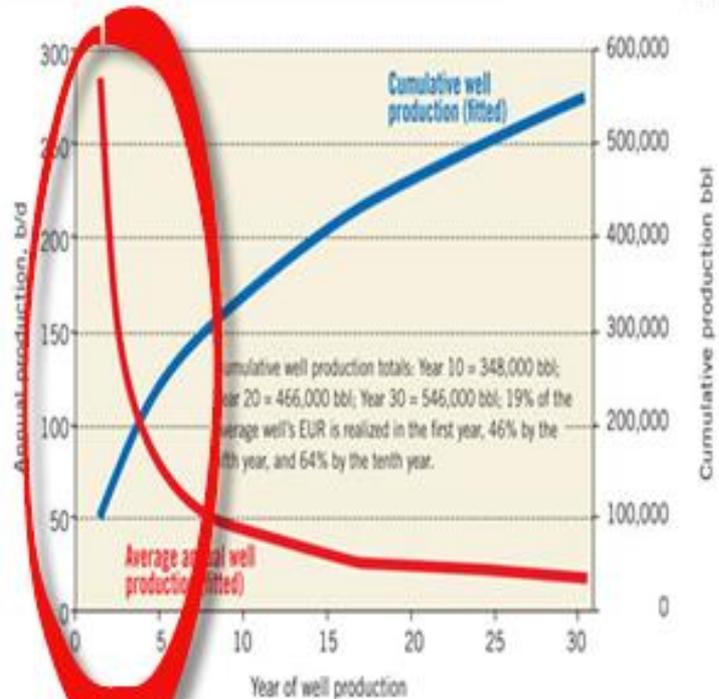
# Major Shale (Gas/Oil) Basin Wells Rapid Declining Production Curve

Average production profiles for shale gas wells in major U.S. shale plays by years of operation (million cubic feet per year)



NORTH DAKOTA BAKKEN WELL PRODUCTION PROFILE

FIG. 5



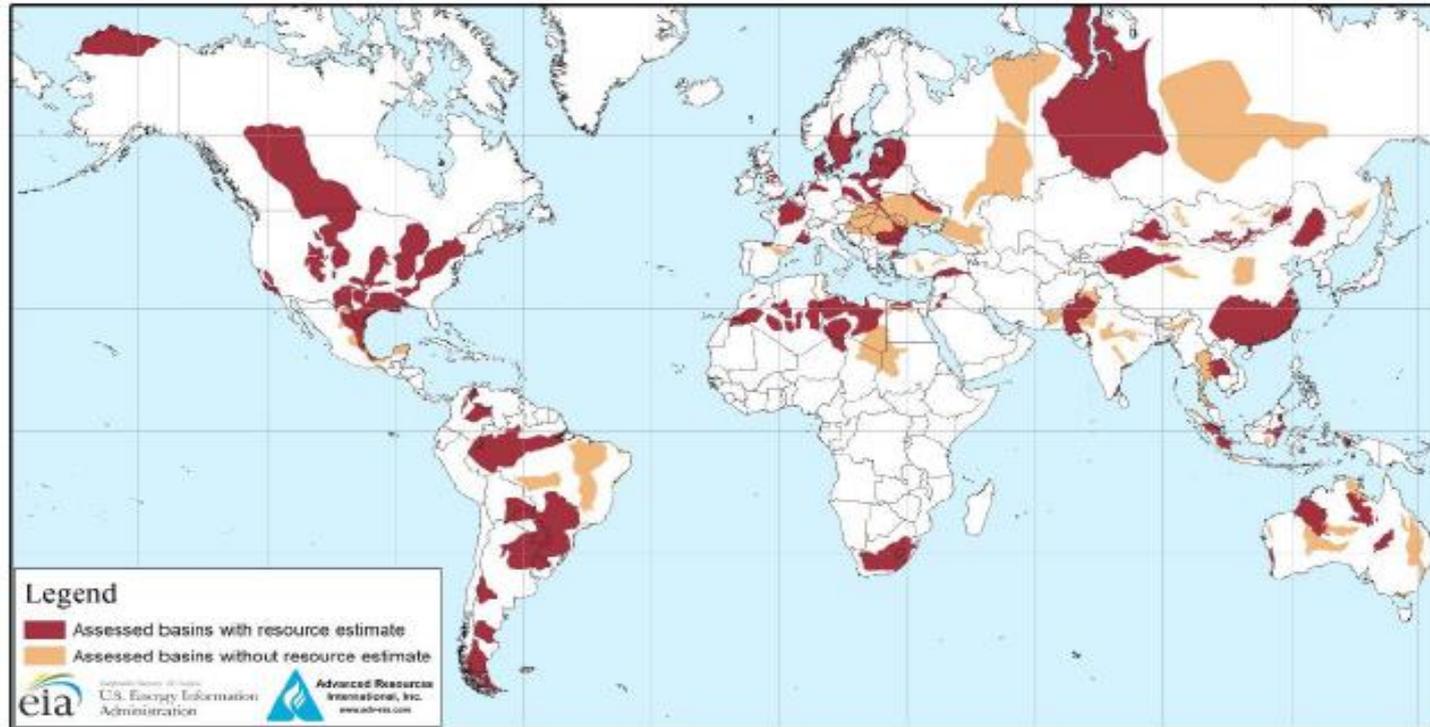
<http://www.ogj.com/articles/print/vol-110/issue-4/exploration-development/bakken-s-maximum.html>

<http://www.ogj.com/articles/print/vol-110/issue-4/exploration-development/bakken-s-maximum.html>

# Impacts and Impactors

- 2012 Lower power costs in US vs. Europe creating competitive industrial tensions. <http://www.cnbc.com/id/101365772>
- Feb. 2014 Natgas shortage in California-Stephanie McCorkle, a spokeswoman for the grid operator, said Southern California has become increasingly dependent on natural gas-fired plants since the decision last year to shutter the troubled San Onofre nuclear power plant, which is located between Los Angeles and San Diego. <http://bigstory.ap.org/article/natural-gas-shortage-affects-calif-power-supply>
- February 21<sup>st</sup>, 2014 East Coast runs short of natgas.. With heating demands for gas soaring, gas prices at two points on the Transco pipeline running through the mid-Atlantic region averaged more than \$120 per million British thermal units on Jan. 21 with a high mark of \$140 per million Btu, -- prices that pushed some generators' costs to more than \$1,200 per MWh. Energy & Environment News 2/24/14
- October 31, 2012 US coal displaces Germany's natgas, shutting down new natgas generation and raising their GHG emissions. <http://www.bloomberg.com/news/2012-10-31/gas-golden-age-darkens-in-europe-on-u-s-coal-energy-markets.html>
- November 7th 2013 'Unburnable' carbon fuels investment concerns-Investors group with €7.3tn of assets asks energy giants about their exposure and response to the risk of falling demand for oil and coal. <http://www.theguardian.com/sustainable-business/unburnable-carbon-investment-agenda>
- June 12th 2013 Obama Quietly Raises 'Carbon Price' as Costs to Climate Increase. The increase of the so-called social cost of carbon, to \$38 a metric ton in 2015 from \$23.80, adjusts the calculation the government uses to weigh costs and benefits of proposed regulations. The figure is meant to approximate losses from global warming such as flood damage and diminished crops. <http://www.bloomberg.com/news/2013-06-12/tougher-regulations-seen-from-obama-change-in-carbon-cost.html>

# Map of Basins with assessed Shale Oil and Shale Gas Formations, as of May 2013

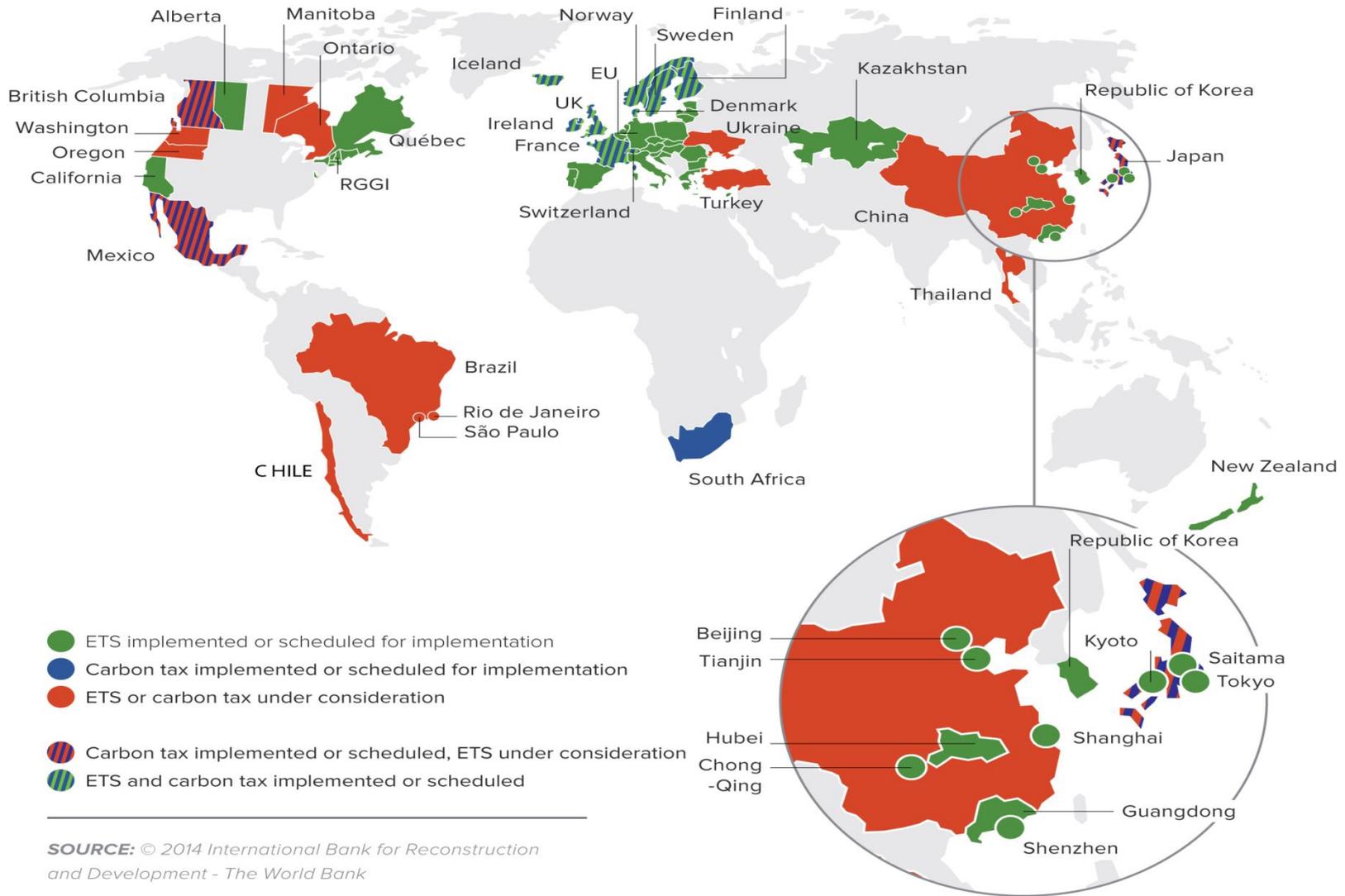


- Red colored areas represent the location of basins with shale formations for which estimates of the risked oil and natural gas in-place and technically recoverable resources were provided. Prospective shale formations rarely cover an entire basin.
- Tan colored areas represent the location of basins that were reviewed, but for which shale resource estimates were not provided, mainly due to the lack of data necessary to conduct the assessment.
- White colored areas were not assessed in this report.

	Crude oil (billion barrels)	Wet natural gas (trillion cubic feet)
Total	3,357	22,882

Source: Technically Re coverable Shale Oil and Shale Gas Resources: An Assessment of 137 Shale Formations in 41 Countries Outside the United States EIA June 13<sup>th</sup> 2013

# International Carbon Markets



*SOURCE:* © 2014 International Bank for Reconstruction and Development - The World Bank

# Questions & Thank You!

**Michael E. Moore**

- VP Energy Commodities and Advisory Services
- FearnOil Inc. (a division of Astrup-Fearnleys)
- [www.fearnleys.com](http://www.fearnleys.com)
  
- Executive Director
- North American Carbon Capture Storage Association
- [www.naccca.org](http://www.naccca.org)
  
- [mmoore@fearnoil.com](mailto:mmoore@fearnoil.com)    Tel: 281-759-0245

- The Astrup Fearnley group represents over a century of history, growth and excellence in the area of shipping services. This fascinating legacy is a success story created by generation after generation of the Astrup Fearnley family. We believe it is a story worth telling.
- Fearnleys traces its history back to the year 1869 when its founder, Thomas Fearnley, established a shipbroking and agency business in Christiania, as the city of Oslo was known in those days. The little company soon prospered and engaged in, among others, the trade in lumber, wine, pitch and ice.
- In connection with its trading activities the company bought shares in vessels and chartered vessels. Although the company began by chartering sailing vessels, by 1880 the age of the steamship had clearly begun. By 1881 the partnership of Fearnley & Eger established the Christiania Steamship Company which contracted two newbuildings at the the Kockums Shipyard in Malmø, the 1235 deadweight 'Oslo' and the 1215 deadweight 'Bygdøy'.
- By the end of the 1880s the company had contracted a further six units. In the beginning of the 1900s Fearnley & Eger became, more or less, a shipowning company and invested in ever larger units. The company engaged in both liner and tramp activities and survived the two world wars. In addition to these shipowning activities, the firm continued to engage in developing its skills in the area of shipping services and was engaged primarily in the area of dry cargo shipbroking. As the tanker industry started to develop at the beginning of the 20th century, Fearnleys became enthusiastically involved in this new field of endeavour. Later on, when the transportation of gas by sea became an important area of commerce, Fearnleys developed a broking department which specialized in this new commodity. All in all, the history of the company has been closely focused on the concept of innovation; whenever new ideas and new industries developed which required seaborne transportation, Fearnleys was quickly on the scene.
- As the 20th century progressed, the need for brokerage services for the transportation industry became so great that Fearnleys began to develop these (along with related ancillary services) as its principal business area. Always on the cutting edge of new trends, the company became involved in car carrier transportation in the 1960s, offshore and rig broking in the 1970s, coinciding with the onset of the development of the Norwegian continental shelf offshore oil fields, and energy trading and financial services in the 1980s. Fearnleys was also a pioneer in the development of transportation industry research and consultancy services, and has been involved in monitoring and analysing shipping markets since the early 1960s when Fearnresearch was first established. Now at the dawn of the 21st century the little company which started in Christiania in 1869 is firmly established in every corner of the world and assumes a global perspective on transportation much to the benefit of its worldwide customer base.

Shipping	Offshore	Energy	Finance
 <p>Shipping is one of the group's major business areas.</p>	 <p>Fearnley Offshore and Fearnley Offshore Supply offer future-oriented broking and advisory services in the growing offshore sector.</p>	 <p>Libra Fearnley Energy AS is a sizeable participant in the oil broking market through its affiliates in Paris, London, Houston and Singapore.</p>	 <p>Fearnley Finans AS and Fearnley Securities AS offer a wide array of financial services</p>

# North American Carbon Capture Storage Association



➤ ABOUT US

➤ MEDIA CENTER

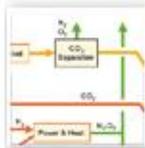
➤ CONCEPT OF CCUS

➤ CONTACT US

➤ MEMBERS



## Benefits of CCUS



CCUS holds the promise of storing large volumes of CO<sub>2</sub> in geologic formations such as deep saline formations, depleting reservoirs (e.g. EOR, ECBM), depleted reservoirs, unminable coal seams and similar geologic structures... [Read more](#)

## What is NACCSA

The North American Carbon Capture & Storage Association (NACCSA) is a nonprofit organization of companies in North America that support the development of a sustainable carbon dioxide (CO<sub>2</sub>) capture use and storage (CCUS) industry in the United States and Canada. Policymakers and companies are interested in CCUS technology because it may be used for energy recovery and holds significant promise as a tool to manage man-made emissions of carbon dioxide, one of the principle greenhouse gases (GHG).

# NACCSA Participants

- American Petroleum Institute
- Anadarko Petroleum Corporation
- BP Alternative Energy North America Inc.
- C12 Energy
- Denbury Resources, Inc.
- Kinder Morgan
- Occidental Petroleum Corporation
- Peabody Energy
- Sasol
- Schlumberger Carbon Services
- Shell

## **Affiliated participants**

- SSEB
- WRI
- EERC
- IEA GHG