Hydraulic Fracturing:
What Informs Me

Presentation to:
2013 National Energy and
Utilities Affordability Conference

By:
John Harpole

Mercator Energy

June 11th, 2013

Who I Am

- 33 years in the Oil & Gas Industry
- Appointed by Gov. Owens to **Low Income Energy Commission** in 1998
- **Energy Outreach Colorado Board Member** since 2006
- Author of **RIK-LIHEAP 2005 Energy Policy Act**
- Friend of Skip Arnold, Mary Grassi & Jim Jacob
- Son of Phil & Mary

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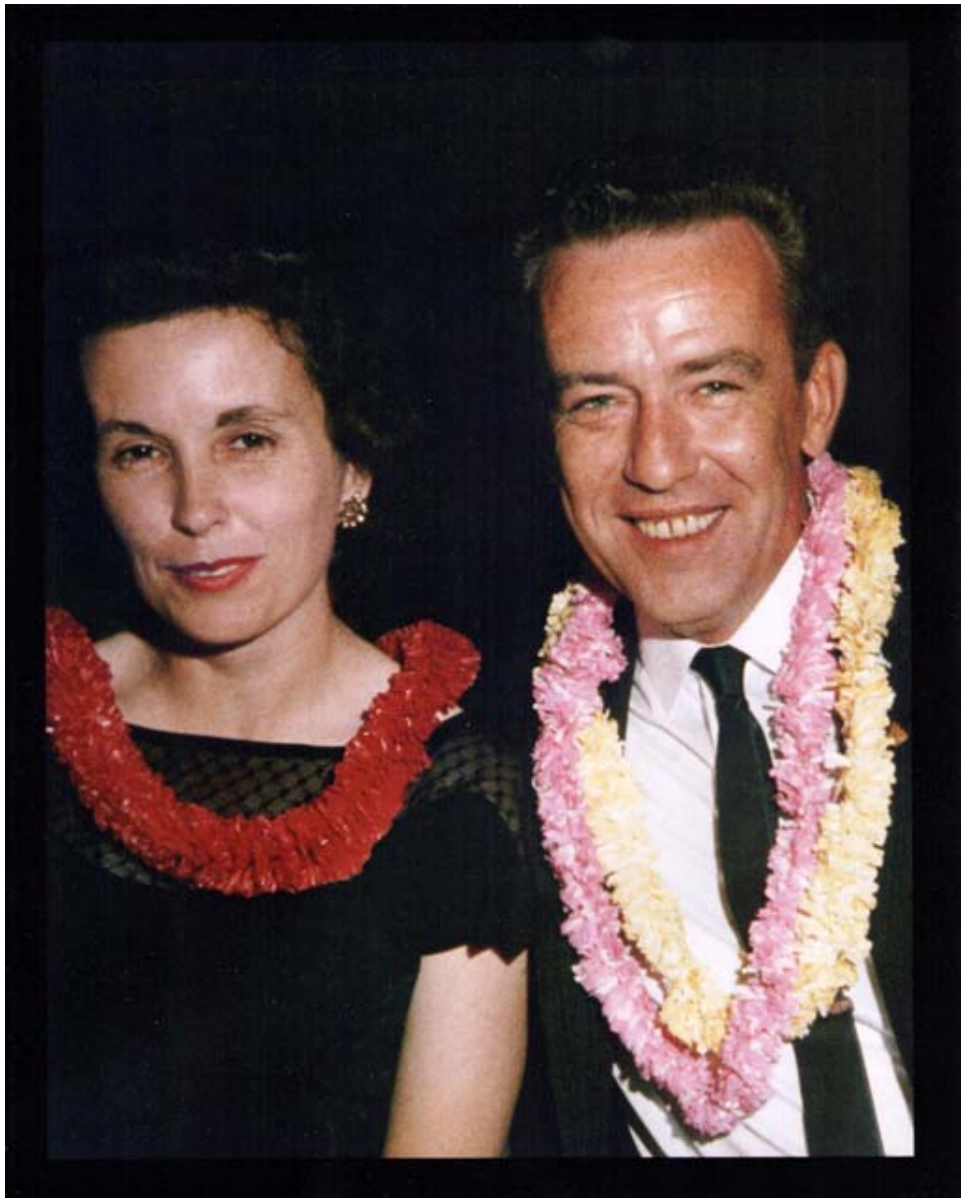

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May 13th, 1966

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35 Years of Energy Bills

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The Cougar's Cubs in Action

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Rocky Mountain News
A Scripps-Howard Newspaper
Reg. U.S. Pat. Off.
Colorado's First Newspaper—Founded in 1859
113TH YEAR, NO. 85
Published every morning by Denver Publishing Co. Second class postage paid at Denver, Colorado
DENVER, COLORADO 80201, FRIDAY, JULY 16, 1971
FINAL EDITION
FORECAST: Partly cloudy
10c
128 PAGES

Trip before May at Chou En-lai's invitation

President to visit mainland China

LOS ANGELES (UPI)—In a stunning surprise, President Nixon announced Thursday night he had accepted an invitation from Premier Chou En-lai to visit the Peoples Republic of China sometime before next May.

He said the trip was arranged during a secret visit of his national security adviser, Dr. Henry A. Kissinger, to Peking July 9 to July 11 while Kissinger was on an around the world trip.

"I have taken this action because of my profound conviction that all nations will gain from a reduction of tensions and a better relationship between the United States and the People's Republic of China," the President said in a five minute nationwide radio and television statement.

He would be the first U.S. President to visit the People's Republic of China, the world's largest Communist nation, which the United States has never formally recognized.

The announcement, made simultaneously here and in Peking, signaled a major departure in the policy which the United States has followed since the Communists took over mainland China at the end of World War II.

"As I have pointed out on a number of occasions over the past three years, there can be no stable and enduring peace without the participation of the Peoples Republic of China and its 750 million people," the President said.

In anticipation of the protest that appeared sure to be heard from the government of the Republic of China in Taiwan, the President said his action in seeking a new relationship with mainland China "will not be at the expense of our old friends.

"It is not directed against any other nation. We seek friendly relations with all nations. Any nation can be our friend without being any other nation's enemy."

The announcement came on the heels of several initiatives toward normalizing relations with the Communist Chinese government. The President recently relaxed trade and travel restrictions to mainland China and indicated that the United States might drop

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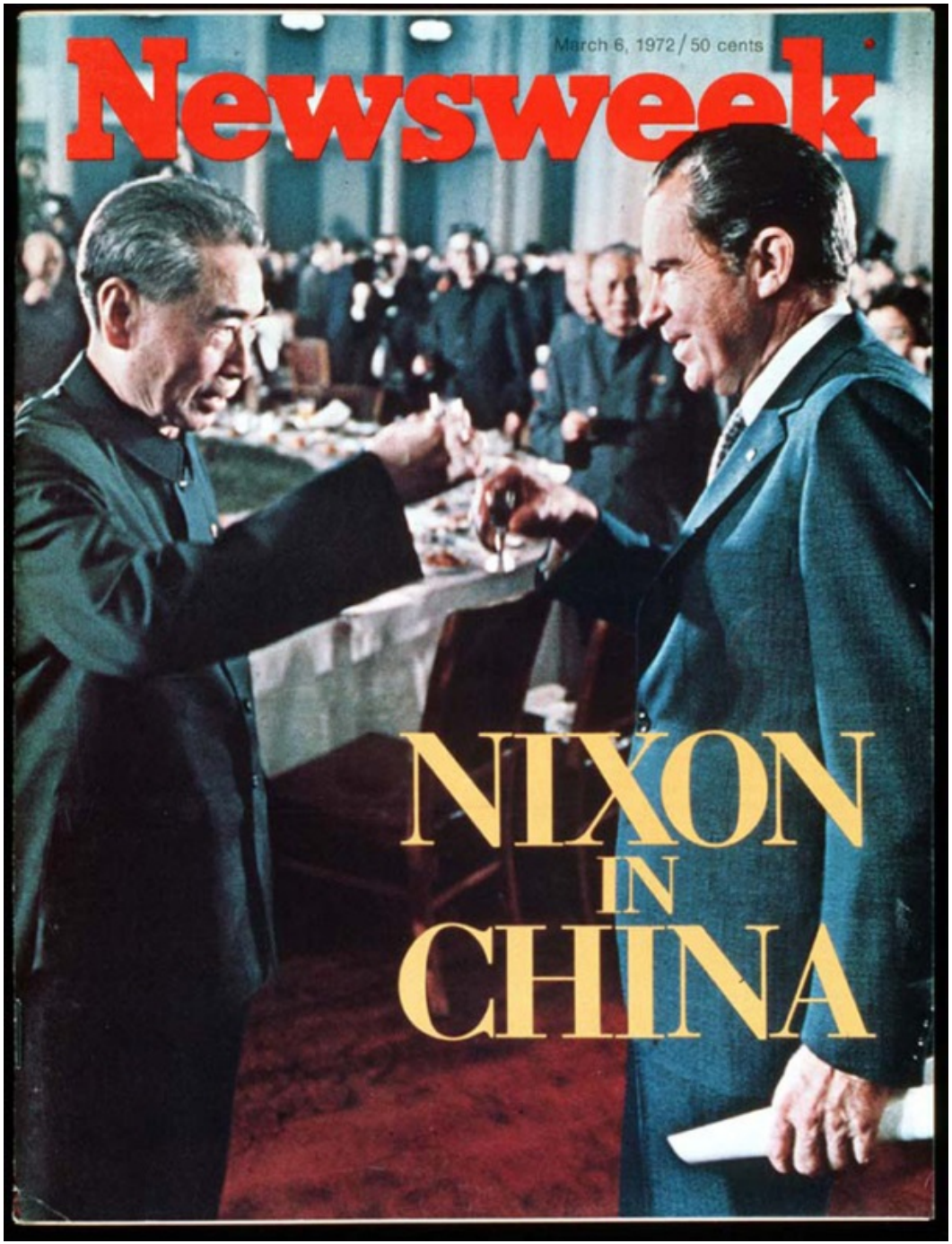

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Harpoles In China: 2010 & 2012

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China is Looking to Us

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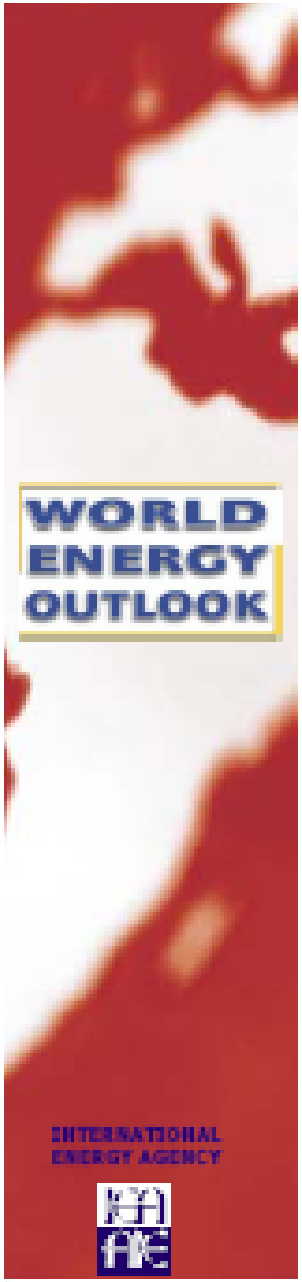
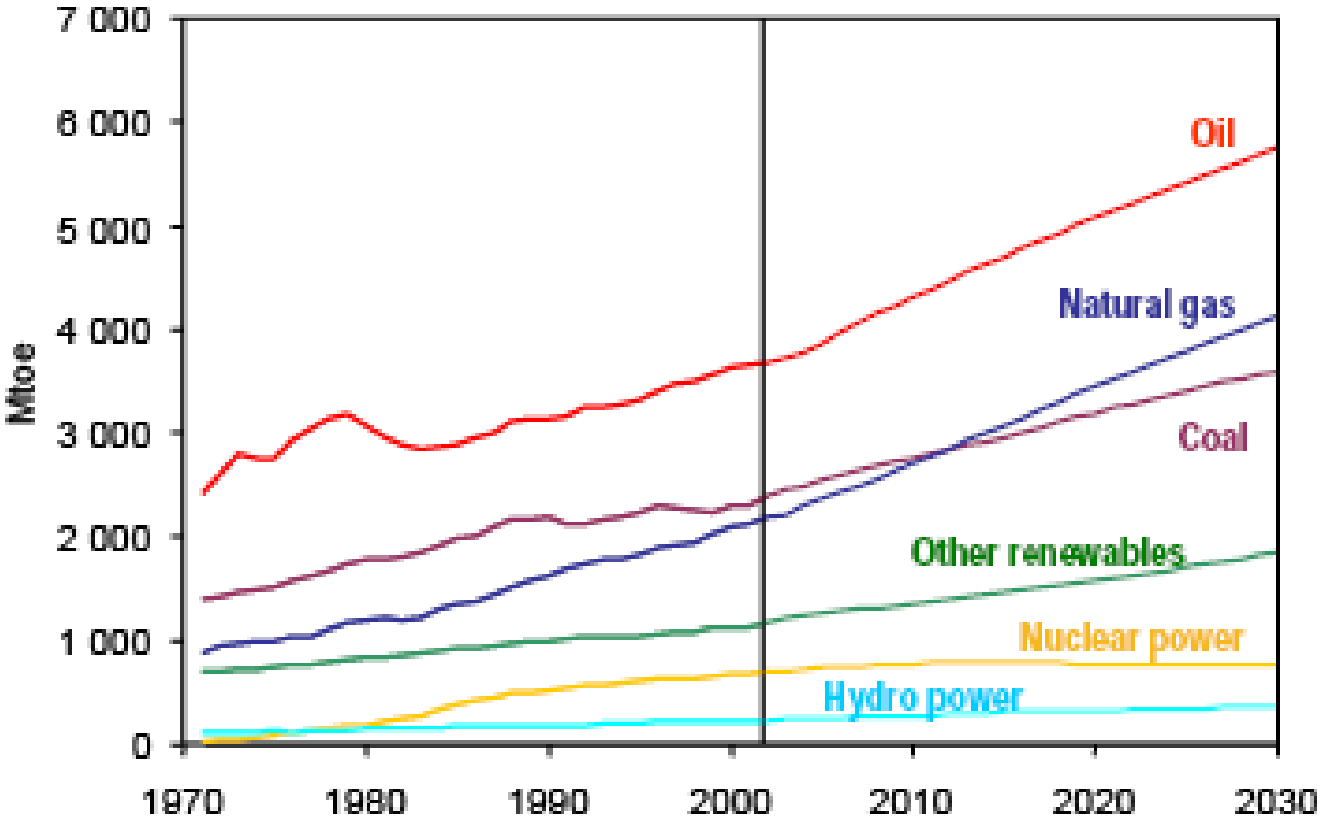


World Primary Energy Demand



Fossil fuels account for almost 90% of the growth in energy demand between now and 2030

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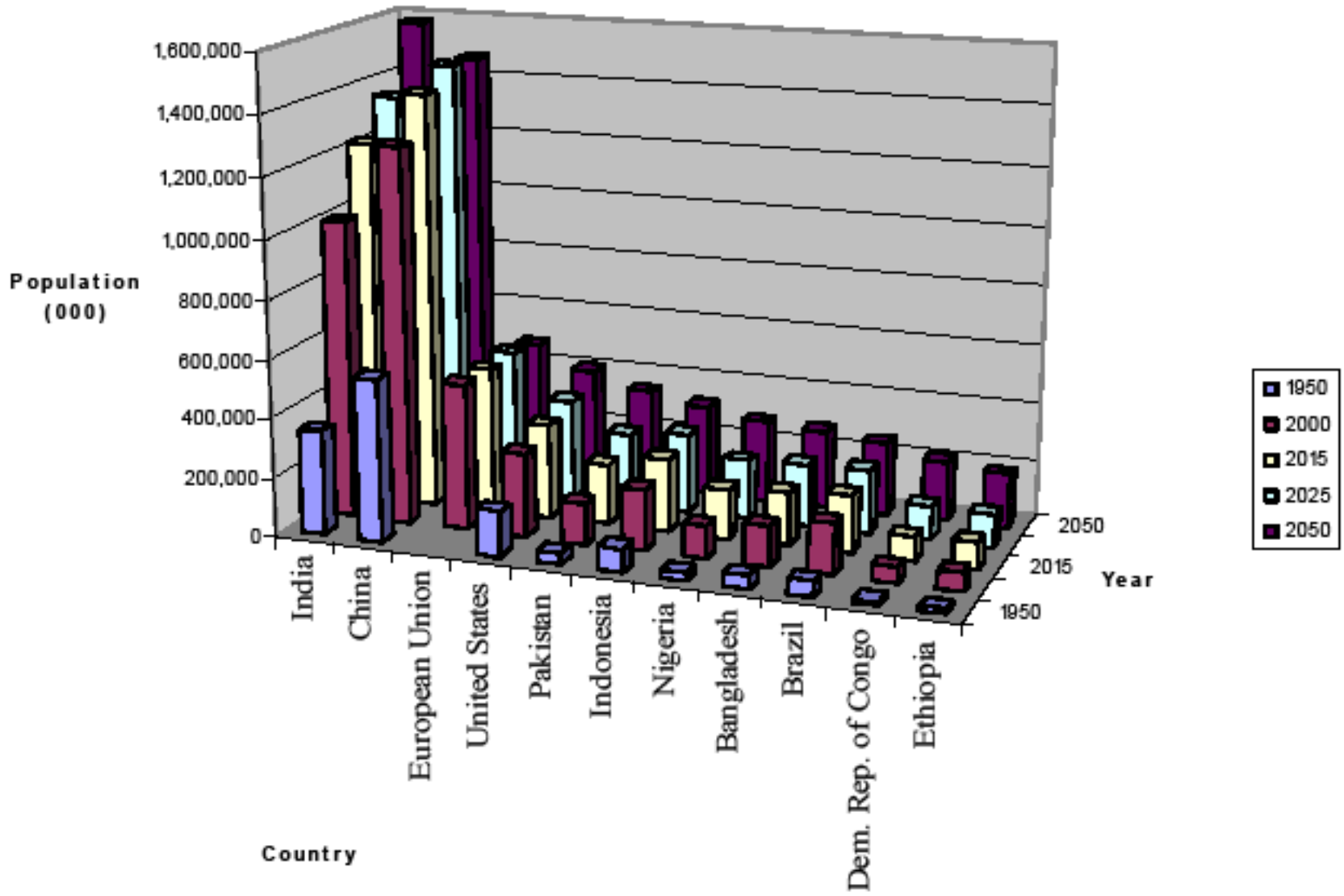
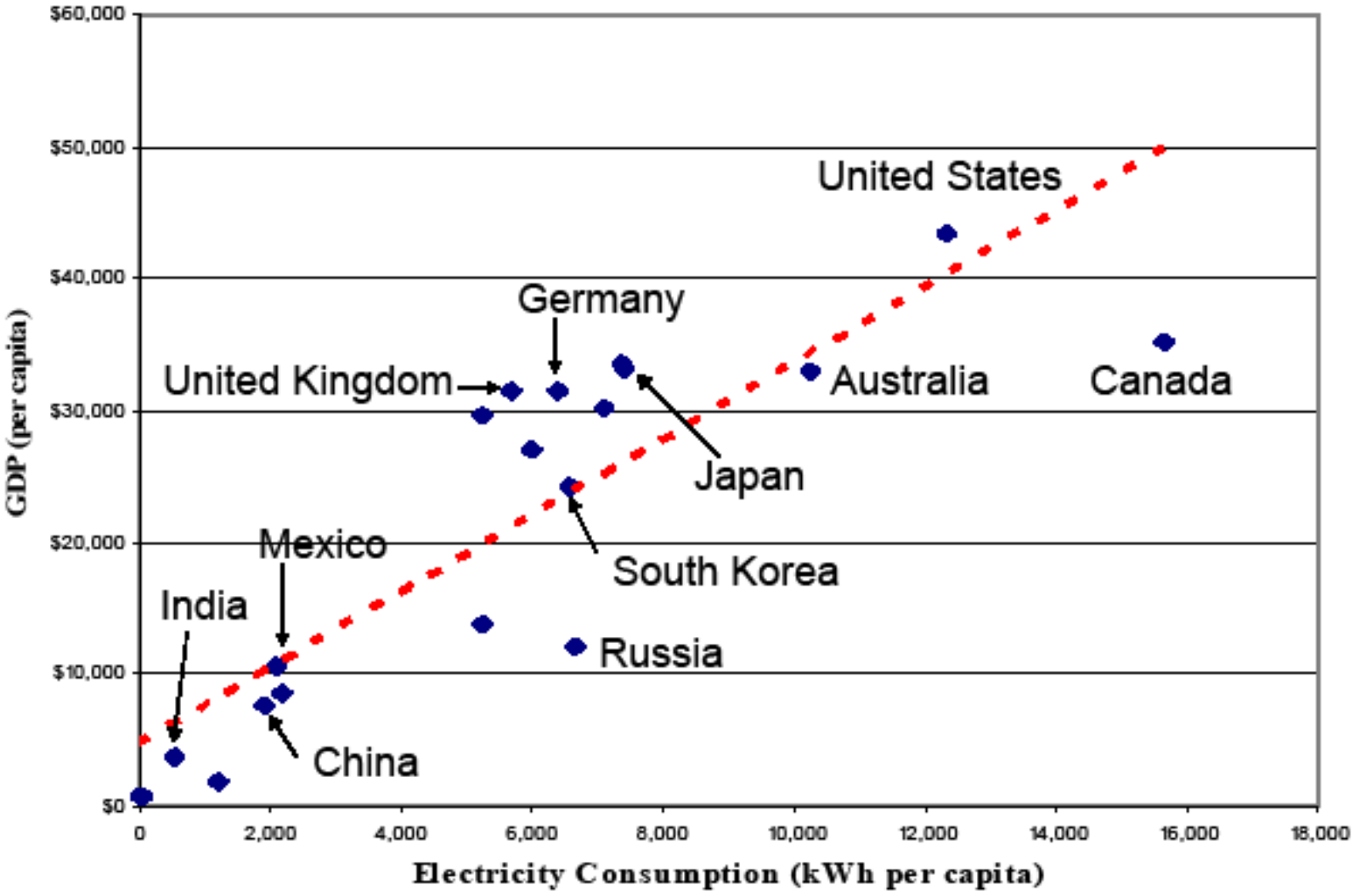
Population Growth from 1950-2050

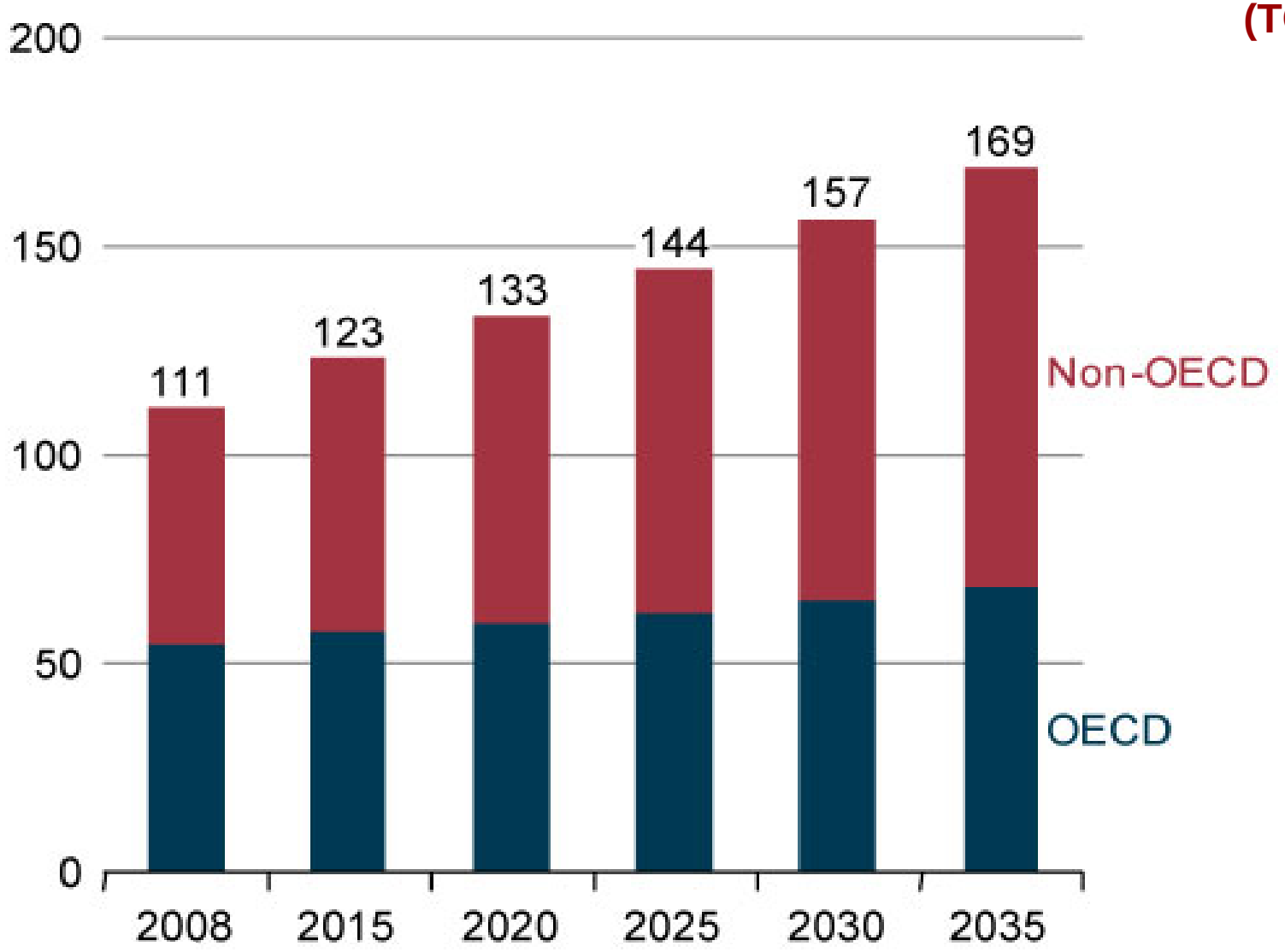


Quality of Life is Strongly Correlated with Electricity Consumption



Source: CIA World Factbook, 2007

World Natural Gas Consumption, 1990-2035



Source: U.S. Energy Information Administration, *International Energy Outlook 2011,* September 19, 2011

Russia, Iran and Qatar Form Natural Gas Cartel

10/21/2008 in Tehran, Iran

Qatar's Deputy Premier and Minister of Energy and Industry, Abdullah bin Hamad Al-Attiya

Iranian Oil Minister, Gholam Hossein Nozari

Alexei Miller, Chief of Russia's state gas monopoly - Gazprom

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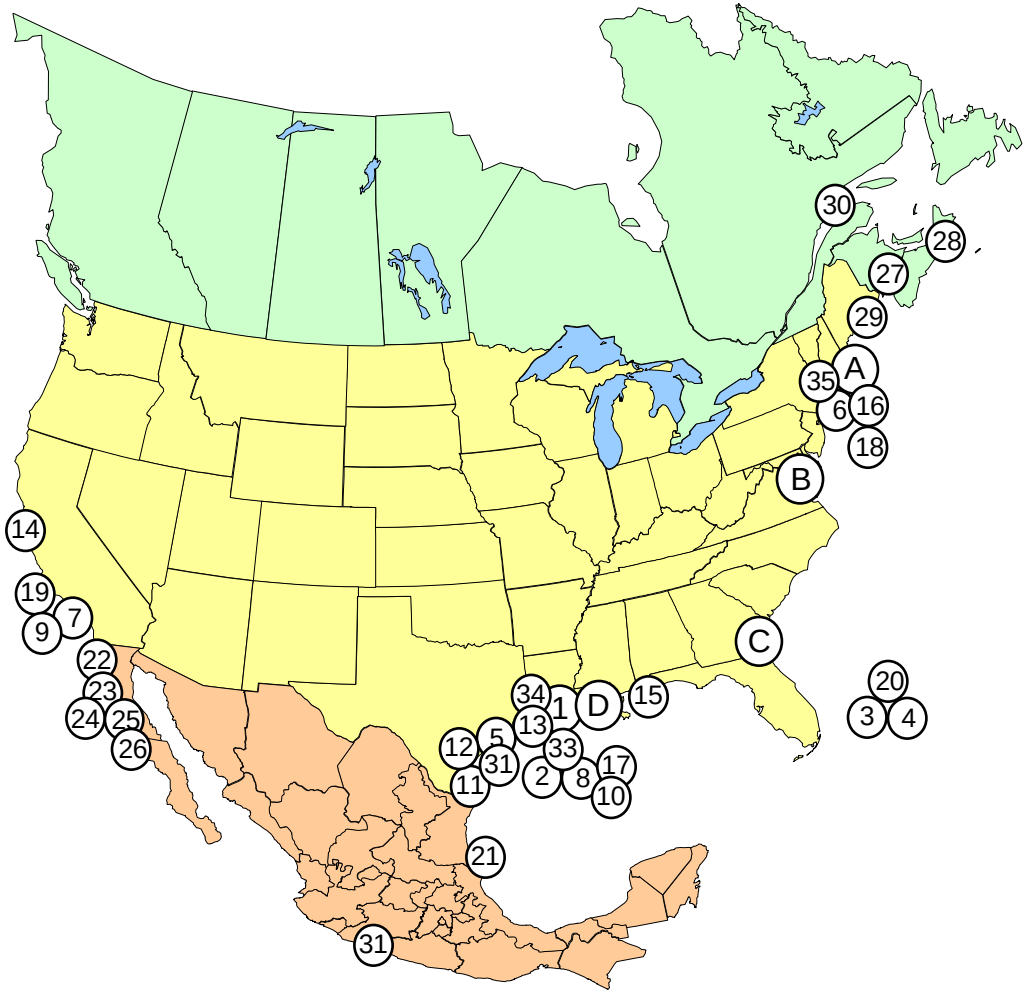
Existing and Proposed Lower-48 LNG Terminals



December 2003

Source: Pat Wood, Federal Energy Regulatory Commission, LNG Ministerial Conference Presentation

Existing Terminals with Expansions

A. Everett, MA : 1.035 Bcfd (Tractebel)
B. Cove Point, MD : 1.0 Bcfd (Dominion)
C. Elba Island, GA : 1.2 Bcfd (El Paso)
D. Lake Charles, LA : 1.2 Bcfd (Southern Union)

Approved Terminals

1. Hackberry, LA : 1.5 Bcfd, (Sempra Energy)
2. Port Pelican: 1.0 Bcfd, (Chevron Texaco)

Proposed Terminals – FERC

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. Fall River, MA : 0.4 Bcfd, (Weaver's Cove Energy)
7. Long Beach, CA : 0.7 Bcfd, (SES/Mitsubishi)

Proposed Terminals – Coast Guard

8. Gulf of Mexico: 0.5 Bcfd, (El Paso Global)
9. California Offshore: 1.5 Bcfd, (BHP Billiton)
10. Louisiana Offshore : 1.0 Bcfd (Gulf Landing – Shell)

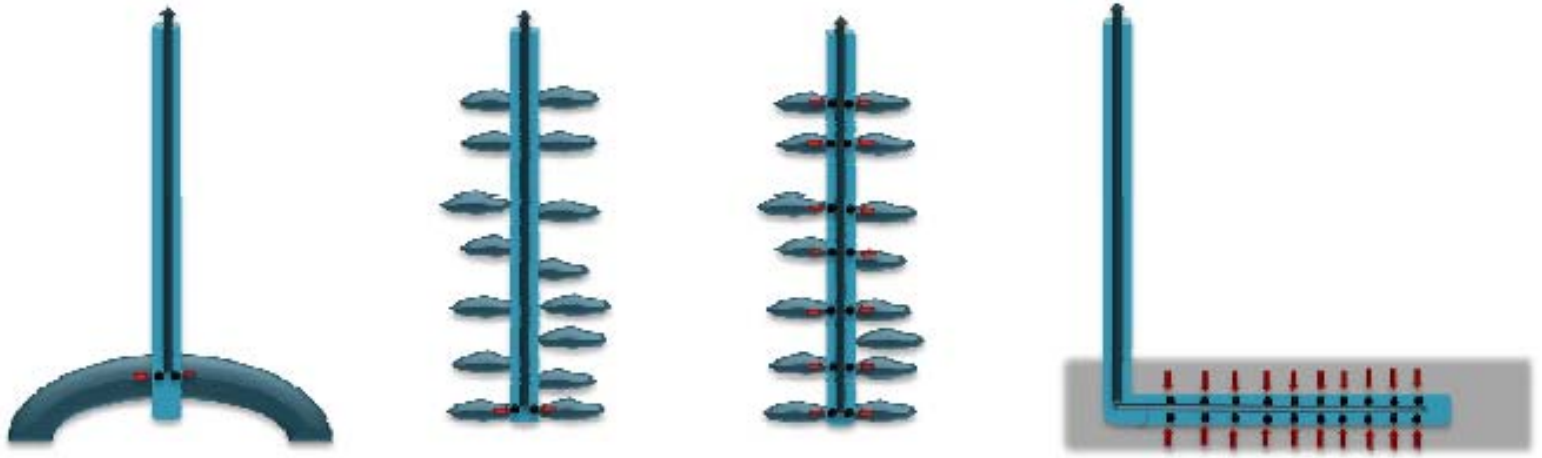
Planned Terminals

11. Brownsville, TX : n/a, (Cheniere LNG Partners)
12. Corpus Christi, TX : 2.7 Bcfd, (Cheniere LNG Partners)
13. Sabine, LA : 2.7 Bcfd (Cheniere LNG)
14. Humboldt Bay, CA : 0.5 Bcfd, (Calpine)
15. Mobile Bay, AL: 1.0 Bcfd, (ExxonMobil)
16. Somerset, MA : 0.65 Bcfd (Somerset LNG)
17. Louisiana Offshore : 1.0 Bcfd (McMoRan Exp.)
18. Belmar, NJ Offshore : n/a (El Paso Global)
19. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
20. Bahamas : 0.5 Bcfd, (El Paso Sea Fare)
21. Altamira, Tamulipas : 1.12 Bcfd, (Shell)
22. Baja California, MX : 1.3 Bcfd, (Sempra)
23. Baja California : 0.6 Bcfd (Conoco-Phillips)
24. Baja California - Offshore : 1.4 Bcfd, (Chevron Texaco)
25. Baja California : 0.85 Bcfd, (Marathon)
26. Baja California : 1.3 Bcfd, (Shell)
27. St. John, NB : 0.75 Bcfd, (Irving Oil & Chevron Canada)
28. Point Tupper, NS 0.75 Bcf/d (Access Northeast Energy)
29. Harpswell, ME : 0.5 Bcf/d (Fairwinds LNG – CP & TCPL)
30. St. Lawrence, QC : n/a (TCPL and/or Gaz Met)
31. Lázaro Cárdenas, MX : 0.5 Bcfd (Tractebel)
32. Corpus Christi, TX : 1.0 Bcfd (ExxonMobil)
33. Gulf of Mexico : 1.0 Bcfd (ExxonMobil)
34. Sabine, LA : 1.0 Bcfd (ExxonMobil)
35. Providence, RI ; 0.5 Bcfd (Keyspan & BG LNG)

AMERICA'S NATURAL GAS ALLIANCE

EVOLUTION IN GAS WELL COMPLETEION TECHNOLOGY - THE KEY TO TODAY'S NATURAL GAS REVOLUTION

Conventional Reservoir	Tight Sands Single-stage HF	Tight Sands Multi-stage HF	Shale – horiz well + Multi-stage HF
1850's to present	1950's to 1990's	1990's to present	2000 to present



Multi-stage hydraulic fracture stimulation (HF) unlocks gas in unconventional reservoirs

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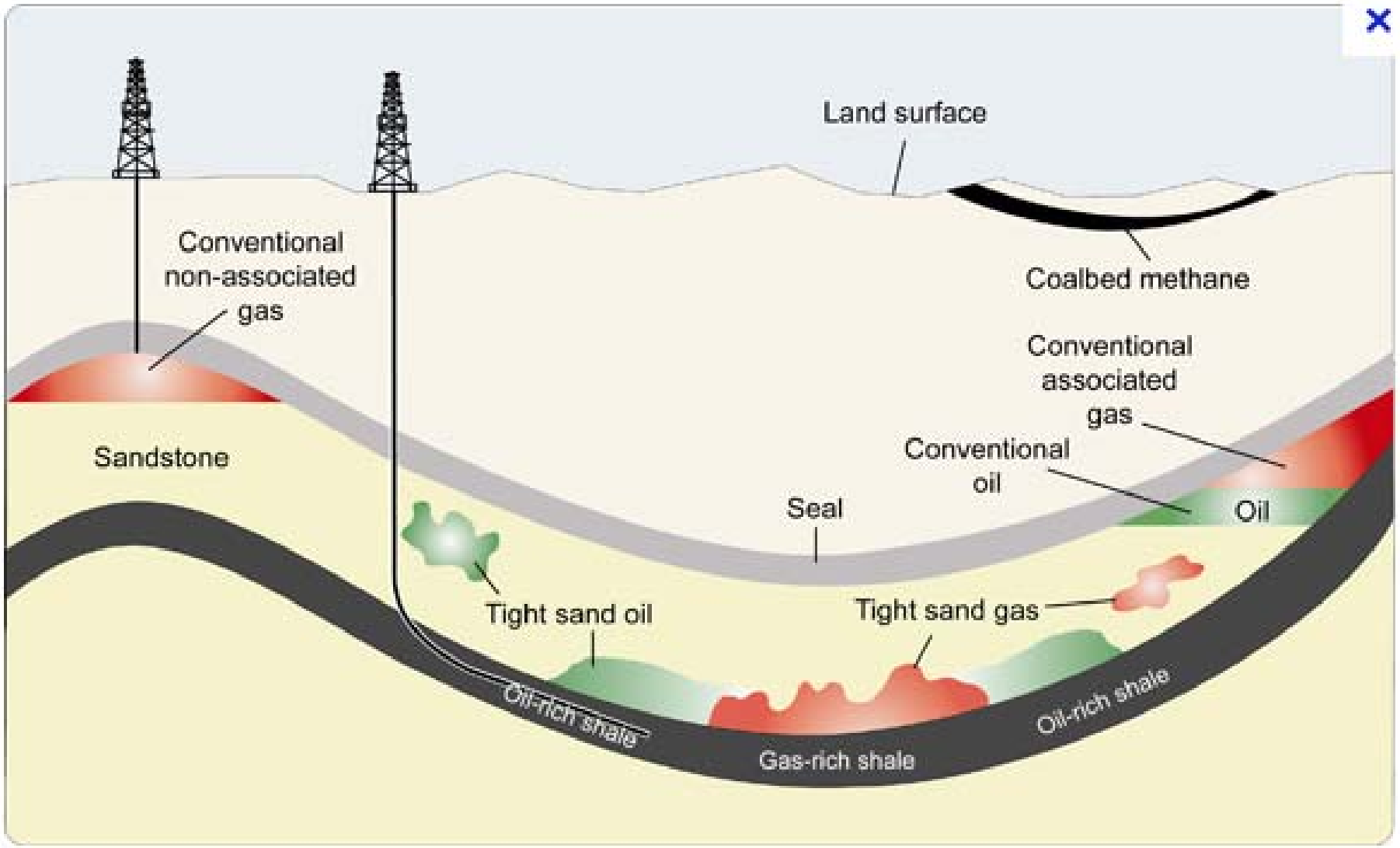
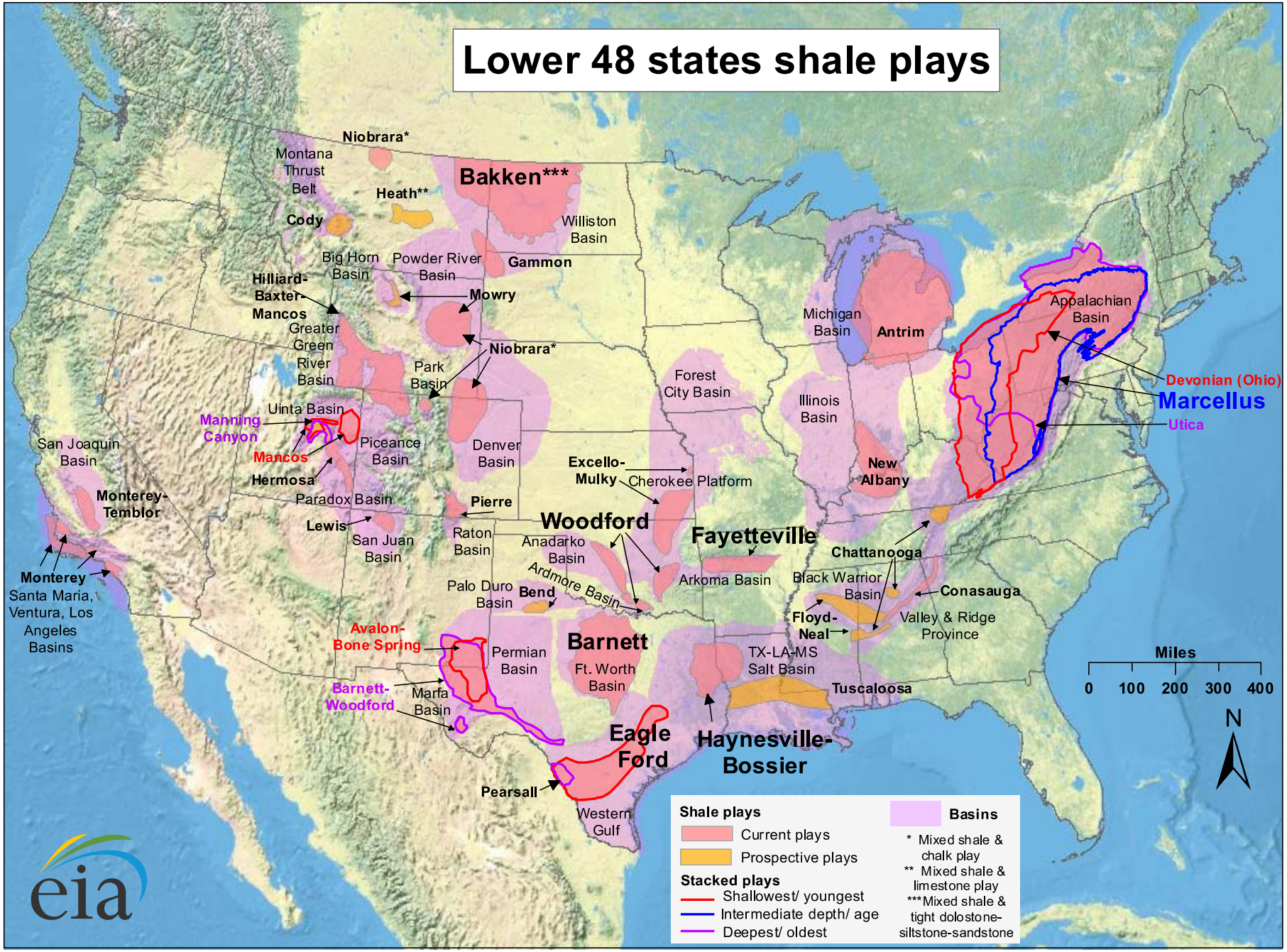
Source: *America's New Natural Gas,* America's Natural Gas Alliance

Conventional vs Unconventional Reservoirs



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

Fracture Treatment in 1949

12 Miles East of Duncan, OK

Source: Platts Gas Daily, April 15, 2013

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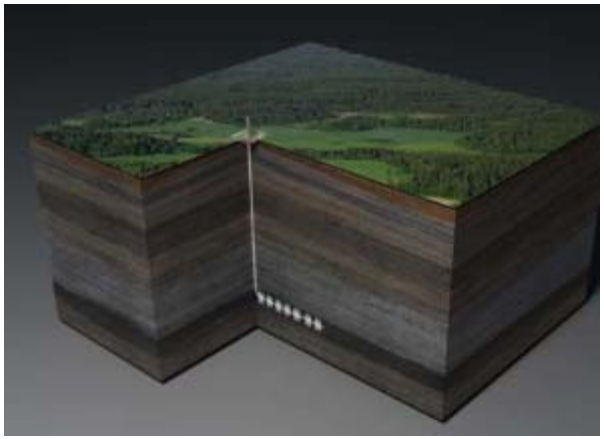
Definition

- The use of fluids to create a crack by hydraulic pressure
- The continued injection of fluids into the created crack fracture to make it grow larger
- The placement of small granular solids into the crack to ensure the crack remains open after the hydraulic pressure is no longer applied



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Why HF a Well?

- Increase the **Rate** at which the well is capable of producing oil or gas
- Most unconventional formations **Require** hydraulic fracturing to be economic
- Does not increase total **Reserves**

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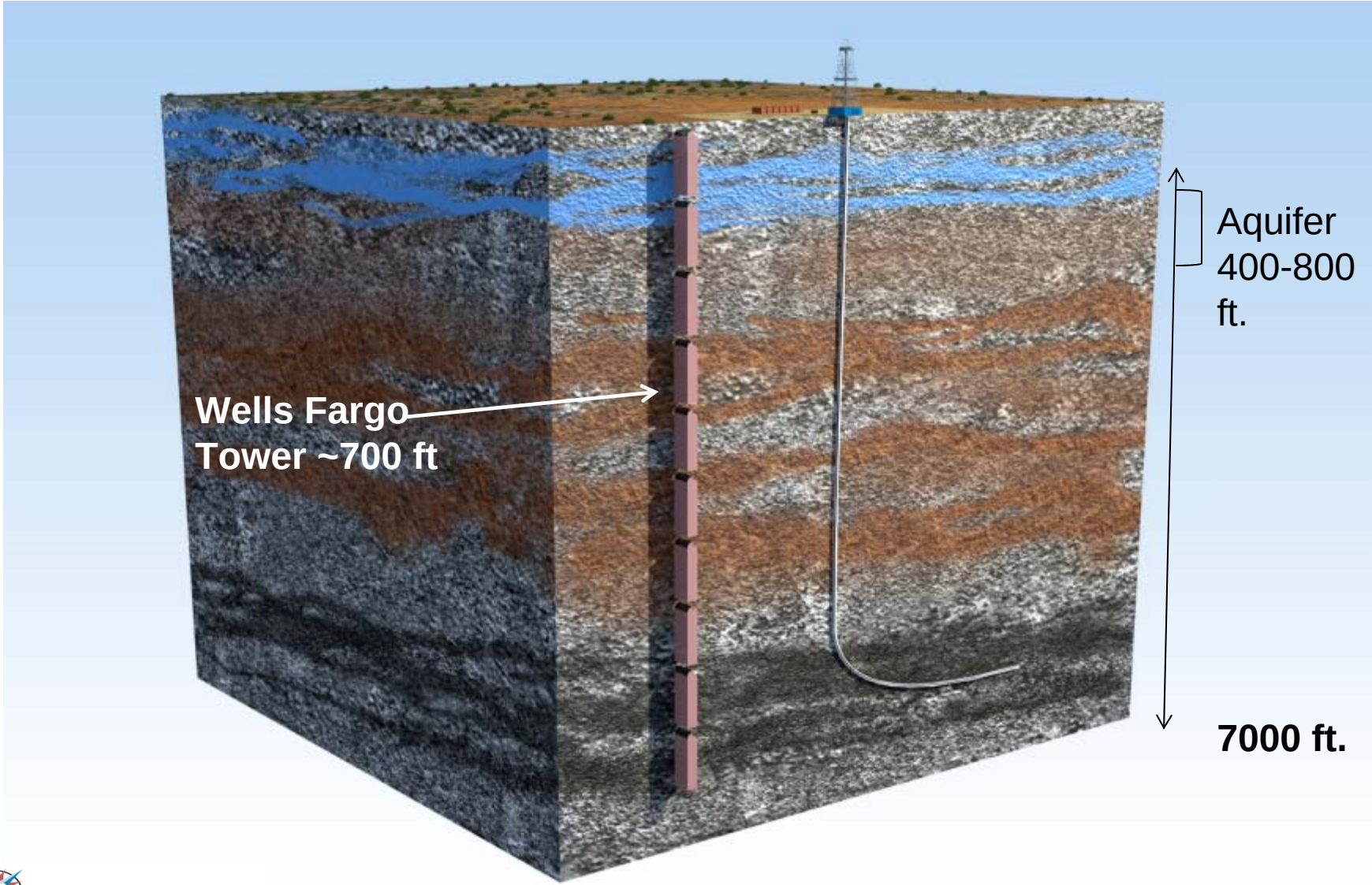
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

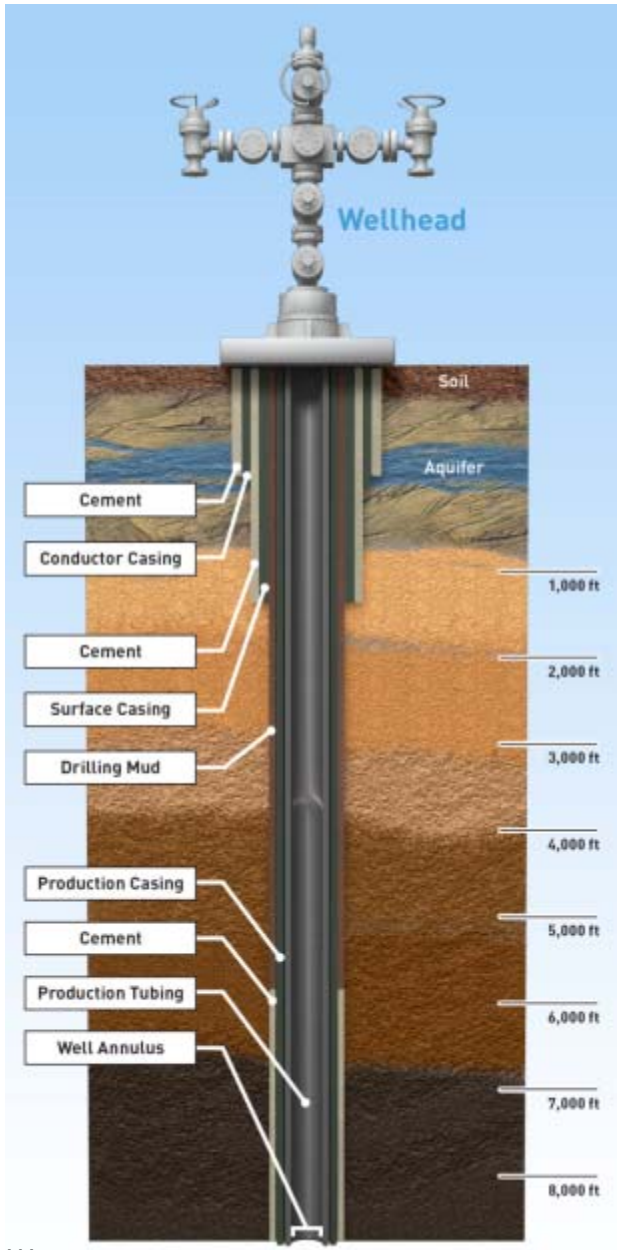
Drilling Distance



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Casing

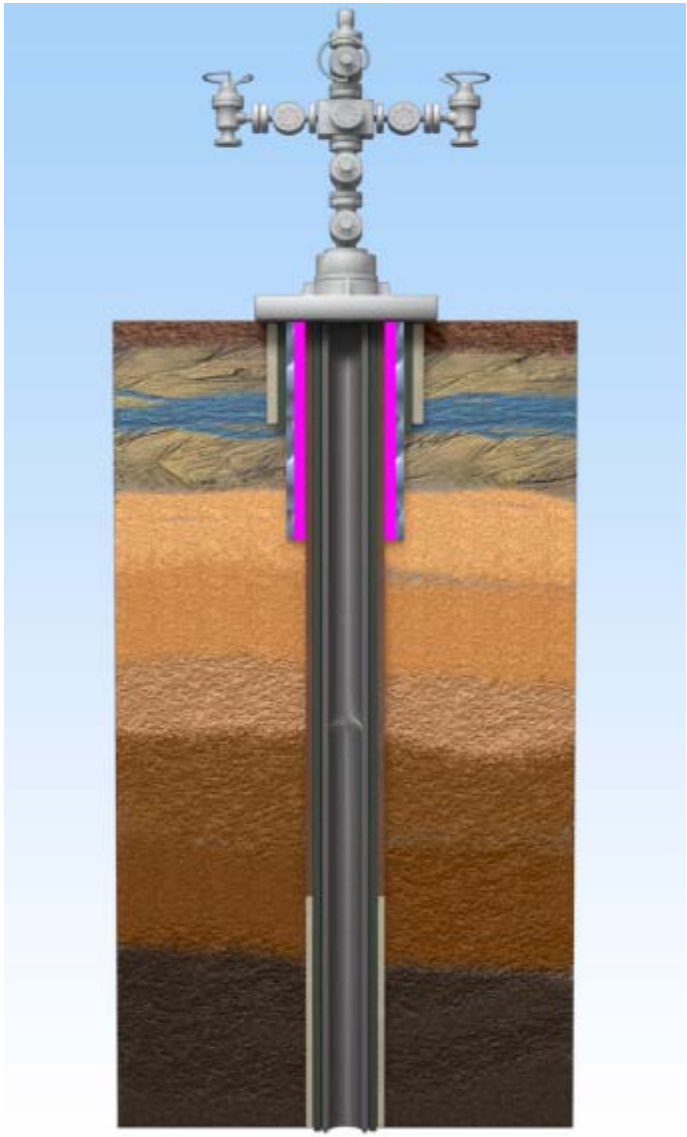
- Multiple layers surrounding the aquifer
  - Cement
  - Conductor Casing
  - Cement
  - Surface Casing
  - Drilling Mud/Cement
  - Production Casing
  - Production Tubing



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Surface Casing

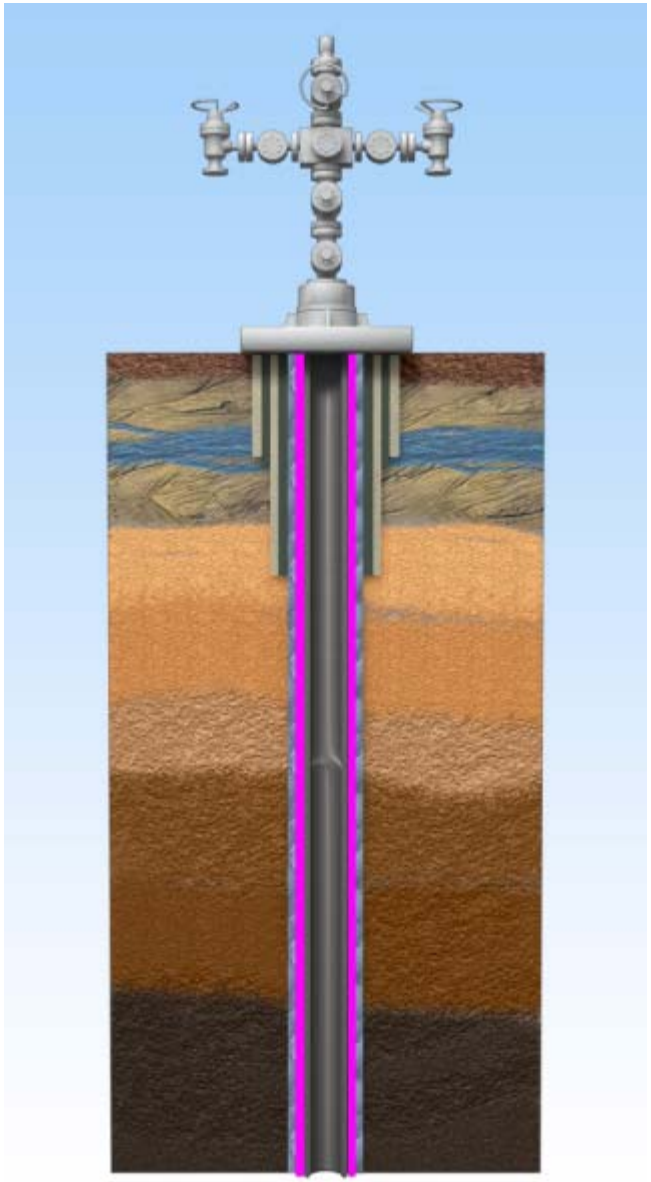
- Purpose
  - Protect ground water
  - Provide stable wellbore during drilling operation
  - Provide well control during drilling
- Depth Requirements
  - Set by State and BLM regulations
  - Extends below the aquifer
- Cement Helps
  - Protect casing from corrosion
  - Provide zonal isolation
  - Support casing in wellbore



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Production Casing

- Purpose
  - Provide zonal isolation
  - Provide well control
  - Well path to productive intervals
- Cement Requirements
  - Set by State regulations
  - Set by BLM regulations
  - Operator requirements
- Cement Helps
  - Protect casing from corrosion
  - Support casing in wellbore



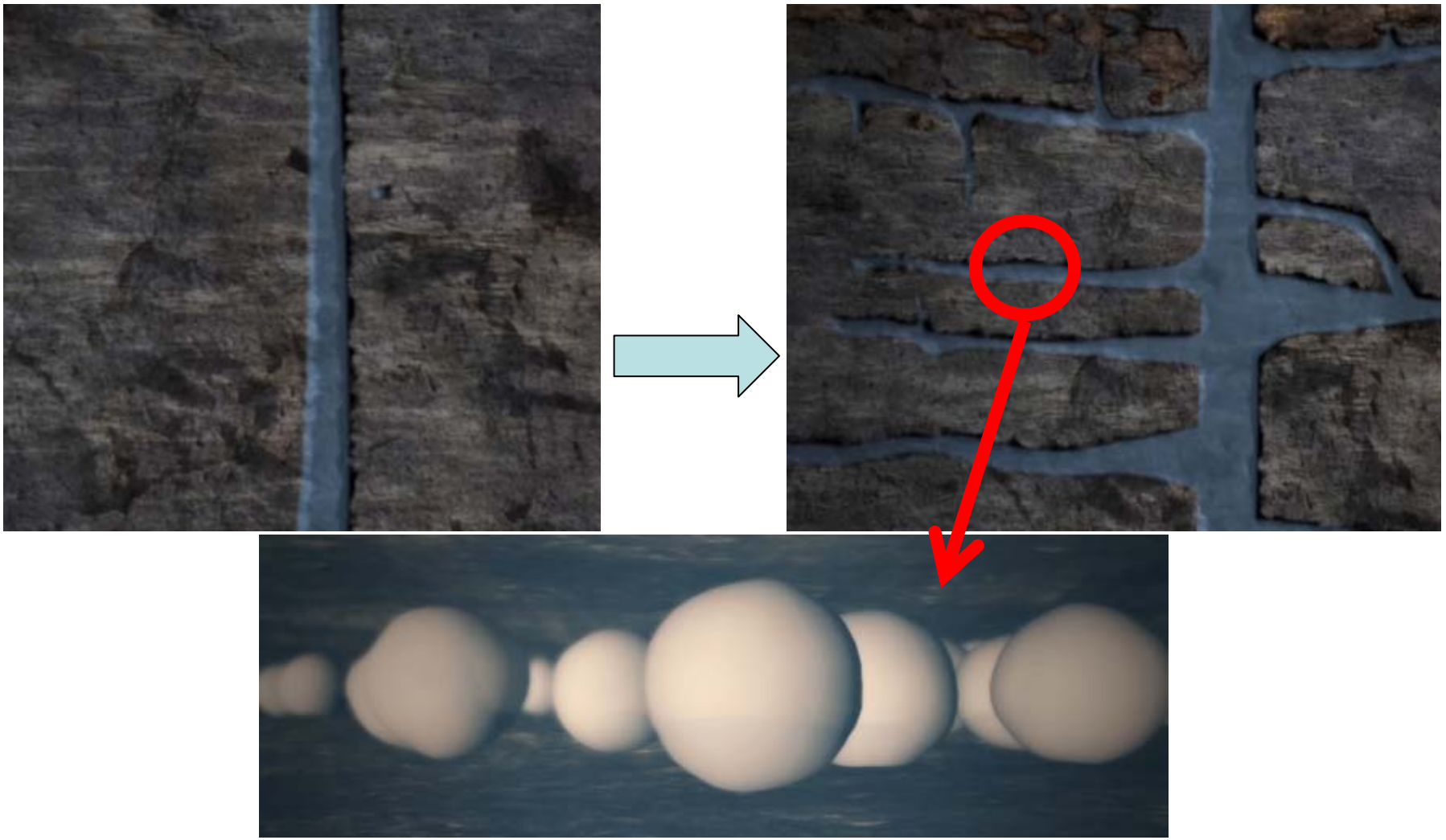
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

HF Fluids

- Depending on the fluid system being pumped various additives are used:
  - Polymers
  - Crosslinkers
  - pH Control
  - Gel Breakers
  - Surfactants
  - Clay Control
  - Bacteria Control
  - Fluid Loss Additives
- Additives are transported in concentrated form
- Typically injected at less than 3 gallons per 1,000 gal of water (0.3%)
- All additive injection rates are controlled.
- The purpose of any additive is to help improve the overall process

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Fractures and Proppant



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

HF Fluids

Additive	Main Compound	Common Use
Diluted Acid	Hydrochloricor, Muriatic Acid	Swimming Pools
Biocide	Glutaraldehyde	Dental Disinfectant
Breaker	Ammonium Persulfate	Bleaching Hair
Crosslinker	Borate Salts	Laundry Detergents
Iron Control	Citric Acid	Food Additive
Gelling Agent	Guar Gum	Biscuits
Scale Inhibitor	Ethylene Glycol	Antifreeze
Surfactant	Isopropanol	Glass Cleaner
Friction Reducer	Polyacrylamide	Water and Soil Treatment

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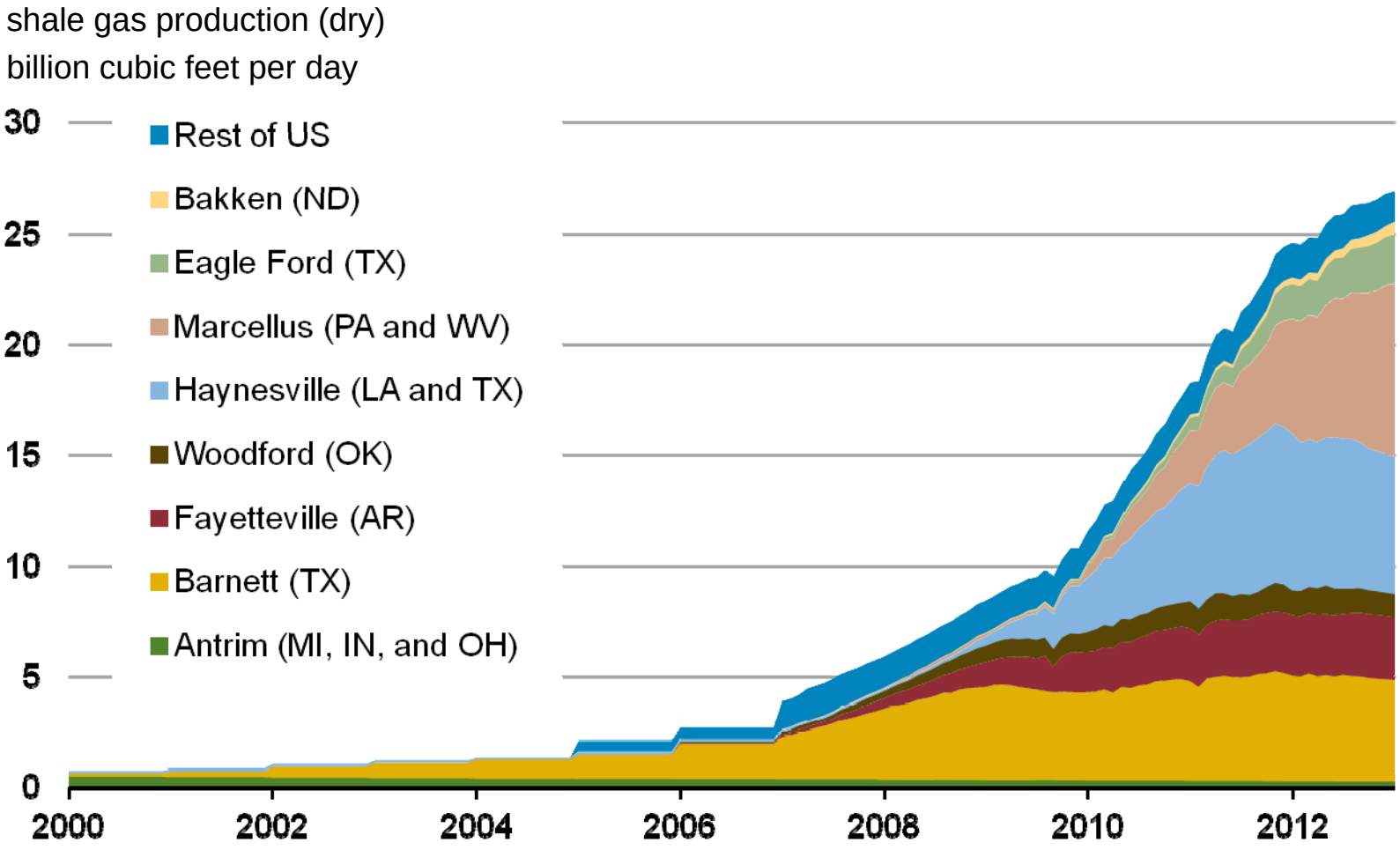
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Domestic production of shale gas has grown dramatically over the past few years



Sources: LCI Energy Insight gross withdrawal estimates as of January 2013 and converted to dry production estimates with EIA-calculated average gross-to-dry shrinkage factors by state and/or shale play.

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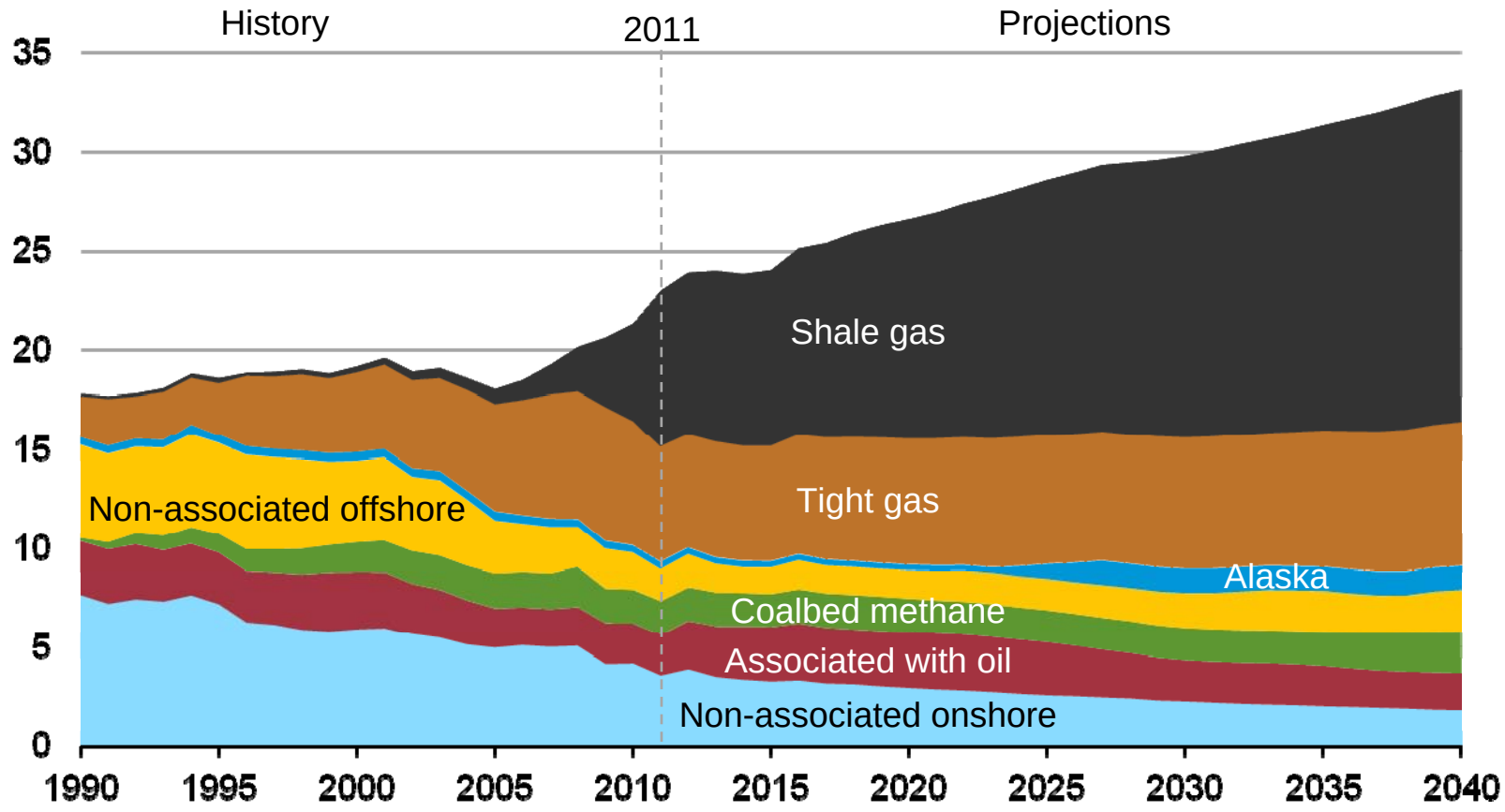
Shale gas leads growth in total gas production through 2040

U.S. dry natural gas production
trillion cubic feet



Source: EIA, Annual Energy Outlook 2013 Early Release

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Forecasts for Shale Gas Resource?

- 2008 - **347 TCF** - Energy Information Administration (EIA)
- 2008 - **840 TCF** - Navigant for Clean Skies Foundation
- 2009 - **616 TCF** - Potential Gas Committee (PGC)
- 2011 - **827 TCF** - Energy Information Administration (EIA)
- 2013 – **1,073 TCF** - Potential Gas Committee (PGC)

Source: Various resource estimates

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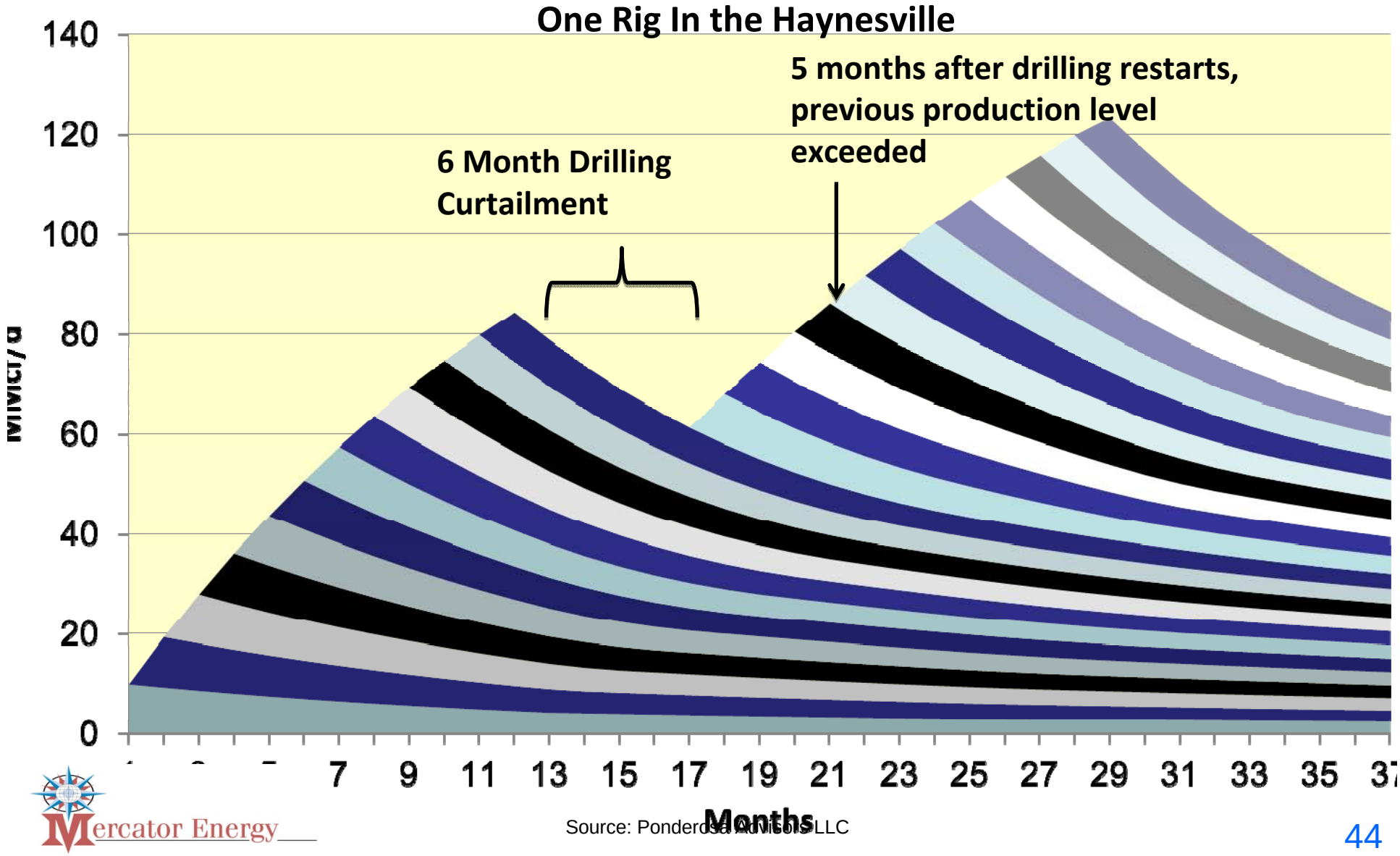
THE SUPPLY CURVE HAS MOVED

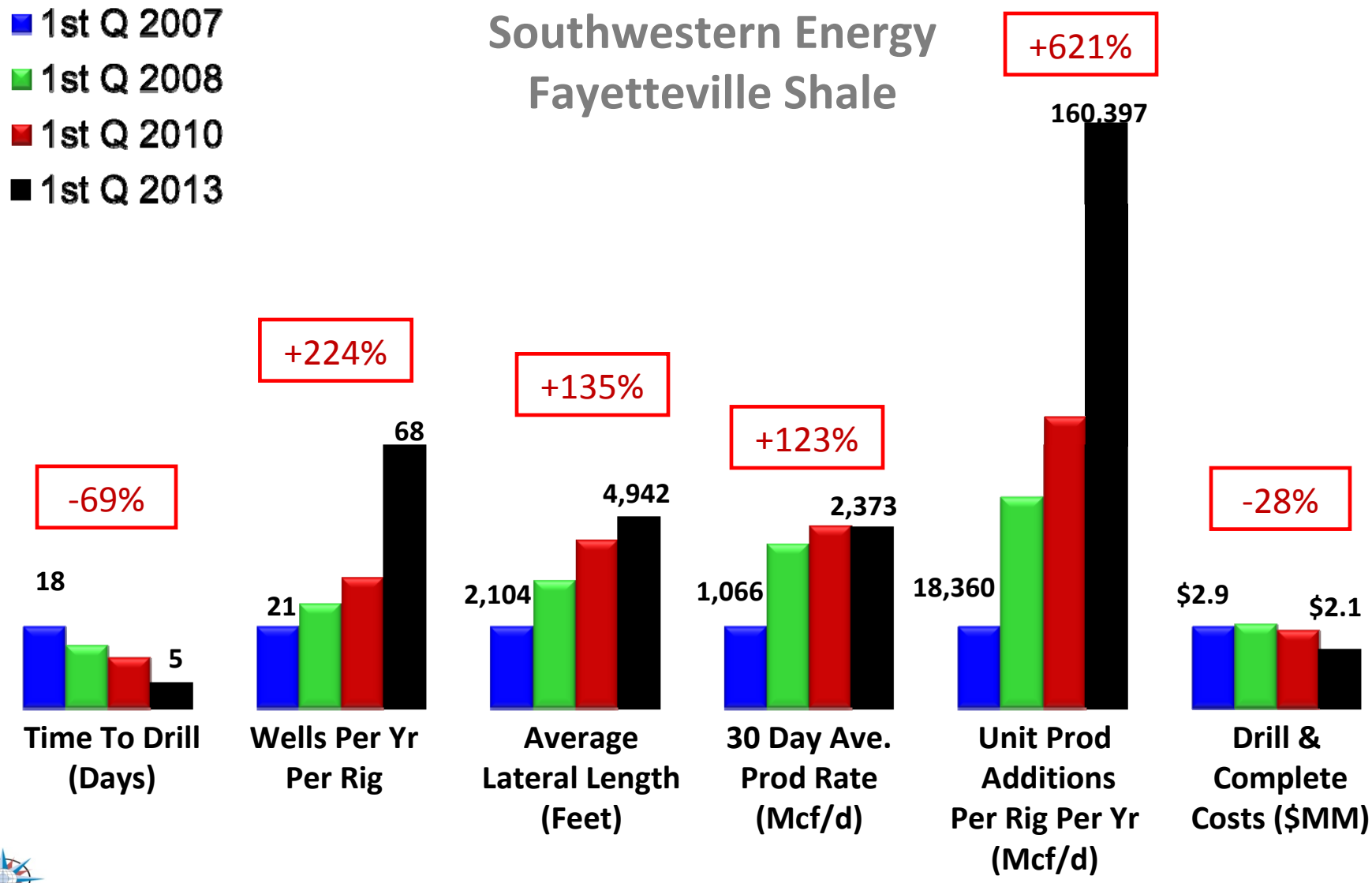
According to the Potential Gas Committee, during the last two years, the future gas supply estimate for the US rose nearly 25% to a 48-year record of **2,688 TCF**.

The "Ferrari" Affect Substantially Reduces The Likelihood Of Price Spikes



Source: Ponderosa Advisors LLC

Drilling Rig Productivity Continues To Improve



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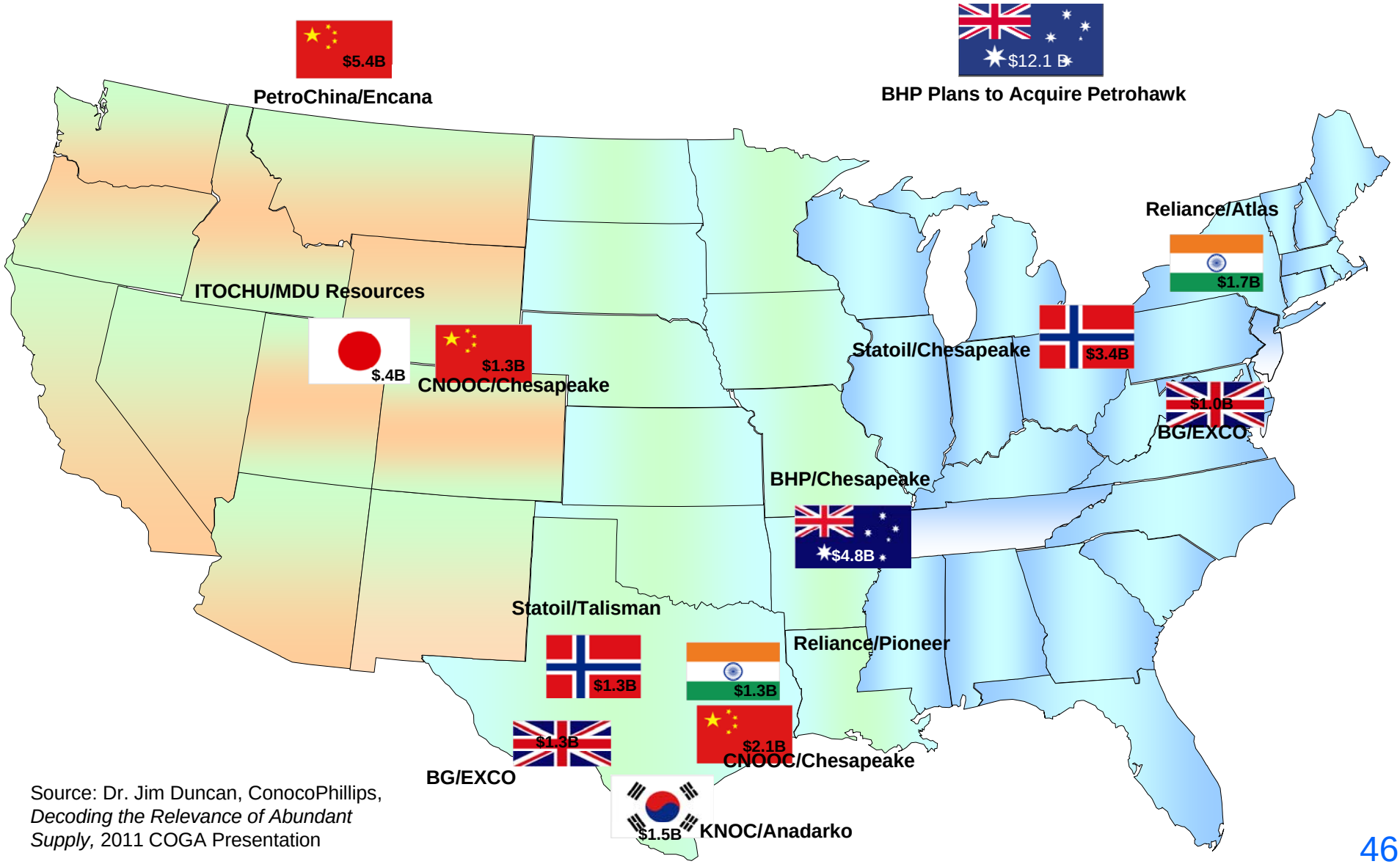
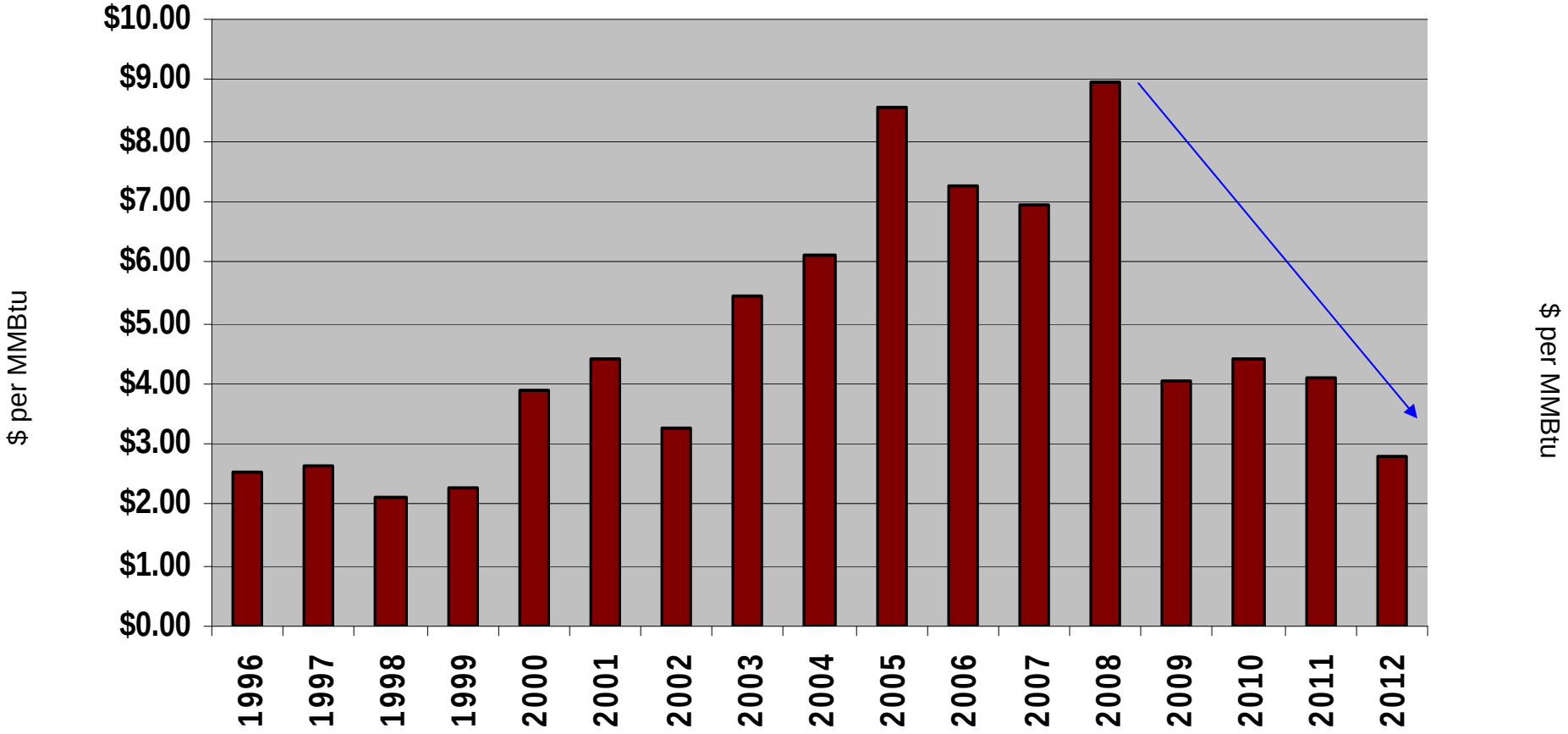
Source: Southwestern Energy Financials

Foreign Investment in U.S. Shale



Source: Dr. Jim Duncan, ConocoPhillips, *Decoding the Relevance of Abundant Supply,* 2011 COGA Presentation

NYMEX Henry Hub Natural Gas Price*
1996 - 2012 Actual



Source: *Average of last three days of trading as published in the Platts Gas Daily Report

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World LNG Estimated June 2013 Landed Prices

Source: *Waterborne Energy, Inc.* Data in $US/MMBtu

Updated Mayl 23, 2013

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Perspective: Residential Gas Usage

In a single year, the average US home uses 84 MCF of natural gas.

Source: Natural Gas Supply Association

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The Effect of Fracking on Residential Gas Cost

Xcel Energy®
RESPONSIBLE BY NATURE™

PUBLIC SERVICE COMPANY OF COLORADO *
P O BOX 840
DENVER, CO. 80201
(800) 895-4999 Español: (800) 687-8778

Page 1 of 1

Customer Name	Service Address	Account No.	Date Due	Amount Due
[redacted]	[redacted]	[redacted]	Dec 26, 2012	$37.75

Account Activity

Date of Bill	Dec 5, 2012
Number of Payments Received	1
Number of Days in Billing Period	34
Statement Number	349691134
Premise Number	300801460

Previous Balance	$29.26
Total Payments	($29.26)
Balance Forward	$0.00
+ Current Bill	$37.75
Current Balance	**$37.75**

Gas Service - Account Summary

Invoice Number	0227514926		
Meter No.	00000R471013		
Rate	RG	Residential	
Days in Bill Period	34		
Current Reading	7720	Actual	12/05/2012
Previous Reading	7668	Actual	11/01/2012
Measured Usage	52		
Therm Multiplier	0.8606		
Therms Used	45.0		

Residential		
Usage Charge	45 therms x 0.090444	$4.07
Interstate Pipeline	45 therms x 0.000020	$0.01
Natural Gas 4 Qtr	45 therms x 0.355870	$16.01
Pipe Sys Int Adj	45 therms x 0.016880	$0.76
Service & Facility		$11.94
Subtotal		**$36.65**
Franchise Fee	3.00%	$1.10
Sales Tax		$0.00
Total Amount		**$37.75**

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The Effect of Fracking on Residential Gas Cost

- With the gas cost in **Spain** of **$10.05/MMBtu**, the total residential bill would have been:

$67.84 **80% Increase**

- With the gas cost in **China** of **$13.70/MMBtu**, the total residential bill would have been:

$82.29 **118% Increase**

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What Fracking Means to Low Income Households

2003-2008 NYMEX[1] Avg. Price[2]/MMBtu	**$7.21**	**61% Drop**
2012 NYMEX[1] Avg. Price/MMBtu	**$2.80**	
Price Differential/MMBtu	**$4.41**	
x		
2012 Residential Gas Usage[3]/MMBtu	**4,179,740,000**	

2012 Residential Cash Savings **= $18,432,653,400**

1 NYMEX – Average last 3 days of close of Natural Gas Contract as reported in Platts Gas Daily Report

2 See Addendum A for supporting documentation

3 2012 Residential Gas Usage – EIA Natural Gas Consumption by End Use

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What Fracking Means to Low Income Households

- 36% of residential households (114 million total[4]) are estimated to qualify for LIHEAP assistance[5]

2012 Residential Cash Savings	**= $18,432,653,400**
Percent of households LIHEAP eligible	**x .36**
2012 LIHEAP Eligible Cash Savings	**= $6,635,755,224**
2012 LIHEAP Total Cash Assistance[7]	**= $2,625,000,000**

4 US Census Bureau State and County Quickfacts

5 LIHEAP Home Energy Notebook for FY 2009: Appendix B: Income Eligibility Household Estimates; See Addendum A

6 Households with income up to 150% of the federal poverty income guidelines or, if greater, 60% of the state median income

7 10% decrease due to General Administrative Expense; 15% due to efficiency

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Reducing Greenhouse Gas Emissions

	Natural Gas	Coal
Carbon Dioxide	117,000	208,000
Carbon Monoxide	40	208
Nitrogen Oxide	92	457
Sulfur Dioxide	0.6	2,591
Particulates	7	2,744
Formaldehyde	0.750	0.221
Mercury	0.000	0.016

Source: EIA – Natural Gas Issues and Trends

Pounds of air pollutants produced per billion Btu energy

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Kyoto Protocol

US Energy Information Agency reports that America's greenhouse gas emissions have **fallen 7 percent to 1992 levels**.
US, a non participant in Kyoto Protocol Treaty, is the only nation to meet 1999 forecasted reduction

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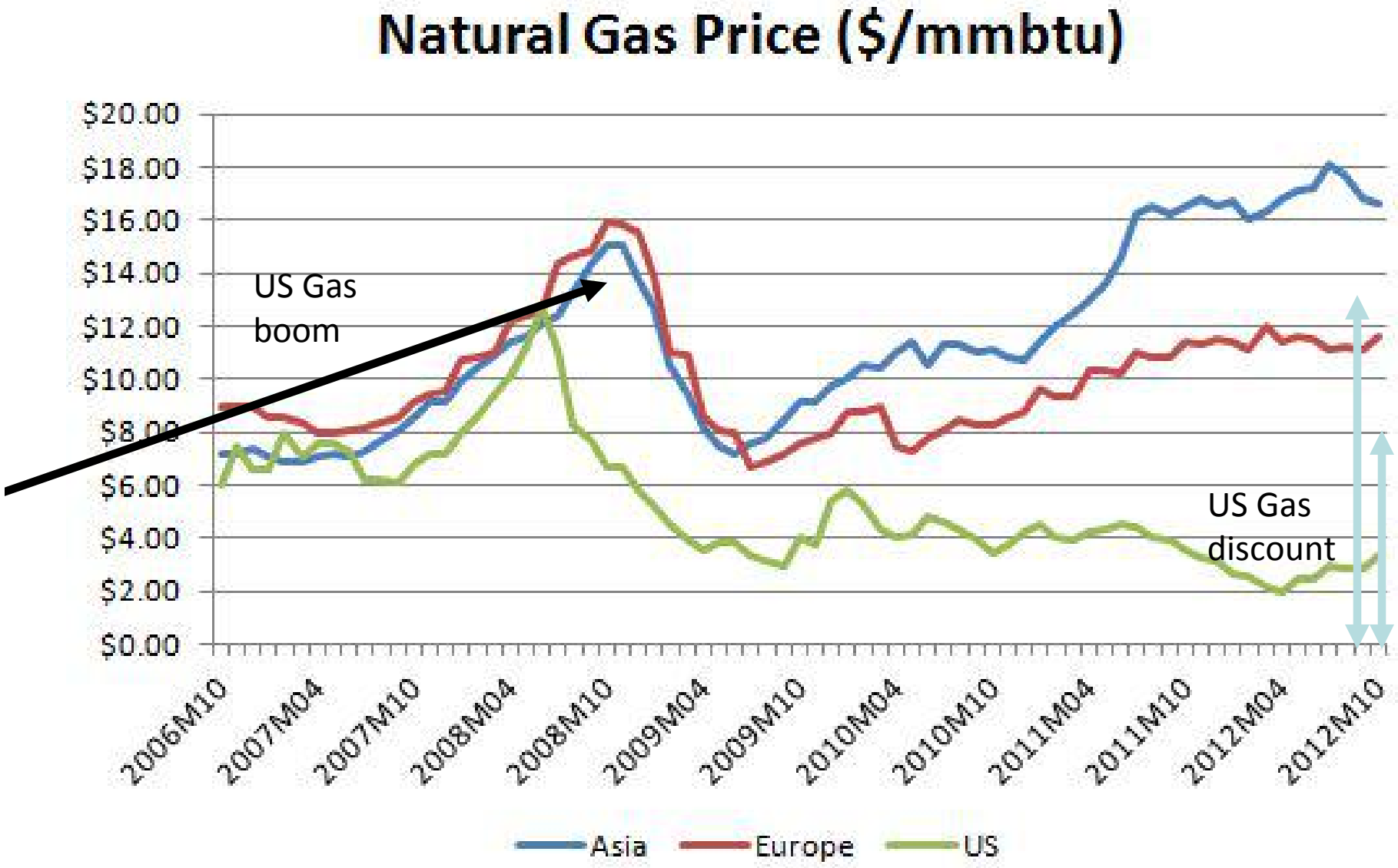
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Gas Prices by Region



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13

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Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of April 2, 2013)

All Changes Since March 7, 2013 Update Are In Red

Company	Quantity [a]	FTA Applications [b] (Docket Number)	Non-FTA Applications [c] (Docket Number)
Sabine Pass Liquefaction, LLC	2.2 billion cubic feet per day (Bcf/d) [d]	Approved (10-85-LNG)	Approved (10-111-LNG)
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC	1.4 Bcf/d [e]	Approved (10-160-LNG)	Under DOE Review (10-161-LNG)
Lake Charles Exports, LLC	2.0 Bcf/d [m]**	Approved (11-59-LNG)	Under DOE Review (11-59-LNG)
Carib Energy (USA) LLC	0.03 Bcf/d: FTA 0.01 Bcf/d: non-FTA [f]	Approved (11-71-LNG)	Under DOE Review (11-141-LNG)
Dominion Cove Point LNG, LP	1.0 Bcf/d [g]	Approved (11-115-LNG)	Under DOE Review (11-128-LNG)
Jordan Cove Energy Project, L.P.	1.2 Bcf/d: FTA 0.8 Bcf/d: non-FTA [g]	Approved (11-127-LNG)	Under DOE Review (12-32-LNG)
Cameron LNG, LLC	1.7 Bcf/d [g]	Approved (11-145-LNG)	Under DOE Review (11-162-LNG)
Freeport LNG Expansion, L.P. and FLNG Liquefaction, LLC [h]	1.4 Bcf/d [g]	Approved (12-06-LNG)	Under DOE Review (11-161-LNG)
Gulf Coast LNG Export, LLC [i]	2.8 Bcf/d [d]	Approved (12-05-LNG)	Under DOE Review (12-05-LNG)
Gulf LNG Liquefaction Company, LLC	1.5 Bcf/d [d]	Approved (12-47-LNG)	Under DOE Review (12-101-LNG)
LNG Development Company, LLC (d/b/a Oregon LNG)	1.25 Bcf/d [d]	Approved (12-48-LNG)	Under DOE Review (12-77-LNG)
SB Power Solutions Inc.	0.07 Bcf/d	Approved (12-50-LNG)	n/a
Southern LNG Company, L.L.C.	0.5 Bcf/d [d]	Approved (12-54-LNG)	Under DOE Review (12-100-LNG)
Excelerate Liquefaction Solutions I, LLC	1.38 Bcf/d [d]	Approved (12-61-LNG)	Under DOE Review (12-146-LNG)
Golden Pass Products LLC	2.6 Bcf/d [d]	Approved (12-88 -LNG)	Under DOE Review (12-156-LNG)
Cheniere Marketing, LLC	2.1 Bcf/d [d]	Approved (12-99-LNG)	Under DOE Review (12-97-LNG)
Main Pass Energy Hub, LLC	3.22 Bcf/d***	Approved (12-114-LNG)	n/a
CE FLNG, LLC	1.07 Bcf/d [d]	Approved (12-123-LNG)	Under DOE Review (12-123-LNG)
Waller LNG Services, LLC	0.16 Bcf/d	Approved (12-152-LNG)	n/a
Pangea LNG (North America) Holdings, LLC	1.09 Bcf/d [d]	Approved (12-174-LNG)	Under DOE Review (12-184-LNG)
Magnolia LNG, LLC	0.54 Bcf/d	Approved (12-183-LNG)	n/a

Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of April 2, 2013)

All Changes Since March 7, 2013 Update Are In Red

Company	Quantity [a]	FTA Applications [b] (Docket Number)	Non-FTA Applications [c] (Docket Number)
Trunkline LNG Export, LLC	2.0 Bcf/d**	Approved (13-04-LNG)	Under DOE Review (13-04-LNG)
Gasfin Development USA, LLC	0.2 Bcf/d	Approved (13-06-LNG)	n/a
Freeport-McMoRan Energy LLC	3.22 Bcf/d***	Pending Approval (13-26-LNG)	Under DOE Review (13-26-LNG)
Sabine Pass Liquefaction, LLC	0.28 Bcf/d[d]	Pending Approval (13-30-LNG)	Under DOE Review (13-30-LNG)
Sabine Pass Liquefaction, LLC	0.24 Bcf/d[d]	Pending Approval (13-42-LNG)	Under DOE Review (13-42-LNG)
Total of all Applications Received		**29.93 Bcf/d(**) (***)**	**28.54 Bcf/d**

** Lake Charles Exports, LLC (LCE) and Trunkline LNG Export, LLC (TLNG), the owner of the Lake Charles Terminal, have both filed an application to export up to 2.0 Bcf/d of LNG from the Lake Charles Terminal. The total quantity of combined exports requested between LCE and TLNG does not exceed 2.0 Bcf/d (i.e., both requests are not additive and only 2 Bcf/d is included in the bottom-line total of applications received).

*** Main Pass Energy Hub, LLC (MPEH) and Freeport McMoRan Energy LLC (FME), have both filed an application to export up to 3.22 Bcf/d of LNG from the Main Pass Energy Hub. (The existing Main Pass Energy Hub structures are owned by FME). The total quantity of combined FTA exports requested between MPEH and FME does not exceed 3.22 Bcf/d (i.e., both requests are not additive and only 3.22 Bcf/d is included in the bottom-line total of FTA applications received). FME's application includes exports of 3.22 Bcf/d to non-FTA countries and is included in the bottom line total of non-FTA applications received, while MPEH has not submitted an application to export LNG to non-FTA countries.

(a) Actual applications were in the equivalent annual quantities.

(b) FTA – Applications to export to free trade agreement (FTA) countries. The Natural Gas Act, as amended, has deemed FTA exports to be in the public interest and applications shall be authorized without modification or delay.

(c) Non-FTA applications require DOE to post a notice of application in the Federal Register for comments, protests and motions to intervene, and to evaluate the application to make a public interest consistency determination.

(d) Requested approval of this quantity in both the FTA and non-FTA export applications. Total facility is limited to this quantity (i.e., FTA and non-FTA volumes are not additive at a facility).

(e) Lake Charles Exports, LLC submitted one application seeking separate authorizations to export LNG to FTA countries and another authorization to export to Non-FTA countries. The proposed facility has a capacity of 2.0 Bcf/d, which is the volume requested in both the FTA and Non-FTA authorizations.

(f) Carib Energy (USA) LLC requested authority to export the equivalent of 11.53 Bcf per year of natural gas to FTA countries and 3.44 Bcf per year to non-FTA countries.

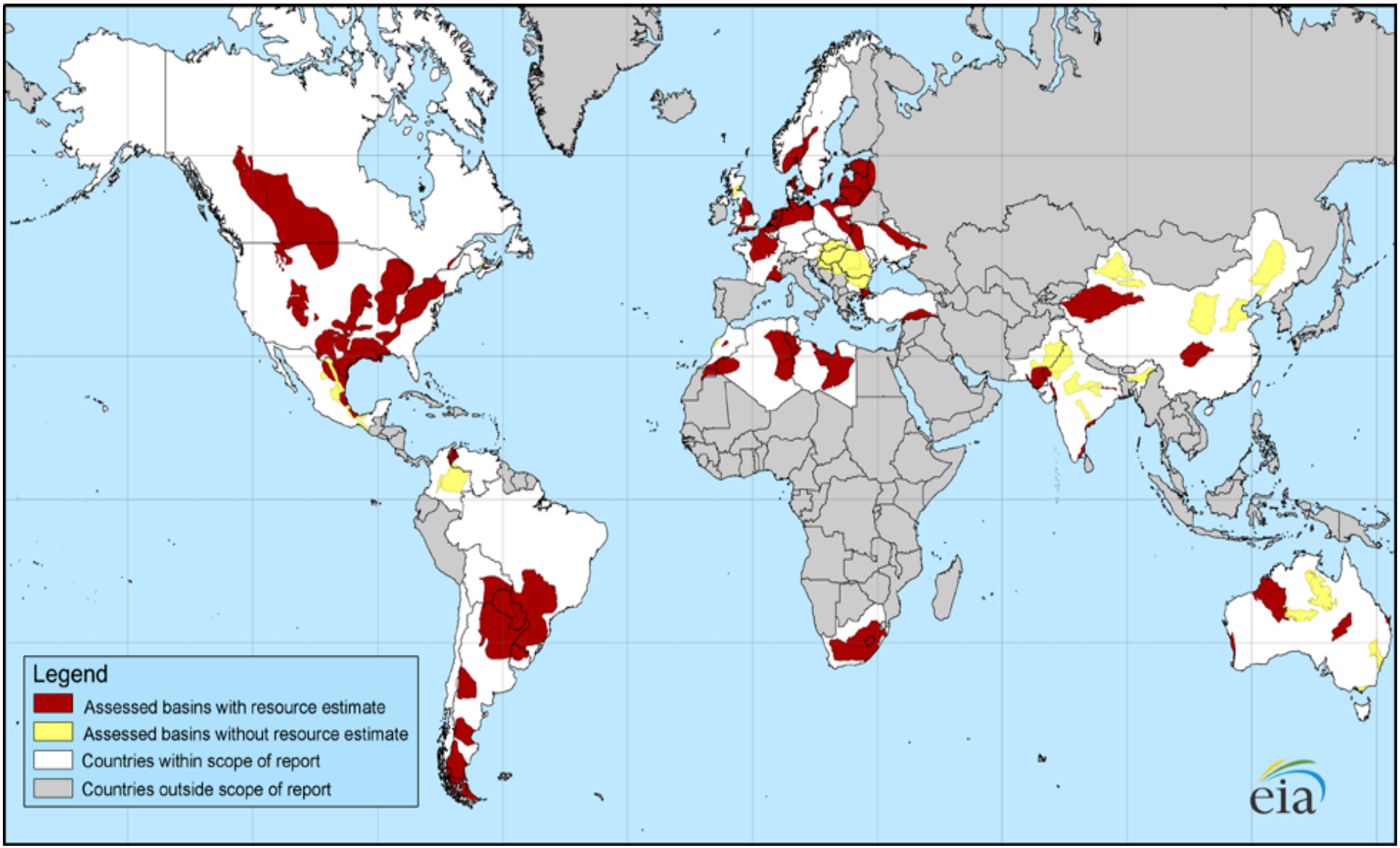
(g) Jordan Cove Energy Project, L.P. requested authority to export the equivalent of 1.2 Bcf/d of natural gas to FTA countries and 0.8 Bcf/d to non-FTA countries.

(h) DOE/FE received a new application (11-161-LNG) by FLEX to export an additional 1.4 Bcf/d of LNG from new trains to be located at the Freeport LNG Terminal, to non-FTA countries, and a separate application (12-06-LNG) to export this same 1.4 Bcf/d of LNG to FTA countries (received January 12, 2012). This 1.4 Bcf/d is in addition to the 1.4 Bcf/d FLEX requested in dockets (10-160-LNG and 10-161-LNG).

(i) An application was submitted by Gulf Coast on January 10, 2012, seeking one authorization to export LNG to any country not prohibited by U.S. law or policy. On September 11, 2012, Gulf Coast revised their application by seeking separate authorizations for LNG exports to FTA countries and Non-FTA countries.

(j) Total does not include 2.0 Bcf/d

Global Shale Reserves



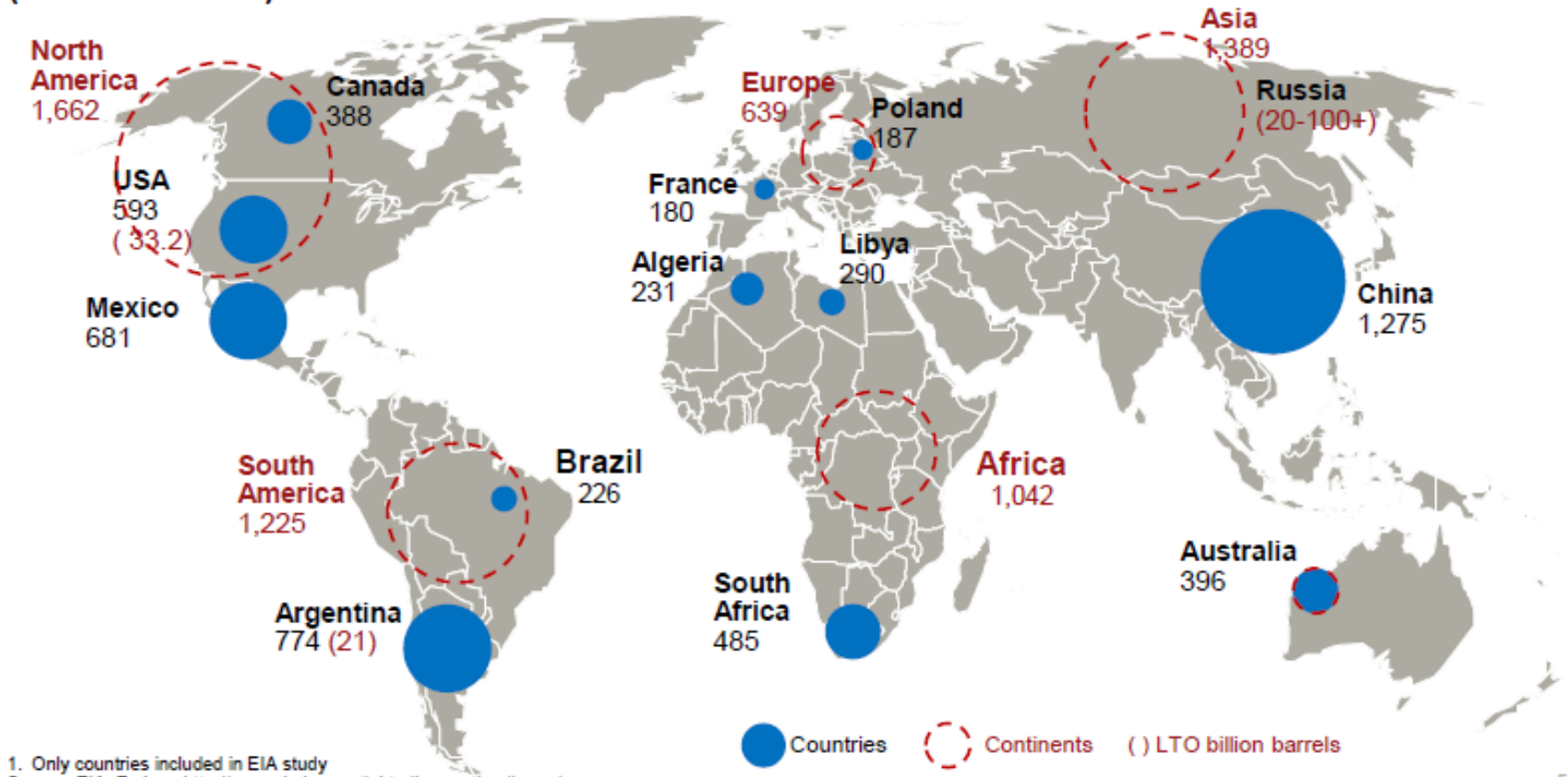
Source: EIA; Dr. Jim Duncan, ConocoPhillips, *Decoding the Relevance of Abundant Supply,* 2011 COGA Presentation

ATKearney

Resource potential in North America is massive – with the Rockies accounting for a significant fraction

Major global shale gas and LTO opportunities[1]

Technically recoverable shale gas (trillion cubic feet) and LTO (Billion barrels) resources



1. Only countries included in EIA study
Source: EIA, Forbes, http://www.shale-gas-tight-oil-argentina-ii.com/

5

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Job Creation

- America's Oil & Natural Gas Industry supports **9.2 million** men and women across the US in a wide range of highly skilled, well-paying professions

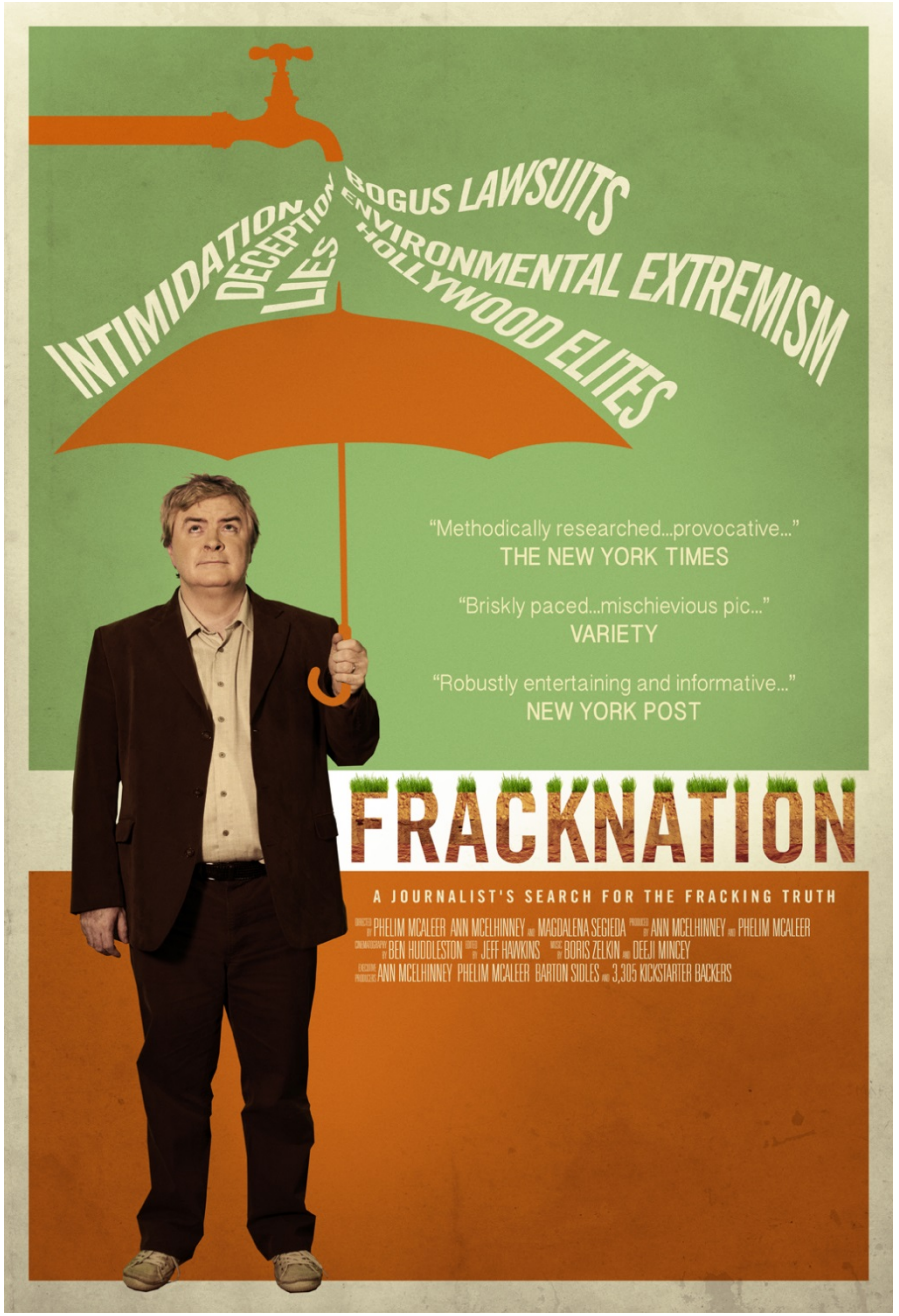
Source: energycreation.org article on job creation

Revenue Creation

- The US Oil and Natural Gas industry contributes **$86 million a day** in taxes, royalties and other fees – about **$31 billion a year**

Source: The Energy Stimulus

The Rest of the Story



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Conclusions

- Since 1949, **1,400,000 wells** have been hydraulically fractured in the US…No one has ever been able to demonstrate that it is harmful to human health

- Low natural gas prices will **significantly** advance the general public health and welfare
  - Conversion coal to gas, reduced air emissions
  - Energy security, job creation & lower energy costs for low income households

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Conclusions

- Increased industry activity in urbanized areas and environmentally sensitive areas should be addressed in a collaborative manner without **demonizing** oil and gas development

- What is more important to environmental groups, **creating an ideological enemy** (oil & gas development) with an artificial bogeyman (hydraulic fracturing) or advancing society?

Mercator Energy

Contact Information

John A. Harpole
President
Mercator Energy LLC
26 W. Dry Creek Circle, Suite 410
Littleton, CO 80120
harp@mercatorenergy.com
(303) 825-1100 (work)
(303) 478-3233 (cell)

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Citations for Report

All of the information utilized for this report is a compilation of information pulled from the following data sources:

Ponderosa Advisors LLC
Blue, Johnson Associates, Inc.
Chris Wright, Liberty Resources
Office of Fossil Energy
Office of Oil Gas Global Security Supply
U.S. Department of Energy
Raymond James and Associates, Inc.
Charif Souki, Cheniere Energy Inc.; Cheniere Research
U.S. Federal Energy Regulatory Commission
Institute for Energy Research (IER)
Energy Information Administration (EIA)
Bernstein Research
Western Energy Alliance
Sutherland LNG Blog
Platts Gas Daily Report, A McGraw Hill Publication
Colorado Oil and Gas Association

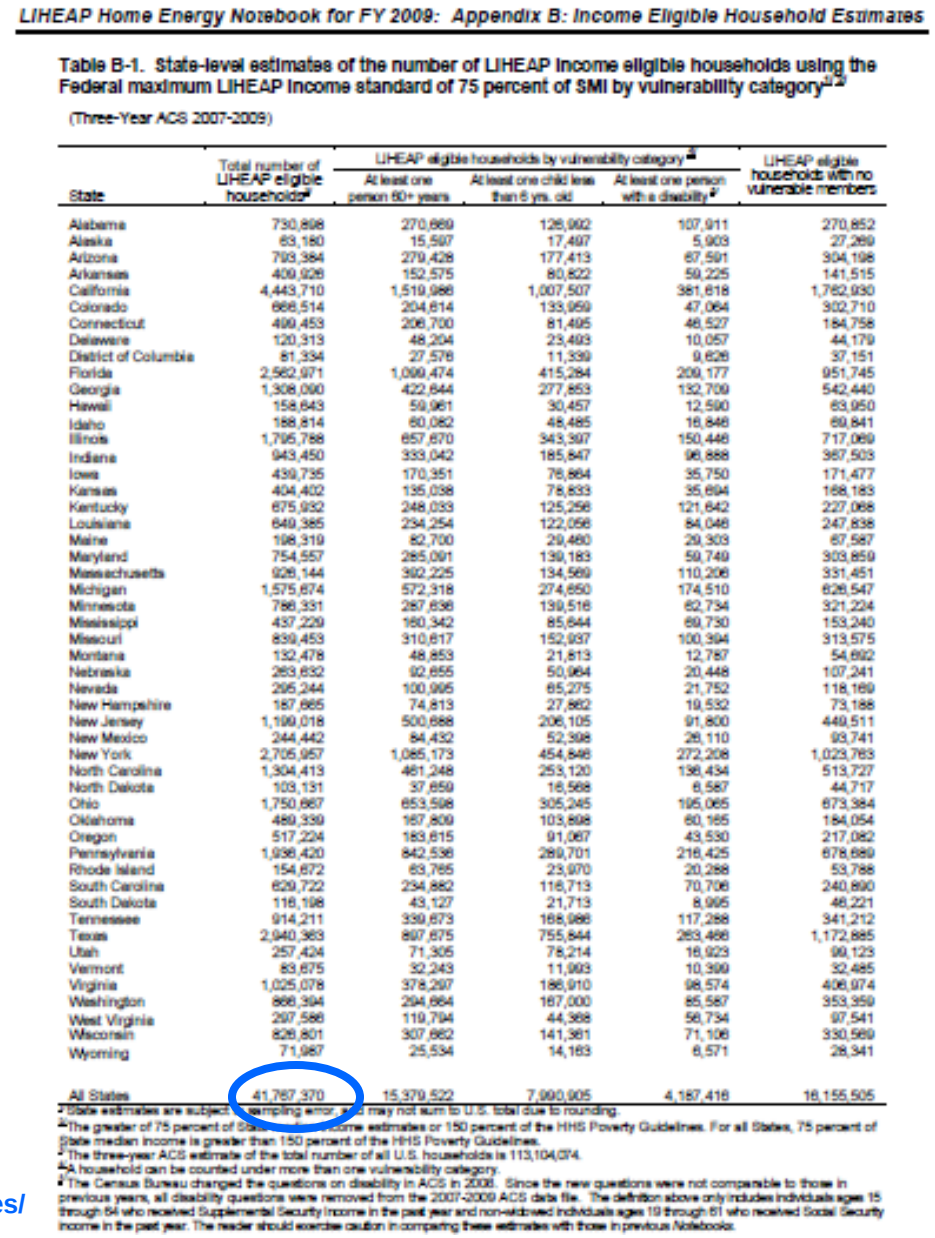
Addendum A

2 Average price calculation between 2003-2008 using NYMEX average pricing

Year	Average Price per MMBtu
2003	$5.441
2004	$6.092
2005	$8.553
2006	$7.261
2007	$6.934
2008	$8.952

2003-2008 NYMEX[1] Avg. Price/MMBtu = **$7.21**

5 LIHEAP Home Energy Notebook for FY 2009: Appendix B: Income Eligibility Household Estimates



LIHEAP Home Energy Notebook for FY 2009: Appendix B: Income Eligible Household Estimates

Table B-1. State-level estimates of the number of LIHEAP income eligible households using the Federal maximum LIHEAP income standard of 75 percent of SMI by vulnerability category[1,2,3]

(Three-Year ACS 2007-2009)

State	Total number of LIHEAP eligible households[4]	LIHEAP eligible households by vulnerability category[5]			LIHEAP eligible households with no vulnerable members
		At least one person 60+ years	At least one child less than 6 yrs. old	At least one person with a disability[6]	
Alabama	730,898	270,669	126,992	107,911	270,852
Alaska	83,180	15,597	17,497	5,903	27,289
Arizona	793,384	279,428	177,413	67,591	304,198
Arkansas	409,926	152,575	80,822	59,225	141,515
California	4,443,710	1,519,986	1,007,507	381,618	1,762,930
Colorado	666,514	204,614	133,959	47,064	302,710
Connecticut	499,453	206,700	81,495	46,527	184,758
Delaware	120,313	48,204	23,493	10,057	44,179
District of Columbia	81,334	27,576	11,339	9,626	37,151
Florida	2,562,971	1,099,474	415,284	209,177	951,745
Georgia	1,308,090	422,644	277,853	132,709	542,440
Hawaii	158,643	59,961	30,457	12,590	63,950
Idaho	188,814	60,082	48,485	16,846	69,841
Illinois	1,795,788	657,670	343,397	150,446	717,069
Indiana	943,450	333,042	185,847	96,888	367,503
Iowa	439,735	170,351	76,864	35,750	171,477
Kansas	404,402	135,038	78,833	35,694	168,183
Kentucky	675,932	248,033	125,256	121,642	227,068
Louisiana	649,385	234,254	122,056	84,046	247,838
Maine	198,319	82,700	29,460	29,303	67,587
Maryland	754,557	285,091	139,183	59,749	303,859
Massachusetts	926,144	392,225	134,569	110,206	331,451
Michigan	1,575,674	572,318	274,650	174,510	628,547
Minnesota	788,331	287,636	139,516	82,734	321,224
Mississippi	437,229	160,342	85,644	69,750	153,240
Missouri	839,453	310,617	152,937	100,394	313,575
Montana	132,478	48,853	21,813	12,787	54,692
Nebraska	283,632	92,655	50,964	20,448	107,241
Nevada	295,244	100,995	65,275	21,752	118,169
New Hampshire	187,665	74,813	27,862	19,532	73,188
New Jersey	1,199,018	500,688	206,105	91,800	449,511
New Mexico	244,442	84,432	52,398	26,110	93,741
New York	2,705,957	1,085,173	454,846	272,208	1,023,783
North Carolina	1,304,413	461,248	253,120	136,434	513,727
North Dakota	103,131	37,659	16,588	6,587	44,717
Ohio	1,750,667	653,598	305,245	195,065	673,384
Oklahoma	480,339	167,809	103,698	60,165	184,054
Oregon	517,224	183,615	91,067	43,530	217,082
Pennsylvania	1,936,420	842,536	289,701	216,425	678,689
Rhode Island	154,672	63,765	23,970	20,288	53,788
South Carolina	629,722	234,882	116,713	70,706	240,890
South Dakota	116,198	43,127	21,713	8,995	46,221
Tennessee	914,211	339,673	168,986	117,288	341,212
Texas	2,940,363	897,675	755,844	283,466	1,172,885
Utah	257,424	71,305	78,214	16,923	99,123
Vermont	83,675	32,243	11,993	10,399	32,485
Virginia	1,025,078	378,297	186,910	98,574	406,974
Washington	866,394	294,664	167,000	85,587	353,359
West Virginia	297,586	119,794	44,368	56,734	97,541
Wisconsin	826,801	307,662	141,361	71,106	330,569
Wyoming	71,987	25,534	14,183	6,571	28,341
All States	41,767,370	15,379,522	7,990,905	4,187,416	16,155,505

[1] State estimates are subject to sampling error, and may not sum to U.S. total due to rounding.
[2] The greater of 75 percent of State median income estimates or 150 percent of the HHS Poverty Guidelines. For all States, 75 percent of State median income is greater than 150 percent of the HHS Poverty Guidelines.
[3] The three-year ACS estimate of the total number of all U.S. households is 113,104,074.
[4] A household can be counted under more than one vulnerability category.
[5] The Census Bureau changed the questions on disability in ACS in 2008. Since the new questions were not comparable to those in previous years, all disability questions were removed from the 2007-2009 ACS data file. The definition above only includes individuals ages 15 through 64 who received Supplemental Security Income in the past year and non-widowed individuals ages 18 through 61 who received Social Security income in the past year. The reader should exercise caution in comparing these estimates with those in previous Notebooks.

41,767,370 Households

Full PDF URL:

http://www.acf.hhs.gov/sites/default/files/ocs/fy2009_liheap_notebook.pdf

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Colorado Water Use

	Total (Million gallons/Day)	Total (Billion gallons/Year)
Irrigation (crop)	12,322	4497
Irrigation (golf course)	41	14
Public-supply	864	315
Domestic	34	12
Industrial	142	52
Livestock	33	12
Mining	21	8
Thermo-electric	123	45
Total withdrawals	13,581	4957

Source: USGS 2005 *Estimated Withdrawals and Use of Water in Colorado, 2005*

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Colorado Water Use

Sector	2010 Use (Acre-Feet/Yr)[4]	Percent of State Total
Total	**16,359,700**	
Agriculture	13,981,100	85.5%
Municipal and Industrial	1,218,600	7.4%
Total All Others	1,160,000	7.1%
Breakdown of "All Others"		
Total All Others	**1,160,000**	
Recreation	923,100	5.64%
Large Industry	136,000	0.83%
Thermoelectric Power Generation	76,600	0.47%
Hydraulic Fracturing	13,900	0.08%
Snowmaking	5,300	0.03%
Coal, Natural Gas, Uranium, and Solar Development	5,100	0.03%
Oil Shale Development	0	0.00%

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Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Estimated Water Use

Projection of Annual Demand for Hydraulic Fracturing (Acre-Feet[2])[3]					
2010	2011	2012	2013	2014	2015
13,900	14,900	16,100	16,900	17,800	18,700

- 2015: 0.10% of total water use

One Acre Foot is Approximately 326,000 Gallons

Source: COGCC

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COLORADO
OIL & GAS
ASSOCIATION

HF Disclosure Registry

New HF Rule

- Requires public disclosure of HF chemicals using FracFocus.org
  - Well-by-well Basis
- Include MSDS Information
- Trade Secret Protection
  - File with COGCC
  - Justify Trade Secret Status

Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

New HF Rule

- 48 hour advance notice from Operator to the Commission is required of intention to hydraulically fracture a well.
- Stakeholder Rulemaking Process Late 2011
- Most Stringent in Nation

Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

HF Disclosure Registry

- Initiated by the Ground Water Protection Council (GWPC) and Interstate Oil & Gas Compact Commission (IOGCC)
- Website Development Committee: Industry, State, & GWPC
- Industry has unanimously supported the Registry
  - ANGA (American Natural Gas Alliance)
  - AXPC (American Exploration & Production Companies)
  - API (American Petroleum Institute)
  - IPAA (Independent Petroleum Association of America)
  - NGSA (Natural Gas Supply Association)
  - INGAA (Interstate Natural Gas Association of America)

Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

Concept of the Registry

- Web interface where operators voluntarily register HF chemicals
  - Timely, consistent data
  - Centralized upload area for operators
  - Secure information
- Web interface where public finds more information on the HF process
- Well site search tool
  - Allow public to search for individual HF wells
  - Query by state, county, API number, production type, lease name or well number
  - From 2011 forward

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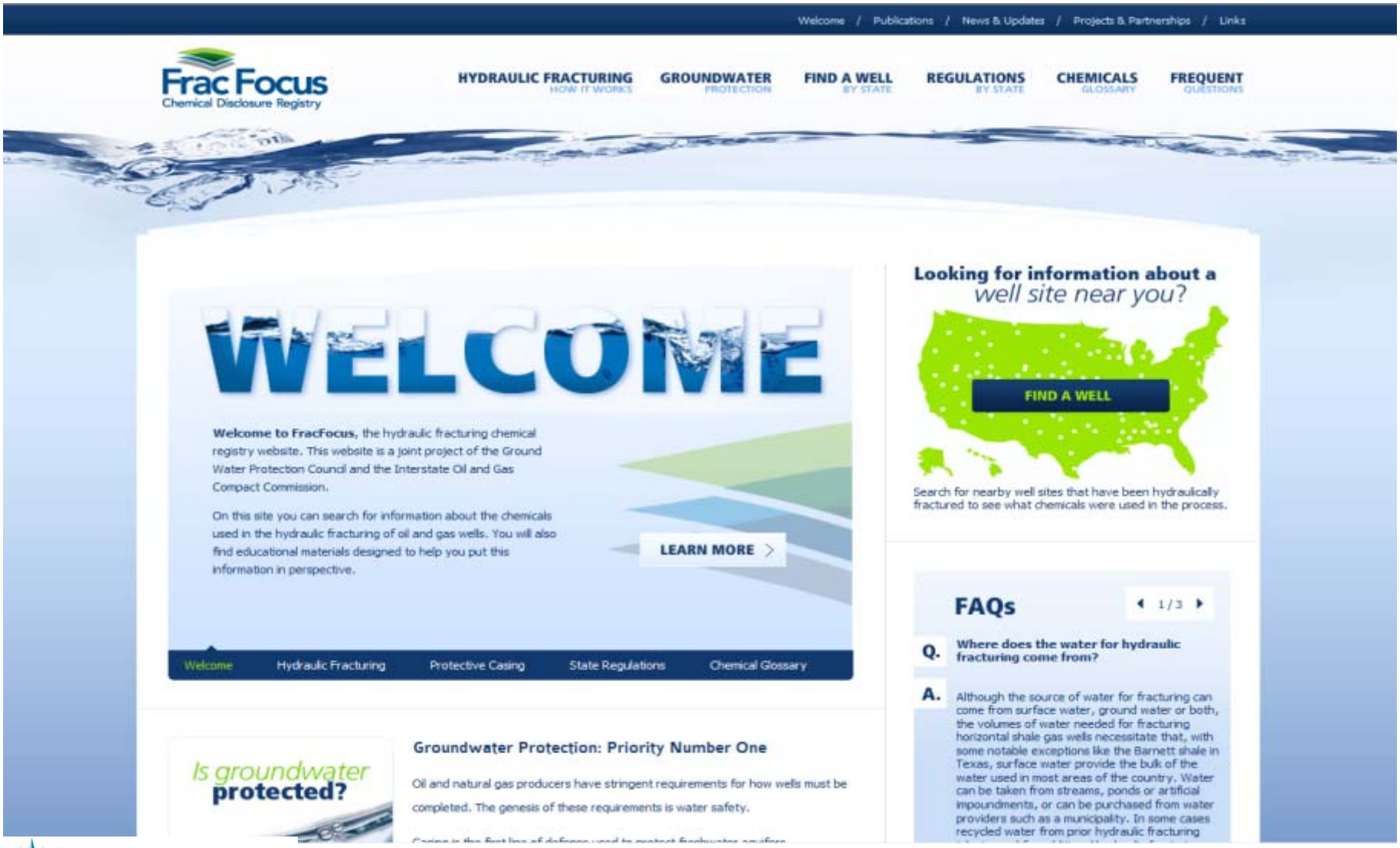
Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

FracFocus Website



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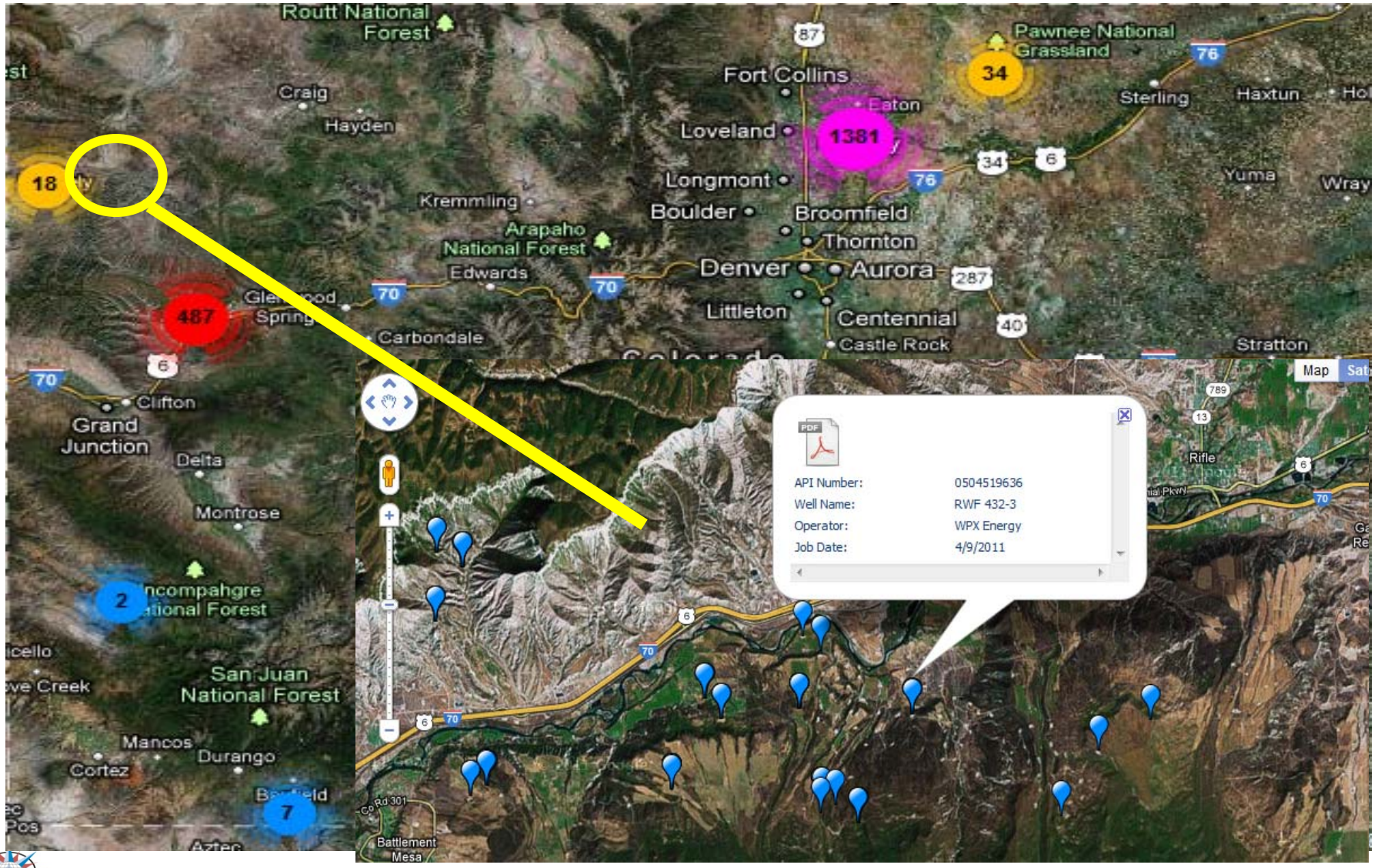
Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

Improved Search



Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

HF Disclosure Example

Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date:	2/17/2011
State:	OKLAHOMA
County:	ROGER MILLS
API Number:	3512923458
Operator Name:	CHESAPEAKE
Well Name and Number:	THOMAS 1-16H
Longitude:	-99.948713
Latitude:	35.510162
Long/Lat Projection:	NAD27
Production Type:	Gas
True Vertical Depth (TVD):	10,607
Total Water Volume (gal)*:	3,977,442

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by Mass)**	Maximum Ingredient Concentration in HF Fluid (% by Mass)**	Comments
Fresh Water		Carrier/Base Fluid				88.72029%	
Sand (Proppant)		Proppant				10.26962%	
15 hcl	TRICAN WELL SERVICE LP	Acid	Hydrochloric Acid	007647-01-0	15.00%	0.01336%	
MC B 8650 WS	MULTI-CHEM GROUP LLC	Bactericide	Glutaraldehyde (Pentanediol)	000111-30-8	50.00%	0.01787%	
			Water	007732-18-5	50.00%	0.01787%	
			Methanol (Methyl Alcohol)	000067-56-1	0.50%	0.00018%	
CC-1 (Clay Control)	TRICAN WELL SERVICE LP	Clay Stabilizer	Choline Chloride	000067-48-1	70.00%	0.11937%	
LFR-30	TRICAN WELL SERVICE LP	Friction Reducer	Anionic Polyacrylamide Copolymer	N/A	100.00%	0.08923%	
			Petroleum Distillate	N/A	100.00%	0.08923%	
			Ammonium Chloride	N/A	2.00%	0.00178%	
WG-111L	TRICAN WELL SERVICE LP	Gelling Agent	Petroleum Distillate Blend	N/A	60.00%	0.08827%	
			Polysaccharide blend	N/A	60.00%	0.08827%	
LBK-30 EP	TRICAN WELL SERVICE LP	Breaker	Ammonium Persulfate	007727-54-0	100.00%	0.00315%	
LNE-20	TRICAN WELL SERVICE LP	Surfactant	Alcohol Alkoxylate	N/A	20.00%	0.00783%	
			Methanol (Methyl Alcohol)	000067-56-1	20.00%	0.00783%	

hay include fresh water, produced water, and/or recycled water

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Source: Colorado Oil & Gas Association, *Moving Beyond Misinformation*

Highly Regulated

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201. Effective Scope of Rules and Regulations
201A. Effective Date of Amendments
202. Office and Duties of Director
203. Office and Duties of Secretary
204. General Functions of Director
205. Access to Records
206. Reports
207. Tests and Surveys
208. Corrective Action
209. Protection of Coal Seams and Water-Bearing Formations
210. Signs and Markers
211. Naming of Fields
212. Safety
213. Forms Upon Request
214. Local Governmental Designee
215. Global Positioning Systems
216. Comprehensive Drilling Plans

323. Open Pit Storage of Oil or Hydrocarbon Substances
324A. Pollution
324B. Exempt Aquifers
324C. Quality Assurance for Chemical Analysis
324D. Criteria to Establish Points of Compliance
325. Underground Disposal of Water
326. Mechanical Integrity Testing
327. Loss of Well Control
328. Measurement of Oil
329. Measurement of Gas
330. Measurement of Produced and Injected Water
331. Vacuum Pumps on Wells
332. Use of Gas for Artificial Gas Lifting
333. Seismic Operations
334. Public Highways and Roads
335. OGCC Form 15. Pit Construction Report/Permit
336. OCCC Form 18. Complaint Form
337. OGCC Form 19. Spill/Release Report
338. OGCC Form 24. Soil Analysis Report
339. OGCC Form 25 Water Analysis Report
340. OGCC Form 27 Site Investigation and Remediation Workplan
341. Bradenhead Monitoring During Well Stimulation Operations

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301. Records, Reports, Notices - General
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303. OGCC Form 2. Requirements for Form 2, Application for Permit-to-Drill, Deepen, Re-enter, or Recomplete and Operate; Form 2A, Oil and Gas Location Assessment
304. Financial Assurance Requirements
305. Notice, Comment, Approval
306. Consultation
307. OGCC Form 4. Sundry Notices and Reports on Wells
308A. OGCC Form 5. Drilling Completion Report
308B. OGCC Form 5A. Completed Interval Report
308C. Confidentiality
309. OGCC Form 7. Operator's Monthly Production Report
310. OGCC Form 8. Mill Levy
311. OGCC Form 6. Well Abandonment Report
312. OGCC Form 10. Certificate of Clearance and/or Change of Operator
313. OGCC Form 11. Monthly Report of Gasoline or Other Extraction Plants
314. OGCC Form 17. Bradenhead Test Report
315. Report of Reservoir Pressure Test
316A. OGCC Form 14. Monthly Report of Fluids Injected
316B. OGCC Form 21. Mechanical Integrity Test
317. General Drilling Rules
317A. Special Drilling Rules - D-J Basin Fox Hills Protection Area
317B. Public Water System Protection
318. Location of Wells
318A Greater Wattenberg Area Special Well Location, Spacing and Unit Designation Rule
318B. Yuma/Phillips County Special Well Location Rule
319. Abandonment
320. Liability
321. Directional Drilling
322. Commingling

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602. General
603. Drilling and Well Servicing Operations and High Density Area Rules
604. Oil and Gas Facilities
605. RESERVED
606A. Fire Prevention and Protection
606B. Air and Gas Drilling
607. Hydrogen Sulfide Gas
608. Coalbed Methane Wells

E&P WASTE MANAGEMENT (900 Series)

901. Introduction
902. Pits - General and Special Rules
903. Pit Permitting/Reporting Requirements
904. Pit Lining Requirements and Specifications
905. Closure of Pits, and Buried or Partially Buried Produced Water Vessels
906. Spills and Releases
907. Management of E&P Waste
907A. Management of Non-E&P Waste
908. Centralized E&P Waste Management Facilities
909. Site Investigation, Remediation and Closure
910. Concentrations and Sampling for Soil and Ground Water
911. Pit, Buried or Partially Buried Produced Water Vessel, Blowdown Pit, and Basic Sediment/Tank Bottom Pit Management Requirements Prior to December 30, 1997
912. Venting or Flaring Natural Gas

UNIT OPERATIONS, ENHANCED RECOVERY PROJECTS, AND STORAGE OF LIQUID HYDROCARBONS (400 Series)

401. Authorization
402. Notice and Date of Hearing
403. Additional Notice
404. Casing and Cementing of Injection Wells
405. Notice of Commencement and Discontinuance of Injection Operations

Mercator Energy

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COGCC

- Rule 205 – Disclosure of Chemicals
- Rule 317 – General Drilling Rules
- Rule 317B – Drinking Water Protection
- Rule 318A – Greater Wattenberg Area
- Rule 341 – Bradenhead Monitoring
- Rule 608 – CBM Baseline Sampling
- Rules 903, 904, and 905 - Updated Pit Rules
- Rule 906 - Spill Notification
- Rule 907 – Management of Waste
- Rule 325 – Underground Disposal of Water
- Rule 908 – Waste Management Facilities

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COGCC

- Rule 317B – Drinking Water Protection
  - Near surface waters and tributaries that are sources of public drinking water
  - Mandatory setbacks
  - Enhanced environmental precautions
- Rule 318A - Greater Wattenberg Area
  - DJ Basin
  - Sample water wells before drilling

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COGCC

- Rule 341 – Bradenhead Monitoring
  - Objective: confine stimulation fluids to the objective formations
  - During stimulation, bradenhead annulus pressure continuously monitored
  - If pressure increases above 200 psig, verbal notification and reporting requirements
  - All well stimulation record kept for at least 5 years

Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COGCC

- Rule 608 – CBM Baseline Sampling
  - Coalbed methane operators
  - Pressure test wells
  - Sample nearby water wells before, during, and after operations
- Rules 903, 904, and 905 - Updated Pit Rules
  - Enhanced requirements for pit permitting, lining, monitoring and containment

Mercator Energy

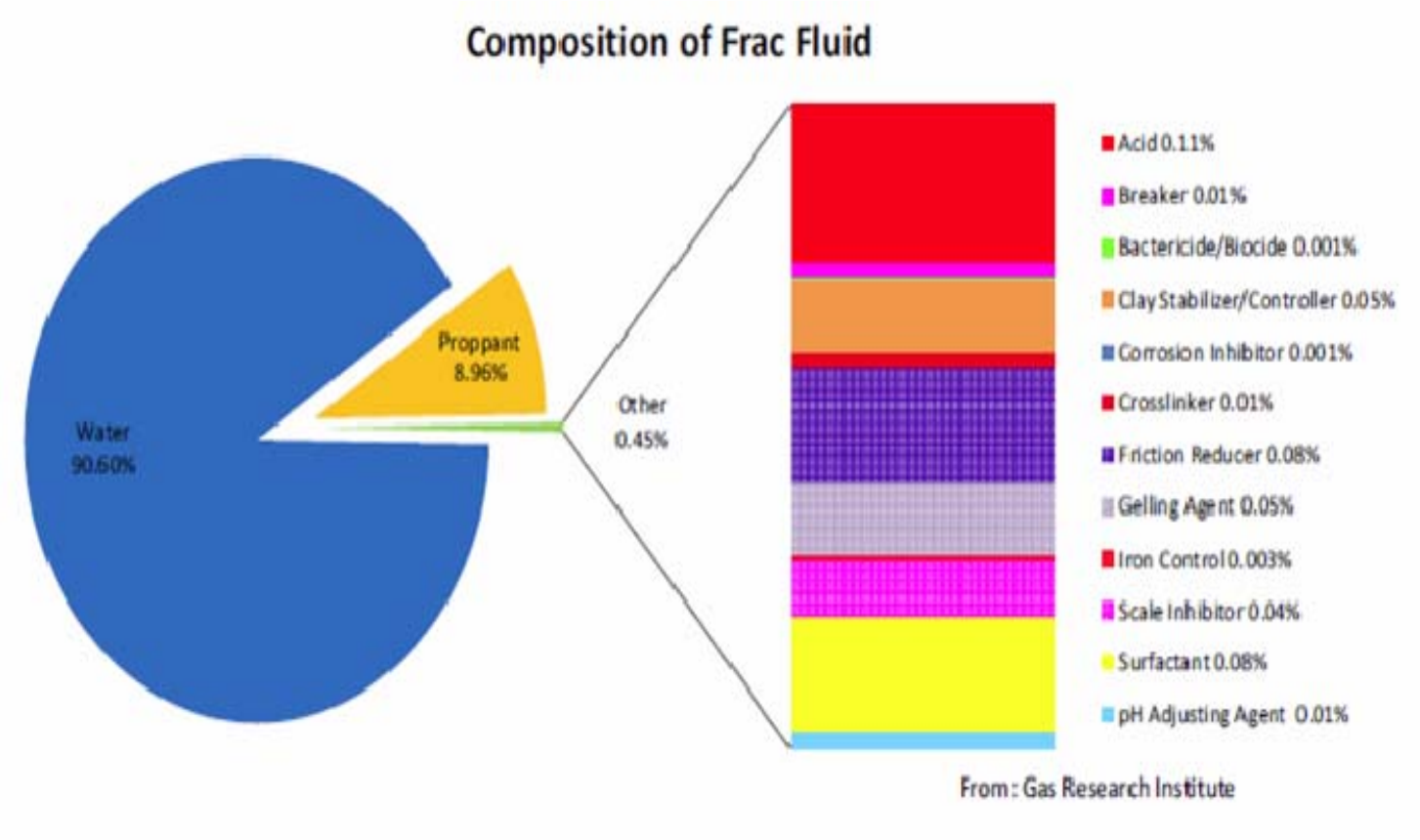
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

COGCC

- Rule 906 - Spill Notification
  - Promptly report any spills that threaten waters
  - Commission, Environmental Release/Incident Report Hotline, and landowner

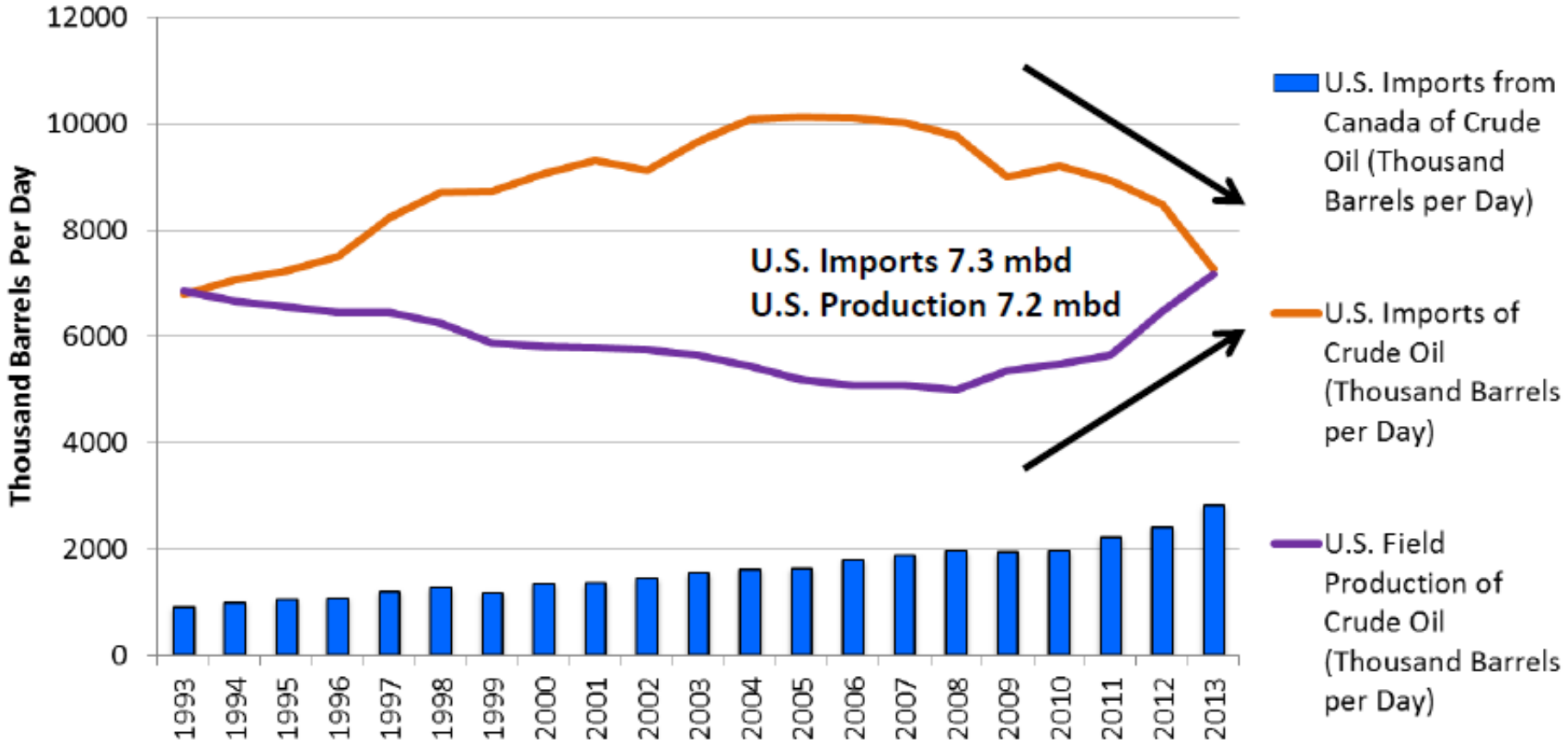
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

HF Fluids



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

U.S. Total Imports, U.S. Production, U.S. Canadian Imports



Source: EIA & DUG Bakken & Niobrara Conference