Penn State Extension

Jon Laughner, PESC, November 14, 2012
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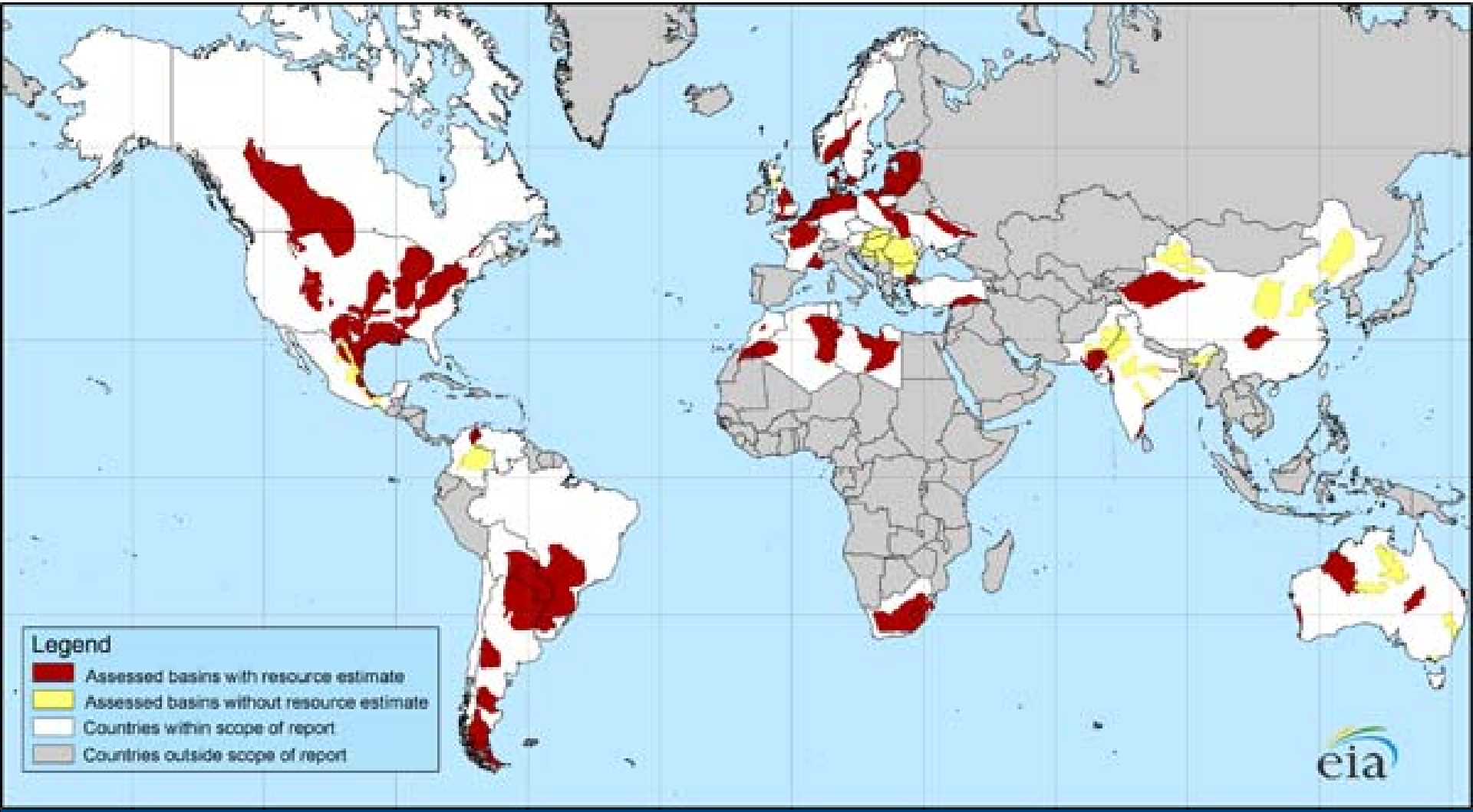
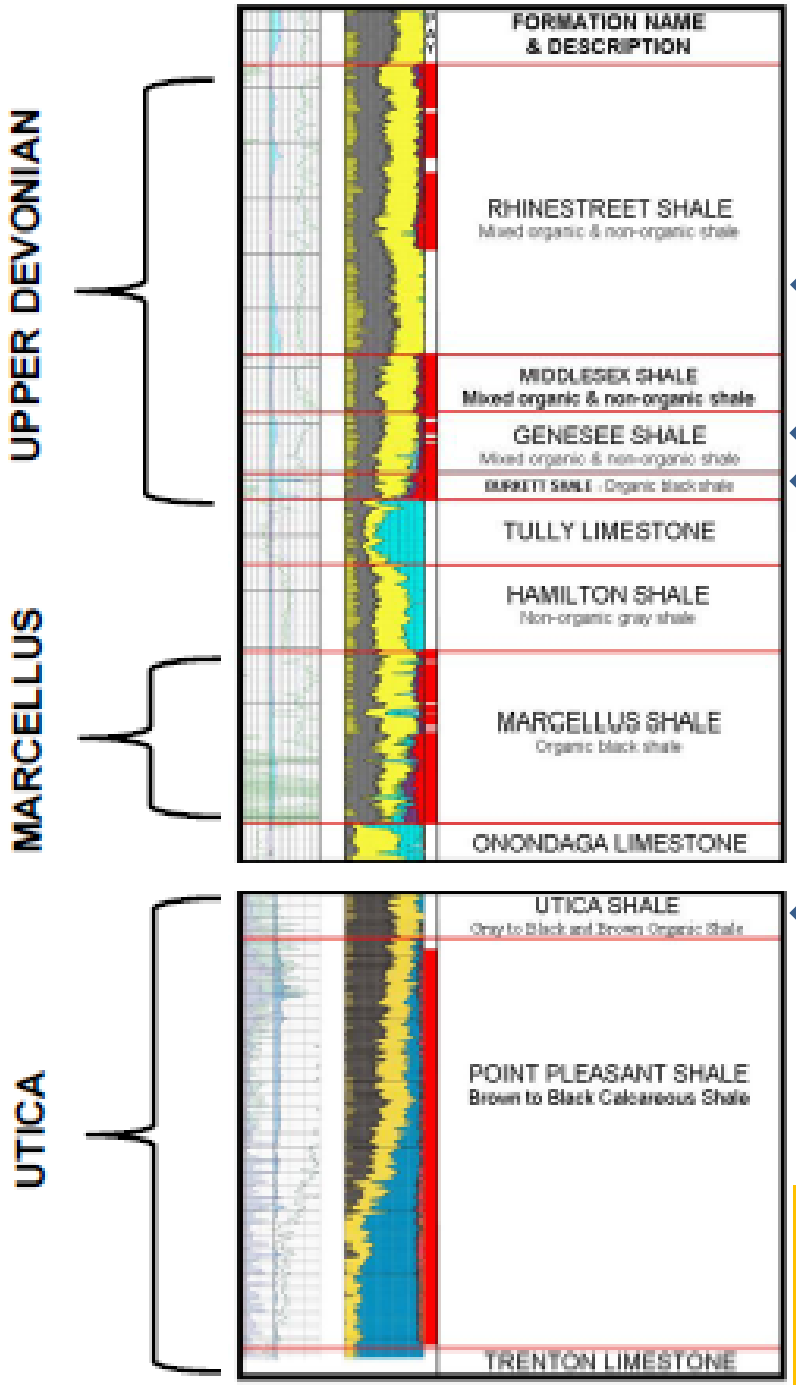
Where are we going?

1. Shale's Economic Drivers and Implications
2. Act 13
3. Utilization

The Bigger Picture





Rhinestreet

Genesee

Burkett

Marcellus

Utica

Point Pleasant

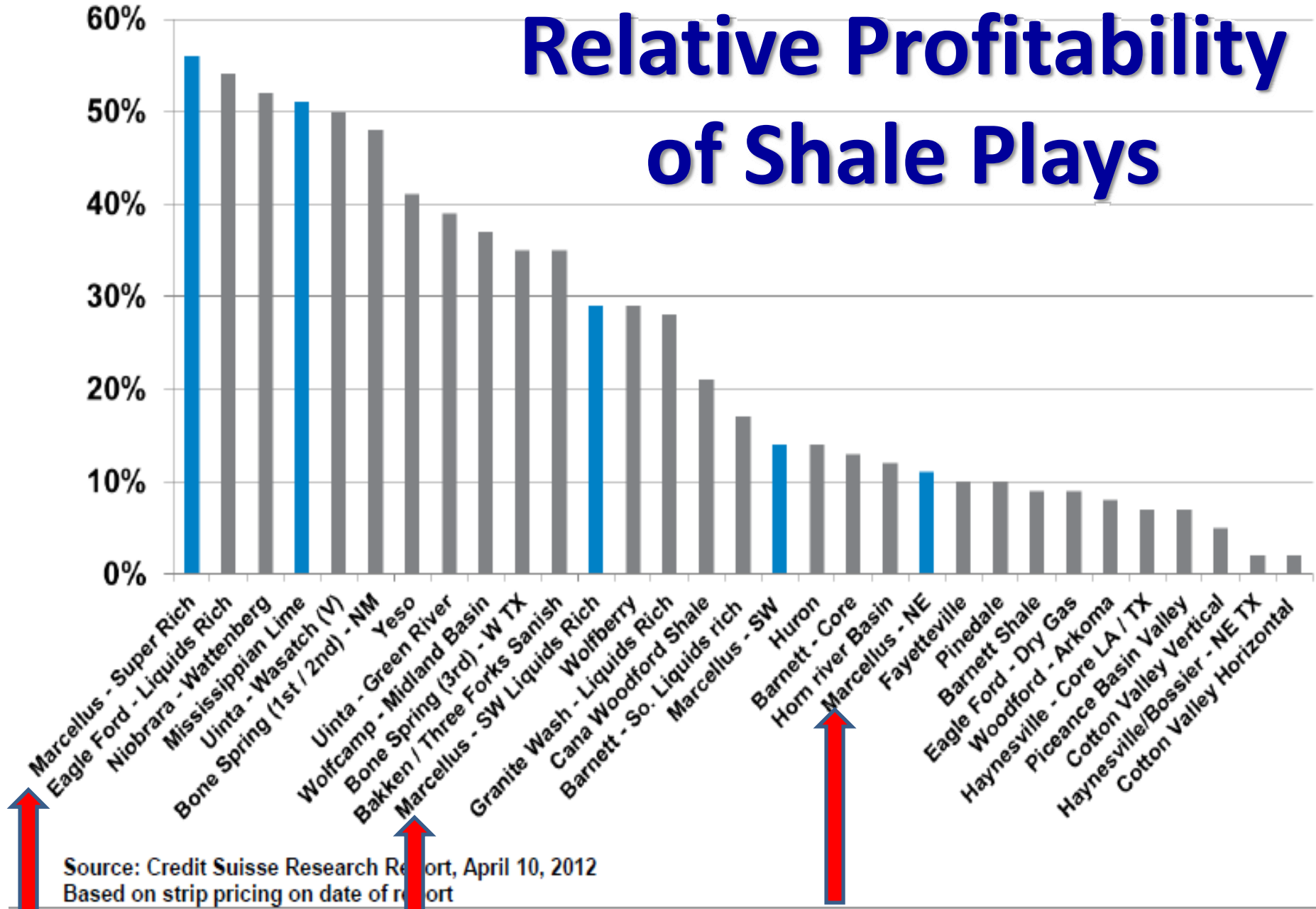
Marcellus and More

Pennsylvania	
Allegheny	1
Armstrong	1
Bradford	8
Butler	4
Clearfield	2
Fayette	1
Forest	1
Greene	8
Indiana	1
Jefferson	1
Lycoming	12
Sullivan	2
Susquehanna	8
Tioga	3
Washington	5
Westmoreland	3
Wyoming	1
Total Pennsylvania	62

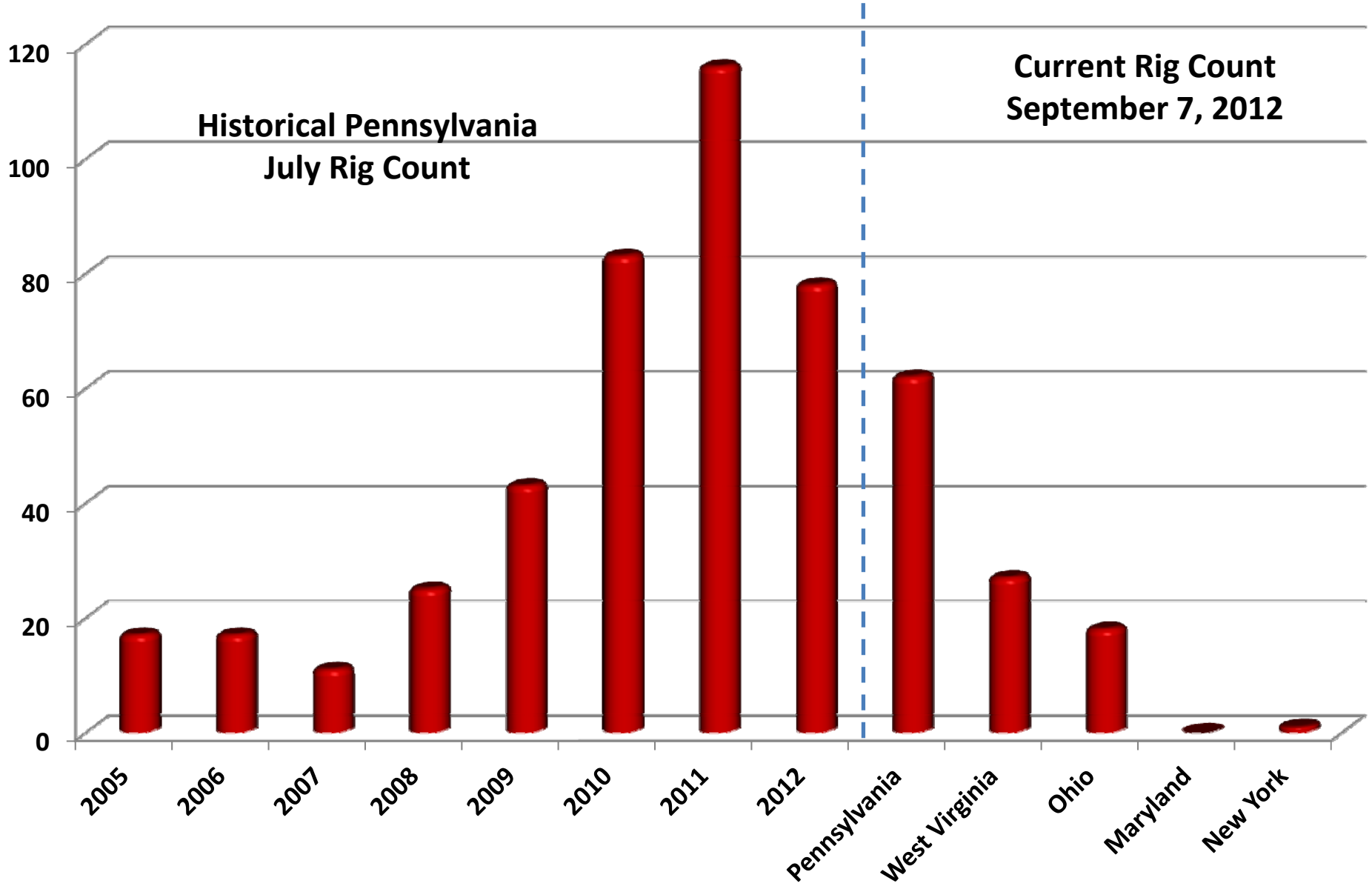
Pennsylvania	
Lawrence	2
Total Pennsylvania	2

Pennsylvania County Rig Count

Relative Profitability of Shale Plays

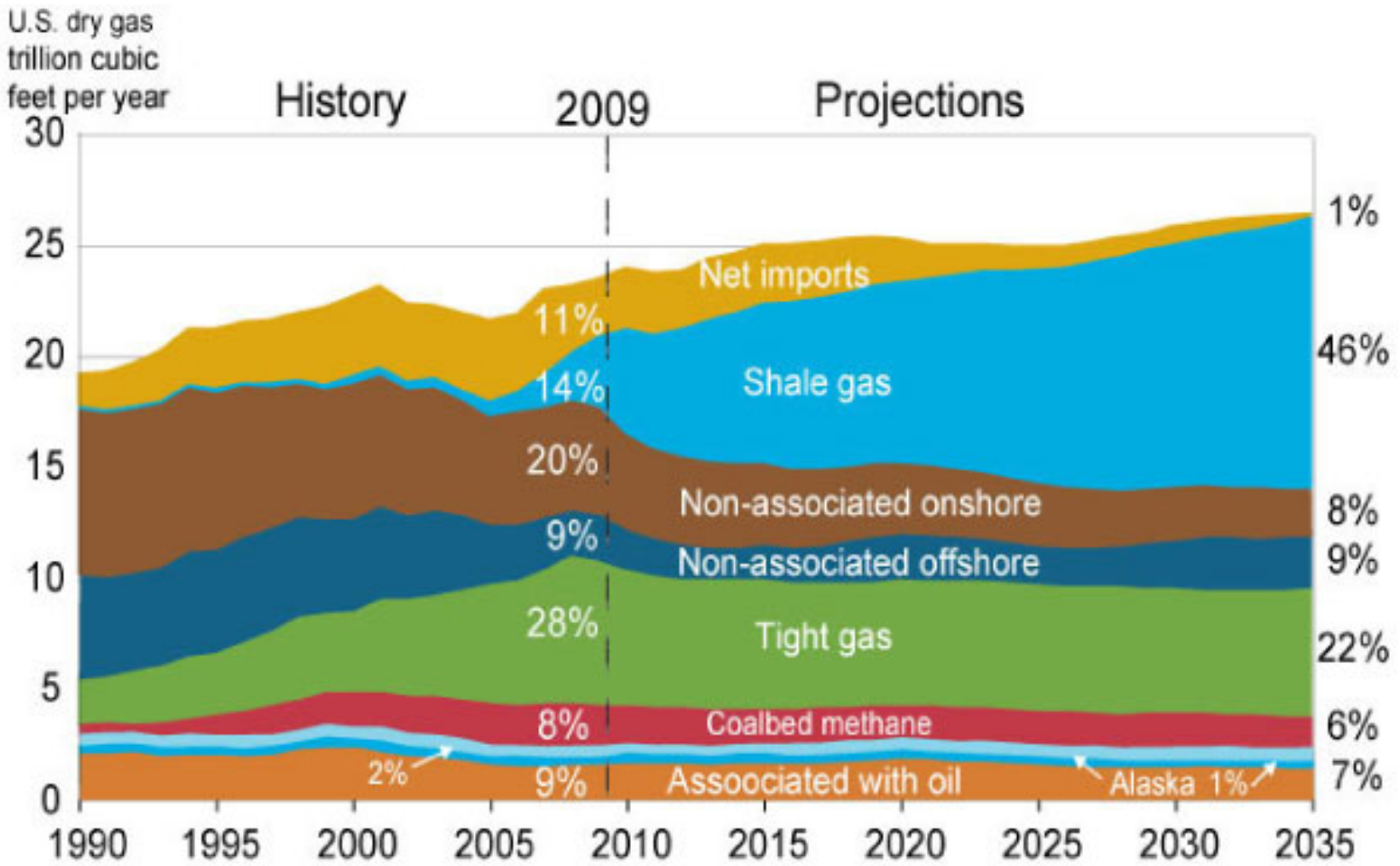


Source: Credit Suisse Research Report, April 10, 2012
Based on strip pricing on date of report



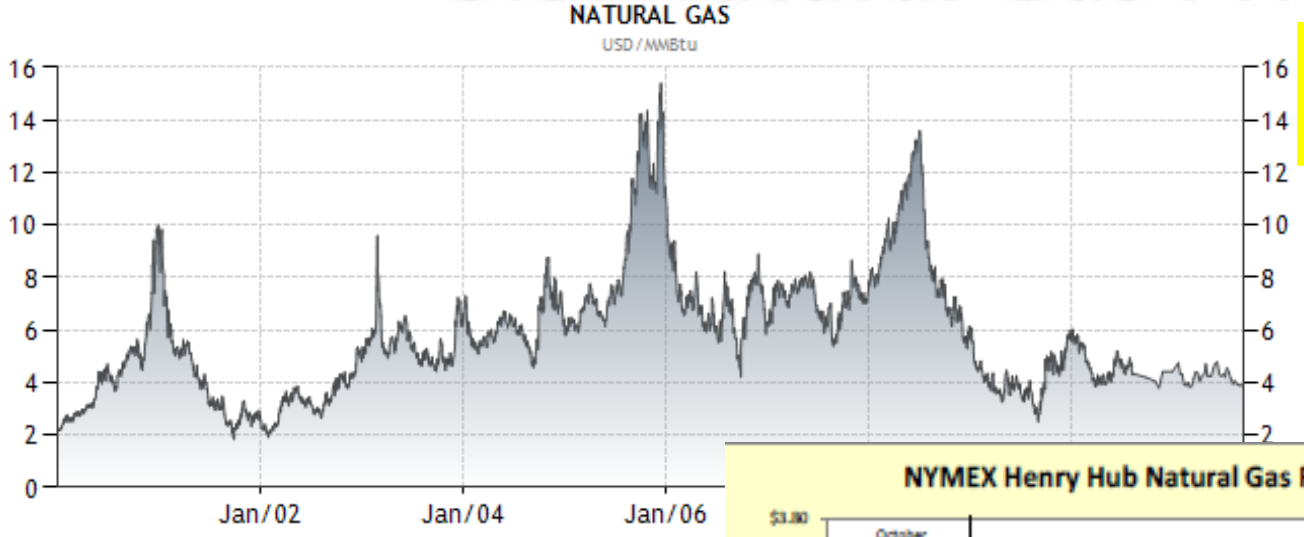
Sources: Baker-Hughes Investor Relations (September 7, 2012)

U.S. Natural Gas Supply, 1990-2035

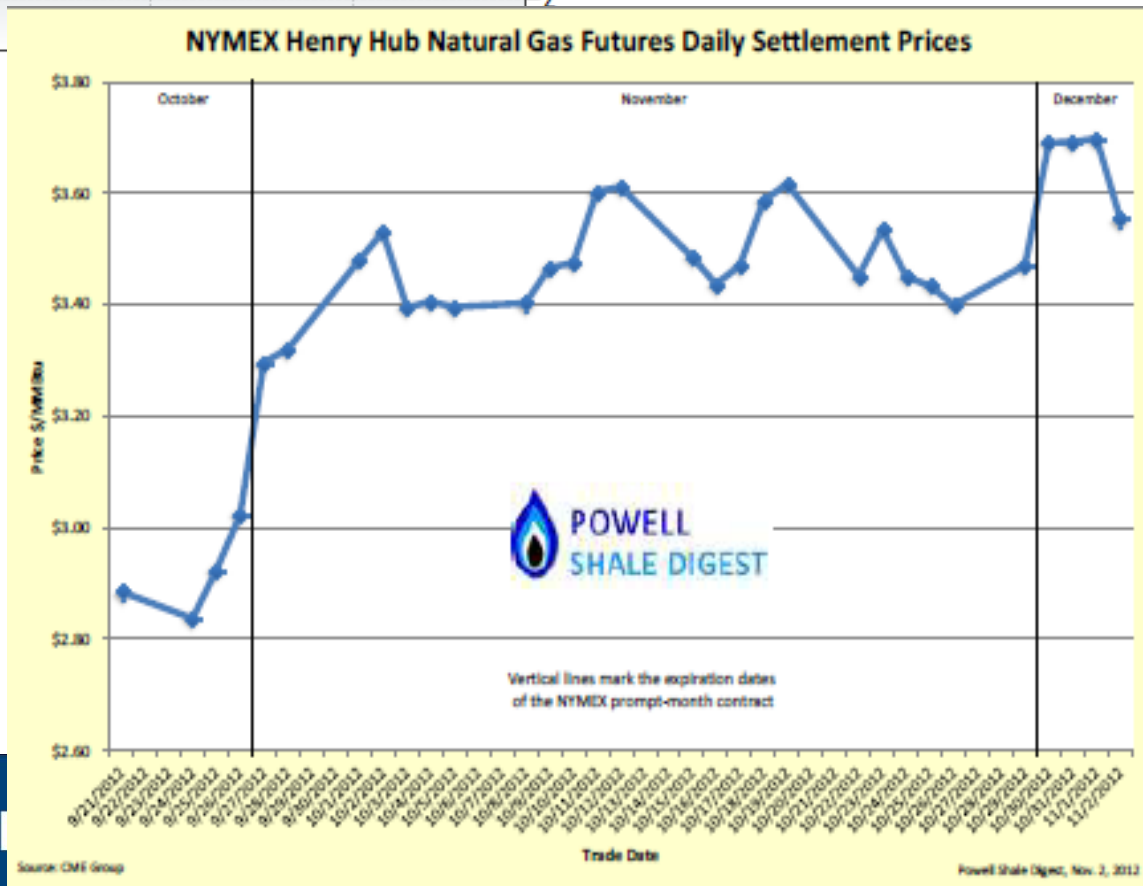


Source: EIA, *Annual Energy Outlook 2011*

U.S. Natural Gas Prices



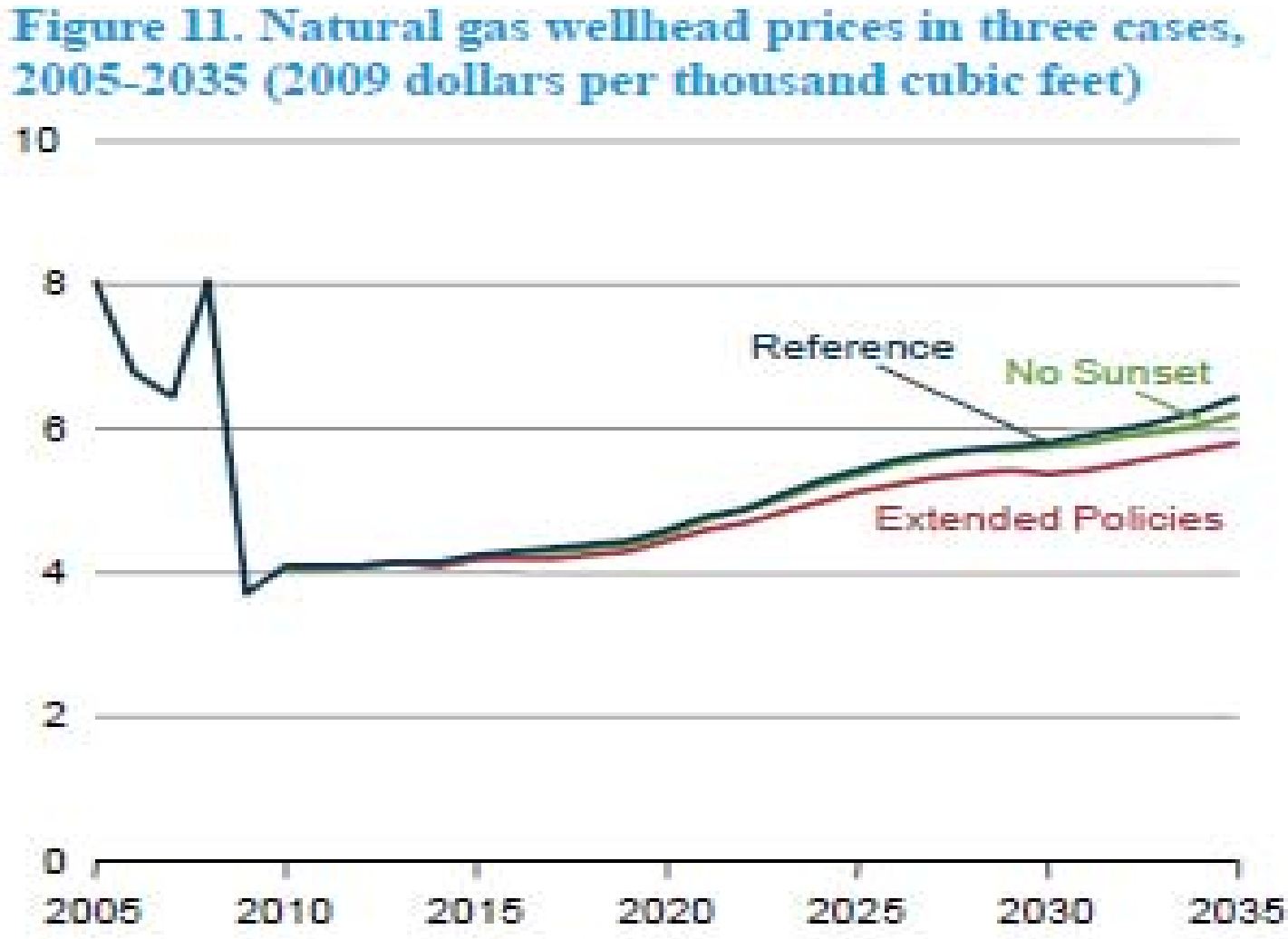
January 2000 through January 2011

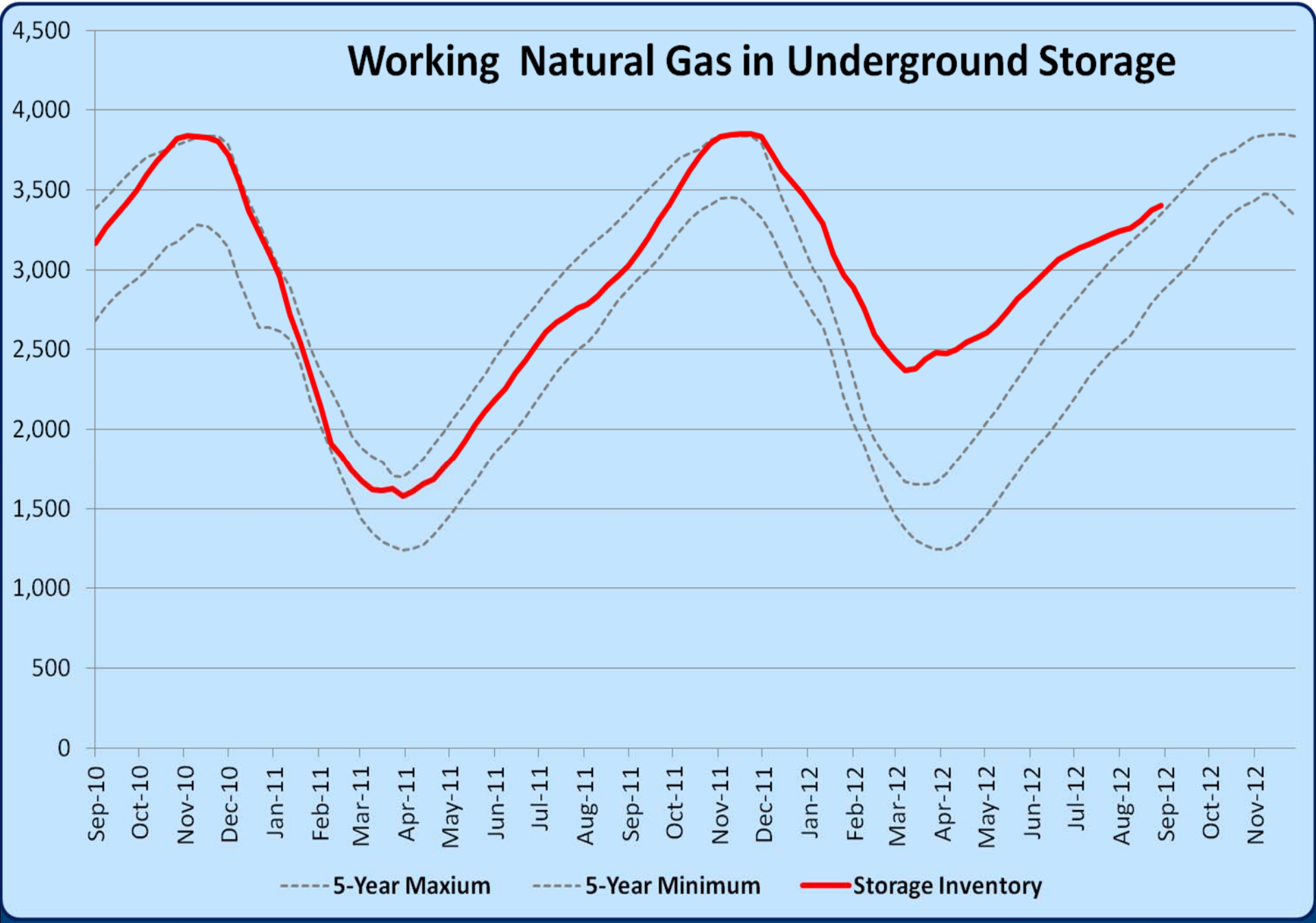


September 21, 2012 thru November 2, 2012

Penn State **Extensio**

EIA Natural Gas Price Projection




Working Natural Gas in Underground Storage
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
Apr-11
May-11
Jun-11
Jul-11
Aug-11
Sep-11
Oct-11
Nov-11
Dec-11
Jan-12
Feb-12
Mar-12
Apr-12
May-12
Jun-12
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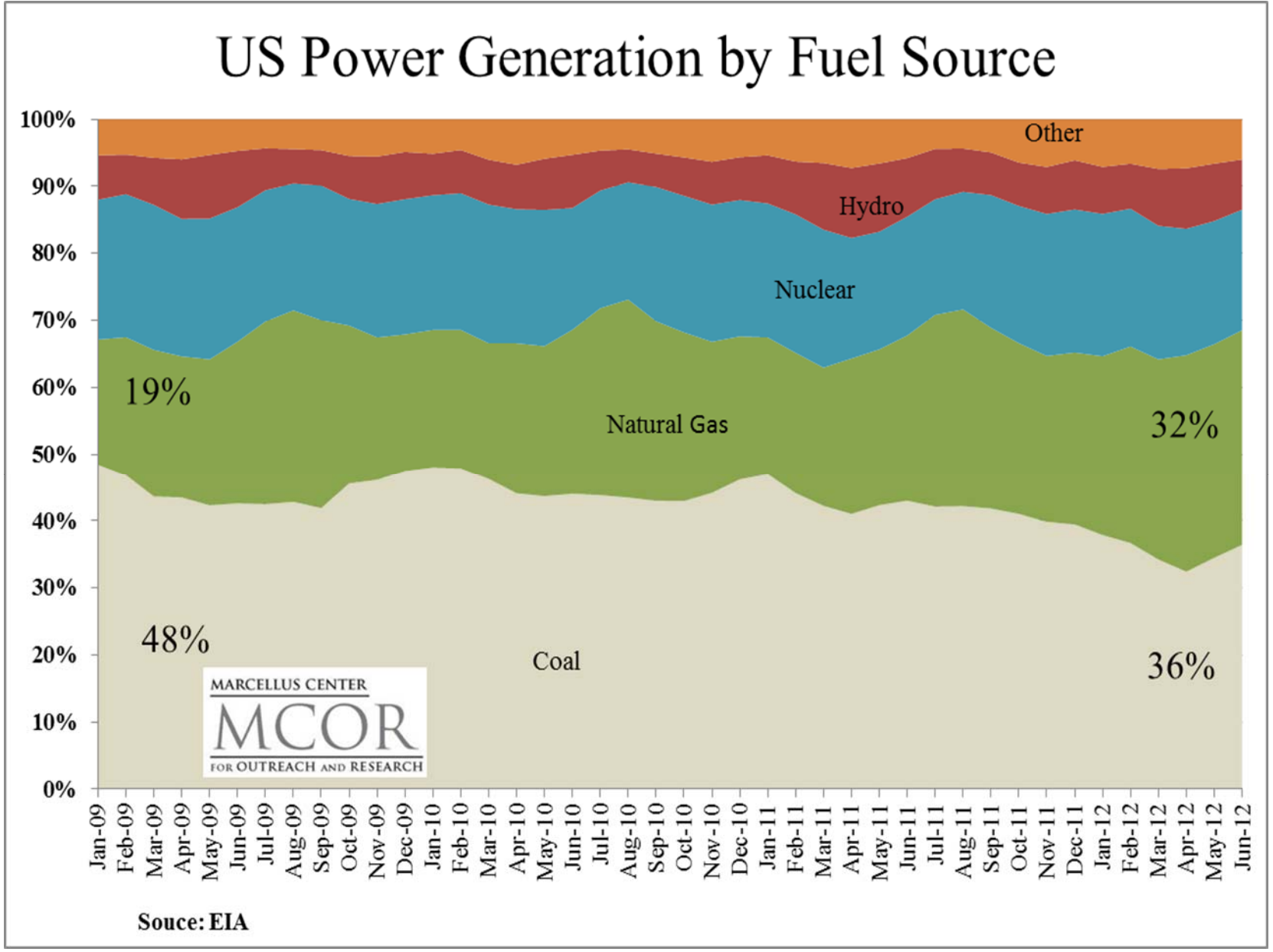
Aug-12
Sep-12
Oct-12
Nov-12
5-Year Maxium
5-Year Minimum
Storage Inventory


US Power Generation by Fuel Source
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Other
Hydro
Nuclear
Natural Gas
Coal
19%
32%
48%
36%
MARCELLUS CENTER
MCOR
FOR OUTREACH AND RESEARCH
Jan-09
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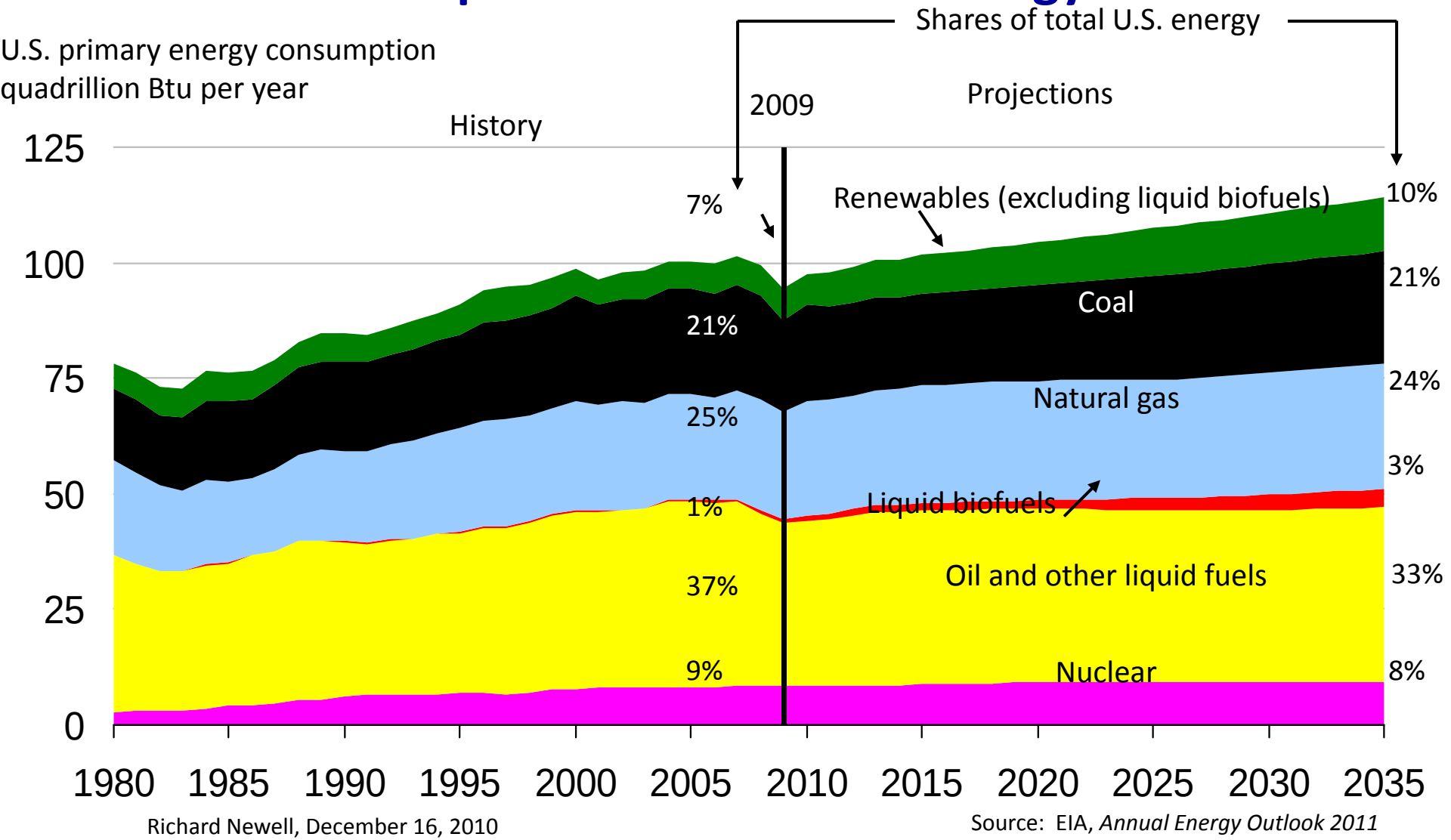
Jun-12
Souce: EIA

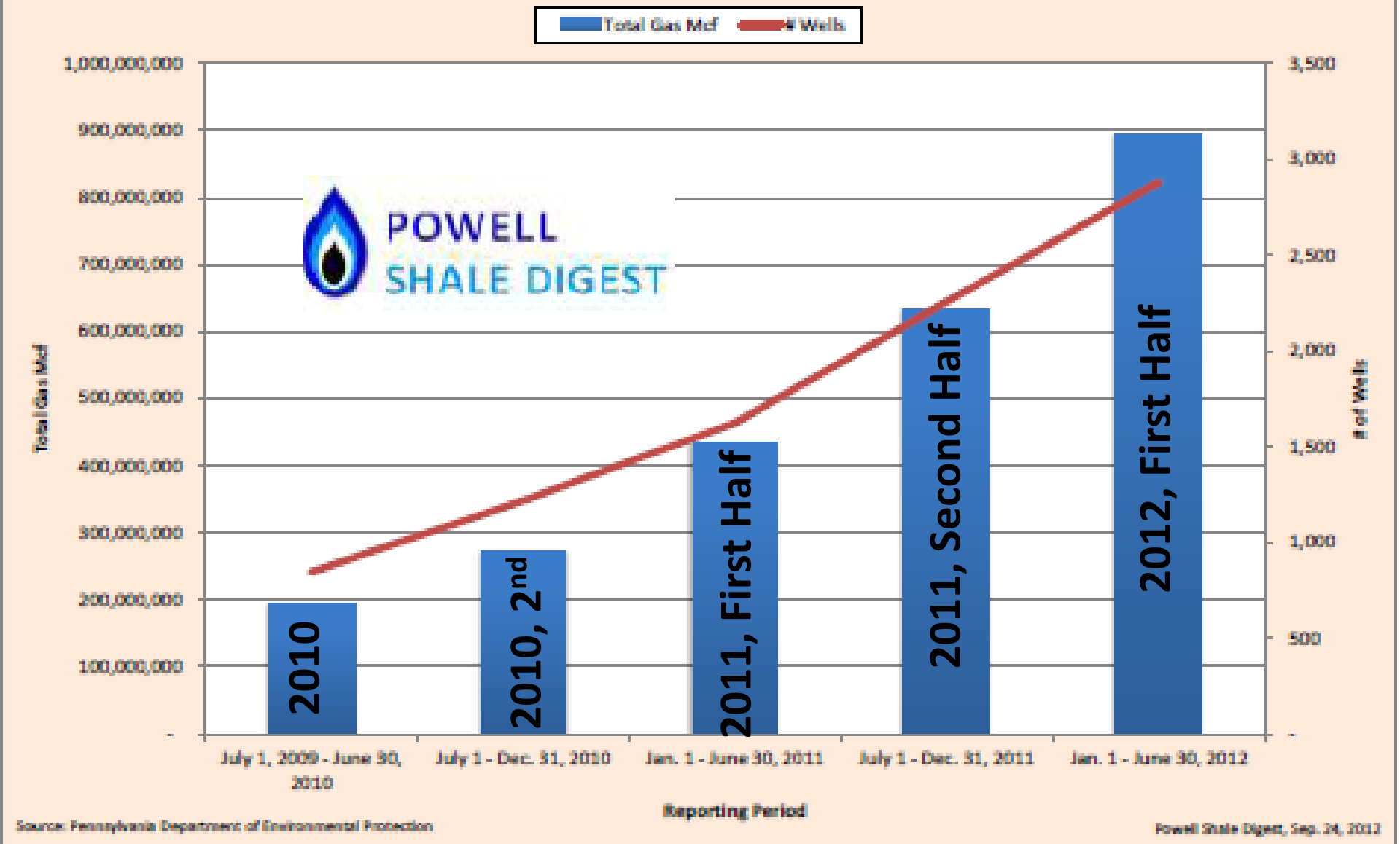
Renewables grow rapidly, but under current policies fossil fuels still provide 78% of U.S. energy use in 2035



Richard Newell, December 16, 2010

Source: EIA, *Annual Energy Outlook 2011*

Pennsylvania Unconventional Growth in Total Gas Mcf & # Wells by Reporting Period July 1, 2009 - June 30, 2012



Source: Pennsylvania Department of Environmental Protection

Powell Shale Digest, Sep. 24, 2012

PA Unconventional Wells Drilled Quarterly Comparison 2011-2012

Wells Drilled by Quarter:

2012			2011			
Q3 2012	Q2 2012	Q1 2012	Q4 2011	Q3 2011	Q2 2011	Q12011
243	380	418	534	551	400	488

PA DEP, Shale Digest-11-5-12

Drilling Longevity?

- 95,000 sq. mile aerial extent
- 28,000 sq. mi. commercially viable (current)
  - 35% drillable = 9,800 sq. mi. (1 pad/sq. mi.)
  - 70% drillable = 19,600 sq. mi. (1 pad/sq. mi.)
- Pad size
  - 6 wells per pad
  - 10 wells per pad

Source: Pa DEP & WV DEP

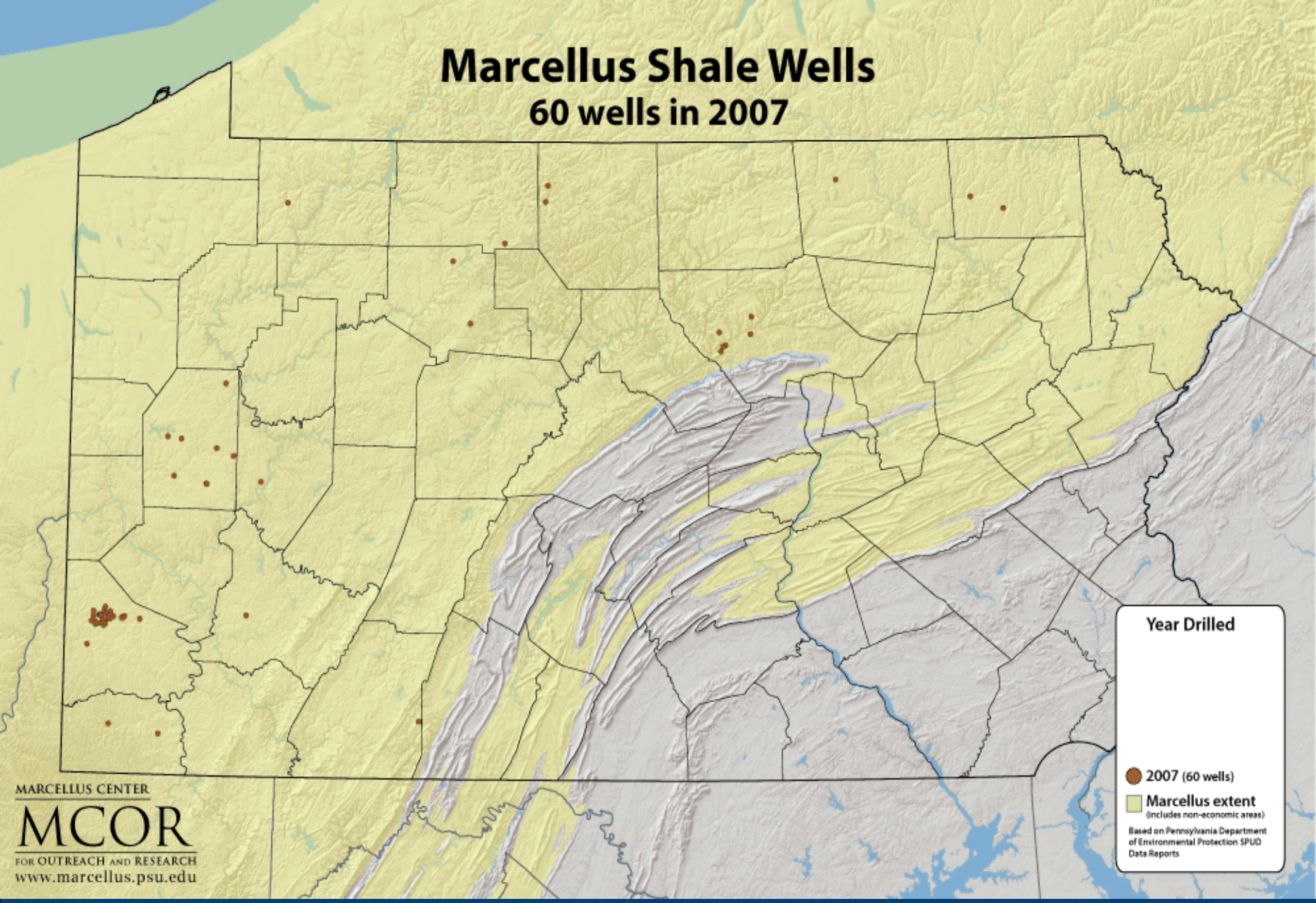
How Much Drilling?

- Total Wells
  - 58,800 – 90,800 total wells (35% drillable)
  - 117,600 – 196,000 total wells (70% drillable)

  The above example is provided as an illustration of scale, not as a forecast of future activity

- Current Activity
  - 5,800 Unconventional wells in PA
  - 1,700 Marcellus wells in WV (est.)
  - 140 Utica wells in OH

Source: Pa DEP & WV DEP


Marcellus Shale Wells
60 wells in 2007
Year Drilled
2007 (60 wells)
Marcellus extent
(includes non-economic areas)
Based on Pennsylvania Department of Environmental Protection SPUD Data Reports
MARCELLUS CENTER
MCOR
FOR OUTREACH AND RESEARCH
www.marcellus.psu.edu

Where are the wells?

- From 2009 to Present:
- 73% of all wells spud
  - –6 counties
    - Washington
    - Lycoming
    - Tioga
    - Greene
    - Bradford
    - Susquehanna

PA DEP

What comes out of a gas well?

- Methane
- Water
- Gases
  - Nitrogen, helium, some limited acidic gases like hydrogen sulfide
- Heavy gaseous hydrocarbons
  - Ethane
  - Propane
  - Butane

Natural Gas Liquids

Methane
(natural gas)

$$$$$$$

Dry Gas:

~ 1000-1050 BTU

Pipeline Quality

Wet Gas:
> 1050 BTU

Methane
(natural gas)

$$$$$$$

$$
Iso-butane

+

$$
Propane

+

$$
Butane

+

$$
Ethane

+

=

Processing Plant

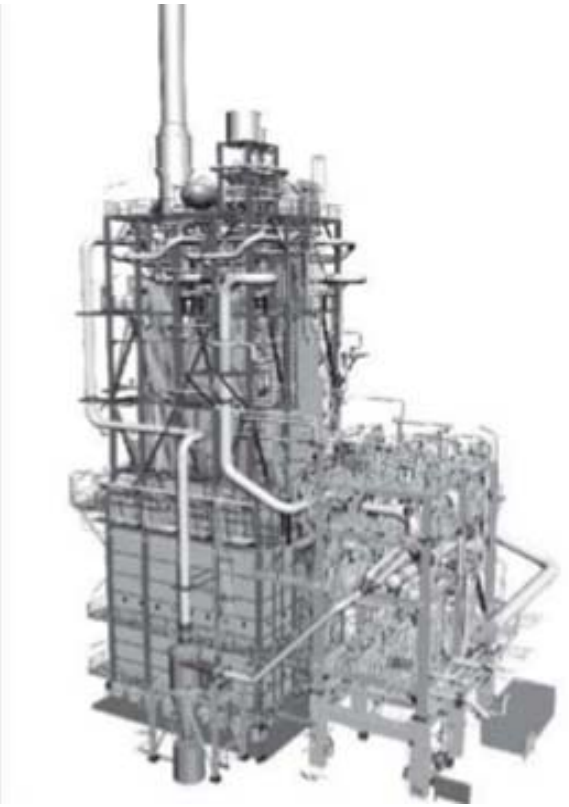
Best Gas, Oil & Condensate Wells

- 19 of 25 top wells were in Susquehanna Co.
- 28 wells produced oil
  - 1 well produced more than 8,500 barrels
  - 3 wells produced more than 3,700 barrels
- 348 wells produced condensate
  - 33 wells produced more than 5,000 barrels
  - 135 wells produced 1,000-5,000 barrels

Source: PA Department of Environmental Protection

“Cracking” – Method of Separation

- Heated 1500 F, pressurized ethane and propane
  - Cracks the hydrocarbon chains into smaller ones
    - Produces **ethylene**
      - Colorless gas
    - “Primary” petrochemicals
      - Responsible for ~75% of worlds chemicals

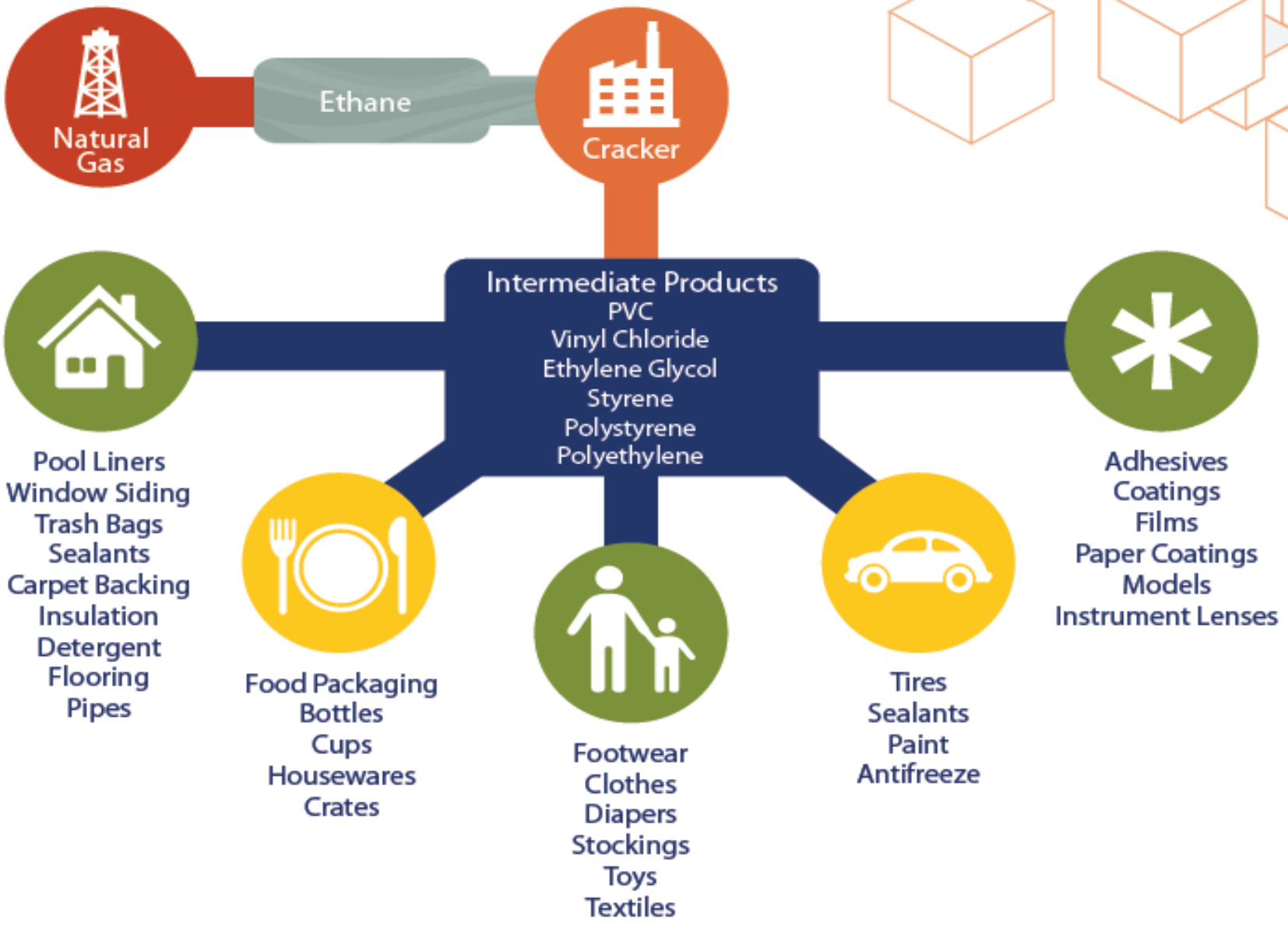


Ethylene

The chemical starting point for:

- »Plastics
- »Pharmaceuticals
- »Electronic materials
- »Fertilizers
- »Adhesives
- »Tires

Ethylene Chain



Looming Natural Gas Trend

International Markets - Marcellus et al. driving reversal?

-- Expectations of imports to supply U.S. demand??

-- U.S. vs. Canadian supplies (exports) Kitimat

-- Exports?? Political will?? --domestically produced energy

-- TX facility –Sabine Pass

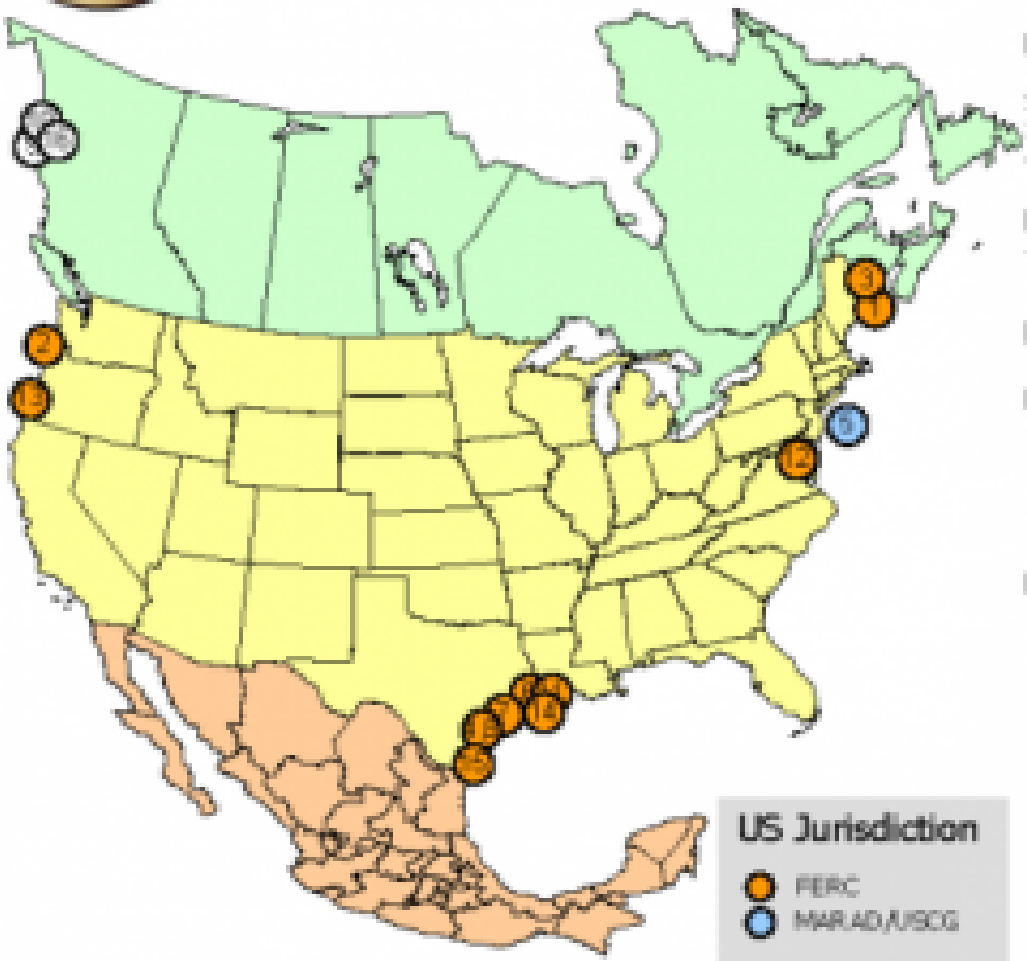
-2015

-Cove Point next?

-- Increasing sources for LNG: Exports to east CA

North American LNG Import/Export Terminals

Proposed/Potential



Import Terminal

PROPOSED TO FERC

1. **Robbinston, ME:** 0.5 Bcfd (Kestrel Energy - Downeast LNG)
2. **Astoria, OR:** 1.5 Bcfd (Oregon LNG)
3. **Calais, ME:** 1.2 Bcfd (BP Consulting LLC)
4. **Corpus Christi, TX:** 0.4 Bcfd (Cheniere – Corpus Christi LNG)

PROPOSED TO MARAD/COAST GUARD

5. **Offshore New Jersey:** 2.4 Bcfd (Excalibur Energy – Liberty Natural)

Export Terminal

PROPOSED TO FERC

6. **Sabine, LA:** 2.6 Bcfd (Cheniere/Sabine Pass LNG)
7. **Freeport, TX:** 1.8 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction)
8. **Corpus Christi, TX:** 1.8 Bcfd (Cheniere – Corpus Christi LNG)

PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

9. **Kitimat, BC:** 0.7 Bcfd (Apache Canada Ltd.)
10. **Douglas Island, BC:** 0.25 Bcfd (BC LNG Export Cooperative)

POTENTIAL U.S. SITES IDENTIFIED BY PROJECT SPONSORS

11. **Lake Charles, LA:** 2.0 Bcfd (Southern Union & BG LNG)
12. **Cove Point, MD:** 1.0 Bcfd (Dominion – Cove Point LNG)
13. **Coos Bay, OR:** 1.2 Bcfd (Jordan Cove Energy Project)
14. **Hackberry, LA:** 1.7 Bcfd (Sempra – Cameron LNG)
15. **Brownsville, TX:** 2.8 Bcfd (Gulf Coast LNG Export)

POTENTIAL CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

16. **Prince Rupert Island, BC:** 1.0 Bcfd (Shell Canada)

As of February 28, 2012


Act 13

How is the Gas Well Fee Calculated?

Year of Production	Average Gas Price				
	< $2.25	$2.25 - $2.99	$3.00 - $4.99	$5.00 - $5.99	> $5.99
Year 1	$40,000	$45,000	$50,000	$55,000	$60,000
Year 2	$30,000	$35,000	$40,000	$45,000	$55,000
Year 3	$25,000	$30,000	$30,000	$40,000	$50,000
Years 4 - 10	$10,000 per year	$15,000 per year	$20,000 per year		
Years 11 - 15	$5,000 per year		$10,000 per year		
Total per well	$190,000	$240,000	$310,000	$330,000	$355,000

Act 13 County/Local Government Impact Fee Disbursement

- Final Adjusted Amounts November 2, 2012
  - Initial amounts posted October 15, 2012
  - 36 pages

- http://www.puc.state.pa.us/NaturalGas/pdf/MarcellusShale/Act13-County_Muncipality_Payments2011.pdf

How can Act 13 funds be used?

- Road, bridge, and infrastructure
- Water, storm water and sewer
- Emergency preparedness and safety
- Environmental programs
- Tax reductions
- Affordable housing
- Records management and IT
- Social services
- Judicial services
- Planning initiatives
- Career and technical centers
- Capital reserve fund

How Will the Fees be Distributed?

- Collected by the PUC
- "Off the Top"
  - Selected State Agencies
    - Ex.: DEP, PEMA, State Fire Commissioner
- The Remaining?
  - 60% to impacted local governments
  - 40% for statewide initiatives

How will the 60% Local Share be Distributed?

- 36% to host counties (based on # wells)
- 37% to host municipalities (based on # wells)
- 27% to host & non-host municipalities in host counties.
  - 50% to all municipalities
  - 50% to host and contiguous municipalities & those within 5 miles of well
  - Calculations based on road mileage and population.

Statewide Initiatives – 40%

- Commonwealth Financing Authority
- Highway Bridge Improvement
- Environmental Stewardship Fund
- Water and sewer projects
- Environmental Initiatives
- DCED (2011-2013 only)
- Hazardous Sites Cleanup Fund (2014 and after)

Statewide Initiatives – 40% (continued)

- Natural Gas Energy Development Program
  - For buying or converting vehicle fleets to natural gas
  - Municipalities and authorities are eligible

Municipality Limits. . . .

Limited to the greater of:

$500,000

Or

50% of the total budget for the prior fiscal year.

Some Examples:

- Adams County - $86,033
- Allegheny County - $1,117,319
- Beaver County - $197,639
- Fayette County - $1,448,563
- Greene County - $3,130,609
- Lancaster County - $440,697
- Tioga County - $4,792,619
- Warren County - $53,127

Utilization

Natural Gas Utilization Opportunities

- ✓ A. Industrial
- ✓ B. Transportation
- ✓ C. Power Generation

A. Industrial

- 50% of all energy consumed
  - 66% from natural gas and liquid fuels
- Top consumers
  - Chemical (including fertilizer) – 22%
  - Iron and steel manufacturing – 15%
  - Nonmetallic minerals production (including cement) – 6%

B. Transportation

- Compressed natural gas (CNG) and liquefied natural gas (LNG) vehicles represent a significant potential to directly displace petroleum.
- Pennsylvania Turnpike Proposal
  - "create a clean natural gas corridor by placing CNG dispensers at fueling stations on the Pennsylvania Turnpike."

B. Transportation

- CNG Fueling Stations
  - Home Base
  - Local governments
    - Trash
    - Fleets
      - Bus
      - Light-duty trucks
- Compressed Natural Gas **(CNG)**
- Liquefied Natural Gas **(LNG)**
- Gas to Liquids **(GTL)**
- Co-fueling
  - Diesel/Natural Gas
  - Electric/Natural Gas

C. Power Generation

- Power Generation
  - Combined Heat and Power
    - PA - 125 CHP sites generating 3,301 MW
    - Most installed prior to 1999
    - Advantages. . . .. .
  - Coal Conversion
  - Peaking Power


trucks
roads
eight
need
long
economy
create
last
cleaner
climate
deep
country
world's
gas
Bryan
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promise
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wind
America's
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away
taxpayer
eliminate
turbine
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strategy
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directing
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factories
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chance
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partnership
comprehensive
high-tech
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Web Resources

- www.naturalgas.psu.edu
- www.marcellus.psu.edu
- www.msetc.org
- PA DEP Bureau of Oil and Gas Management

Thank you.