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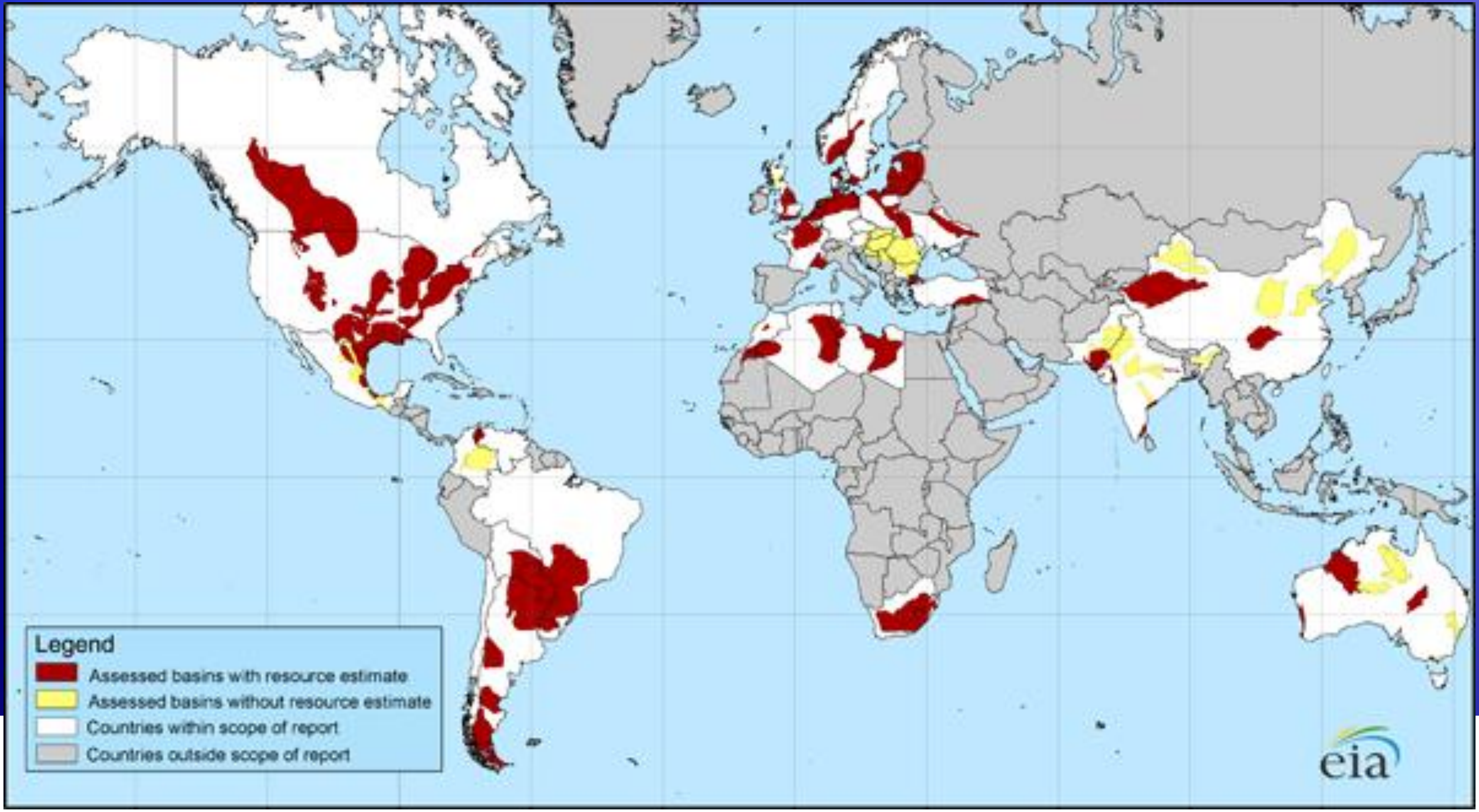
Pennsylvania's Shale Gas Resource: *Current and Future Trends*

Global Shale Gas Reserves

U.S. Department of Energy released a new report on April 5, 2011 that assessed 48 shale gas basins in 32 countries, containing almost 70 shale gas formations around the world.

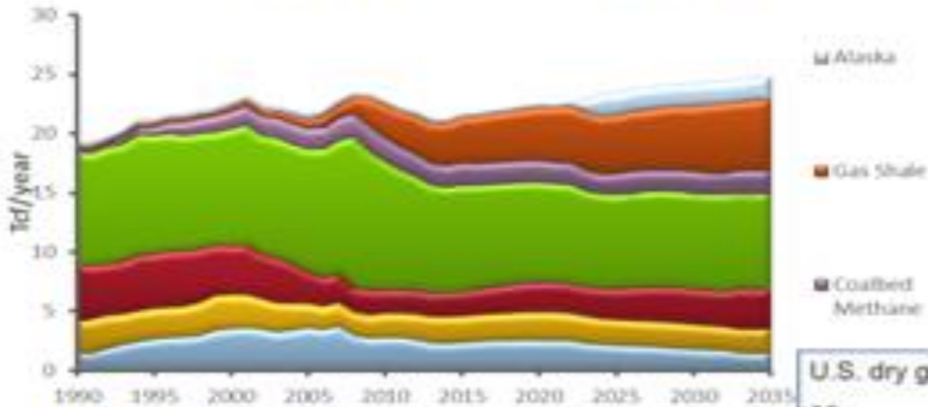
http://www.eia.gov/analysis/studies/worldshalegas/



U.S. Energy Consumption

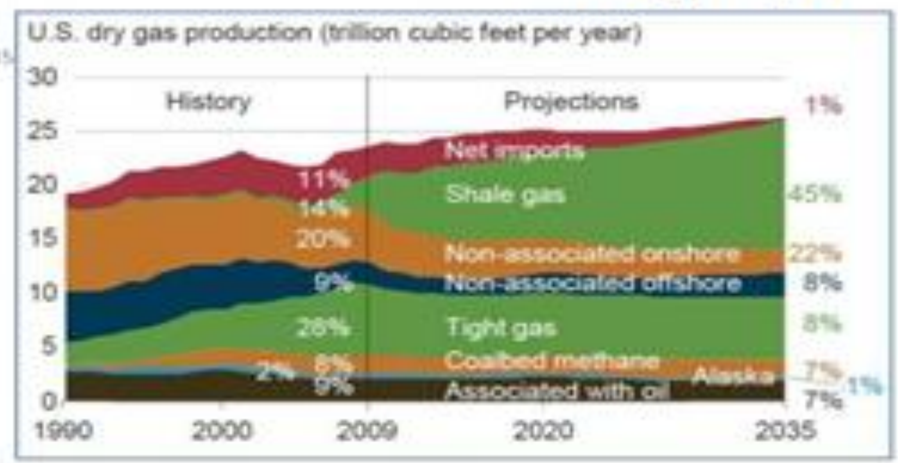
Importance of Shale Gas to the USA

- Natural gas is an important energy source for the United States. Shale formations represent a growing source of natural gas for the nation and are among the busiest oil and gas plays in the country.



U.S. Department of Energy, 12/09

U.S. Department of Energy, 12/10



Coal's future? EPA policy?

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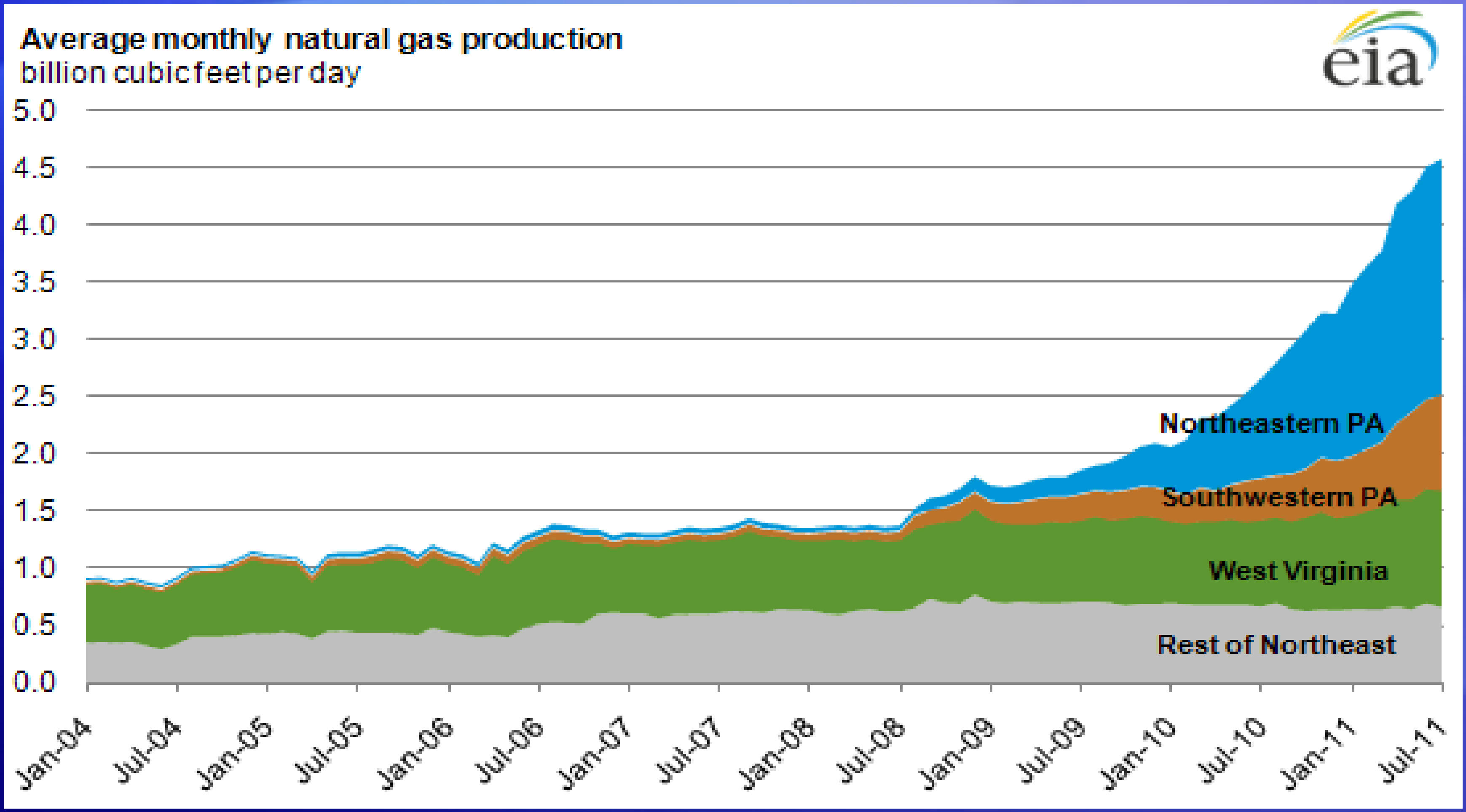
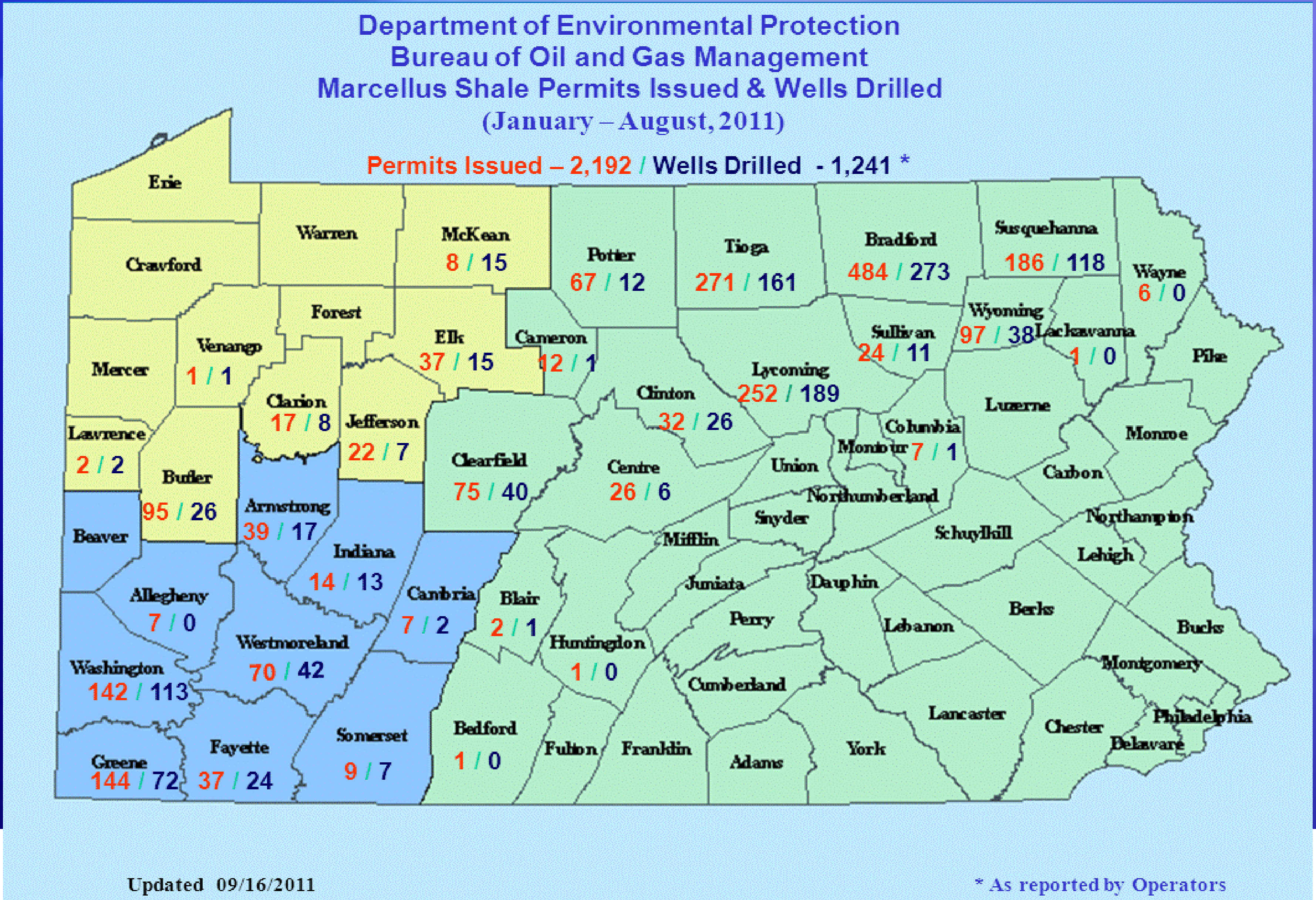


Source: U.S. Energy Information Administration based on Bentek Energy, LLC.
Note: Rest of Northeast includes KY, MD, NY, OH, TN, VA.

2011 Marcellus Permits and Wells Drilled as of 9-16-2011



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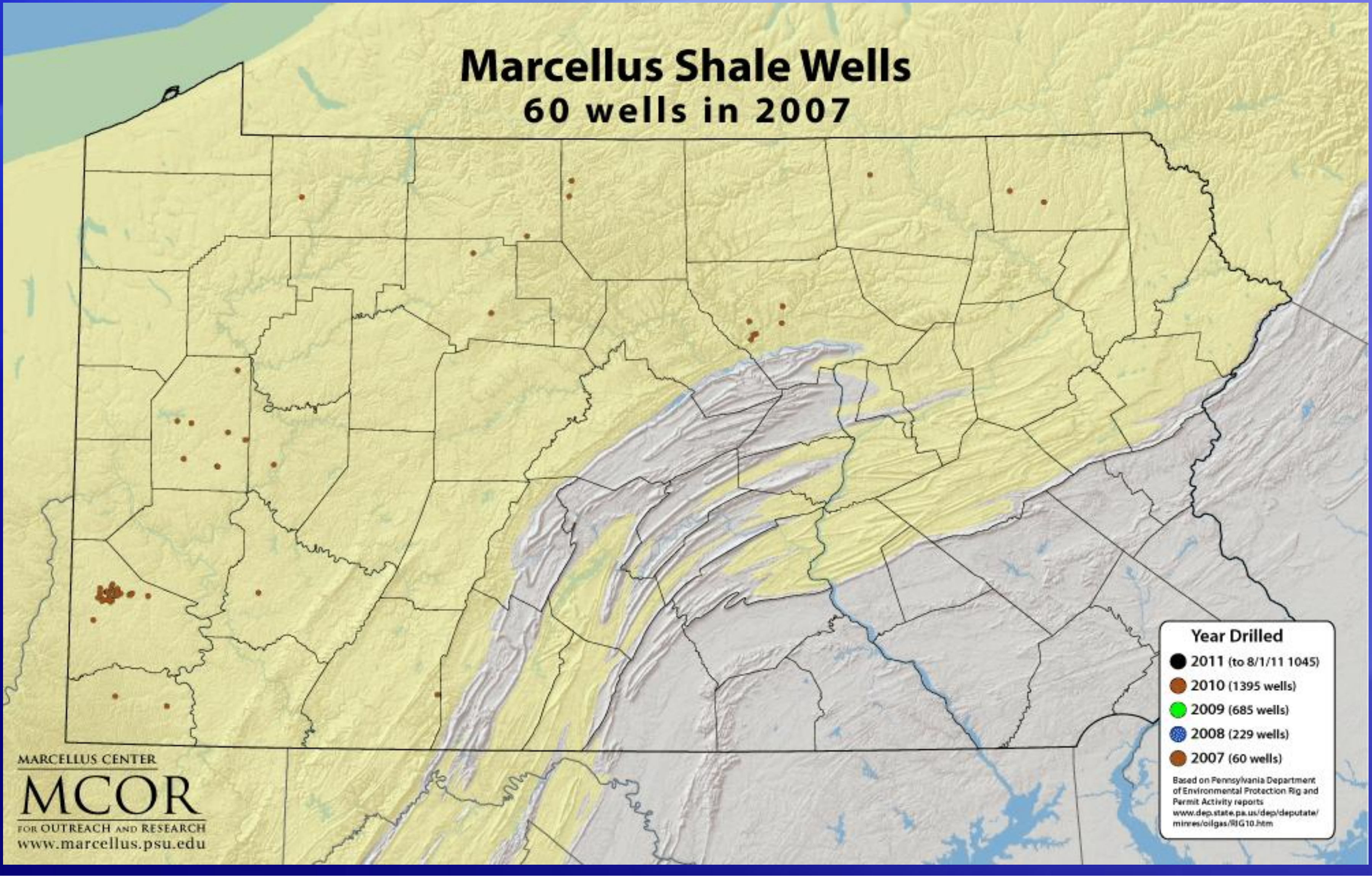
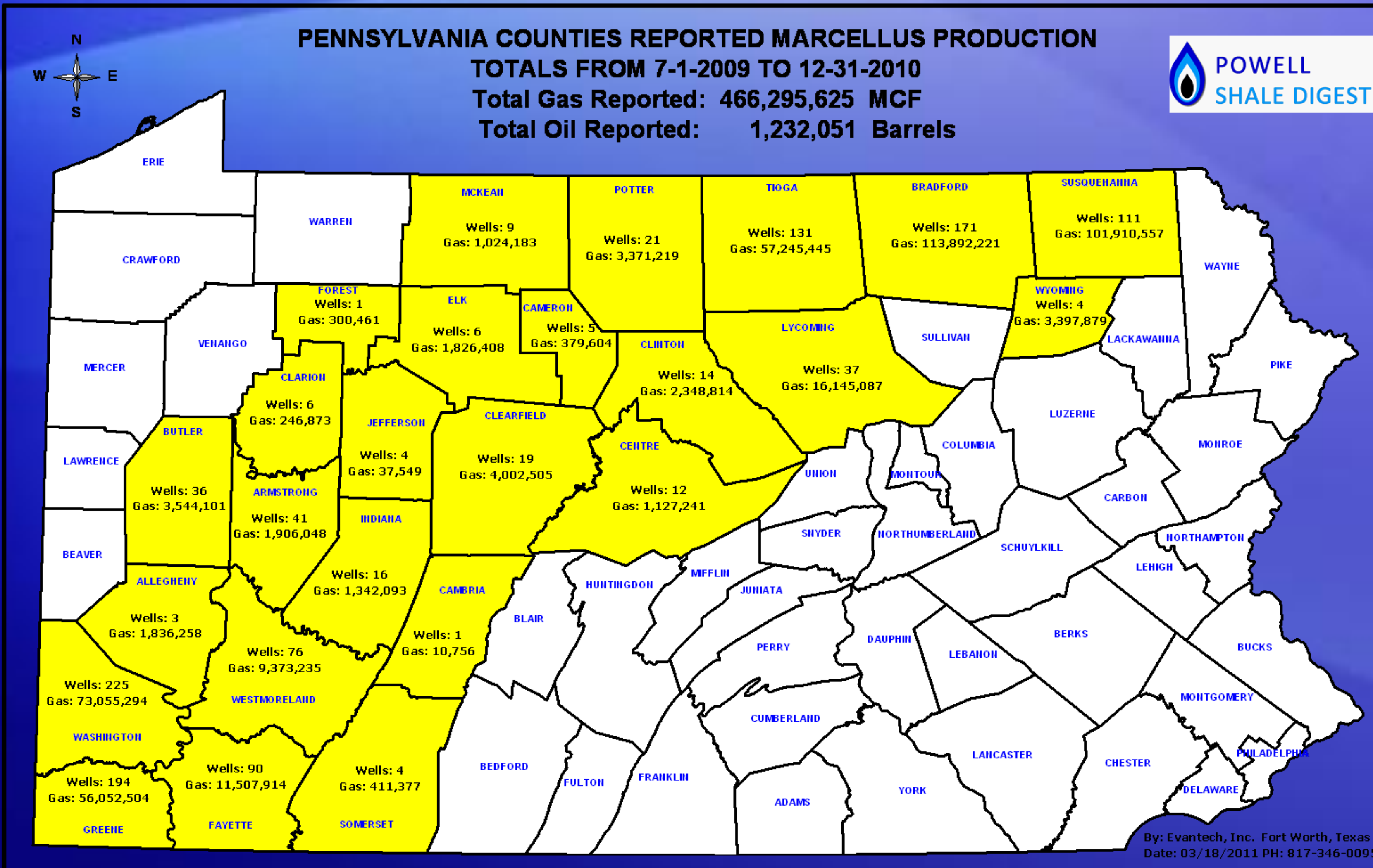
Wells Drilled

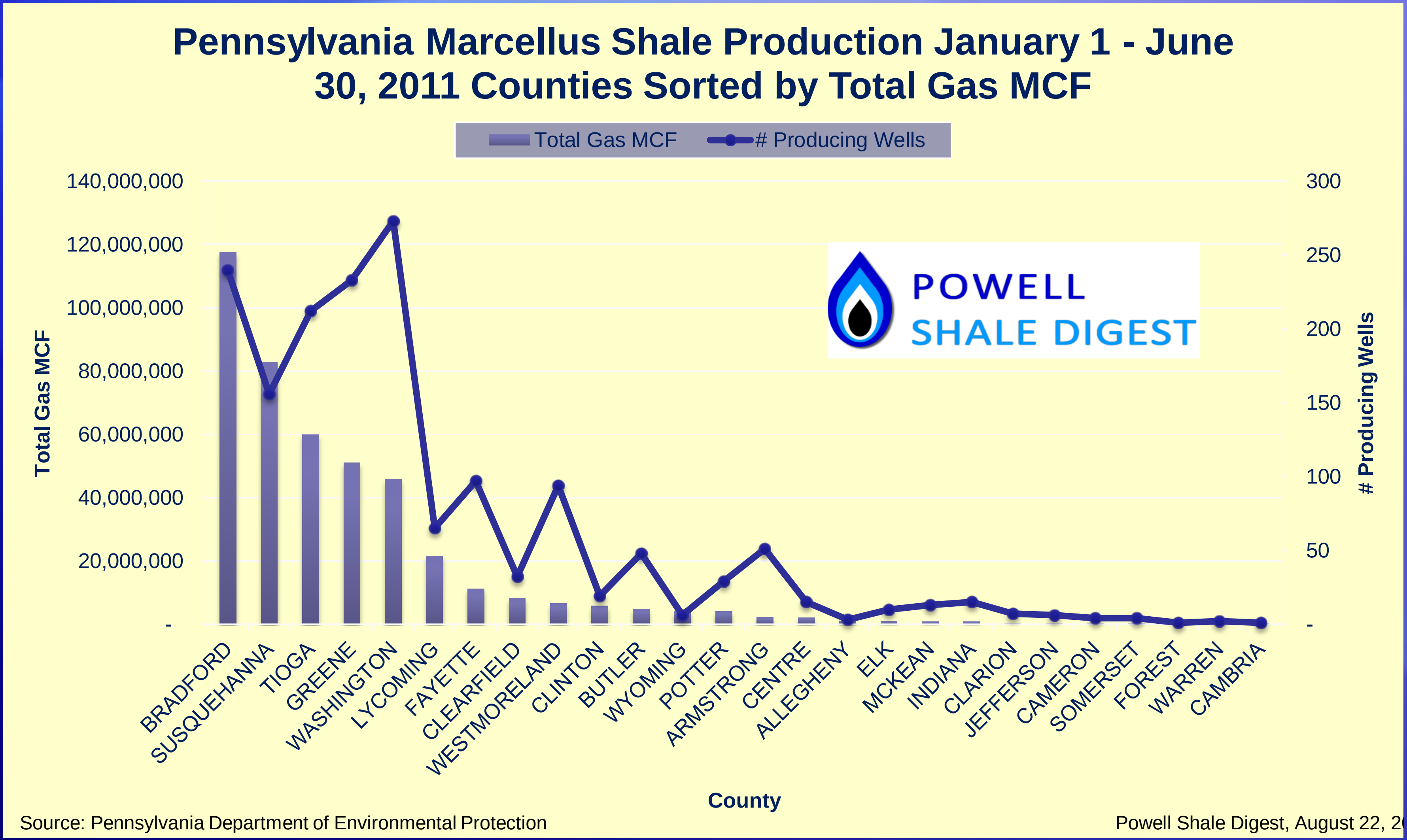


Marcellus Production Data

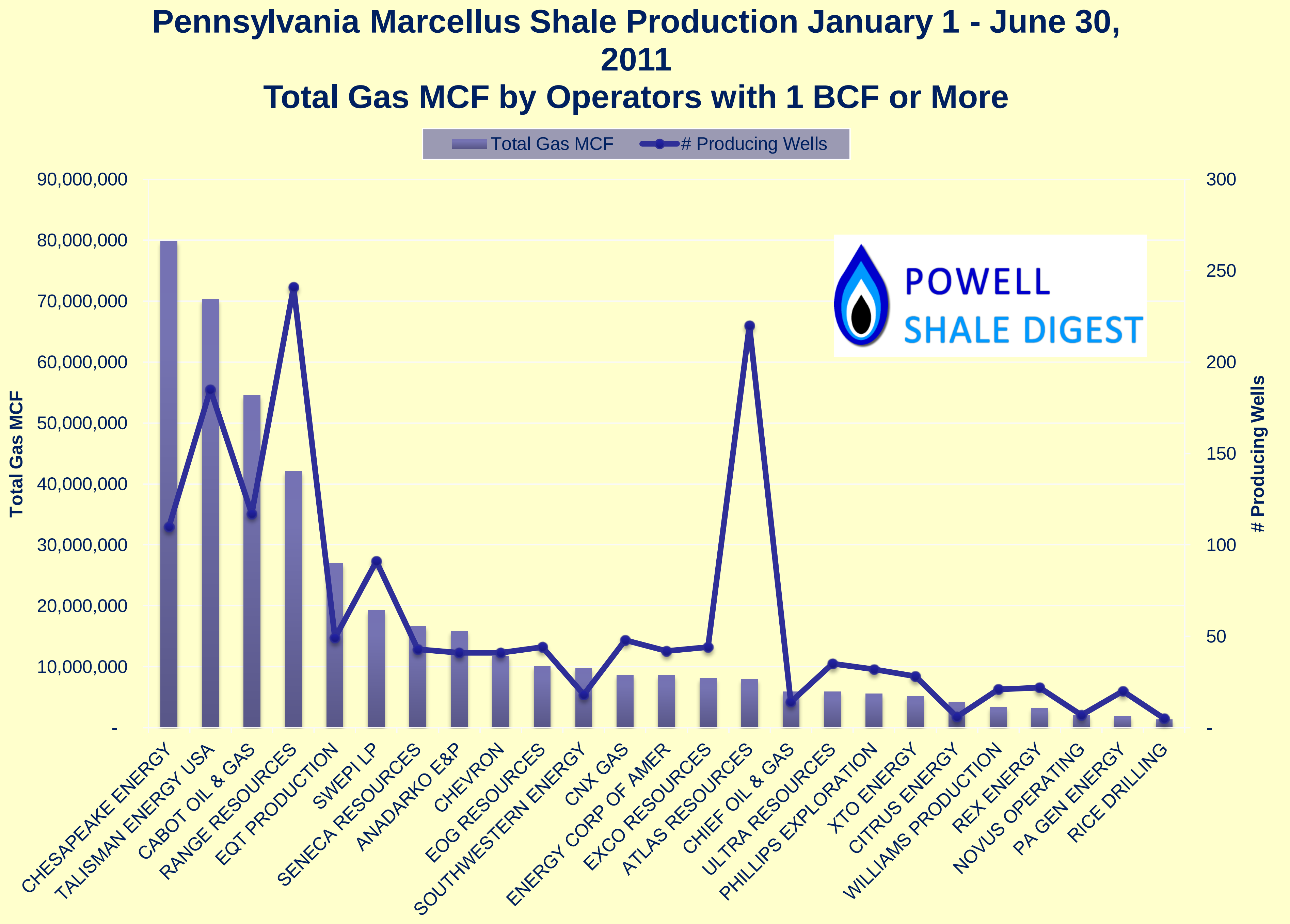


Data Source: DEP

Marcellus Production in PA



Data Source: DEP



Source: Pennsylvania Department of Environmental Protection

Powell Shale Digest, August 22, 2011

Change in Region's Energy Future

Energy consumer to producer/exporter. Value-added??

Utilization—A New Future

PA's public policy for energy?

***what do the "have not's" get in the deal?

Transportation fuels –New initiatives

-$M in new alternative fuel usage-CNG/LNG

- "Marcellus Works" Initiative

-Public/private use

-refueling corridors East/West, North/South

Long Term Economic Impacts?

--Power generation/industrial use

--plastics, paper, steel, glass

Transportation NGV's

Transportation fuels

CNG and hydrogen hybrids and blends

Natural gas used as the hydrogen reformer feedstock

--Ultra low emissions

Gas To Liquids technologies

-synthetic diesel (Shell, Exxon, Sasol)

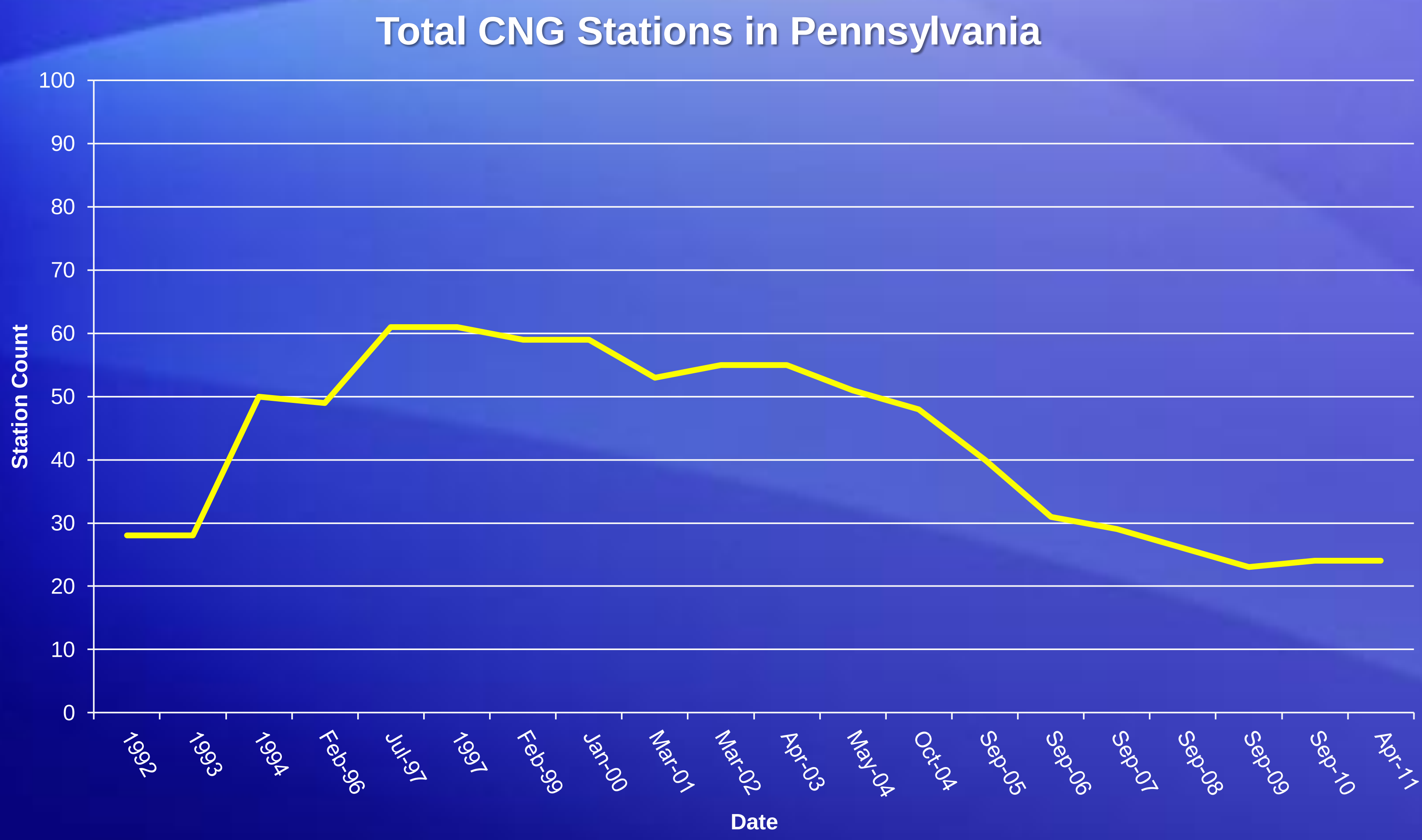
-other more efficient fuel chemistry (DME), Ethanol??

-engine modification and/or redesign

-research initiatives -- Commercialize?

-LNG for long haul trucking

CNG Infrastructure Trends



Source: DOE

LNG Shipments

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

-- Shale dev'l driving reversal?

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

-- Political will --domestically produced energy

-- TX facility –Sabine Pass

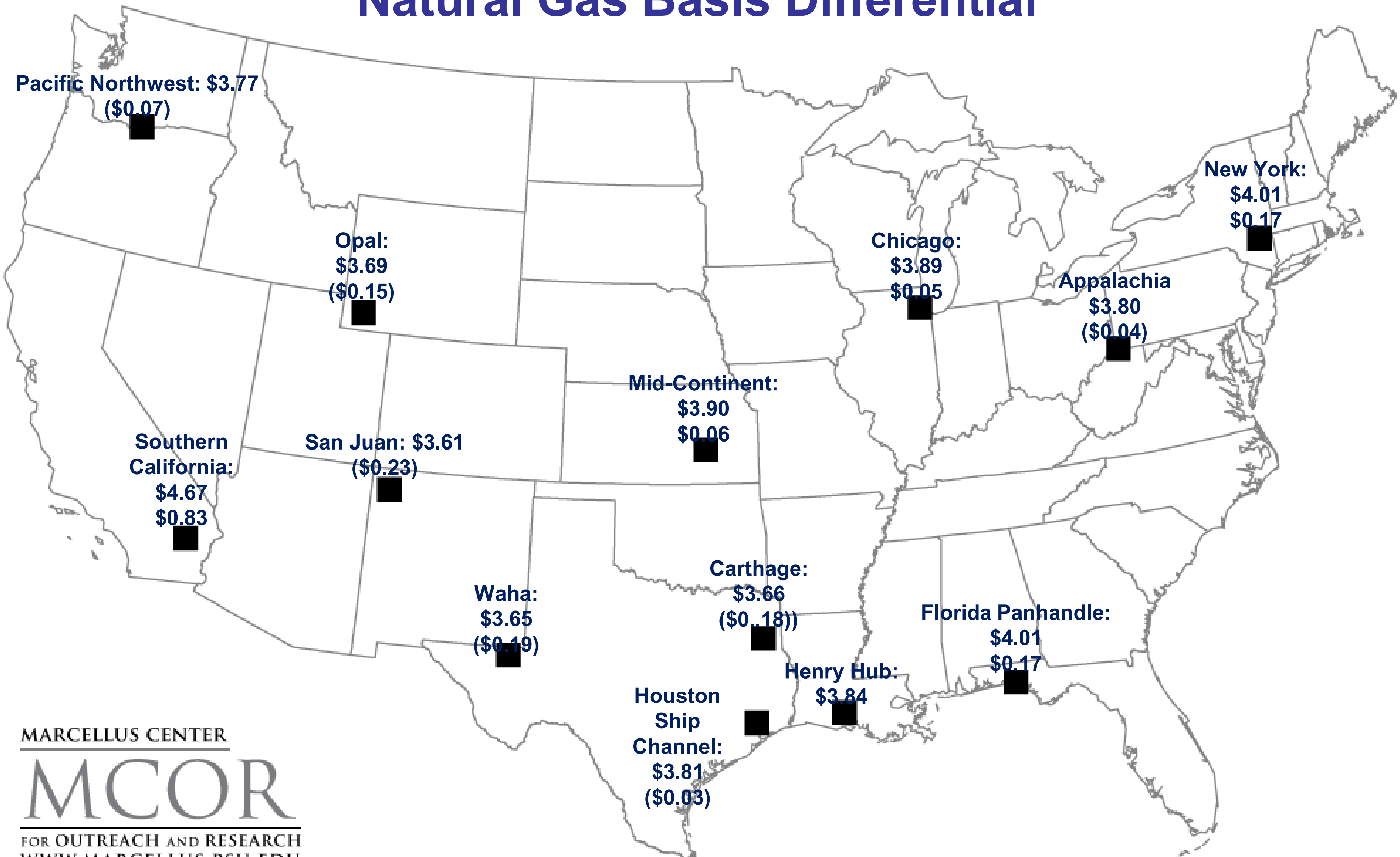
 -2.2 bcf/d

 -2015

 -Cove Point next?

-- Increasing sources for LNG –price stability –Qatar

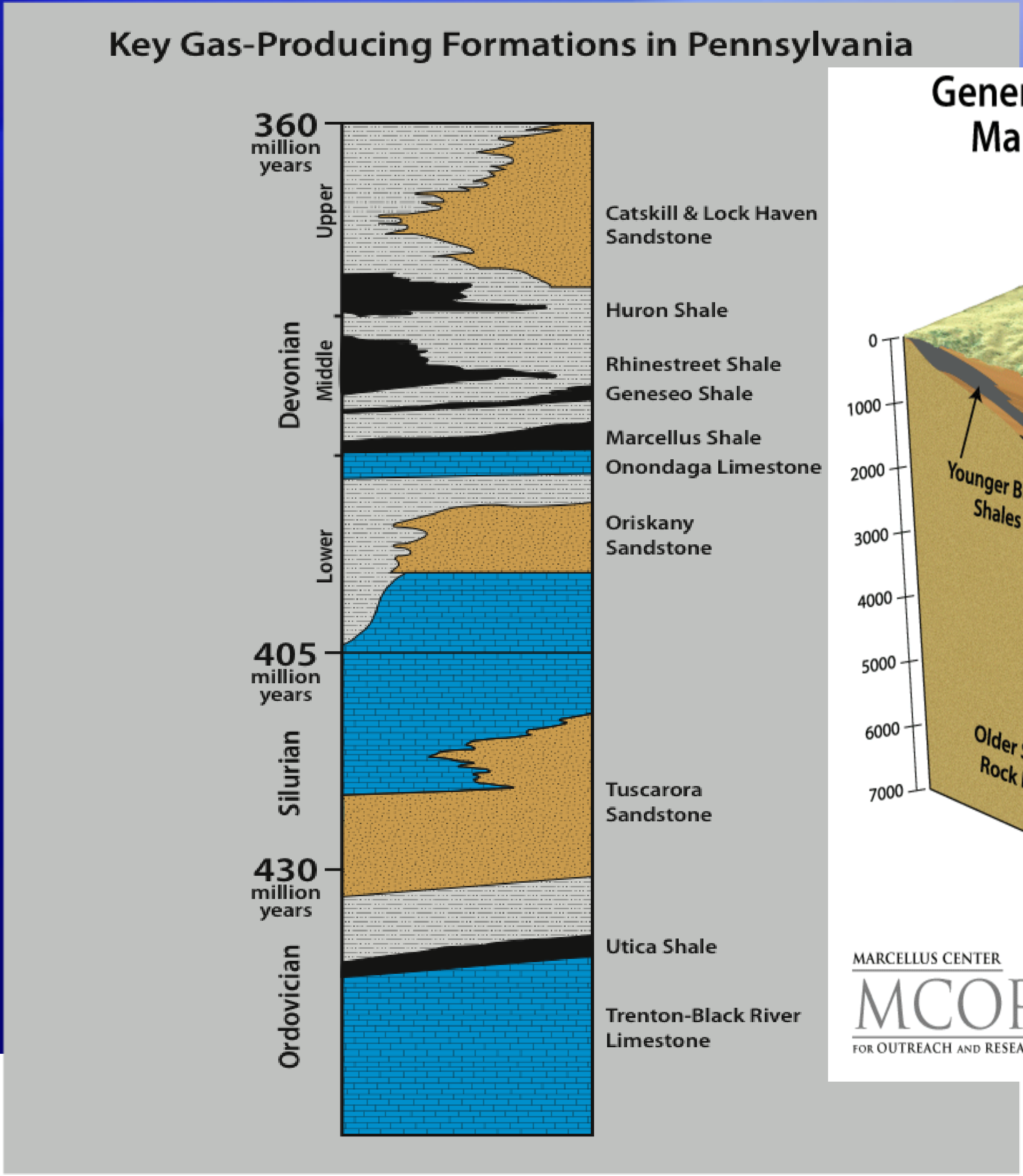
Natural Gas Basis Differential

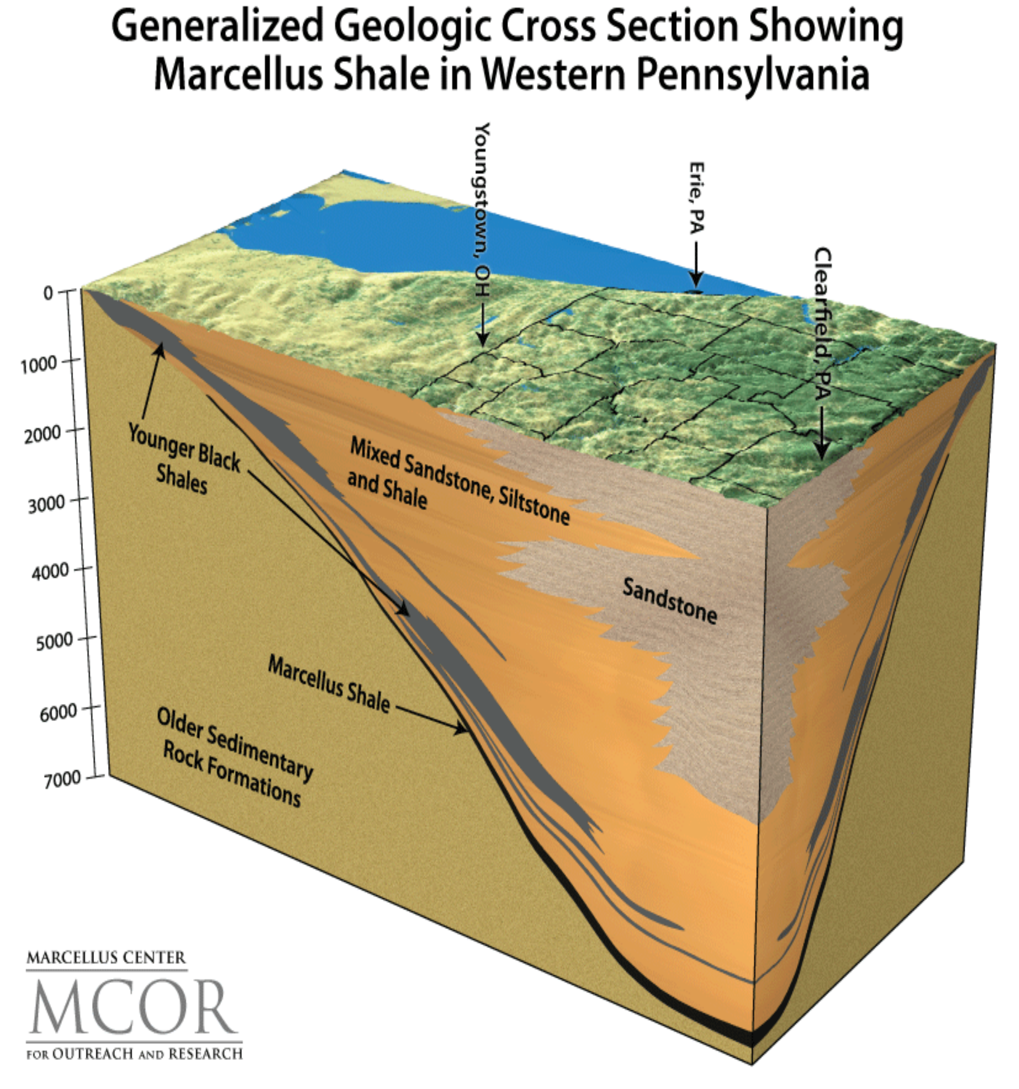


MARCELLUS CENTER
MCOR
FOR OUTREACH AND RESEARCH
WWW.MARCELLUS.PSU.EDU

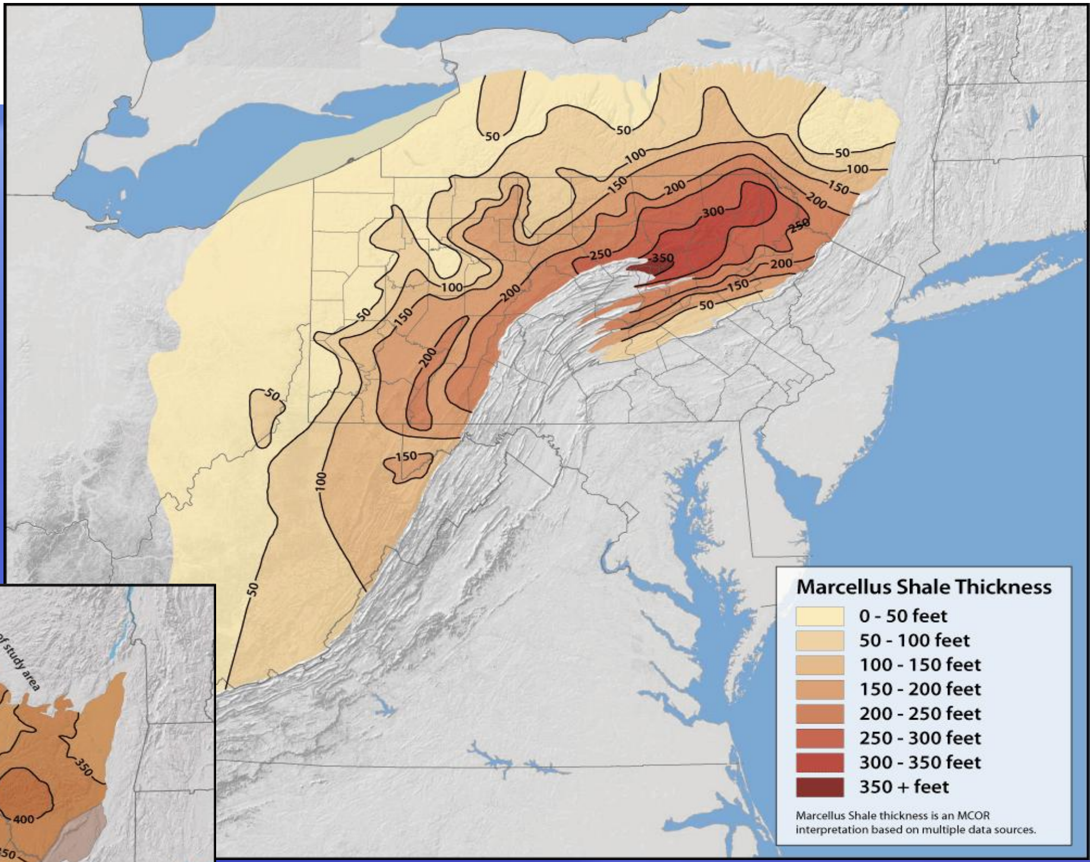
Prices as of: 9/16/11
Source: Bloomberg, Credit Suisse

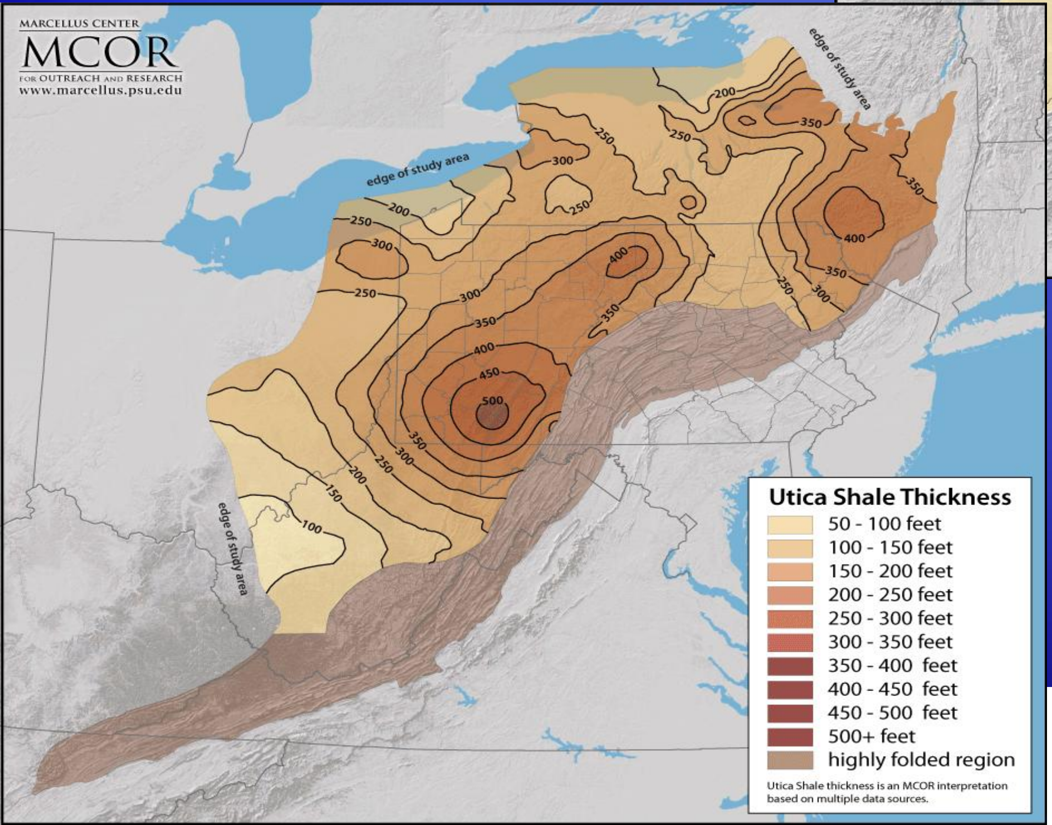
Other Shale Targets (What Else?)





Stacked Plays?





Marcellus vs. Utica/others

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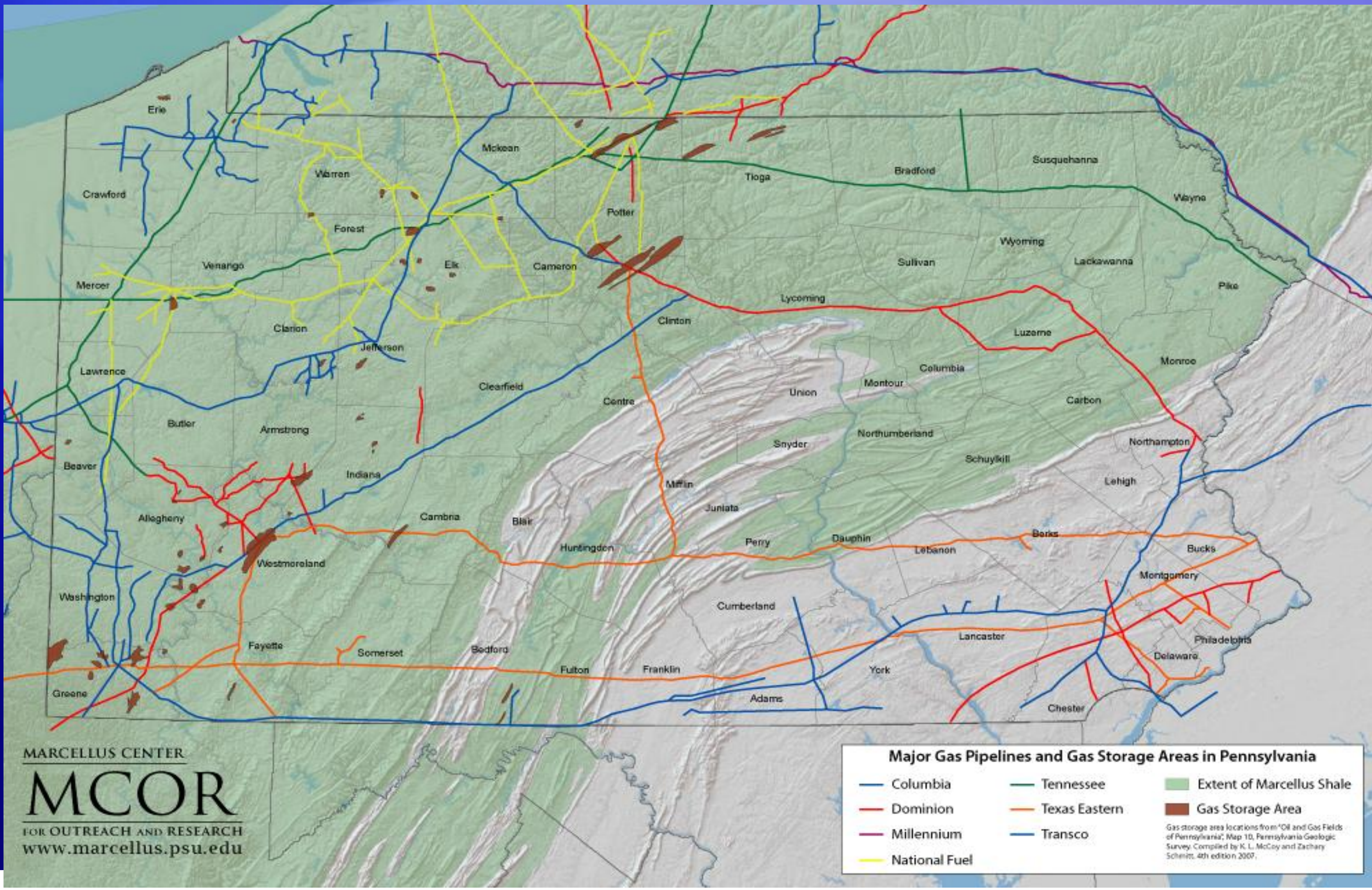
Interstate Pipeline and Storage



Summary of Natural Gas Facilities Impacting the Marcellus Shale Basin

Natural Gas Basin	Status	Company/ Project	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)
Marcellus	In-Service 11/10	Texas Eastern Trans., LP (TEMAX & TIME III projects)	455	62	84,433
Marcellus	In-Service 10/09	Texas Eastern Trans., LP (Northern Bridge Project)	150	0	10,666
Marcellus	In-Service	Columbia Gas Trans., LLC (Appalachian Exp. Proj.)	100	0	9,470
Marcellus	Under Construction	Tenn. Gas Pipeline Co. (Line 300 Expansion)	350	129	59,158
Marcellus	Prior-Notice In-Service	Columbia Gas Trans., LLC (Majorsville Compressor/ MarkWest Upgrade)	250	4	0
Marcellus	Prior-Notice In-Service	Columbia Gas Trans., LLC	150	6	0
Marcellus	Prior-Notice In-Service	Equitrans, LP (Low Pressure East and West Upgrade Project)	92	0	0
Marcellus	Under Construction	Dominion Trans., Inc. (Appalachian Gateway Project)	484	107	17,965
Marcellus	Pending	Central NY Oil and Gas Co. (MARC I Project)	550	39	31,660
Marcellus	Under Construction	National Fuel Gas Supply Corporation (Line N R & I Project)	150	20	4,740
Marcellus	Pre-Filing	National Fuel Gas Supply Corporation (E-W / Overbeck to Leidy)	425	82	25,000
Marcellus	Pending	Texas Eastern Trans. & Algonquin Gas Trans. (NJ-NY Project)	800	20	0
Marcellus	Under Construction	Equitrans, LP (Sunrise Project)	314	47	14,205
Marcellus	Pending	Texas Eastern Trans., LLC (TEAM 2012 Project)	200	16	20,720
Marcellus	Pending	Tenn. Gas Pipeline Co. (Northeast Upgrade Proj.)	636	40	22,310
Marcellus	Approved	Tenn. Gas Pipeline Co. (Northeast Supply Diversification Project)	250	7	0
Marcellus	Approved	Dominion Trans., Inc. (Ellisburg to Craig Project)	150	0	10,800
Marcellus	Approved	Dominion Trans., Inc. (Northeast Expansion Project)	200	0	32,440
Marcellus	Pre-Filing	Transco (Northeast Supply Link)	250	39	36,000
Marcellus	Pending	National Fuel Gas Supply Corporation (Northern Access Project)	320	0	14,210
Marcellus	Pending	Tennessee Gas Pipeline Company (Station 230C Project)	0	0	12,260
Marcellus	Pending	National Fuel Gas Supply Corporation (Line N 2012 Expansion Project)	150	5	20,620
Marcellus	Under Construction	Empire Pipeline, Inc (Tioga County Extension)	350	16	0
Total			6,776	640	426,657

Natural Gas Basin	Status	Company/ Project	Capacity (MMcf/d)	Miles of Pipe	Compression (HP)
Marcellus	Potential	Nisource (New Penn)	500	82	
Marcellus	Potential	TETCO (Appalachia to Market Expansion- TEAM)	500		
Marcellus	Potential	Dominion/Williams (Keystone Connector)	1,000	240	
Marcellus	Potential	Williams (Northeast Supply)	688	250	
Marcellus	Potential	NFG (West to East Connector)	625	324	
Marcellus	Potential	Iroquois Gas Transmission System LP (NYMarc System Project)	500	66	
Marcellus	Potential	Millennium Pipeline (Marcellus to Manhattan)	675	0	
Marcellus	Potential	NiSource Gas Transmission and Storage & UGI Corporation	500	0	
Total			4,988	962	0

Source: FERC

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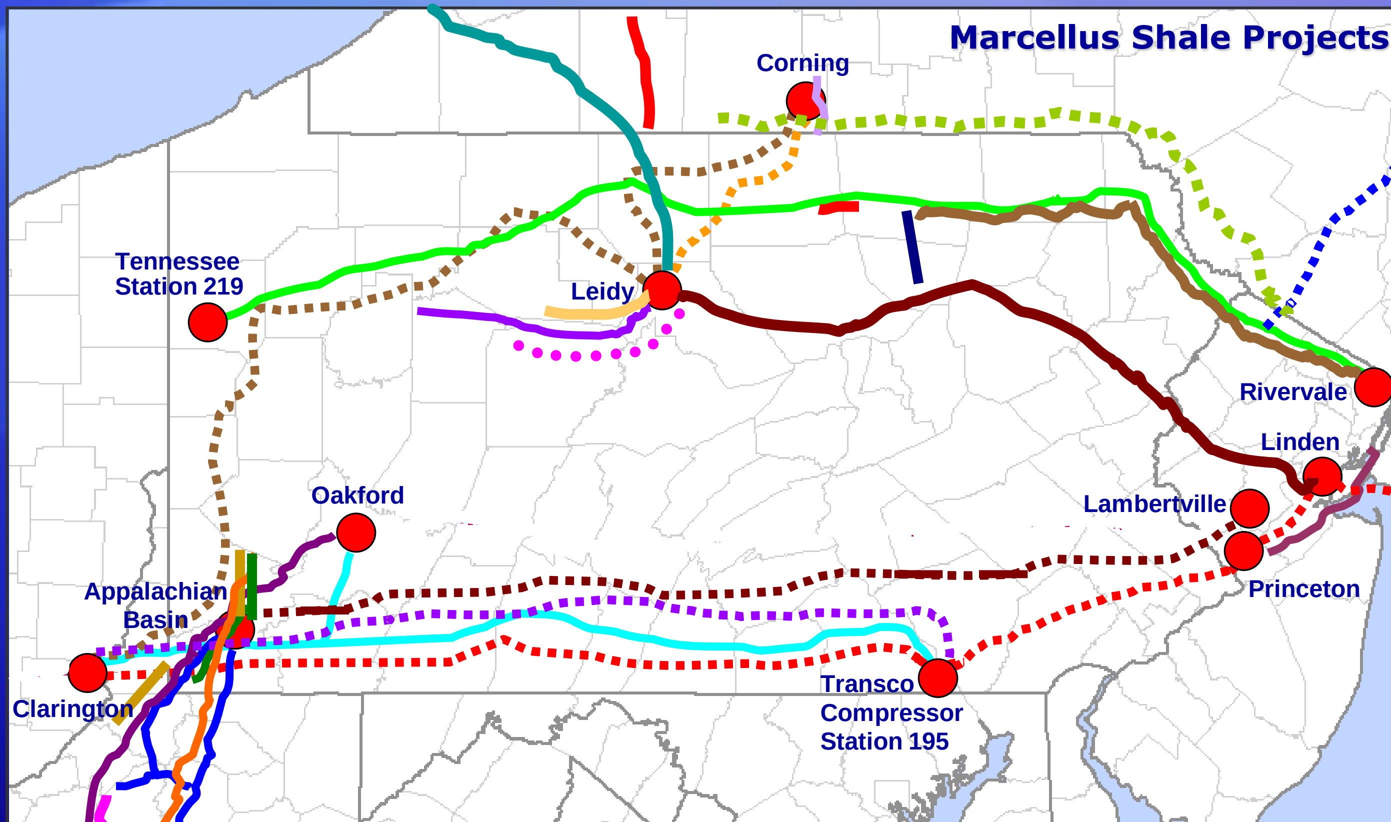
Marcellus Shale Projects



Approved or Pending Projects

- Appalachian Expansion (NiSource)
- Line 300 Exp (Tennessee)
- NiSource/MarkWest & NiSource
- N Bridge, TIME 3, TEMAX (TETCO)
- Appalachian Gateway (Dominion)
- Line N & N, R & I Projects (NFG)
- Tioga County Extension (Empire)
- NSD Project (Tennessee) & Ellisburg to Craigs (Dominion)
- Northern Access & Station 230C (NFG & Tennessee)
- Sunrise Project (Equitrans)
- TEAM 2012 Project (TETCO)
- Northeast Upgrade (Tennessee)
- Marc I (Central NY)
- Low Pressure East-West (Equitrans)
- East-West - Overbeck to Leidy (NFG)
- NJ-NY Project (TETCO & Algonquin)
- Northeast Expansion (Dominion)
- Northeast Supply Link (Transco)

Potential Projects

- NYMarc (Iroquois)
- New Penn (NiSource)
- Marcellus to Manhattan (Millennium)
- Appalachia to Market Expansion & TEAM 2013 (TETCO)
- Keystone (Dominion/Williams)
- West to East Connector (NFG)
- NiSource & UGI
- Northeast Supply (Williams)*

* Combined Transco's Rockaway Lateral and Northeast Connector Projects

Source: FERC

Impacts on Business/Communities

Local businesses

-New business ventures

--ex: 75 to 100 new in Wmspt area

--7th ranked in nation

-New business models

-Satellite offices

-Brownfields development

-Hotels/airports

-Job migration

Local Communities

-Road and traffic impacts

--costs/agreements

--reconstruction

--industry spent est. $200M in ‘10

-emergency response

-human services

-water and sewer infrastructure

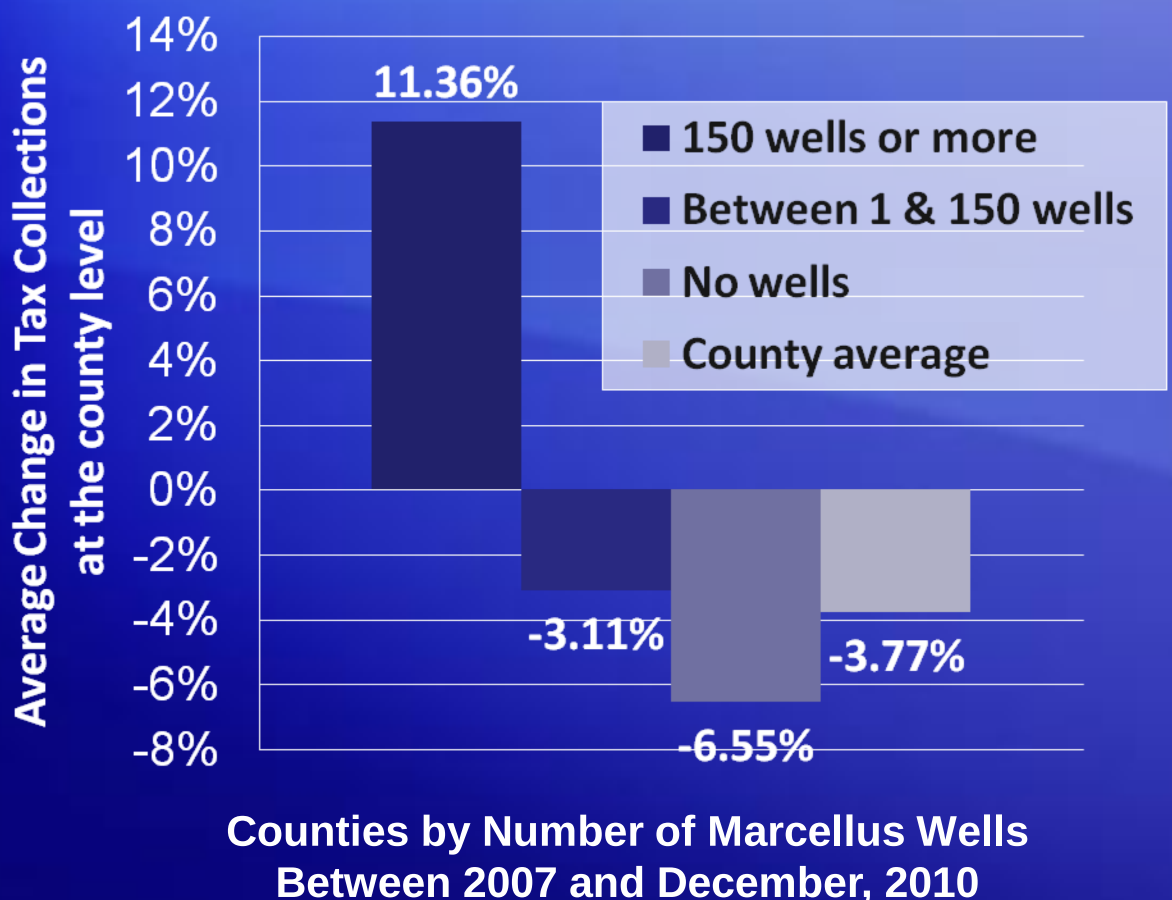
-landfill utilization

-workforce

-current research to determine impacts

Change in State Sales Tax Collections, by County Level Marcellus Drilling Activity

July, 2007- June, 2010



Sales tax dollars go to the state - none remains at the local level (except in a few urban counties)

Counties with more than 150 wells since 2007 include:

- Bradford (482 wells)
- Tioga (387 wells)
- Washington (305 wells)
- Greene (179 wells)
- Susquehanna (174 wells)

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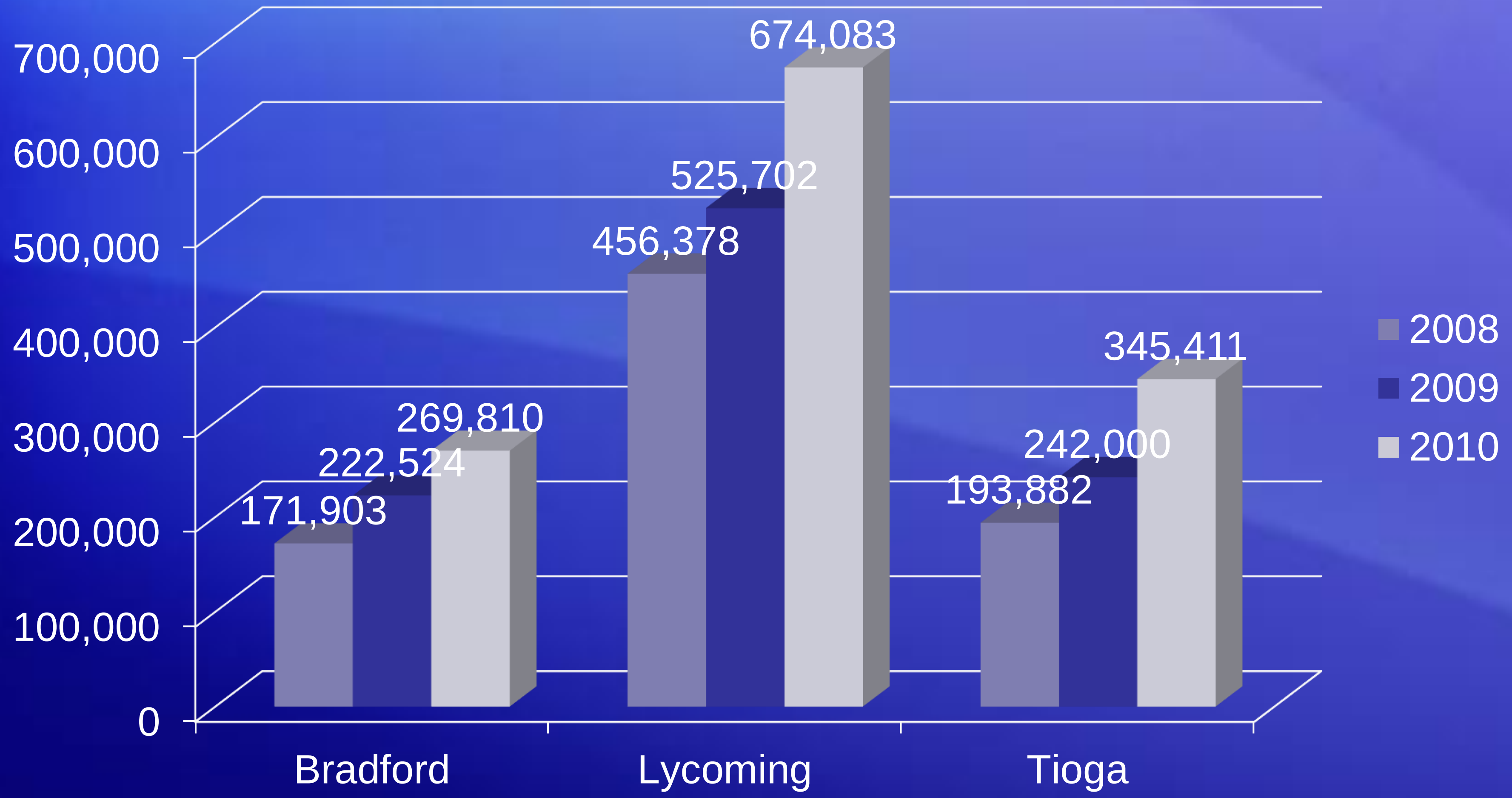
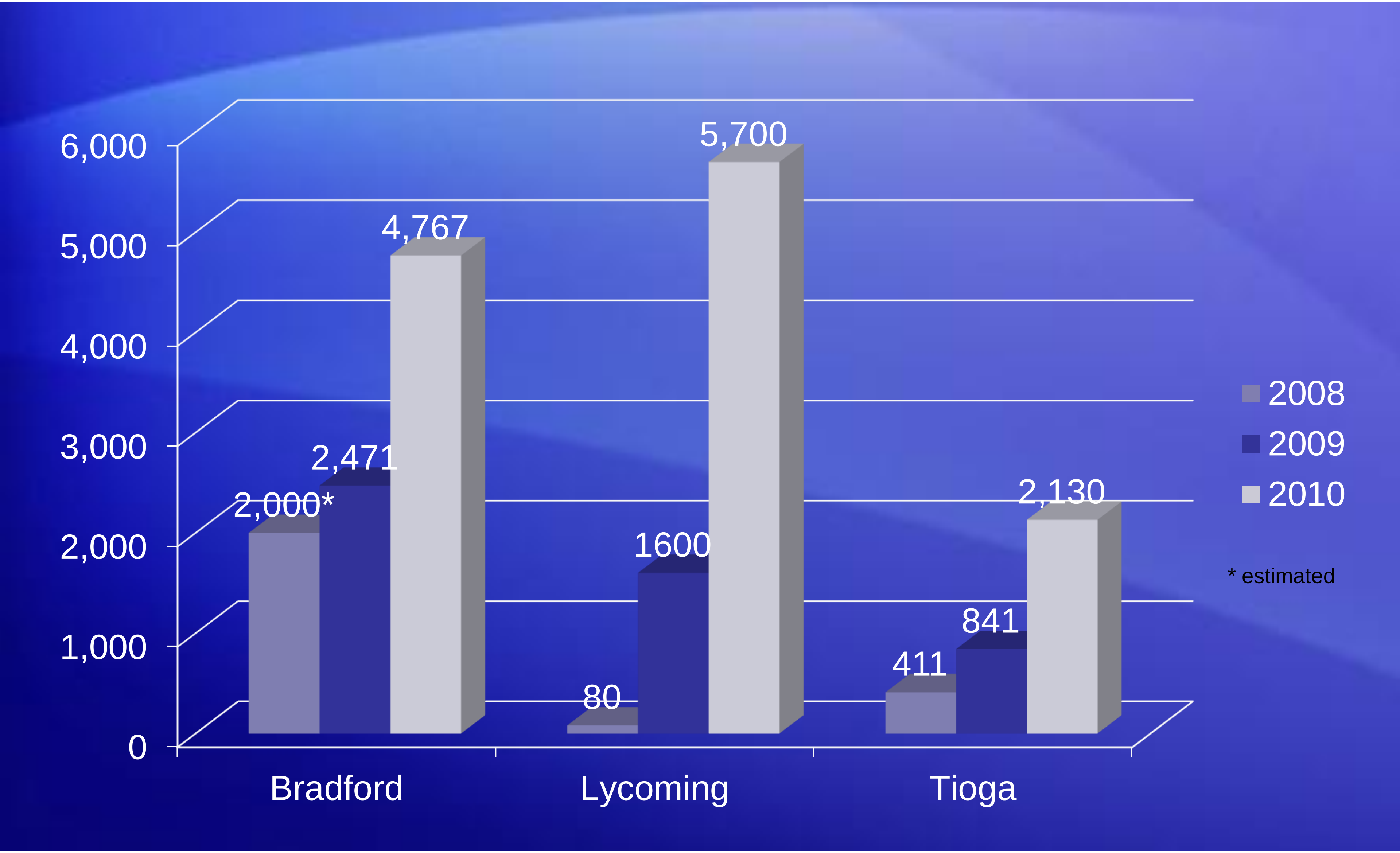
Source: PA Department of Revenue 'Statistical Supplements for the Tax Compendium

Hotel Taxes Collected



Source: Norfolk Southern Railroad

Rail Car Traffic



One railcar equals 4 truck loads

Airport Traffic

Williamsport Regional Airport

--7% increase in passengers from 2008 to 2009

--14% increase in passengers from 2009 to 2010

--24 % increase in passengers in last 6 months of 2010

In first two months of 2011, a 27.7% increase in passengers vs. the same period of 2010

On the corporate side, saw a 60% increase in corporate traffic from 2009 to 2010

Additional 72% increase in aircraft that weigh 35,000 lb or more from 2009 to 2010 (includes regional jet types)

Airport surveys indicate 32 % of the people are gas related.

Current airline went from 35 seat to 50-seat aircraft recently.

Second airline with connection to TX currently proposed.

Impacts of Marcellus on Pennsylvania Local Governments

	Change in Services	Change in Costs	Change in Revenues
Increased	28% (35)	26% (33)	18% (24)
Decreased	4% (5)	1% (1)	1% (1)
No Change	67% (84)	70% (89)	75% (97)
Don’t Know	2% (2)		6% (8)

Source: Survey of 494 PA municipal governments, fall, 2010
59% response rate (293). 131 reported having Marcellus activity
Kelsey, Ward et al.

Impact on Municipalities and Communities

	Percent Selecting Response (Number Selecting Response)		
Area	Increased	Decreased	No Change
Population	25% (31)	2% (2)	73% (91)
Road Maintenance	58% (73)	2% (2)	40% (50)
Road Construction	24% (29)	1% (1)	75% (90)
Tourism	7% (8)	4% (5)	89% (109)
School Enrollment	19% (23)	2% (1)	79% (96)
Property Values	38% (47)	7% (9)	55% (68)
Crime	15% (19)	0 (0)	77% (94)
Use of Emergency Services (Fire, Ambulance, etc)	23% (28)	0 (0)	77% (94)
Community Conflict	31% (37)	0 (0)	69% (82)

Source: Survey of 494 PA municipal governments, fall, 2010
59% response rate (293). 131 reported having Marcellus activity
Kelsey, Ward et al.

Impact on Environment, as reported by Municipal Governments Experiencing Marcellus Shale Activity

	Percent Selecting Response (Number Selecting Response)		
Area	Increased	Decreased	No Change
Water Use/Disposal	48% (58)	0 (0)	52% (64)
Water Quality	2% (2)	18% (22)	80% (96)
Air Quality	2% (2)	12% (15)	86% (105)
Storm Water Runoff	20% (25)	2% (2)	78% (97)
Other Environmental Issues	13% (10)	0 (0)	88% (70)

Source: Survey of 494 PA municipal governments, fall, 2010
59% response rate (293). 131 reported having Marcellus activity
Kelsey, Ward et al.

Impacts on Local Governments

Jacobson and Kelsey, 2011

Analysis of municipal audit data in Washington and Susquehanna counties

Key informant interviews with local officials in both counties, and with gas industry representatives

Report to be released in late July

Findings:

Many impacts so far on local governments have been non-monetary (e.g. time required of elected officials), or they have internally shifted resources

The data and interviews showed they are receiving little if any new tax revenues due to the activity

Major road repair costs are being paid by the gas companies, not taxpayers

The impacts likely will change over time, with potential new services being required

2010 Survey of Businesses
Bradford and Washington Counties

Bradford County

- Most active Marcellus drilling county
- 60,384 residents in 2009
- 1,345 businesses

Washington County

- Third most active Marcellus drilling county
- 200,505 residents in 2009
- 5,082 businesses

Source: Ward & Kelsey, PSU 2011

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2010 Survey of Businesses
Bradford and Washington Counties

Survey to 1,000 businesses in each county

- All tourist-related businesses
- Plus random selection

Responses from 619 (response rate of 31%)

Conducted by Marcellus Shale Education & Training Center (Penn State Cooperative Extension & Penn College)

Funded by PA Dept of Community & Economic Development

Source: Ward & Kelsey, PSU 2011

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Impacts on Businesses, 2010
Bradford & Washington Counties

	Percent responding 'Yes'		
Because of natural gas drilling…	All Responses	Bradford County	Washington County
Have your business activities changed?	17%	22%	9%
Have your annual sales increased?	28%	32%	23%
Have your annual sales decreased?	3%	3%	2%
Has the number of regular non-gas customers increased?	7%	10%	3%
Has the number of regular non-gas customers decreased?	3%	3%	2%

Source: Ward & Kelsey, PSU 2011

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Effects on Worker Retention & Hiring
Bradford & Washington Counties

	Percent responding 'Yes'		
Has Natural Gas Drilling…	All Responses	Bradford County	Washington County
Affected the ability of your business to find and hire qualified employees?			
Somewhat easier to find	0.4%	1%	-
Somewhat more difficult to find	5%	7%	1%
Much more difficult to find	4%	6%	1%
Affected your ability to retain your workforce?			
Turnover has increased	5%	9%	1%
Turnover has decreased	0.4%	0.3%	0.5%

Source: Ward & Kelsey, PSU 2011

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Impacts by Type of Businesses, 2010
Bradford & Washington Counties

	Percent responding 'Yes'			
	Business Activities Changed?		Annual Sales Increased?	
	Bradford	Wash.	Bradford	Wash.
Construction	35%	16%	27%	15%
Wholesale Trade	28%	20%	33%	50%
Retail Trade	25%	8%	44%	28%
Financial, Insurance, Real Estate	28%	10%	50%	40%
Business Services	20%	6%	33%	16%
Eating & Drinking Places	29%	0%	38%	33%
Hotels & Campgrounds	80%	50%	100%	50%

Source: Ward & Kelsey, PSU 2011

Analysis of changes in market and assessed values, by level of drilling activity

Milchak and Kelsey, forthcoming 2011

Analysis of State Tax Equalization Board data

Report to be released later this year

Findings:

At Municipal level: Market values generally have increased more in municipalities with much gas activity than in other municipalities. Assessed values in general also are up more in municipalities with gas activity, but the pattern isn't clear cut.

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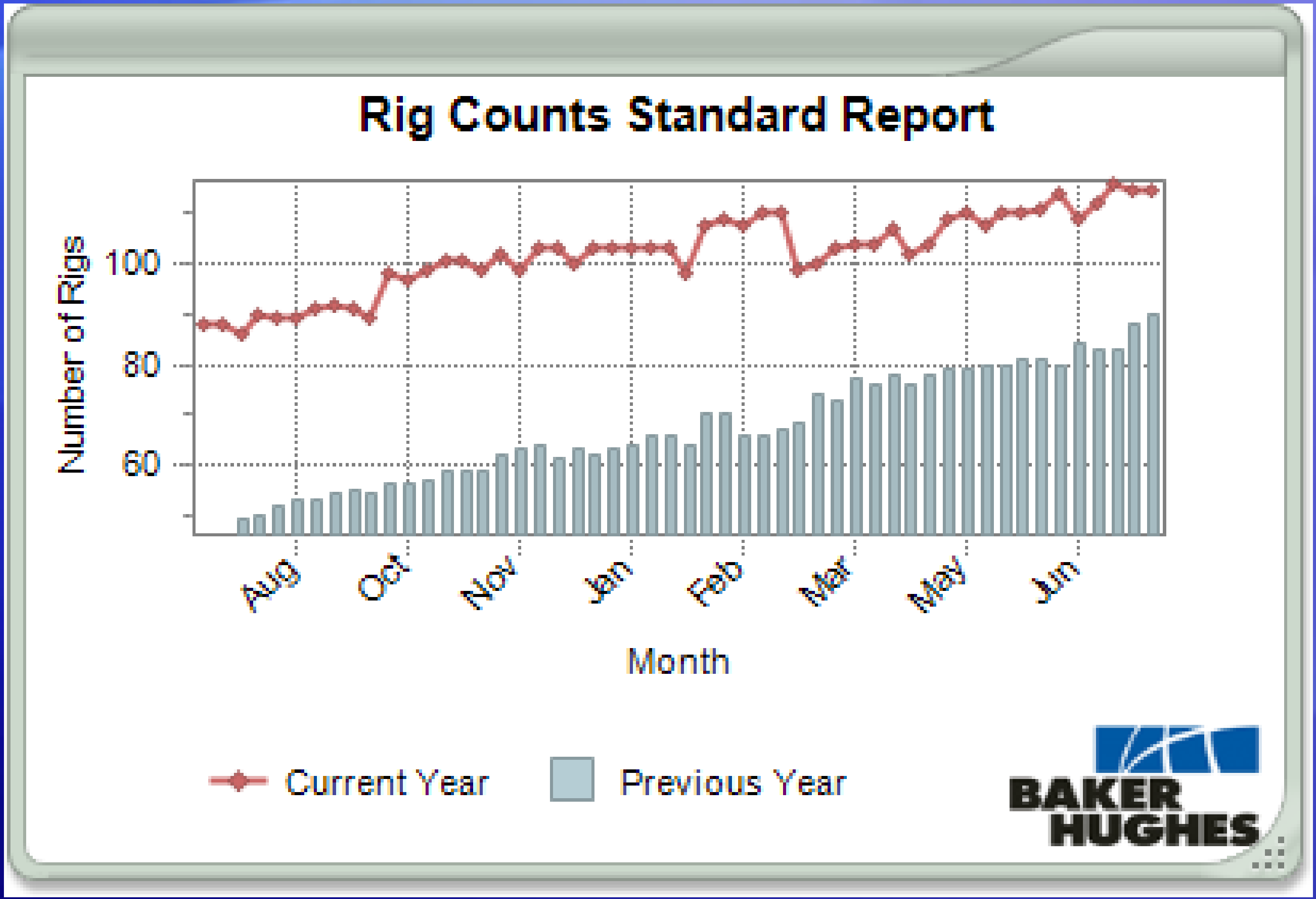
PA Unemployment Trends

COUNTY	FEBRUARY 2010	FEBRUARY 2011
Bradford	7.2%	5.1%
Sullivan	7.6%	6.8%
Susquehanna	9.7%	6.9%
Tioga	8.3%	6.1%
Wyoming	7.8%	9.4%
Pennsylvania	8.9%	8.0%

Source: NTRPDC

Pennsylvania Rig Count as of July 15, 2011

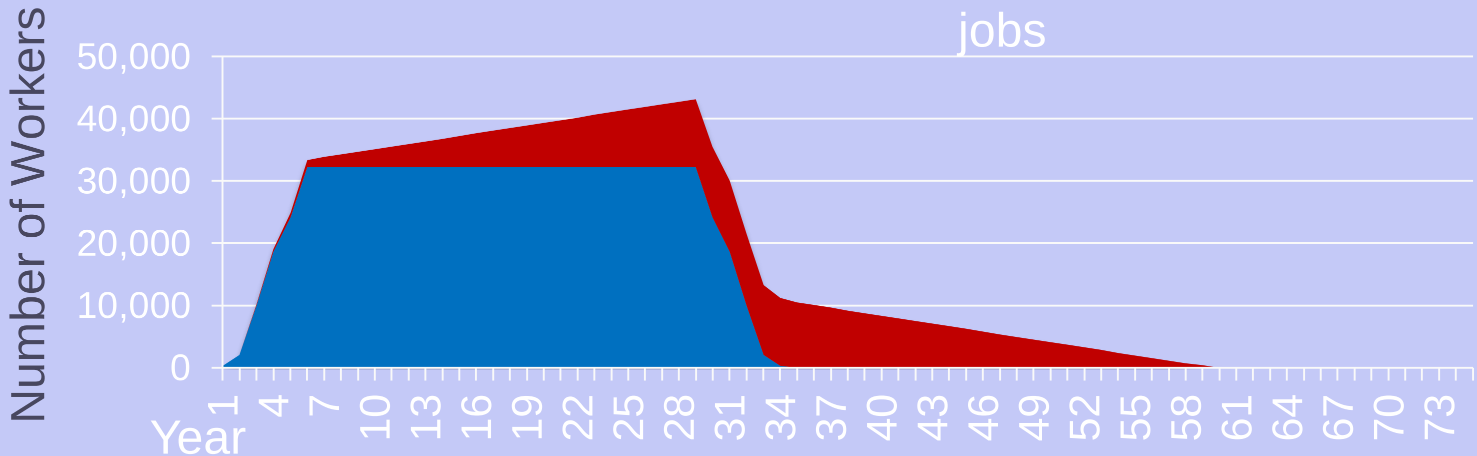


115 vs. 90 on July 16, 2010

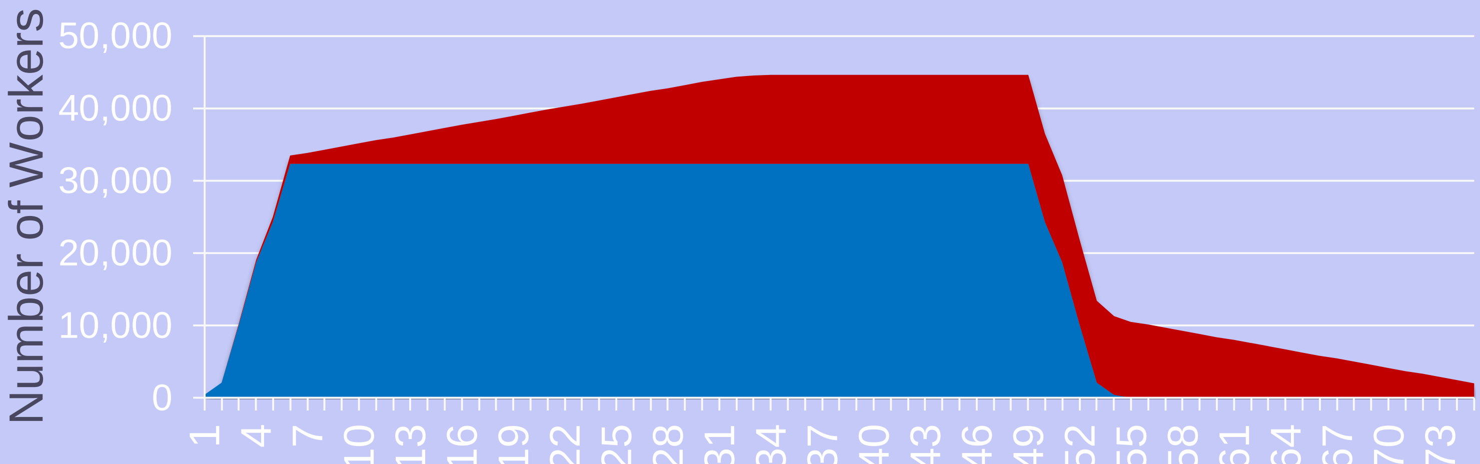
Pennsylvania Estimated Direct Workforce, by Phase

= Development phase jobs = Production phase jobs

If 30 years of active drilling…



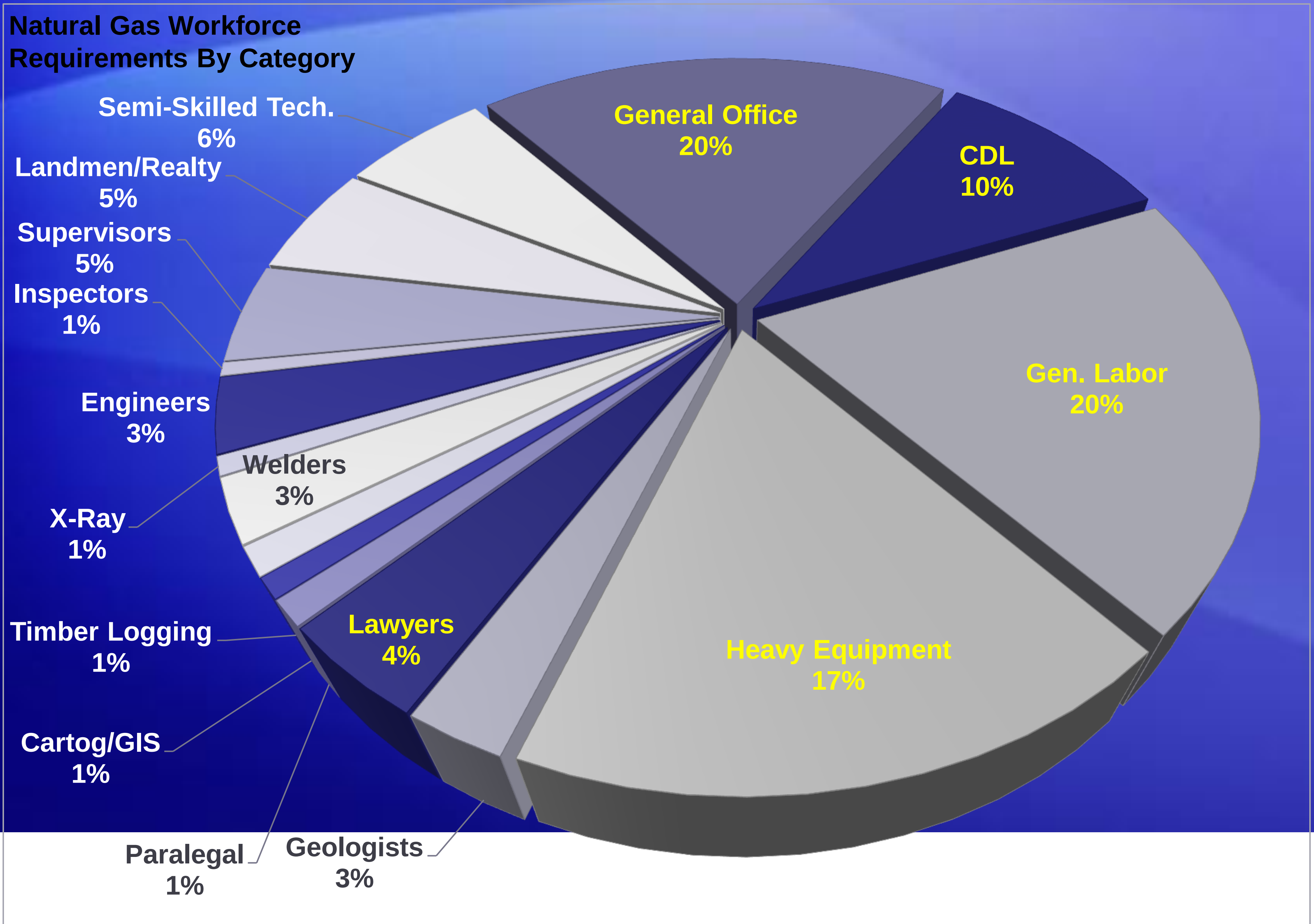
If 50 years of active drilling…



Assumes 30 year active life per well
2,500 wells drilled /year pace
Labor requirements based upon MSETC per well workforce estimates
Source: Tim Kelsey PSU

www.msetc.org

What specific direct jobs are required?



Headwinds?

- Political
- Regulatory
- Water
  - Other environmental issues
- Economics
  - Oil vs. gas
  - Rig Count
  - Dry vs. wet
  - Low cost shale(s)
  - Fee/Tax implications

Web Resources:

www.marcellus.psu.edu

www.msetc.org

www.naturalgas.psu.edu