The Marcellus Resource – *Impacts in Pennsylvania*

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Change in Our Energy Future

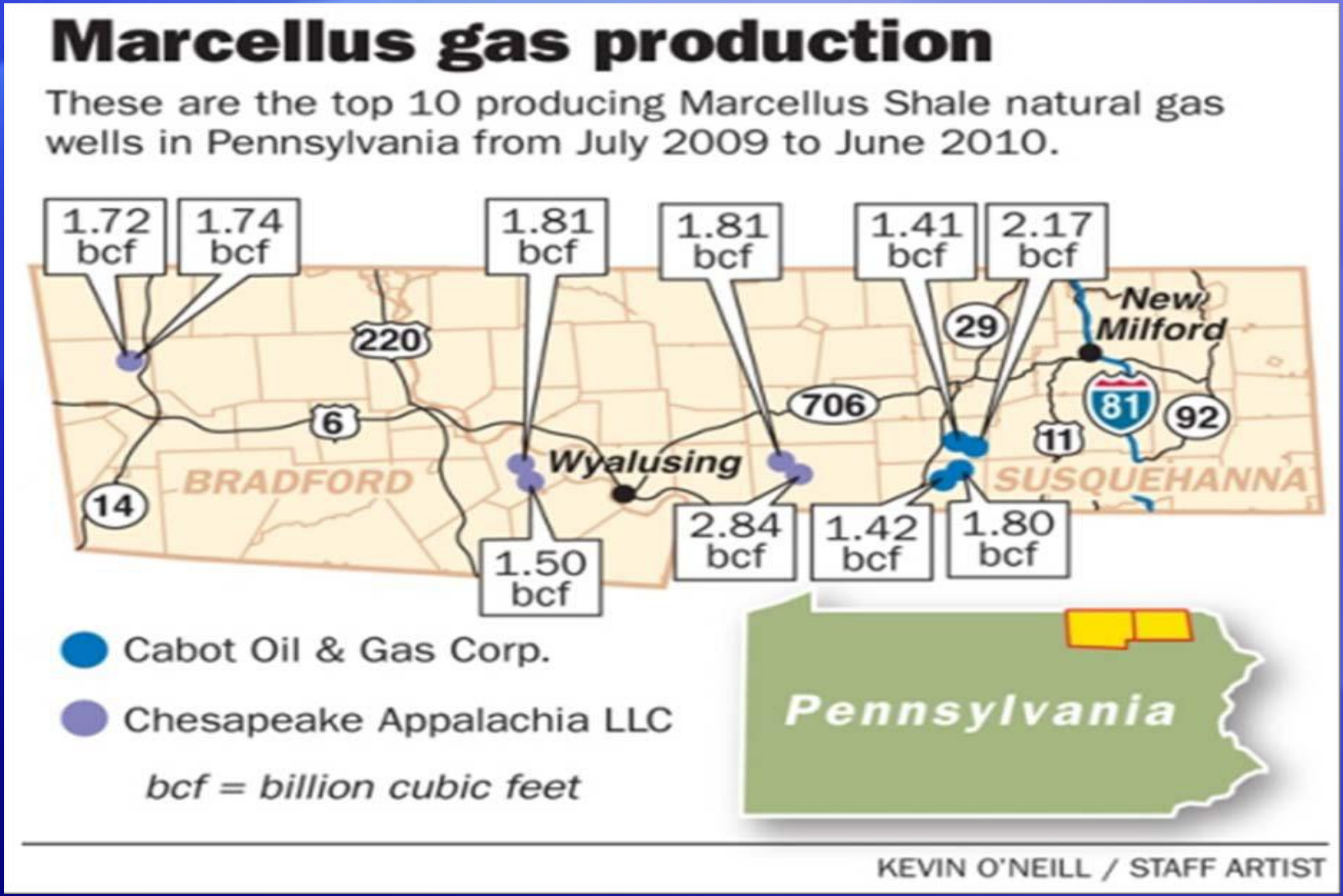
FACT-BASED INFORMATION
natural gas
Marcellus Education Team
www.naturalgas.psu.edu

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

How big is the Marcellus Shale?

- …now estimated that potential recoverable gas could be 489 trillion cu. ft. w/current technology.
  - -Increases over time??
  - -Current production #'s
- 100+ year supply
- World class resource
- Decades to drill/produce
- Proximity/transport

Production Data



Graphic: The Scranton Times Tribune

Marcellus vs. Barnett Shale Comparison

Best County Shale Production Comparison: 7/1/09 to 6/30/10

County	# Wells	Ave. Prod Months	Daily Ave (mcf/d)
Bradford, PA*	**84**	**6**	**3,436**
Tarrant, TX*	**490**	**6**	**1,666**
Marcellus exceeds Barnett by:			**1,770**

CHK's Clapper 2H in Susquehanna County, has produced about 2.8 BCF *in only 270 days*. By contrast, the top-producing Barnett well has produced about 5.1 BCF *in five years*. That means the Clapper 2H is producing gas at approx. three times the rate*

*Analysis from Powell Barnett Shale Newsletter 9/13/10

…the reality is Marcellus is a very large gas field in terms of geography with very superior geology…

…1.2 bcf in Aug ‘10 to 5 bcf+ (est) in 2015…

Marcellus Depths

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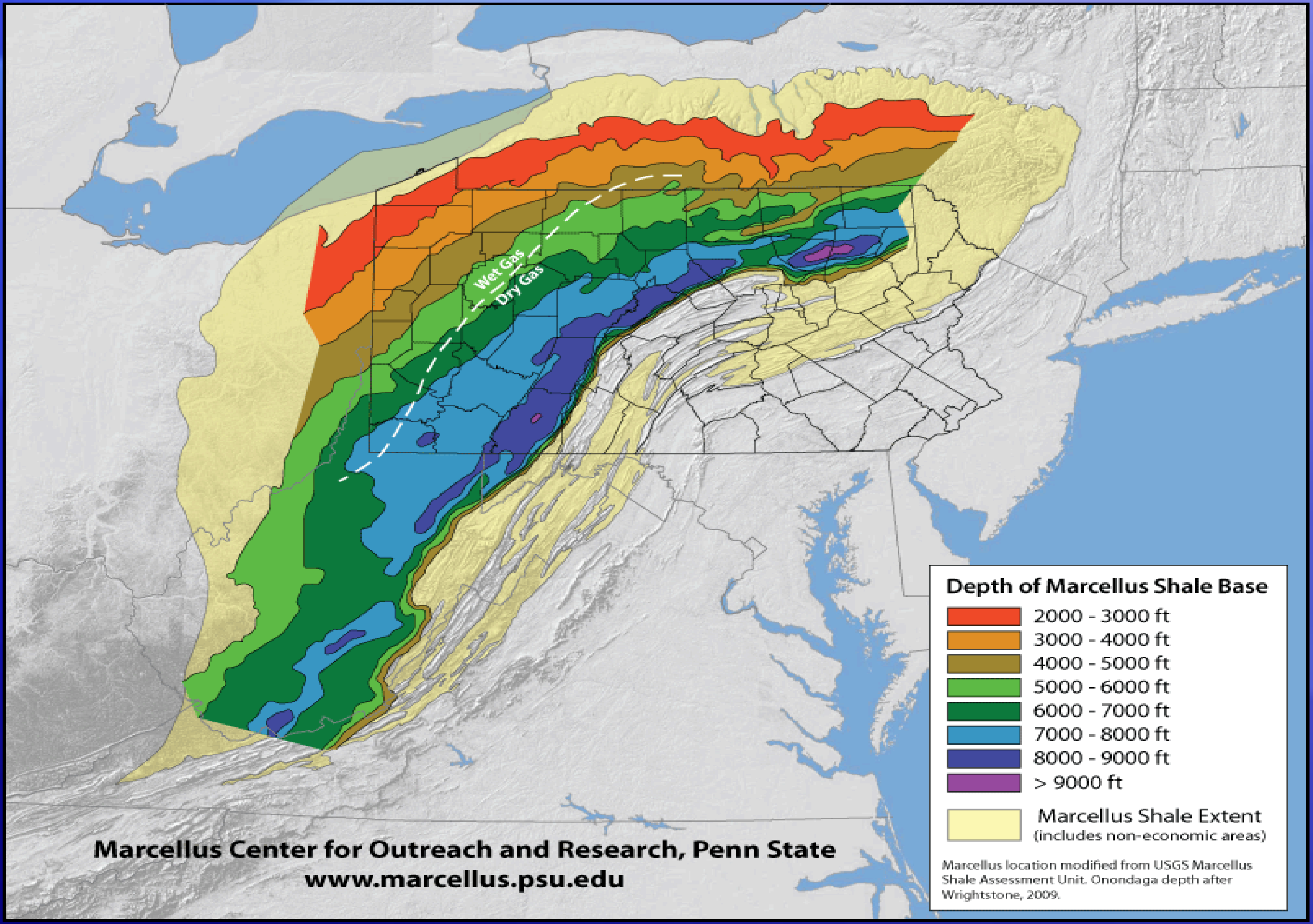


Marcellus Shale Economics

~70+ energy companies looking at Marcellus and increasing

$8 Billion+ collectively -$55B by 2014

~ Royalties to PA landowners – $250 billion?

--Variable lease rates -$750 to $6500/ac

--$14K+ between companies

--Some selling other assets to reposition here

--Large companies consolidating

--International interest.

--Lowest cost shale?? Other shales??

Marcellus Economics

- Globally
  - European shale resource development
  - LNG shipments
- North America
  - Shale gas a “game changer”
  - --Broad impacts
  - New commodity dynamics
- Regionally
  - NG sales cross border
  - Self-sufficient in natural gas in NE U.S.

Natural Gas Price

--Flat price expected

Promotes usage

New business development

Power production

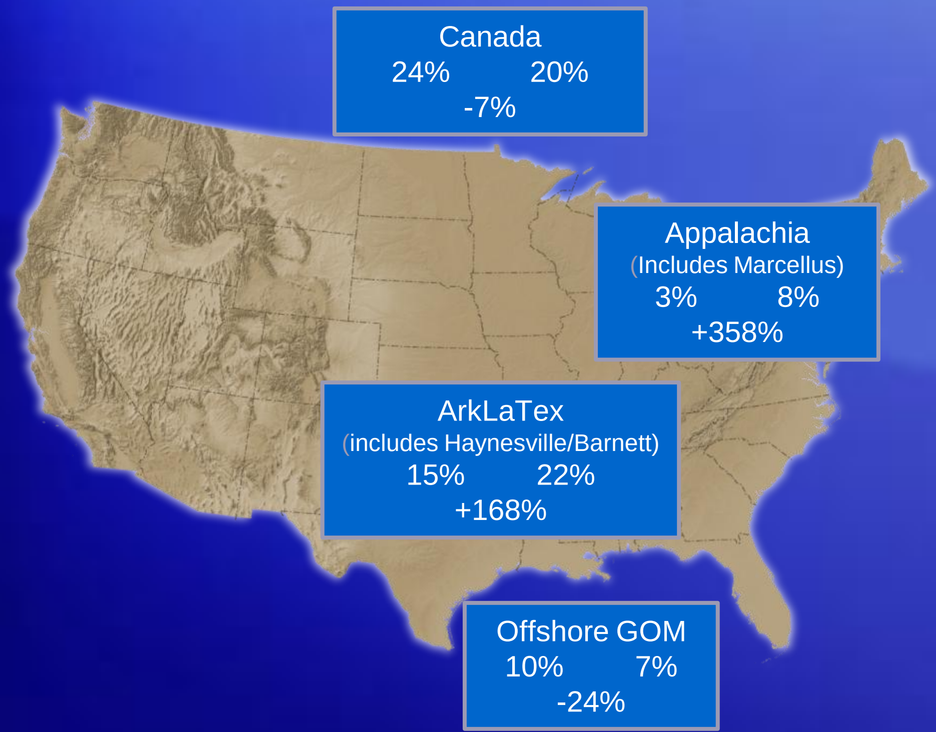
--Increasing supply from unconventional/shale

--Gulf supply??

--National Energy Policy??

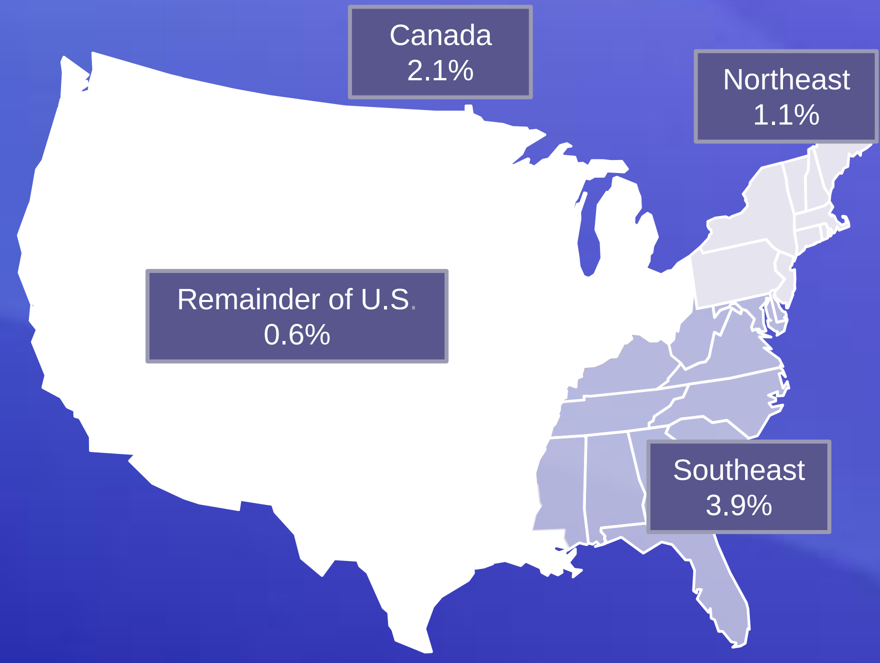
Natural Gas Macro Forecast Trends

Gas Supply



% of U.S./Canada Production
2008 2018
Region Supply Growth 2008-2018

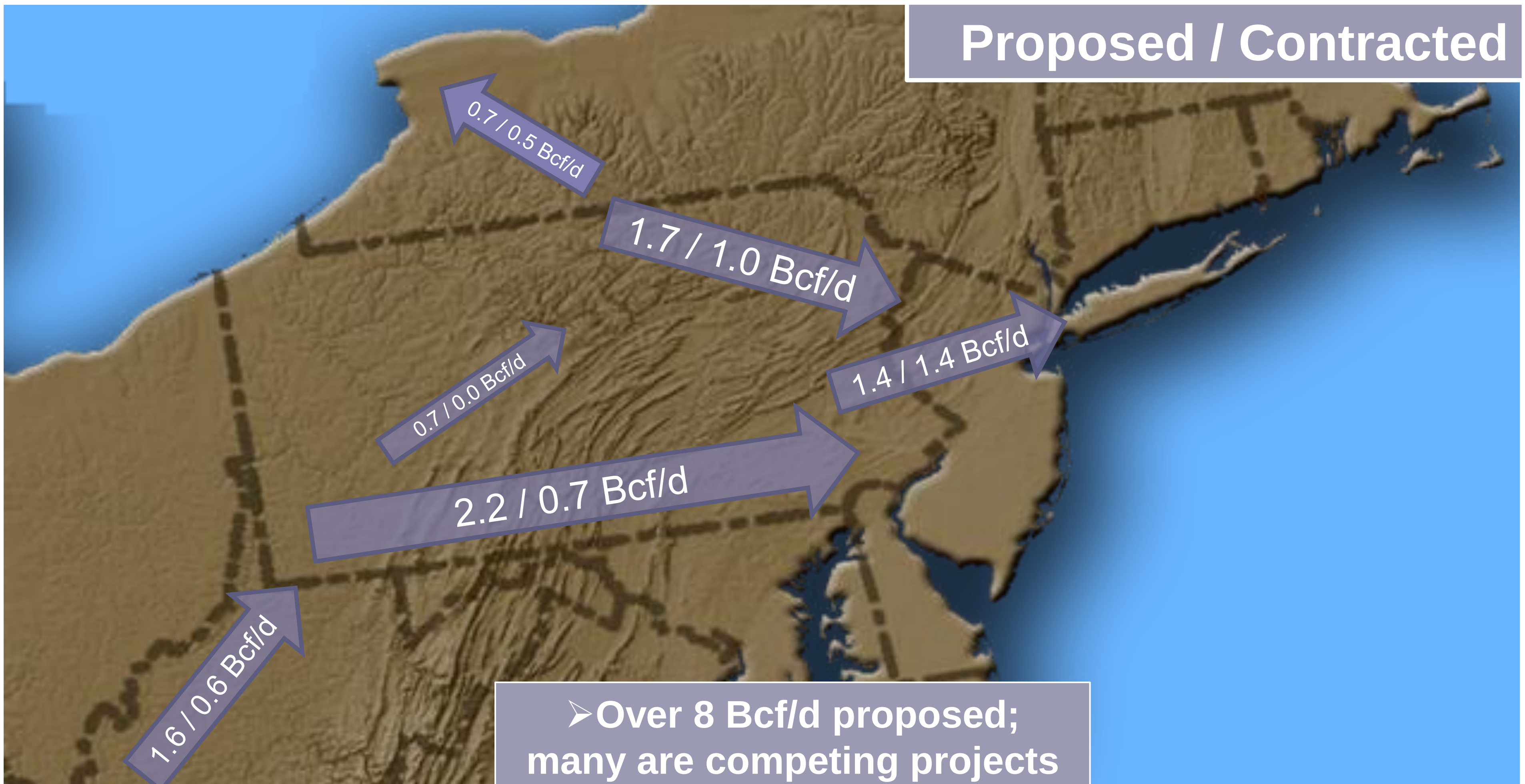
Gas Demand



Gas Demand
CAGR 2008-2018
Total U.S./Canada = 1.4%

Source: El Paso April 2010 Macro Forecast

Major Pipeline Expansion Projects



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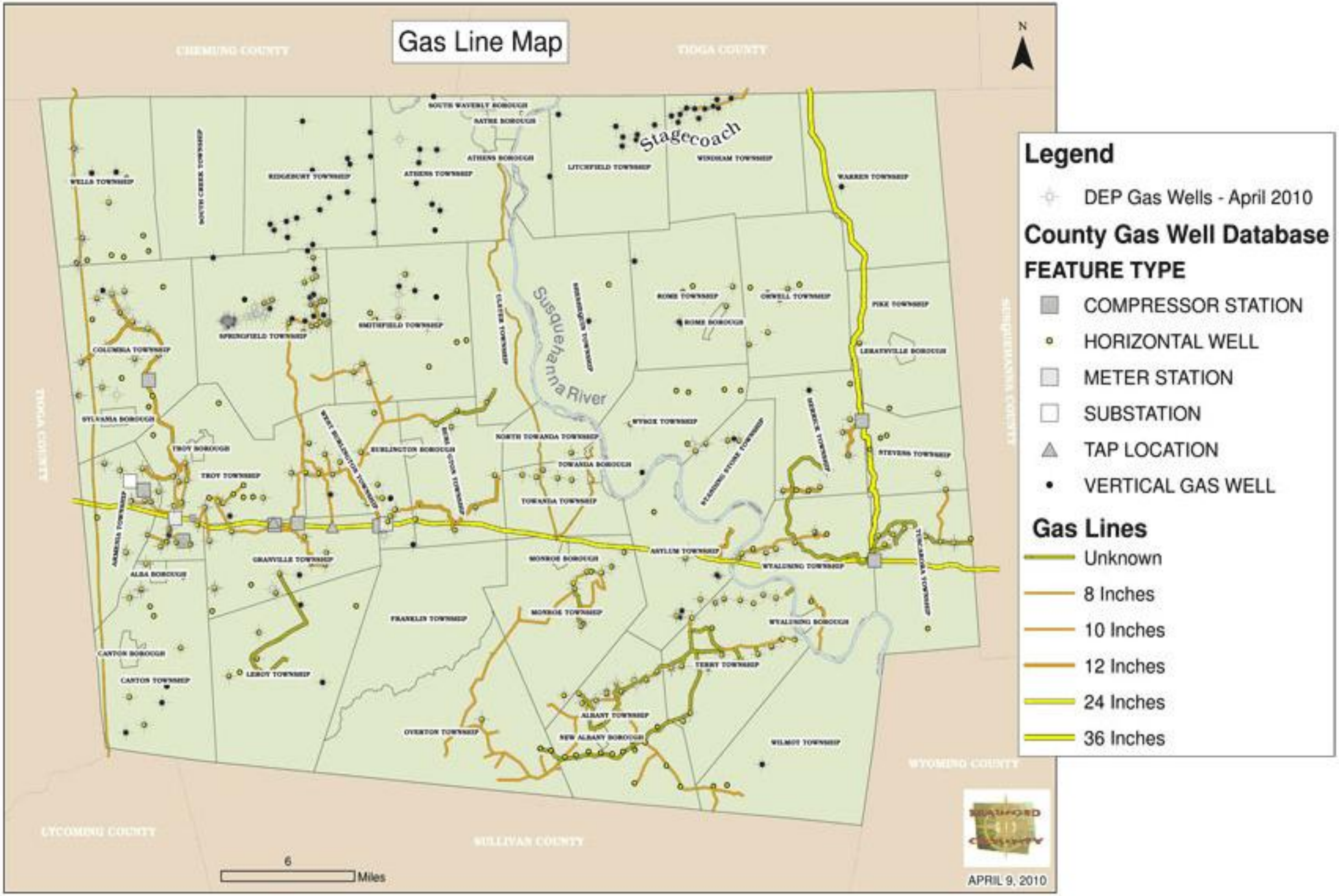
Bradford Co Pipeline Development



ROW Acquisition and Pipeline

--early estimates of 10K miles of gathering lines needed for Marcellus

--345 already built in Bradford alone to date.

--estimated 100K of disturbed acres

--other shales??

--water access points

--road access

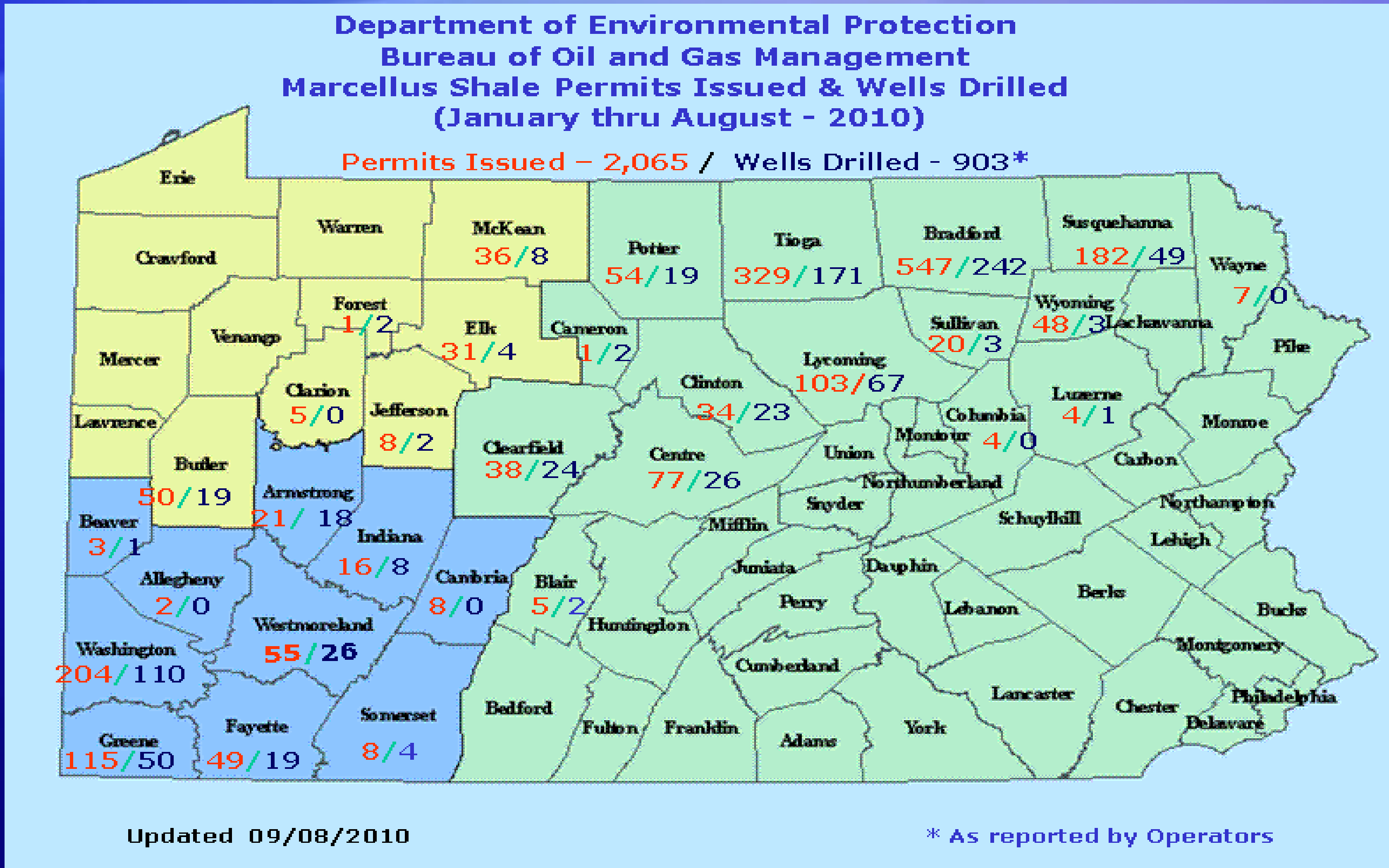
--centralized ponds

--other ROWs

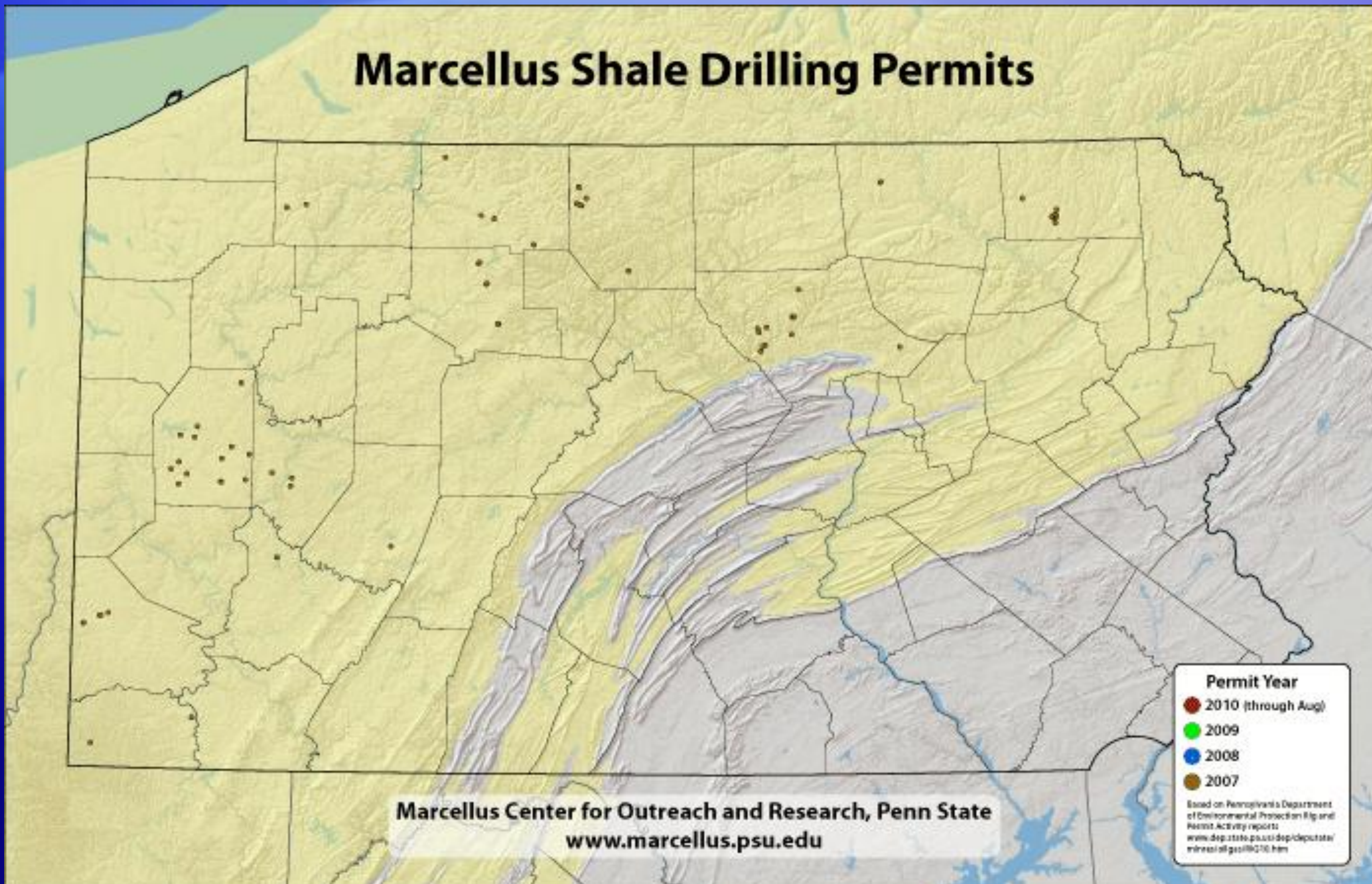
--NGL to East Coast for transport to Gulf

-also Midwest & Canada

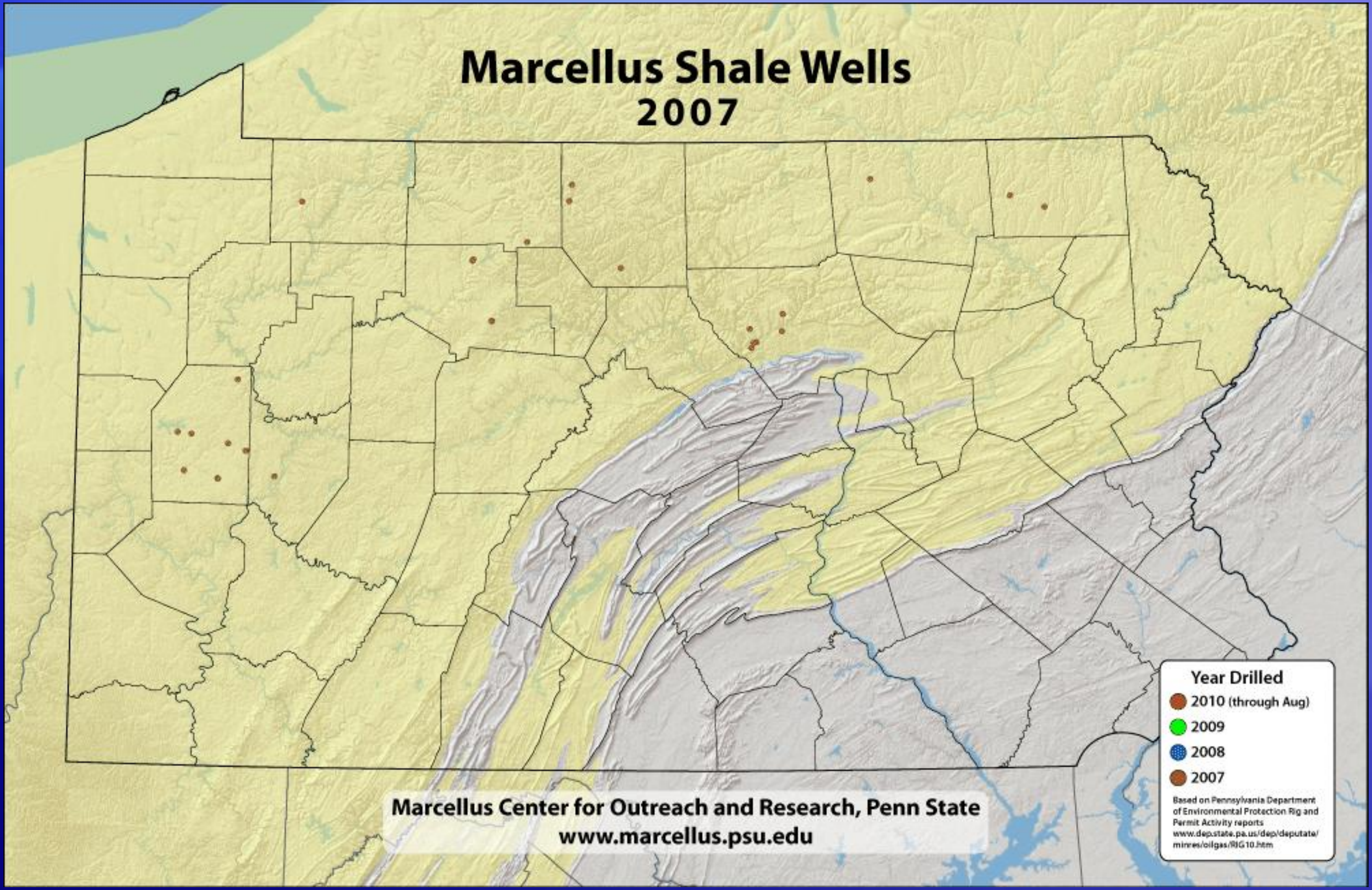
Permits & Wells Drilled (thru 9/8/10)



Drilling Permits



Wells Drilled



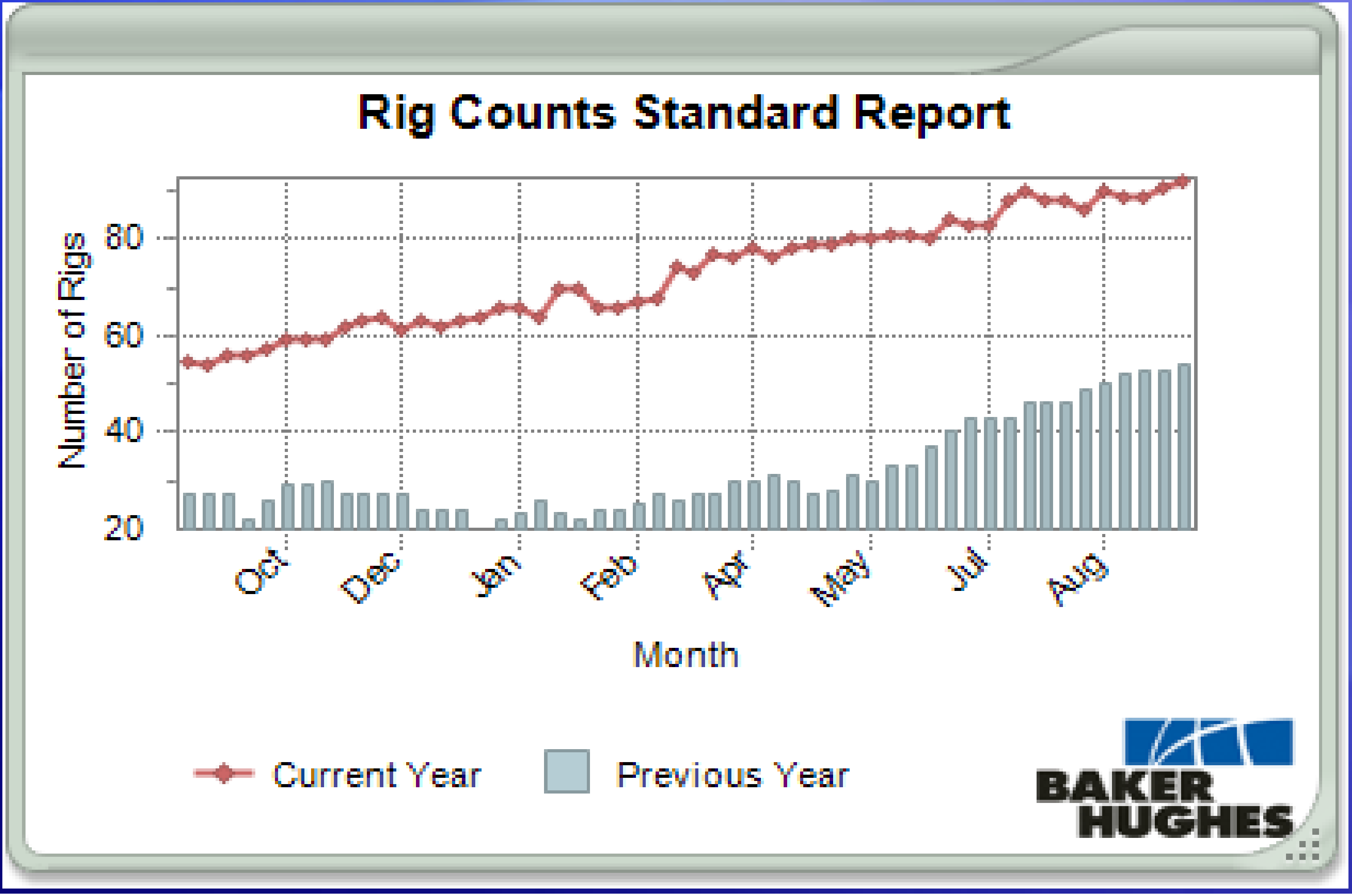
PA Drilled Well Trends

2008	200
2009	749
2010	1750 (est.)
2011	3.5 – 4K (proj'd)

Bradford County Permit Applications

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	0	0	1	2	16	3	2	3	3	14	36	21	101
2009	33	40	3	21	86	31	9	33	38	57	54	23	429
2010	53	117	92	88	66	81	1						500

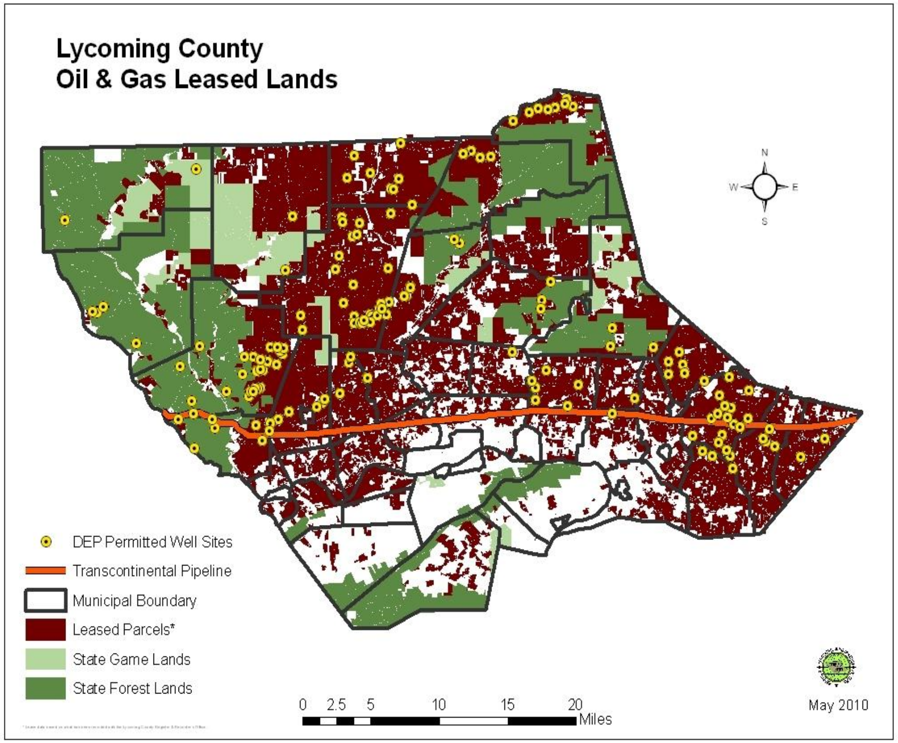
PA Rig Counts



92 rigs as of 9-10-10 vs. 54 rigs on 9-11-09

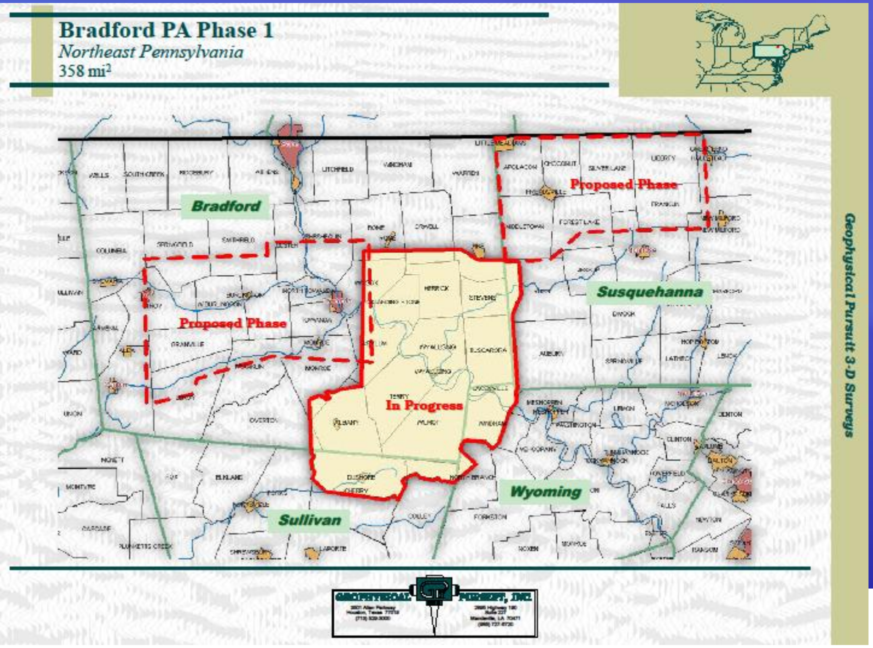
September 10, 2010

Leasing/Seismic Frenzy

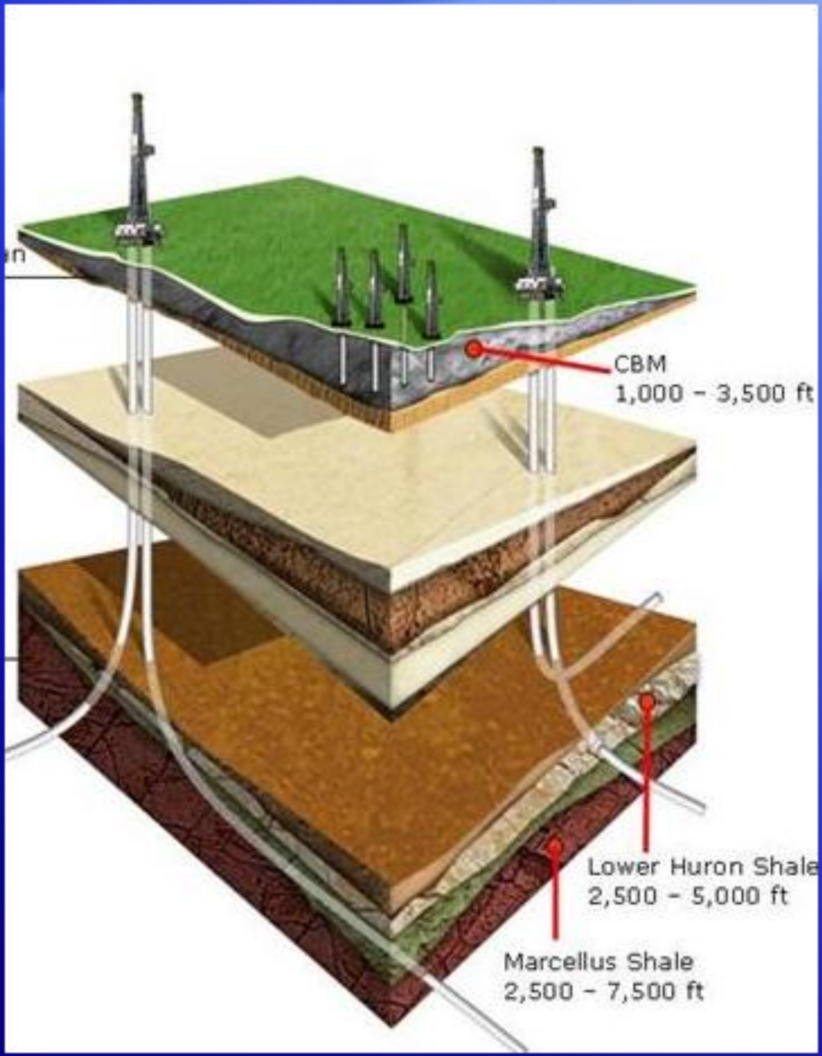


--Continued movement for leasing activity

--Major expansion of seismic testing across PA



Technology for the Marcellus



“Hydrofrac” : fluids pumped into well at high pressure to create fracture pathways for gas migration

Horizontal Drilling

Process

- Lease land
- Seismic
- Acquire permits
  - DEP/SRBC/others
  - E&S
  - Water access
- Construct well site
- Drill well
- Completion process
- Pipeline
- Restoration
- Market gas

Impacts Associated w/ Marcellus

Roads

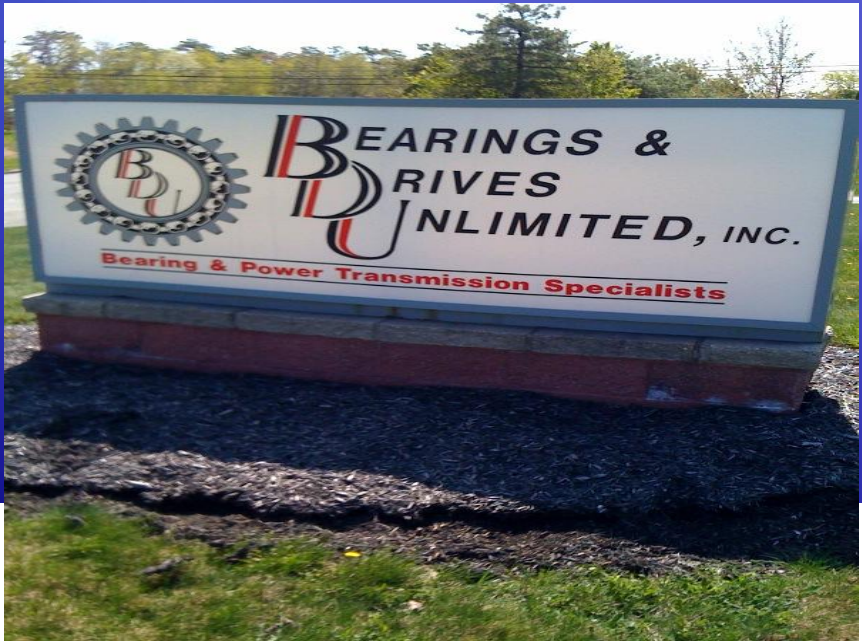
-Truck traffic/accidents
-Overweight loads/fines
-Agreements for repairs
-Centralized ponds, piped water, land use issues
-Dirt and gravel road pgm

Housing

-Limited in certain areas
-Increased rents, prices
-Tourism

Impacts on Communities

- Local businesses
  - New business ventures
  - Biz to Biz/Workforce Expos
  - Job migration
- Local elected officials
  - New issues –roads, water, planned housing, infrastructure
  - New skills needed
  - New costs – income?
  - Taxing issues



Business Development

Impacts

Financial

- Banking changes in region
- Taxes and new landowner legal structures
- Investments for multiple generations
- Circulating dollars locally
- Hydrocarbon conveyance –sale vs. lease

Severance Tax

- Tax on the value of production at point of extraction
- 35 states tax one or more non-renewable resources *(incl. Arkansas, Oklahoma, Texas, W. Virginia, Wyoming)*
- Often applies to multiple resources, not just natural gas
- Variously administered:
  - Percentage basis (e.g. like sales tax)
  - Production basis (per unit)
  - Combination

Questions: Severance Tax

1. What to tax *(Flat rate? Value? Combination?)*?
2. Tax rate?
3. How to distribute the revenue?
4. Grant exemptions?
5. Local control vs. state control of dollars?

Partial source: Patriot News, July 6, 2010

NY Moratorium Implications

-Limited drilling w/o hydrofracing

-Permitting?? EPA study results

-Extremely polarized conversation

-Business development cross-border

-Force Majeure?

Land Use Impacts

Environmental in the Marcellus

Water

NORM

Gas migration

Sound

Air emissions

Forest fragmentation

<u>Fact vs. perception</u>

DEP violations

EPA Frac Study

Research needed???

Concerns

Risk Free??

Large scale industrial process

Photo source : Towanda Daily Item 8.10

Groundwater/Pad Protections

PSU's Marcellus Center (MCOR)

Mike Arthur, Professor of Geosciences –College of Earth and Mineral Sciences

Tom Murphy, Extension Educator –College of Agricultural Sciences

** Multi-disciplinary, cross University effort to establish baseline data set, identify and fill knowledge gaps, and provide outreach.

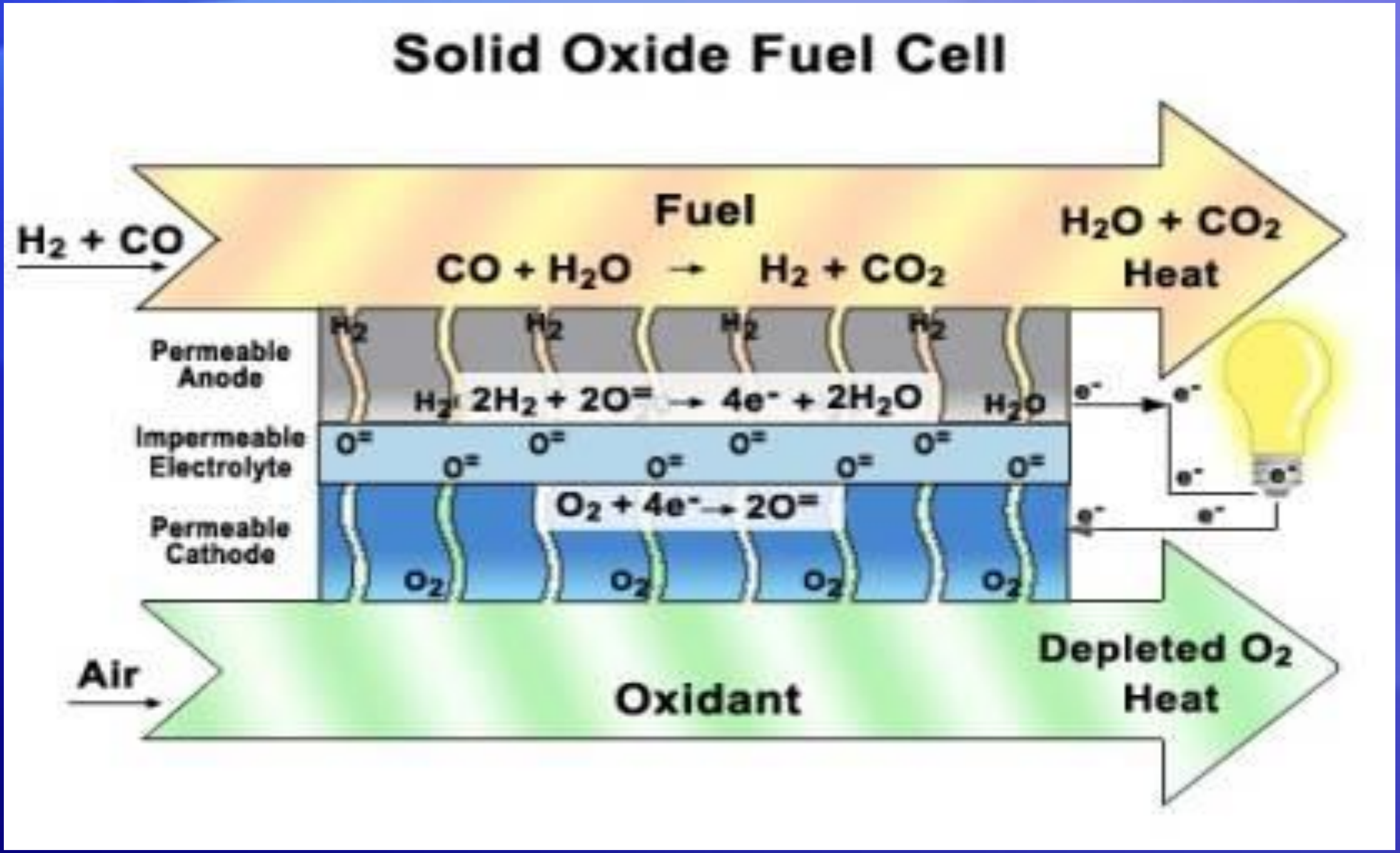
PSU’s MCOR

- Five “key” areas of focus
- Coordinate across University’s colleges
- Critical mass of researchers in each area
- Evolving process over time
- Central “door to knock on” at University
- Multi-state?? Multi-institutional??

Center’s Focus Areas

1. Energy & Energy Independence.
2. Environmental Quality and Constraints.
3. Business and Economics.
4. Social and Community Impacts
5. Legal Dimensions

New Energy Capacities…



Workforce Development

Marcellus Shale Education & Training Center

Workforce Development & Continuing Education

Pennsylvania College of Technology
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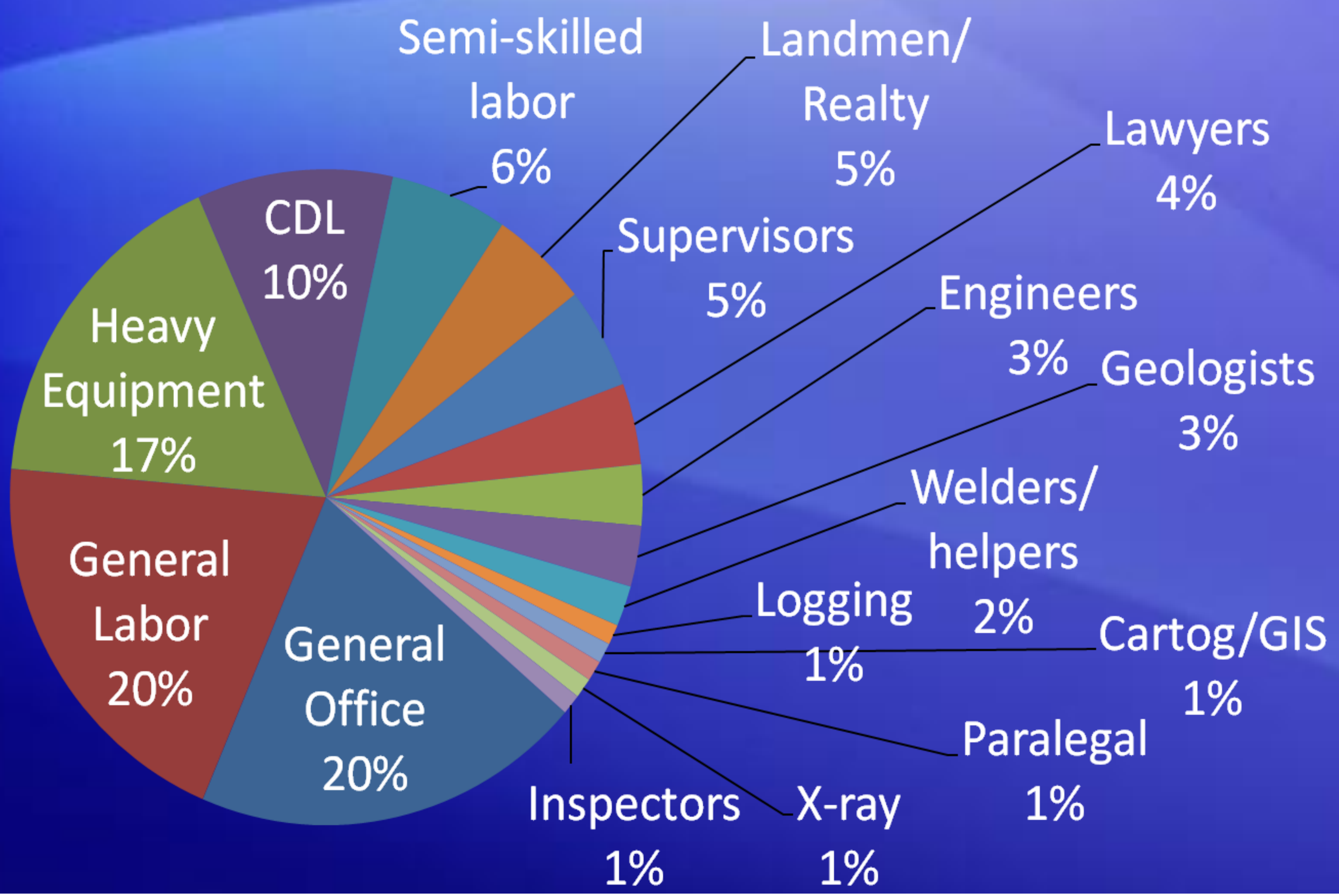
PENNSTATE
College of Agricultural Sciences

FACT-BASED INFORMATION
natural gas
exploration & drilling
http://naturalgas.psu.edu

Work Force Development



Source: MSETC workforce study, 2009

Marcellus Resources

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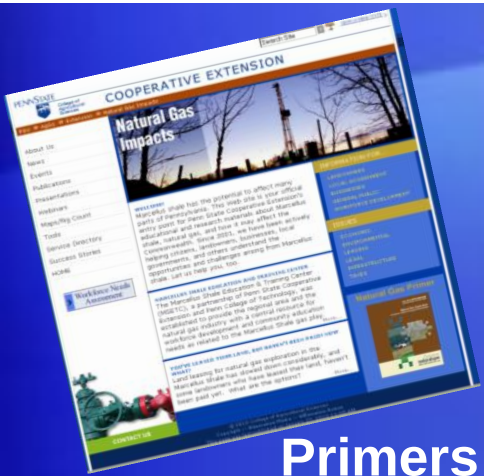

- Website & e-newsletter
- www.marcellus.psu.edu

www.naturalgas.psu.edu

www.msetc.org

Primers

Marcellus Shale: What Local Government Officials need to Know

Natural Gas Exploration: A Landowner's Guide to Leasing Land in Pennsylvania

Natural Gas Exploration: A Landowners Guide to Financial Management

Short Fact Sheets