

Oil & Gas Development in Pennsylvania



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An aerial photograph showing an oil and gas drilling site in a rural Pennsylvania landscape. The site is located in a green field, with a dirt road leading to it. A drilling rig is visible, along with several blue and white vehicles parked nearby. The surrounding area includes rolling hills, forests, and some residential buildings. The title "Oil & Gas Development in Pennsylvania" is overlaid in large yellow text at the top left.

Stephen Rhoads
President
Pennsylvania Oil and Gas Association

Oil & Gas Development in Pennsylvania

An overview of the oil & gas extraction industry:

- **Who we are**
- **Where we operate**
- **What we do**

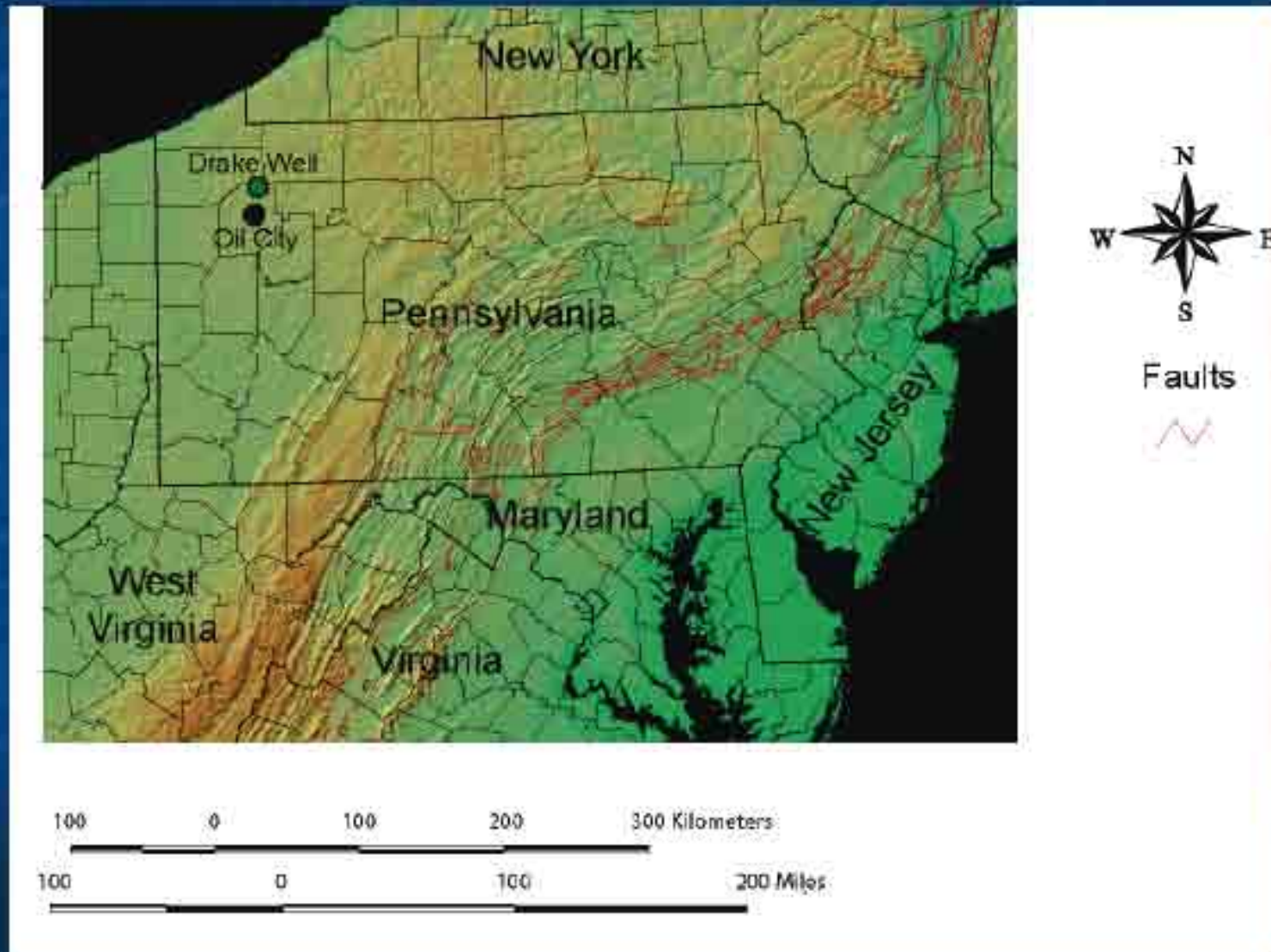


Pennsylvania Oil & Gas Association

- ✦ Founded as the **Pennsylvania Oil, Gas and Minerals Association** (POGAM) only 59 years after Colonel Drake drilled the world's first oil well in Titusville, PA
- ✦ believed to be the oldest continuously operating oil and gas trade association in the United States
- ✦ POGAM reorganized and incorporated as the **Pennsylvania Oil and Gas Association** on March 10, 1983
- ✦ represents all facets of the oil and gas exploration and production industry working in the Commonwealth and neighboring Appalachian Basin states



The Drake Well: Where it all began



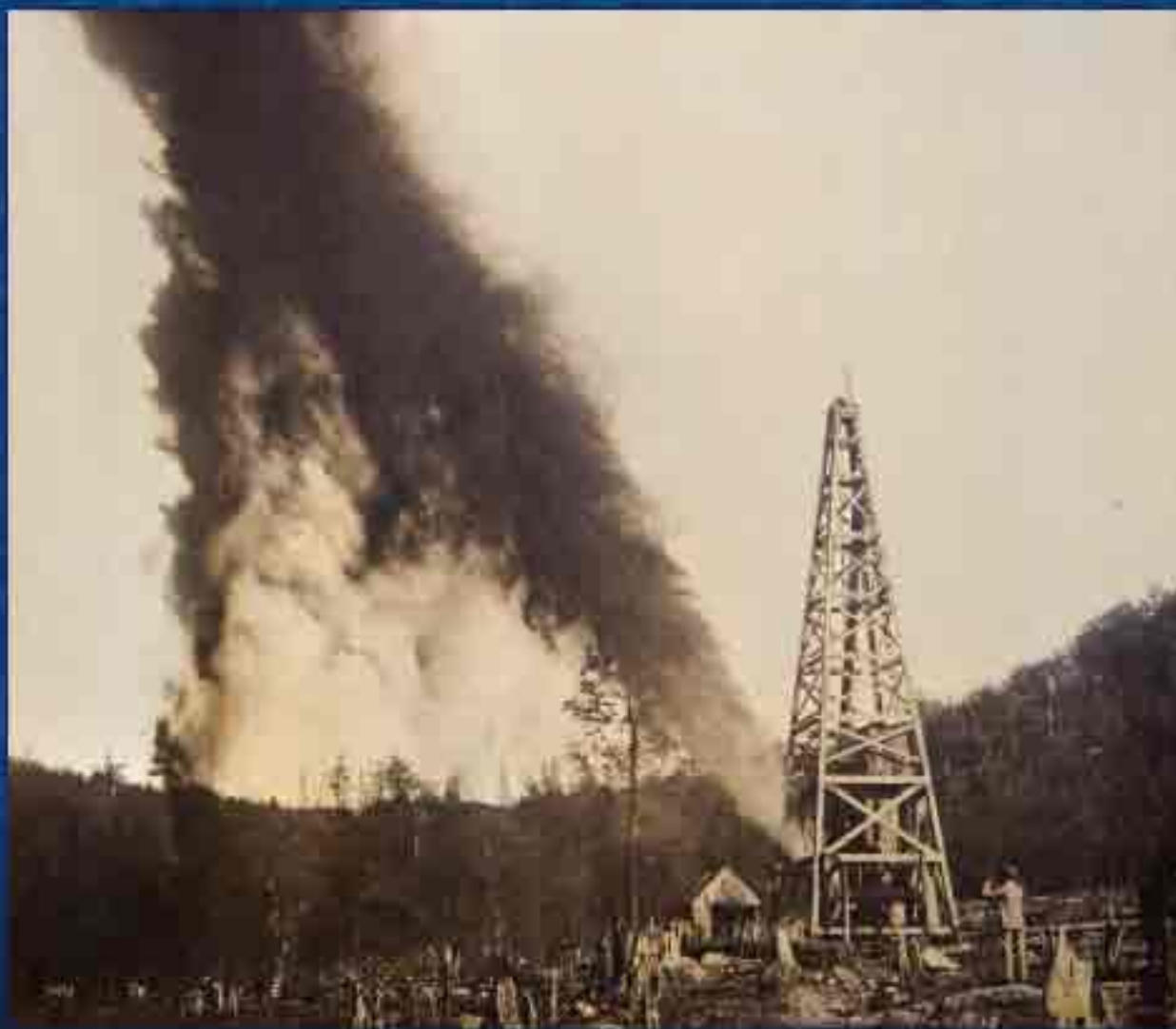
What it was like



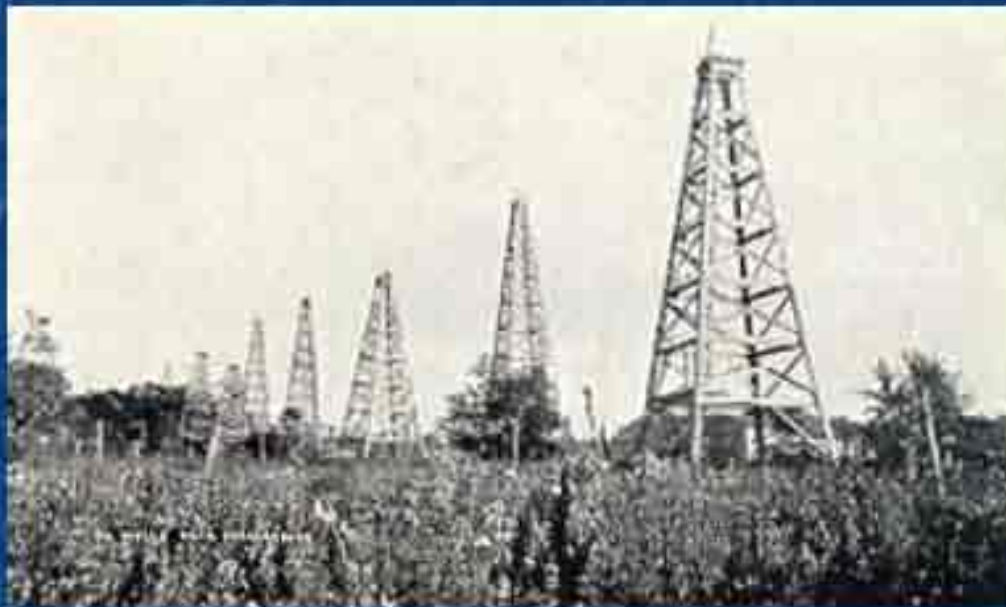
What it was like



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What a difference a century makes!



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What happened from 1859 to 2008?

- Producers got smarter & stopped wasting money and energy
- Technology improved making exploration & production more efficient & cost-effective
- Society became more aware of the costs and the benefits of energy production

New State Laws

established requirements for:

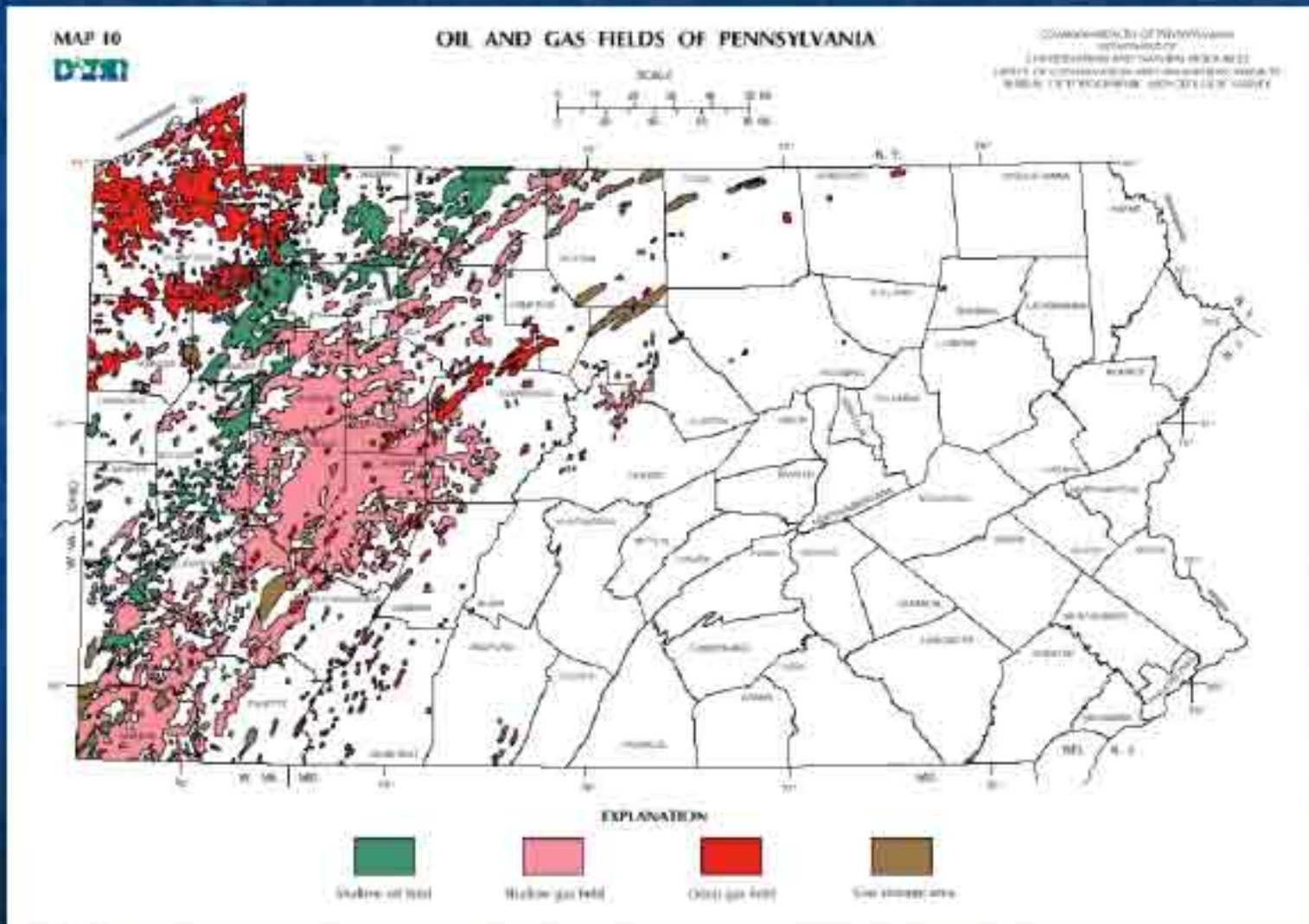
- Well Permits
- Erosion & Sediment Control and Stormwater Best Management Practices
- Protection of Surface & Ground Water Resources
- Preparedness, Prevention and Contingency (PPC) Plans

New State Laws

established requirements for:

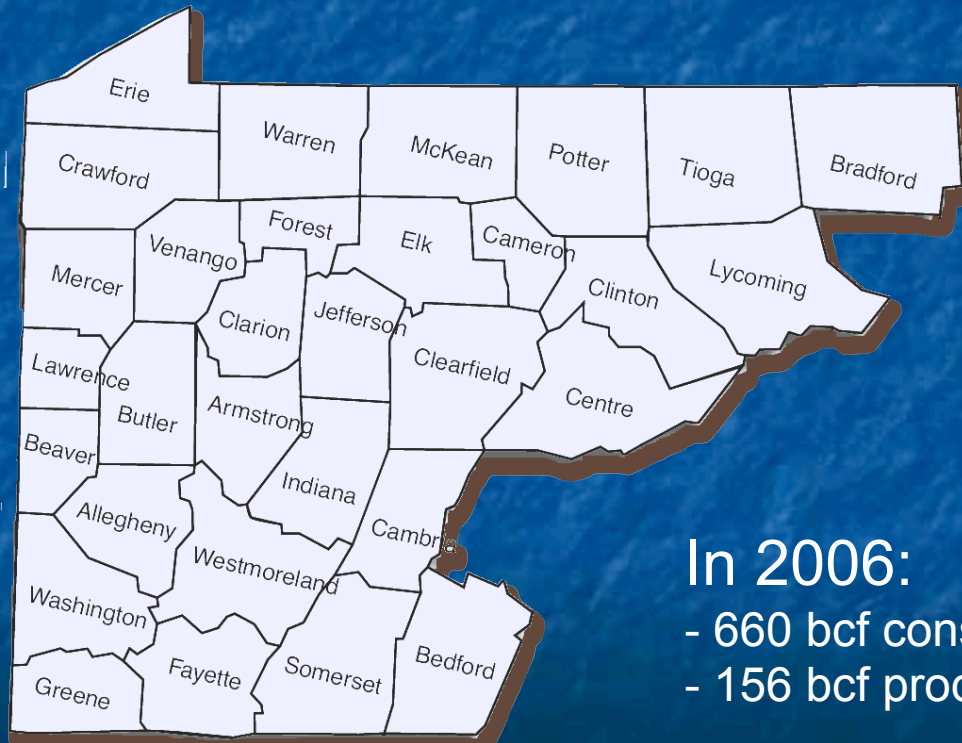
- Siting restrictions:
 - to protect streams, wetlands, buildings & water supplies
 - to protect threatened & endangered species
- Rebuttable presumption for water supply replacement

Where is the Oil & Gas?



Oil & Gas in Pennsylvania

- 32 Pennsylvania counties produce natural gas

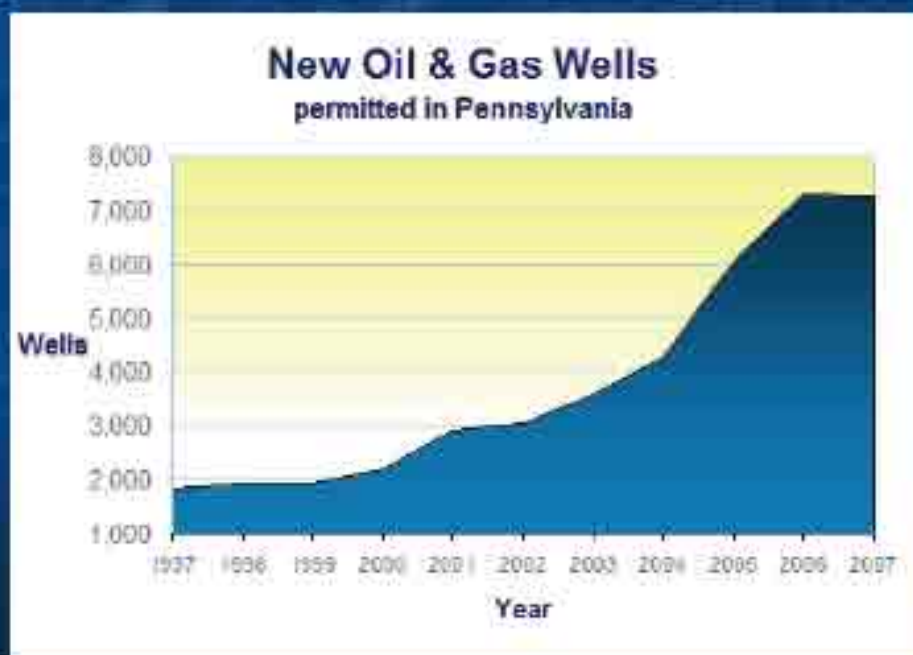


In 2006:

- 660 bcf consumed
- 156 bcf produced (24% of consumption)

Oil & Gas in Pennsylvania

- Well drilling at an all time high:
 - 4,183 wells drilled in 2006 on 7,292 well permits
 - 7,241 well permits issues in 2007

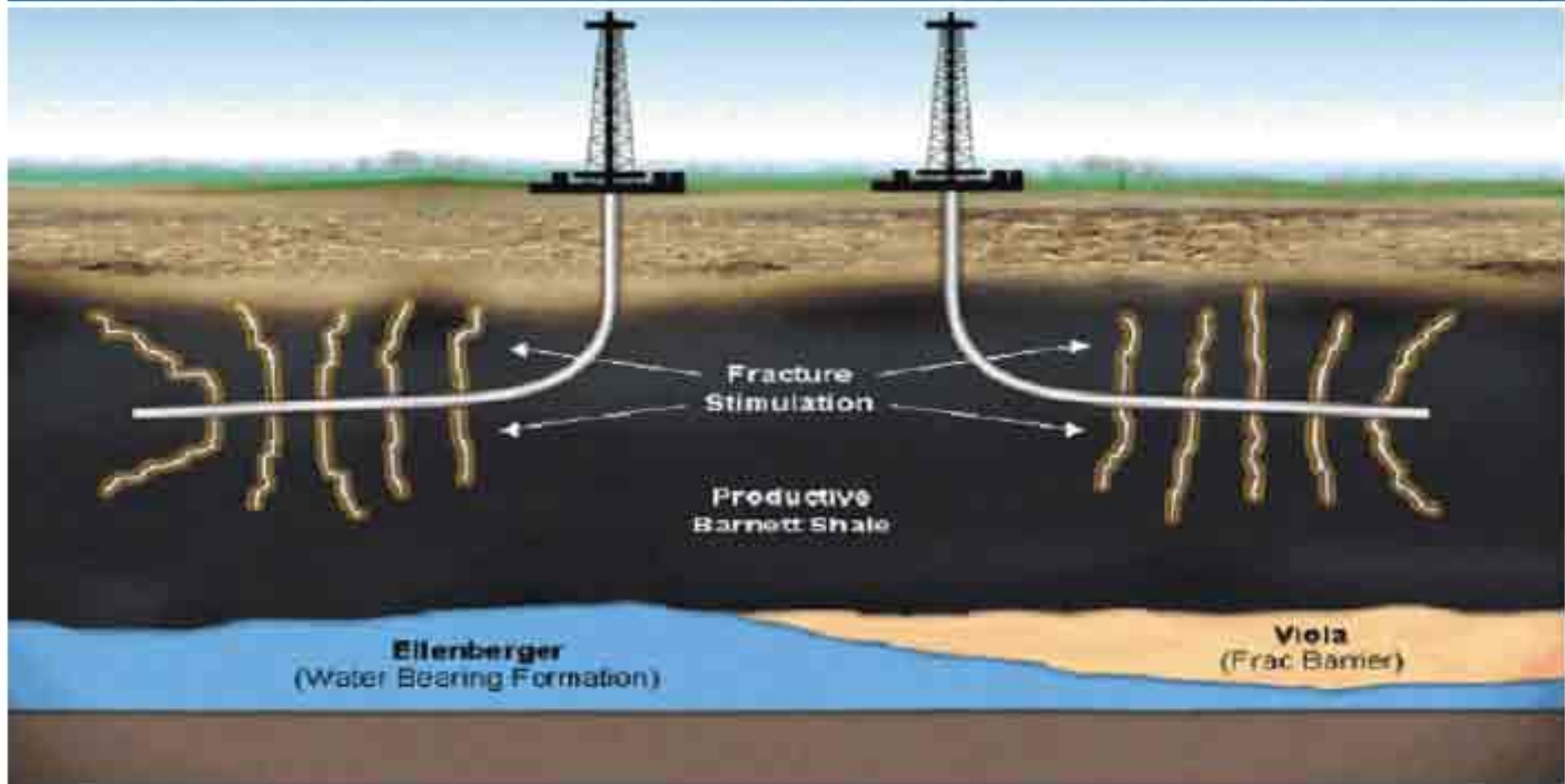


What's Driving Current Development Activity?

- High crude oil & natural gas prices
- Horizontal drilling technology
- Advanced well treatment methods
- Advanced 3-D seismic

Horizontal-Well Side View

Fort Worth Basin

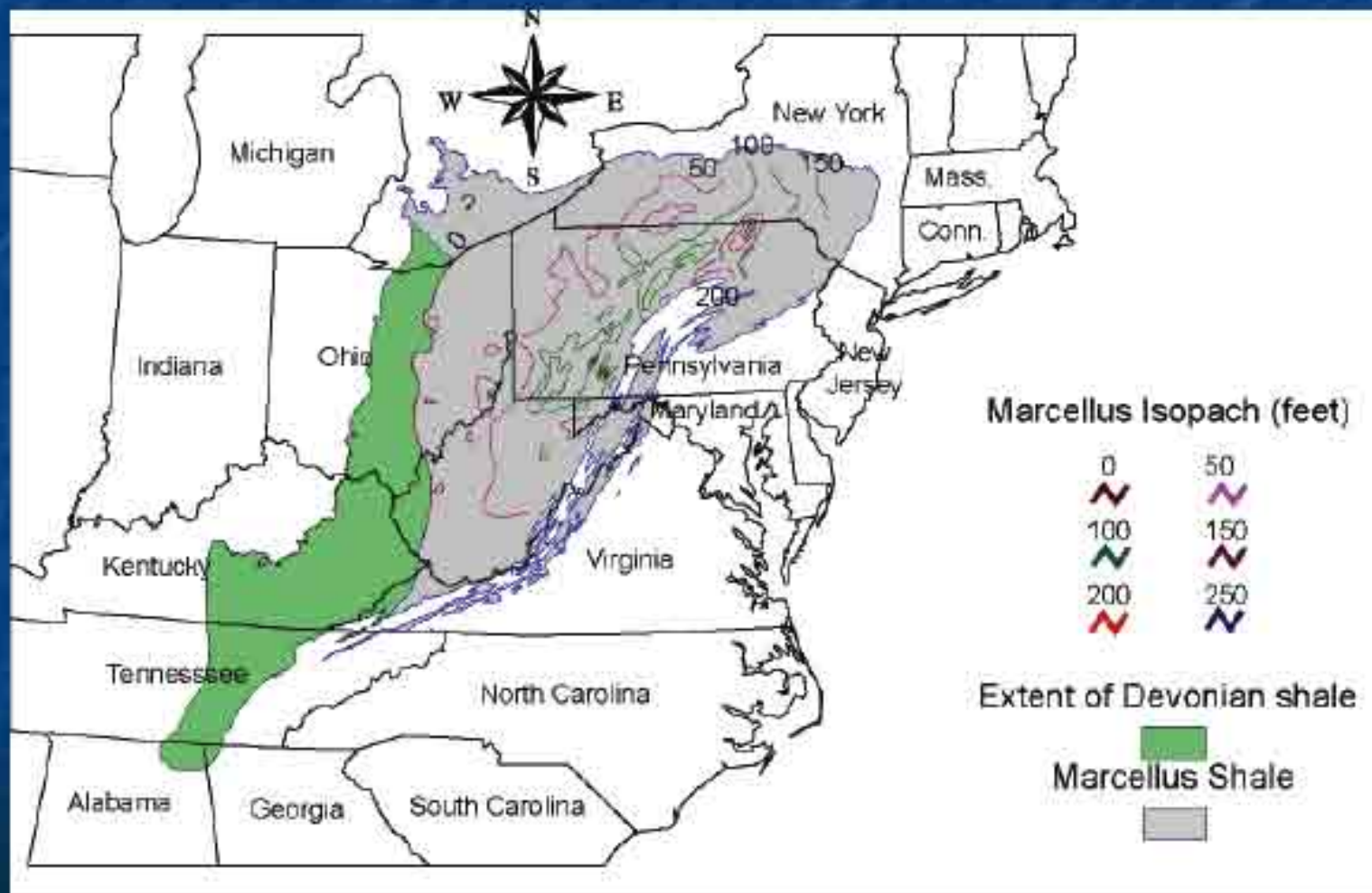


Unconventional Gas Opportunities

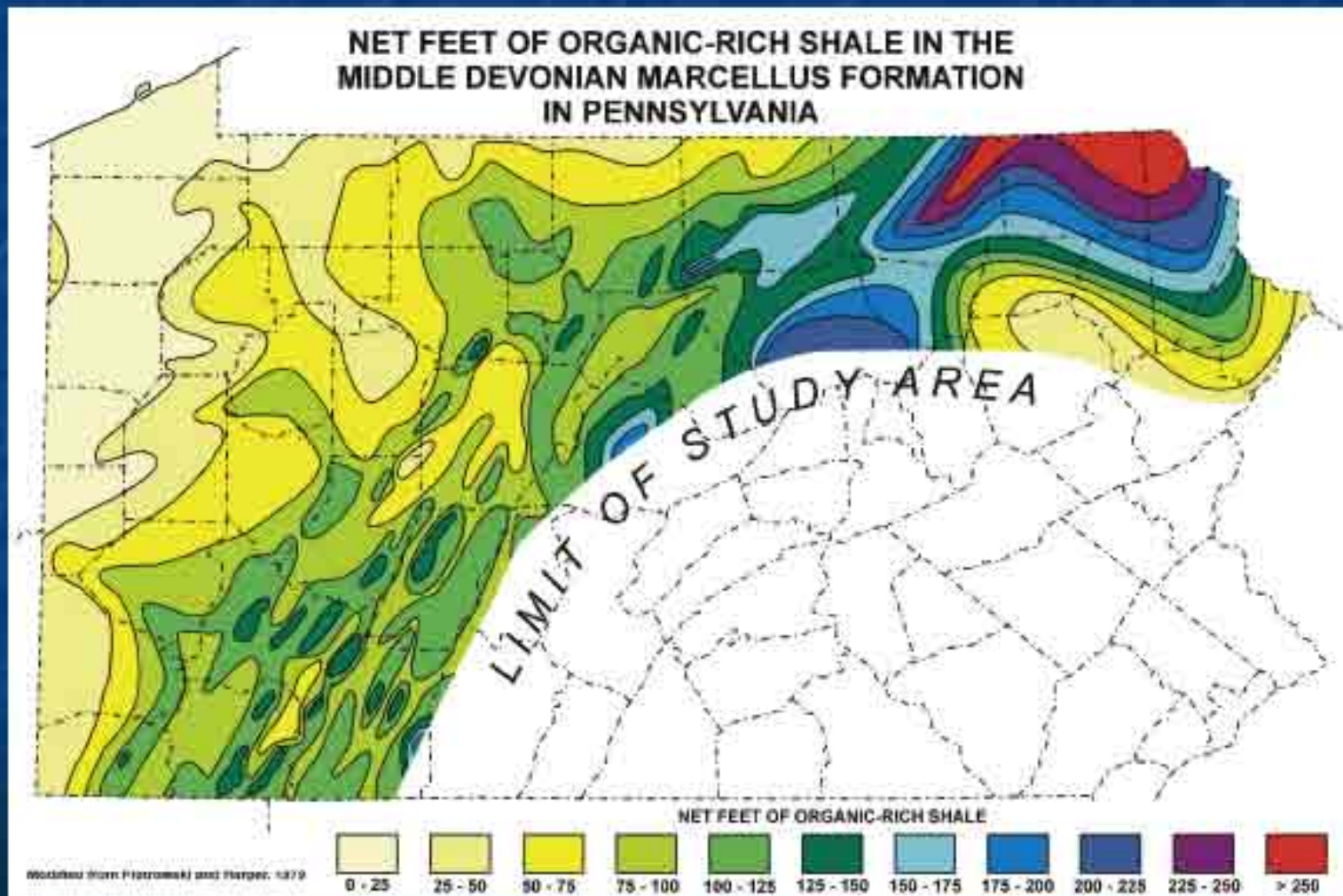
U. S. Shale Gas Resources



Marcellus Shale



Marcellus Shale



How Much Gas is in the Marcellus?

- **Engleder & Lasch:**
500 TCF gas in place
50 TCF recoverable reserves
(2x Total US Annual Demand)
- **USGS:**
1.9 TCF undiscovered natural gas potential

Typical Vertical Well

- Hydraulically fractured in one or more stages, depending on shale thickness and separation of organic intervals
- Foam or slick water: 300,000 - 500,000 gallons per stage
- Proppant: 100,000 to 300,000 lbs. sand per stage
- **\$400,000 to \$800,000 per well**

Variables: # Frac Stages & Size of the Frac

Typical Horizontal Well

- Single lateral, 2,000' to 3,000' length
- MTD = vertical + angle build + lateral
- 3 to 10 frac stages:
25,000 to 50,000 lbs. sand per stage
- Foam or slick water: 1 million gallons +++
- **\$1.2 to \$2.3 million per well**

Marcellus Shale Gas Resource Estimates

**In very broad terms
some recent drilling shows:**

- 1 Bcf recoverable reserves per vertical well on 40-acre spacing
- 2.5 Bcf recoverable reserves per horizontal well on 80-acre spacing

Marcellus Shale Gas Resource Estimates

Other data are more conservative:

Well Type	Well Unit (<i>acres</i>)	Shale Thickness (<i>feet</i>)	Gas Content (<i>Mcf/af</i>)	Gas In Place (<i>MMcf</i>)	Recovery Factor (<i>%</i>)	Gas Resource (<i>MMcf</i>)
Horizontal	80	150	100	1,200	60	720
Vertical	80	150	100	1,200	25	300

Source: Marshall Miller & Associates

Why does all this matter?

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Energy Independence Strategy

Governor Rendell called a Special Session of the General Assembly to take action on a series of legislative initiatives designed to address a variety of energy needs with indigenous energy resources

One key of his program:

- **expand the percentage of renewable energy sources used in Pennsylvania for electricity generation**

Why does all this matter?

Energy Independence Fund

New \$850 million Bond Issue paid for over 20 years with a 5¢ per kWh surcharge on electric bills

\$500 million for Clean energy projects:

- wind energy and solar manufacturing
- advanced coal technologies
- biofuels
- energy conservation, efficiency & demand management

Why does all this matter?

Creating Markets for Renewables

Rendell-sponsored Act 35 of 2007 amended the Alternative Energy Portfolio Standards Act:

- to establish an **18% goal** by 2020 of electricity production from renewable and other alternative energy sources
- to ensure that:
 - at least **850 megawatts of solar power** is generated in the commonwealth by 2020
 - only renewable energy produced within the territory of the grid operator serving the regulated PA energy utility can qualify for AEPS credits

Why does all this matter?

Creating Markets for Renewables: Climate Change Initiative

"I think everyone now understands that **you cannot deal with energy policy without addressing global warming**. It is the largest environmental problem we face, and Pennsylvania needs to do something about it.

"The efforts I am announcing today to save energy and produce more clean energy are a good first step, but they are only a first step.

"In the next 90 days I will present a comprehensive strategy to make Pennsylvania a leader in addressing climate change."

Why does all this matter?

What's Missing?

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**An appreciation for the role of Natural Gas in
the Commonwealth's Energy Future**

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An appreciation for the role of Natural Gas in the Commonwealth's Energy Future

- **10% ethanol in gasoline supplies = 77.5 million gallons**
 - **New annual Natural Gas demand = 2.3 BCF**

Why does all this matter?

What's Missing?

An appreciation for the role of Natural Gas in the Commonwealth's Energy Future

- **Combination of AEPS & CO₂ Emission Limits**
 - **8% Renewable Electric Power Generating Capacity by 2020**
 - **858 MW Solar Photovoltaic**
 - **12,870 MW Wind and other "pure" renewables**

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Renewable generation has a <20% Capacity Factor

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An appreciation for the role of Natural Gas in the Commonwealth's Energy Future

"For every 10 MW of renewable power put on the grid, you have to build 9 MW of gas."

Bob Fleck, VP, Wood Mackenzie (April 25, 2007)