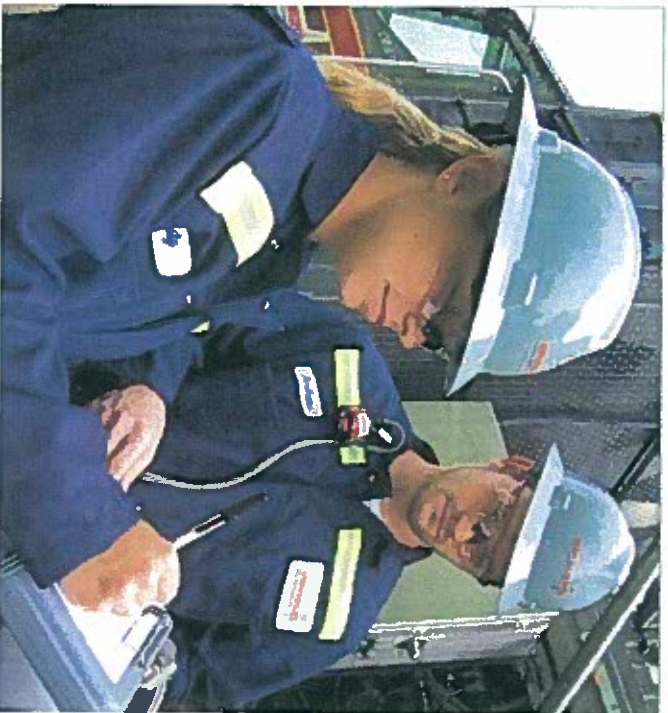


# **Marcellus Shale: A Backgrounder**

**Barbara Sexton**  
**Chesapeake Energy Corporation**  
**David Callahan**  
**Marcellus Shale Coalition**

# Marcellus Shale Coalition



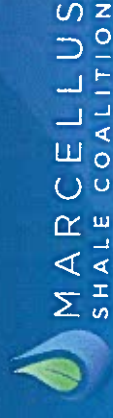
## About Us

- Founded in 2008
- More than 170 members strong
- From producers to suppliers

## Our Focus

- Long-term development of resource
- Protecting the environment and responsible use of water resources
- Addressing landowner, government and public issues
- Benefits to our region's future

# Our Guiding Principles



- ✓ We provide the safest possible workplace for our employees, with our contractors, and in the communities in which we operate;
- ✓ We implement state-of-the-art environmental protection across our operations;
- ✓ We continuously improve our practices and seek transparency in our operations;
- ✓ We strive to attract and retain a talented and engaged local workforce;
- ✓ We are committed to being responsible members of the communities in which we work;
- ✓ We encourage spirited public dialogue and fact-based education about responsible shale gas development; and
- ✓ We conduct our business in a manner that will provide sustainable and broad-based economic and energy-security benefits for all.

# Natural Gas Fundamentals



## Three Phases

**Upstream:** bringing natural gas to the surface (drilling)

**Midstream:** storing and transporting natural gas (pipelines, etc.)

**Downstream:** selling and distributing natural gas (your supplier)

***The Marcellus Shale Coalition (MSC) is comprised of members from all three – especially upstream and midstream.***

## Types

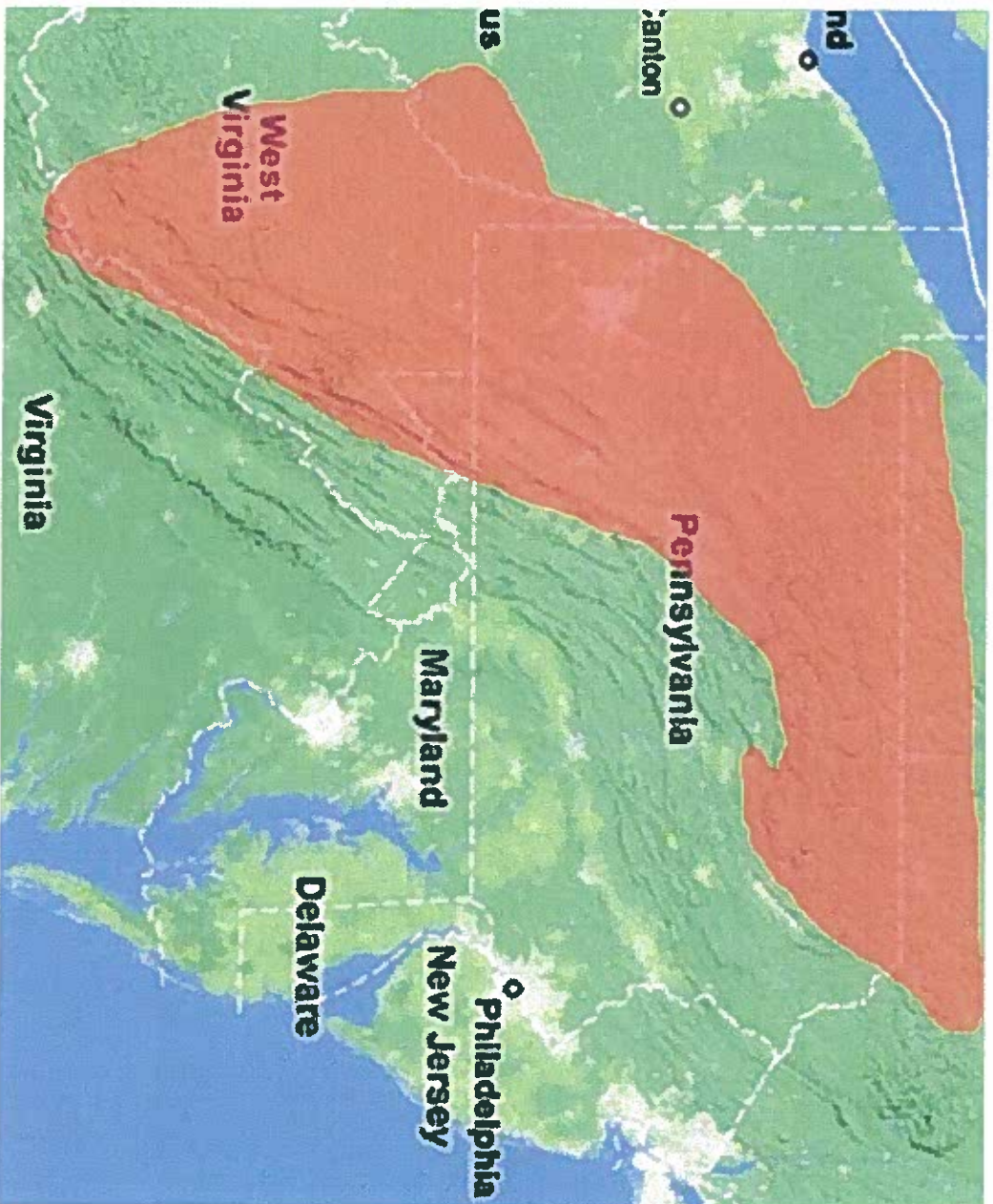
**Dry Gas:** Home, business heating and fueling

**Wet Gas (Natural Gas Liquids, or NGLs):** Raw material for other products (polymers, paints, plastics, fertilizers, etc.)

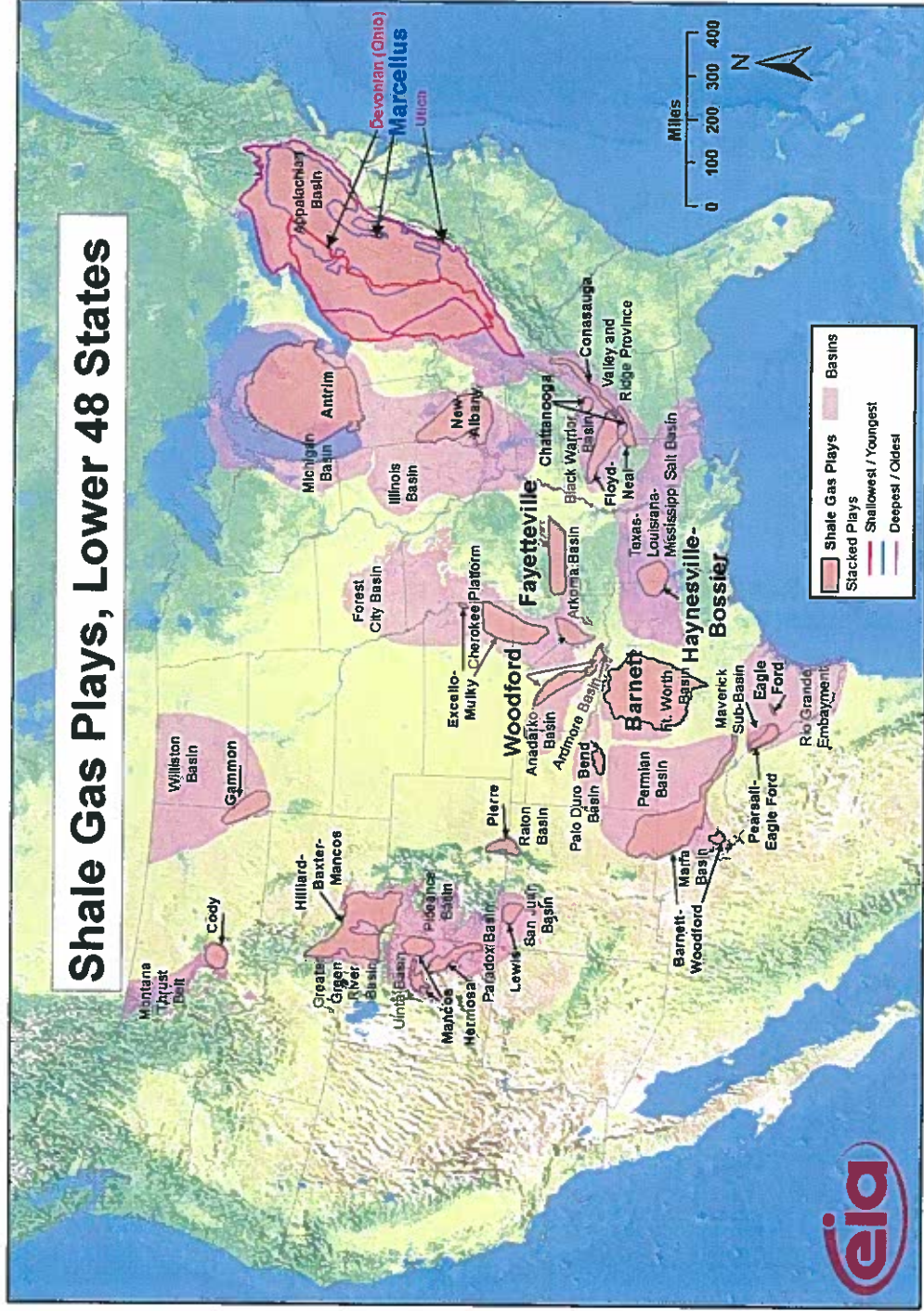
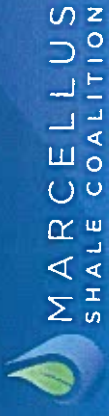
## The Future

- ✓ **Traditional uses (home heating, fueling)**
- ✓ **Electricity generation**
- ✓ **Raw materials for other products**
- ✓ **Natural gas vehicles (NGVs)**

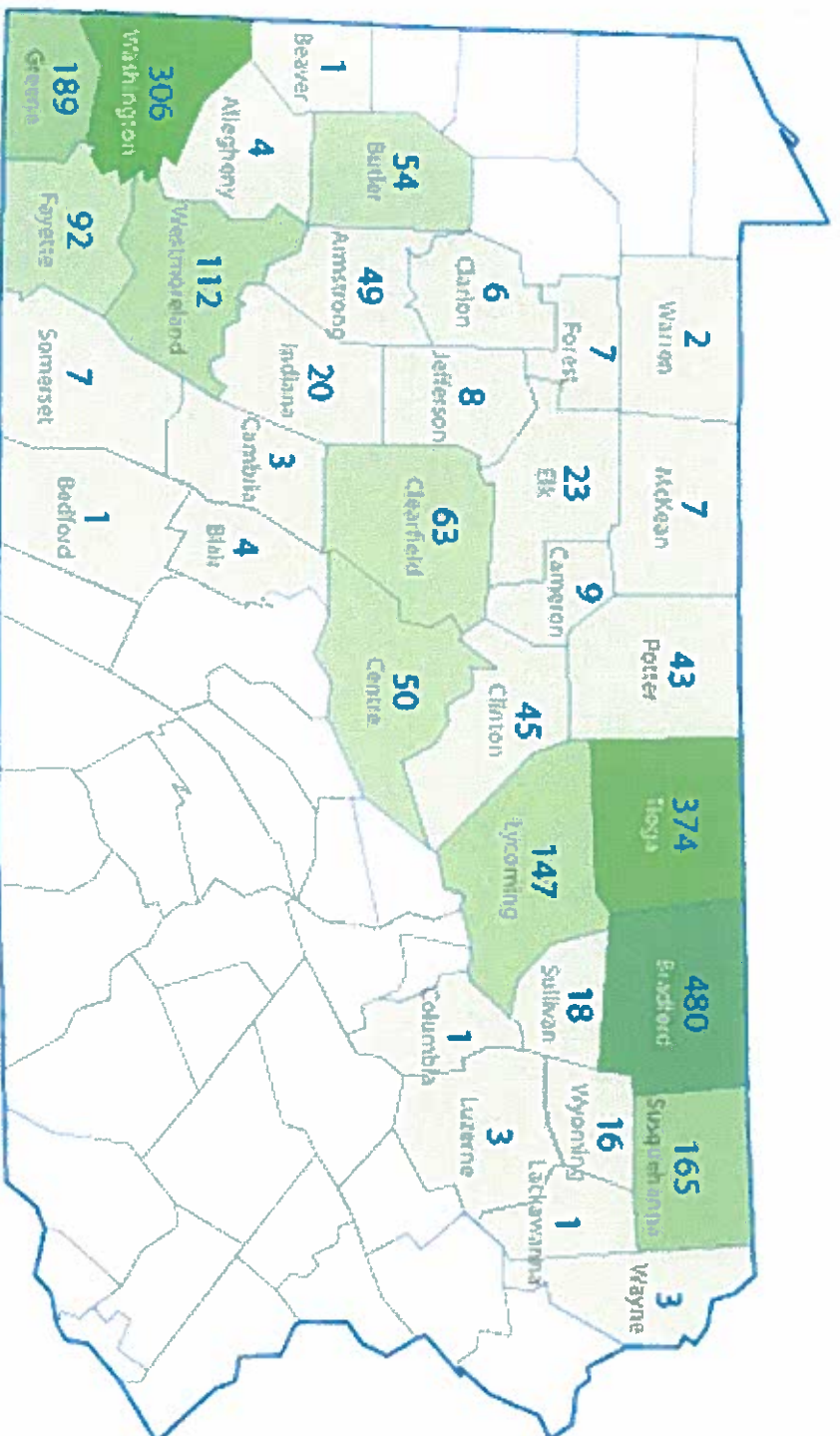
# Marcellus Shale: Geographic Footprint



# Shale Gas Revolution Across the U.S.



# PA Marcellus Wells Drilled By County



Total: 2,313 Marcellus Wells

\*Statistics cover 2005-2010

# Marcellus Shale: Steps in Production



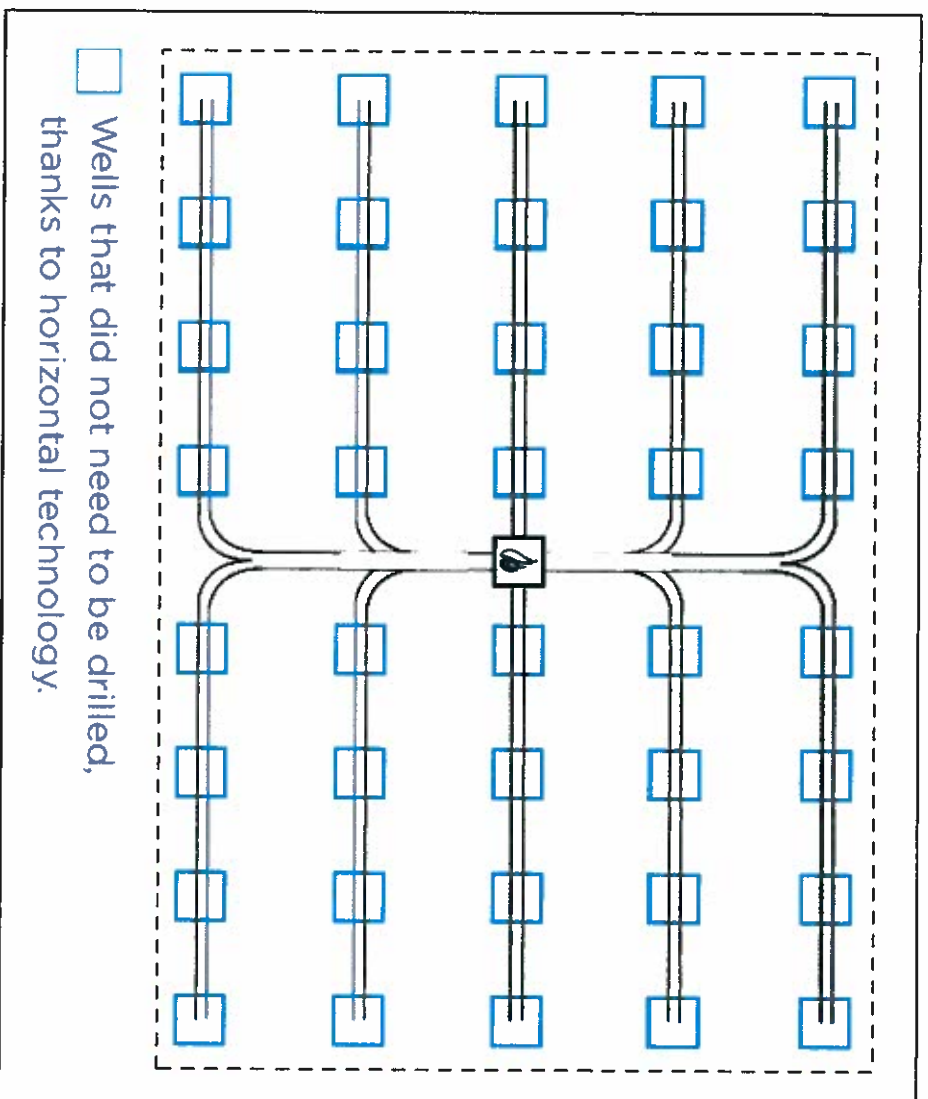
## Drilling

- Vertical or, more commonly, horizontal. Horizontal drilling allows for more efficient production, smaller footprint.
- First step is securing the well's integrity with a string of conductor casing, followed by a string of surface casing to protect underground sources of drinking water.
- Remainder of well is drilled vertically and horizontally as much as 5,000 feet.
- Each hole drilled is approximately 20 inches in diameter at its widest, becoming smaller as drilling progresses downward.

# Organized Development means Environmental Stewardship



New Technologies Allow for Increased  
Production, Reduce Aboveground Disturbance



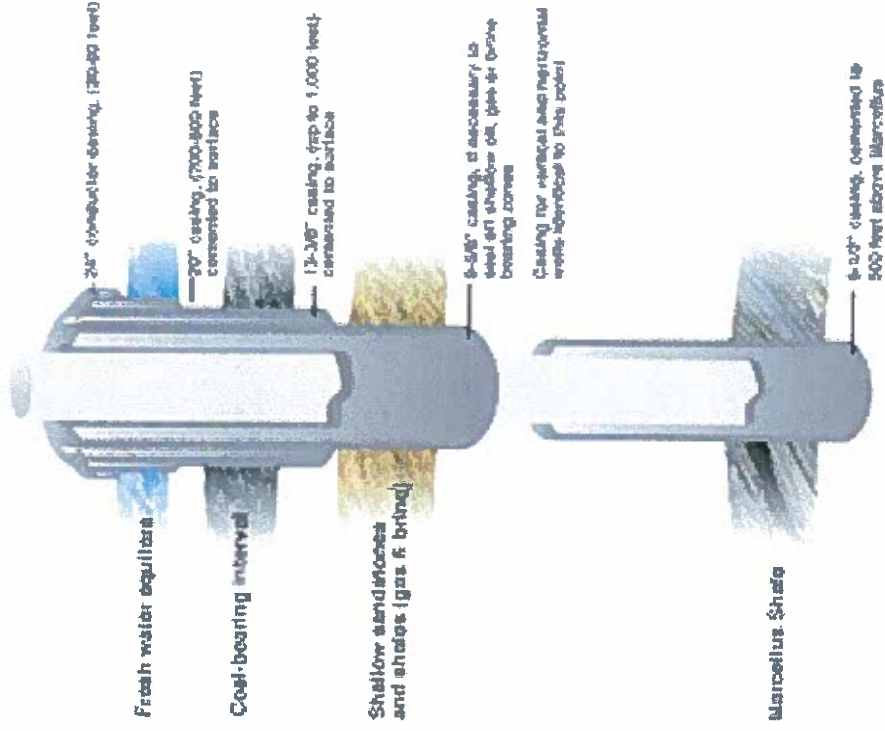
# Marcellus Shale: Steps in Production



## Well Casing

- Metal casing shores up the drilled area (wellbore), both vertically and horizontally, assuring long-term integrity of the well from end-to-end.
- Cement seals the steel casing throughout the entire well, preventing the release of hydrocarbons.

Generalized casing design for a Marcellus Shale gas well to protect the environment



# Marcellus Shale: Steps in Production

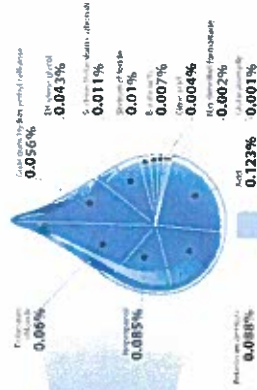


## Hydraulic Fracturing (HF)

- For more than 60 years, more than 1 million wells hydraulically fractured in 27 states
- 90 percent of oil and gas wells use HF technology
- What's in HF Fluid?
  - 99.5 percent water/sand mix
  - Other 0.5 percent consists of other compounds
- Steel and Cement Casing Protect Drinking Water/Ecosystems
  - 25 PA Code Chapter 78 upgrades reflect best practices in well casing

## A FLUID SITUATION: TYPICAL SOLUTION\* USED IN HYDRAULIC FRACTURING

**0.49%  
ADDITIVES\***



On average, **99.5%** of fracturing fluids are comprised of freshwater and compounds are injected into deep shale gas formations and are typically confined by many thousands of feet or rock layers.

Component	Purpose	Common Application
Acids	Helps dissolve minerals and reduce fracture in rock (pre-fractured)	Solvent for cleaner
Aluminate hydroxide	Eliminates bacteria in the water	Disinfectant. Sanitizer for residential and dental equipment
Sodium Chloride	Allows a delayed break down of the gel polymer chains	Table salt
Hydroxyethyl formamide	Prevents the corrosion of the pipe	Used in pharmaceuticals, acrylic fibers and plastics
Borate salt	Increases fluid viscosity as temperature fluctuates	Used in laundry detergents, hand soaps and cosmetics
Polyethylene glycol	Increases friction between fluid and pipe	Water treatment, self-conditioning
Potassium nitrate	"Scales" the water to minimize friction	Makes up primers, dusters, and sand
Gum gum	Thickens the water to suspend the sand	The inner coating on pipes, for use in paint, paper, and ink
Calcium Acetate	Prevents precipitation of metal oxides	Food additive, food and beverage preservative
Potassium chloride	Creates a brine water fluid	Low sodium table salt substitute
Ammonium bicarbonate	Removes oxygen from the water to protect the pipe from corrosion	Cosmetics, food and beverage preservative
Sodium or potassium carbonate	Reduces the effect of iron and other components, such as crystalline	Washing soda, detergent, soap, water softener, glass and jewelry
Proppant	Allows the fractures to remain open so the gas can escape	Building material, sand
Ethylene glycol	Prevents scale deposits in the pipe	Automotive antifreeze, household cleaners, de-icing, and fuel
Surfactant	Used to increase the viscosity of the fracture fluid	Glass cleaners, windshield, and hair color

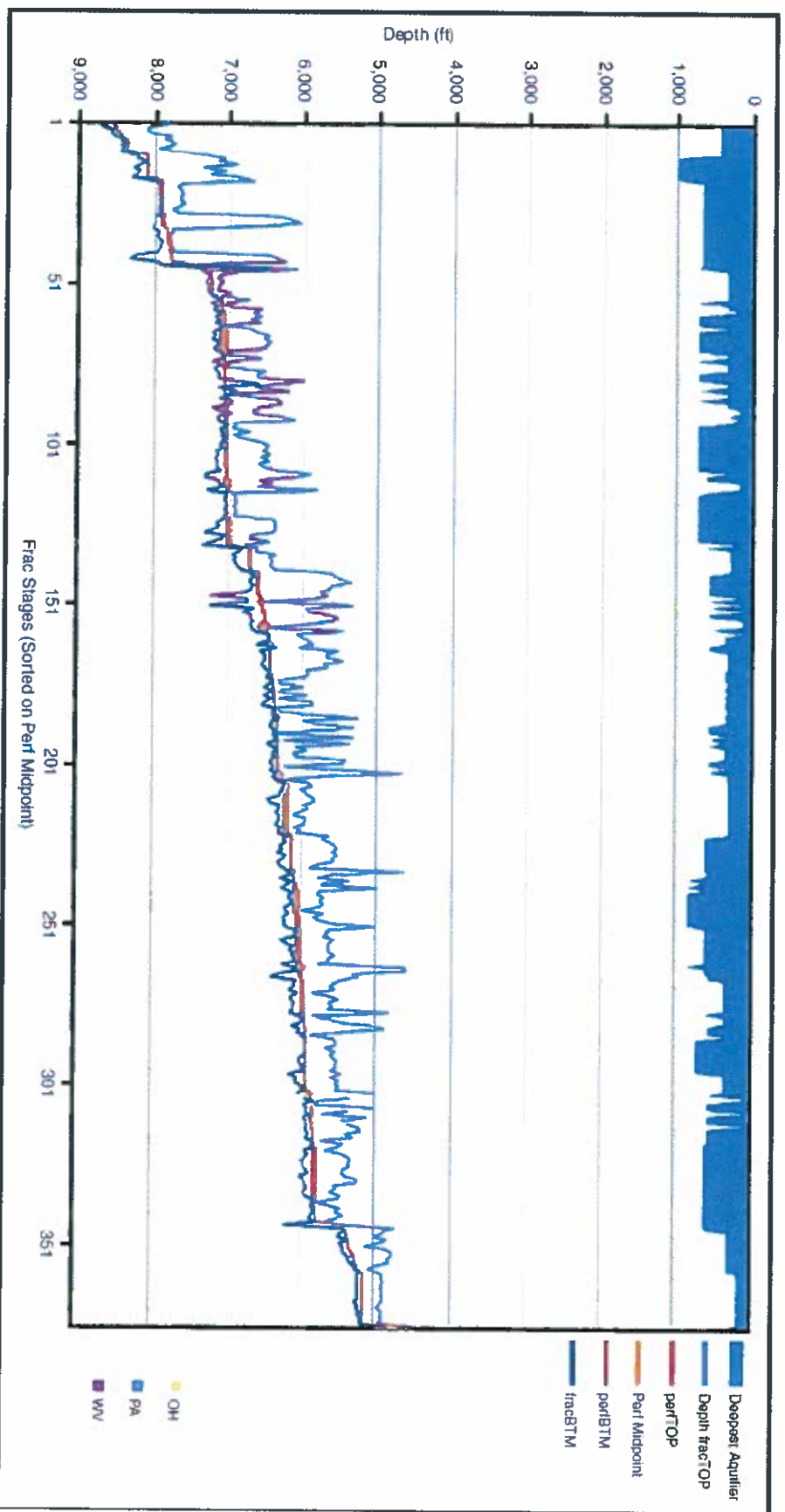
Source: DOE, DRIAC, Modern Gas Shale Development in the United States, 4/2009, 2009

# Marcellus Shale: Steps in Production



## Hydraulic Fracturing: No Impact on Deepest Aquifers

Marcellus Shale Mapped Fracture Treatments (TVD)



Source: *The American Oil and Gas Reporter*, July 2010

# Environmental Protection



## Less Reliance on Water Resources

	Range	Gallons per million BTU Mid-point
Deep shale natural gas	0.60 – 5.80	3
Nuclear	8 – 14	11
Conventional oil	8 – 20	14
Coal	13 – 32	23
Fuel ethanol from corn	2,510 – 29,100	15,800
Biodiesel from soy	14,000 – 75,000	44,500

Source: Ground Water Protection Council, U.S. Department of Energy

## Site Restoration

- Involves landscaping and contouring the property as closely as possible to pre-drilling conditions.
- Property owners generally see:
  - Small wellhead on a level concrete pad
  - Small amount of equipment
  - Two to three water storage tanks
  - Metering system to monitor gas production

# Marcellus Matters: To Our Region



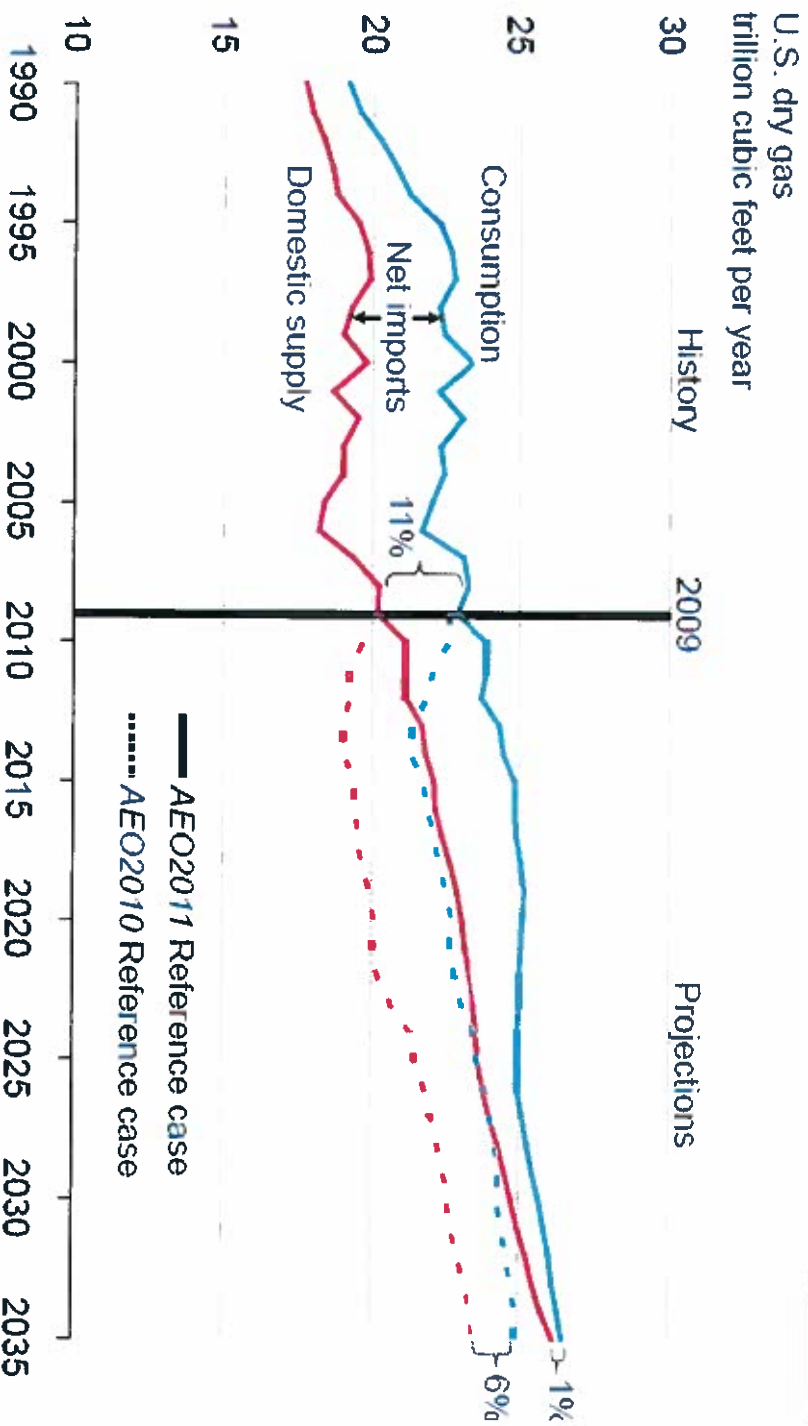
	2009	2010	2020
<b>Economic</b>			
<b>Value Added:</b>	\$3.87 billion	\$8.04 billion	\$18.85 billion
<b>State/Local Taxes:</b>	\$389 million	\$785 million	\$1.87 billion
<b>Cumulative</b>			
<b>Employment:</b>	44,098	88,588	211,909
<b>Wells Drilled:</b>	710	1,743	3,587
<b>Output (bcfe/day):</b>	0.3	1.0	13.5



# National Energy Landscape



**30% domestic gas production growth outpaces 16% consumption growth, leading to declining imports**



Source: Energy Information Administration **DRAFT** Annual Energy Outlook, November 2010

# Thank you!

## Marcellus Shale Coalition

[www.MarcellusCoalition.org](http://www.MarcellusCoalition.org)



