

# Natural Gas Resource Development

February 19, 2014



# Shale Gas 101



#### **Marcellus Shale: Introduction**



Marcellus Shale bank along Route 174 just south of Slate Hill Rd in Marcellus, NY\_\_\_\_\_

#### What is the Marcellus Shale?

- Geological formation formed by accumulation of sediment into a sea almost 400 million years ago

- Compressed to produce an organic-rich black shale.

- Starts at NY, Catskills, stretches across toward Marcellus, New York then southwest to PA, West Virginia, Kentucky, and Ohio.

#### Why Now?

- Success of other shale plays has allowed companies to transfer horizontal drilling and technology to other areas.

- Proximity to high-demand markets along the East Coast make it an attractive target for energy development.



### Shale Gas – Global Opportunity

#### An Elusive Prize | Many nations are believed to have large shale deposits





### Shale Gas Revolution Across the U.S.



Source: Energy Information Administration



### Marcellus Shale: Geographic Footprint





### **Utica Shale**

- Below the Marcellus
- Bigger, deeper, denser
- One of the latest U.S. unconventional energy fields
- Particularly attractive in OH
- Success in the Marcellus has led to success in the Utica





#### **PA Well Count**



#### Marcellus Wells - 5,367 / Utica Wells - 29 / Upper Devonian Wells - 50





#### **OH Well Count**





#### **WV Well Count**





#### **NY Well Count**



# MARCELLUS

### **Industry Segments**

#### UPSTREAM



Exploration and Production

- Gas Field Exploration
- Well Drilling and Hydraulic Fracturing
- Gas Recovery and Production

#### MIDSTREAM



Gathering and Gas Processing

- Gas Collection and Transportation Systems (Gathering Pipelines)
- Gas Processing (Dehy, Separation, Fractionation)
- Compression (Well Head, Gathering)

#### DOWNSTREAM



#### Selling and Distribution

- Interstate and LDC Transportation Systems (Transmission and Distribution Pipelines
- Compression (Transmission)
- Regulation
- Metering

### Segments of the Oil and Gas Industry



Source: MarkWest Energy Partners

MARCELLUS Shale coalition



# Exploration/Production, Midstream, and Downstream 101



#### Land Acquisition/Site Preparation

- Obtain rights from landowner.
- Educated landowner is an ideal partner.
- "Production unit" contiguous parcels of land combined for development.
- Production unit incorporated into a company's drilling program.
- Site is prepared for drilling activity.



### **Steps in Drilling**

#### **Horizontal Drilling**

- More efficient production, smaller footprint.
- Conductor, surface casing protect drinking water source.
- Well is drilled vertically and horizontally as much as 5,000 feet.
- Wellbore is approximately 20 inches in diameter at its widest.
- 5 ac vs. 24 ac = 1 acre when done

#### New Technologies Allow for Increased Production, Reduce Aboveground Disturbance



### **Environmental Protection in Wells**

#### Well Casing

- Multiple layers of steel and cement to ensure redundant protection
  - 1 through fresh water aquifer
  - 2 to depths of ~1,500 feet
  - 3 to final depths

MARCELLUS SHALE COALITION

- Cementing to surface at each layer provides stability and protection, preventing the crossflow of hydrocarbons
- 25 PA Code, Chapter 78 rules have further strengthened standards



#### MARCELLUS SHALE COALITION

### **Steps in Completion**

#### Hydraulic Fracturing

- Permits from state regulatory agencies for water withdrawal.
- New technologies allow producers to recycle most water
- 30 State and federal agencies monitor hydraulic fracturing
- Industrial process; properly encased well, along with proper containment at the surface is critical.





### **Steps in Completion**

#### Hydraulic Fracturing (HF)

- > 60 years: more than 1 million wells in 27 states
- 90 percent of oil and gas wells use HF technology
- 99.5 percent water/sand mix
- 3 to 5 million gallons of water fractures the shale.
- Well casing protects water supply
- PA Chapter 78 upgrades reflect best practices in well casing



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#### **Transparency in Completion**

#### **MSC Commitment to FracFocus.org Bolsters PA Requirements**





FracFocus.org is a Project of the Groundwater Protection Council and the Interstate Oil & Gas Compact Commission



### **Environmental Protection**





#### **Center for Rural PA Study**

- Comprehensive research over two years, published in 2011
- Suggested private water well standards are needed
- Pre-drill testing by natural gas companies a public service
- Regulations require testing of all water supplies within 2,500' of proposed gas well.
- >40% of 1.2 million private water wells do not meet safe drinking water standard, separate from industry activity
- Another 20% percent of wells contained pre-existing methane



### **Steps in Production**

#### **Site Restoration**

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



Courtesy: Range Resources



#### **Recommended Practices**

#### Developed in collaboration with: PA Federation of Sportsmen's Clubs Ducks Unlimited National Wild Turkey Federation Wildlife for Everyone Foundation The Nature Conservancy Ruffed Grouse Society Western PA Conservancy PA Outdoor Writers Association American Chestnut Foundation





- Gathering Line defined in PA state law as a pipeline used to transport natural gas from a production facility to a transmission line
  - Along the way, the lines can lead to a compressor station and possibly a processing plant (in wet gas areas)
- Location of pipelines are subject to negotiation between property owner and pipeline company
- Right of Way Agreements between property owner and pipeline company recorded with county
- Right of Way can contain multiple pipelines and can range from 50-75 feet in width
  - Additional width for construction

Source: MarkWest Energy Partners



#### **Focus on Midstream**



#### **Gathering and Transmission Pipelines**

- Critical link between production and consumers
- Pipelines can transport gas before or after processing
- Designed and constructed to the latest pipeline safety standards
- Utilize new construction methods to minimize the environmental impact
- New coating technologies mean pipelines will last even longer
- Geographic Information Systems allow for efficient layout and accurate tracking of pipeline systems
- Subject to regulatory inspection (PAPUC, DOT PHMSA)



- Pipelines are considered the safest mode of transportation for natural gas and hazardous liquids
  - Does not mean that other modes are not safe
  - State and federal regulation of pipelines and safety
- Federal Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011
  - Pennsylvania Gas and Hazardous Liquids Pipelines Act of 2011
  - Pennsylvania Underground Utility Line Protection Law (PA One Call Law)
  - Pennsylvania Act 13 of 2012
- Third party damage is the greatest threat to pipeline safety
  - Pipeline Placement report recommendation for mandatory One Call participation



### **Compression Systems**



#### **Compressor Stations**

- State of the art sound attenuation
- Built to the highest welding, fabrication, and material standards
- 24/7 monitoring and control
- Automatic safety systems
- Annual inspections by regulating entities

#### **Compressor Packages**

- High tech integrated control systems (engine and compressor)
- 24/7 monitoring and control
- Produced and packaged in the USA
- Operated and maintained by local workers





# **Marcellus Shale Coalition**



#### **Marcellus Shale Coalition**



#### About Us

- Approximately 300 members strong
- From producers to midstream 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



### **Environmental Protection**



### Highly regulated. Highly sophisticated.

- Transparency in permitting
  - Staffing, permit fee increases
- Advances in water recycling and reuse
- Protective well casing standards
- Focus on best practices

FracFocus.org



### **Regulatory Framework**



### MARCELLUS SHALE COALITION Environmental Regulation – Midstream

- Various environmental permits and clearances may be required for the construction of pipelines
  - Erosion and Sediment Control Permits under the PA Clean Streams Law
  - Stream Crossing Permits under the PA Dam Safety and Encroachments Act
  - PA Natural Diversity Inventory clearances to protect threatened and endangered species
  - PA State Programmatic General Permits (PA DEP- US Army Corps of Engineers) under the Federal Clean Water Act
- Other midstream facilities, such as compressor stations and processing plants, require multitude of permits and clearances



#### Land required (acres) to produce fuel to generate enough electricity to serve 1,000 households for one year





### **Environmental Protection**

#### Air Quality Standards

- Short-term monitoring in Northeastern, Southwestern, and North Central PA:
  - "[D]id not identify concentrations of any compound that would likely trigger air-related health issues associated with Marcellus Shale drilling activities."
- Air quality standards tightly-regulated:
  - Gas Processing Plants: Plan approval/air permit
  - Compressors: Covered by GP-5
- Companies exploring "bifuel" rigs to reduce use of diesel



#### Northeastern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report

January 12, 2011

Commonwealth of Pennsylvania Department of Environmental Protection

> Edward Rendell, Governor Commonwealth of Pennsylvania

John Hanger, Secretary Department of Environmental Protection



#### Environmental, Public Health Benefits of Natural Gas

- When used to generate electricity, natural gas emits just over half of the CO<sub>2</sub> per megawatt-hour (MWh) of a traditional power plant.
- Natural gas combined-cycle turbines emit 60 percent less CO<sub>2</sub> per MWh than a typical coal plant.
- Natural gas vehicles emit 25% less CO<sub>2</sub> than vehicles that run on traditional fuels.
- According to the Congressional Research Service, if U.S. doubled the utilization of combined cycle natural gas capacity to 85%, we could displace approximately 636 million metric tons of CO<sub>2</sub>. This amounts to an 8.8% reduction of all CO<sub>2</sub> emissions in the U.S.



- PA Department of Labor and Industry
  - 231,969 employees in Marcellus and related industries as of 2013 Q1\*
  - Core industries were 35.0% higher in 2013
    Q2 than in 2010 Q2\*
  - Core Industry occupations
    - Crude Petroleum & Natural Gas Extraction (\$110,119)
    - Natural Gas Liquefied Extraction (\$100,841)
    - Drilling Oil and Gas Wells (\$84,862)
    - Support Activities of O&G Operations (\$70,401)
    - O&G Pipeline & Related Structures (\$82,127)
    - Pipeline Transportation of Natural Gas (\$85,747)
  - \$83,300 average core industry wage (\$34,800 higher than PA avg.)\*

\*Source: Marcellus Shale Fast Facts, September 2013, PA Department of Labor and Industry





### PA Jobs, PA Workers

- PA Department of Labor and Industry
  - Ancillary Industries
    - Non residential site preparation contractors (\$53,191)
    - Trucking (general freight, specialized freight) (\$42,582-\$51,771)
    - Commercial & industrial machine and equipment repair (\$54,323)
    - Water Supply, Sewage treatment facilities, and infrastructure construction (\$45,560-\$66,741)
    - Engineering Services (\$79,147)
  - \$65,000 average ancillary industry wage (\$16,500 higher than PA avg.)\*

\*Source: Marcellus Shale Fast Facts, September 2013, PA Department of Labor and Industry





### **Statewide Job Opportunities**

- Department of Labor and Industry: 3,730 Marcellus job postings statewide
- Most found at MSC job portal
- Support for ShaleNET
- Training network responds to market demands









- More than 4,500 wells drilled between 2010 and 2012, an investment of approximately \$31.5 billion
- 2013 projection: \$13.5 billion
  - Leasing and bonuses
  - Exploration
  - Drilling and completion
  - Pipelines and processing
  - Royalties

Source: Survey of Marcellus Shale Coalition Board Member Companies



Paid by Natural Gas Industry	
Overall taxes since 2006 <sup>1</sup>	> \$1.8 billion
Road construction investments since 2008 <sup>2</sup>	> \$700 million
Royalty payments to state in 2011 <sup>3</sup>	\$177 million
Permitting and enforcement fees to increase DEP personnel since 2009 <sup>4</sup>	\$40.5 million
Impact Fee in first two years <sup>5</sup>	> \$400 million

<sup>1</sup> – Fox News, July 23, 2013

<sup>2</sup> – On-going Survey of Marcellus Shale Coalition Members

<sup>3</sup> – Pennsylvania Department of Conservation and Natural Resources, 2013

<sup>4</sup> – Pennsylvania Department of Environmental Protection, 2013

<sup>5</sup> – Pennsylvania Public Utility Commission (2007-2011 grandfathered wells plus 2012 assessment)



#### **Impact Fee Revenue Allocations**





**Revenue to Local Government** 

#### Impact Fee Payment 2011 & 2012 County and Municipal Government \$200MM





### **Impact Fee Top 10 Earning Counties**

#### Impact Fee Allocations 2011 & 2012 \$96.8MM





### **Savings for Consumers**

#### Notice of Proposed Annual Change in Natural Gas Rates

Columbia Gas of Pennsylvania, Inc. (Columbia) has filed a request with the Pennsylvania Public Utility Commission (PUC) for a decrease in your gas cost rates as of October 1, 2013. This notice describes the company's rate request, the PUC's role, and what actions you can take.

Columbia has requested an overall rate decrease of \$2.6 million per year as a result of decreases in its costs to purchase gas. If the company's entire request is approved, the total bill for a residential customer who purchases 73 therms of gas from Columbia will decrease from \$75.71 to \$75.41 per month or by 0.40%. The total bill for a commercial customer purchasing 467 therms of gas from Columbia per month will decrease from \$370.92 to \$368.99 per month or by 0.52%. Rates effective for an industrial customer purchasing 5,365 therms of gas from Columbia per month will produce a bill decrease from \$3,776.96 to \$3,754.89 per month or by 0.58%.

While this rate decrease will affect primarily the rates of those customers who purchase their gas from Columbia, it may also have an impact on the rates of those customers who purchase their gas from other natural gas suppliers under Choice® service. In accordance with PUC regulations,

- Heating
  - <u>EIA</u>: Family of four in an 1,800 sq. ft. home can save about \$1,500 a year, or 60%, by switching to gas.
- Electricity
- Natural gas vehicles
- Consumer products

Source: Philadelphia Inquirer, May 19, 2013







### **Marcellus Multiplier**

#### Fast Facts

- \$7+ million investment to produce each well
- ✓ 400+ individuals within nearly 150 different occupations needed to complete and produce gas from a Marcellus well (MSETC, 2010)





#### Act 13, §2316 – Small business participation

- Producers shall provide maximum practicable contracting opportunities for diverse small businesses, including minority, women and veteran-owned businesses.
- Producers shall do the following:
  - Maintain a policy prohibiting discrimination in employment and contracting based on gender, race, creed or color
  - Use the Department of General Services' Internet database to identify certified diverse small businesses
  - Respond to a survey conducted by the Department of General Services
  - Survey shall be sent to all producers within one year to report the producers' efforts to provide maximum practicable contracting opportunities related to unconventional natural gas extraction for diverse, small business participation



# **The Economics of Shale Gas**



### "Decoupling" of Oil and Gas Prices





- 1. Electricity generation, heating
- 2. Combined heat and power applications
- 3. Light and heavy duty transportation applications
- 4. Feedstock for industries and other liquids use
- 5. Exports



### **Energy Consumption Overview**

Quadrillion Btu



Sources: U.S. Energy Information Administration, Annual Energy Review 2010, Tables 1.3, 2.1b-2.1f, 10.3, and 10.4 (October 2011).



# **1.** Electricity generation, heating

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### Pennsylvania CHP Summary

Source	Sites	Capacity (kW)
Total	135	3,276,430
Boiler/Steam Turbine	54	1,929,075
Combined Cycle	5	1,156,400
Combustion Turbine	10	97,715
Fuel Cell	3	580
Microturbine	14	4,290
Other	1	231
Reciprocating Engine	47	85,139
Waste Heat Recovery	1	3,000

Source: ICF International, 2011



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#### **NGV Market Penetration**

	U.S NGV Population		U.S Market Penetration (by vehicle count)		U.S Annual NGV Fuel Use (thousand DGE)		U.S. Market Penetration (by fuel use)	
Vehicle Type	Low	High	Low	High	Low	High	Low	High
Transit Buses	8,500 <sup>b</sup>	12,200 <sup>e</sup>	12.82%	17.43%	146,616 <sup>a</sup>	153,400°	22.79%	23.59%
Refuse Trucks	1,300 <sup>c</sup>	1,500 <sup>b</sup>	0.95%	1.09%	12,856°	14,833°	1.05%	1.21%
School Buses	1,360 <sup>d</sup>	2,300 <sup>b</sup>	0.27%	0.46%	1,635 <sup>d,g</sup>	2,765 <sup>d,g</sup>	0.30%	0.51%
Medium-Duty Trucks/Vans	10,000 <sup>b</sup>	22,000 <sup>a</sup>	0.35%	0.76%	13,042ª		0.15%	
Other Heavy-Duty Trucks	1,600 <sup>a</sup>	3,651ª	0.02%	0.04%	3,253 <sup>a</sup>	7,424ª	0.01%	0.02%
Light Trucks/Vans	41,000 <sup>a</sup>	71,500 <sup>f</sup>	0.05%	0.09%	15,261ª		0.02%	
Passenger Cars	31,000 <sup>a</sup>		0.02%		10,107 <sup>a</sup>		0.01%	
Total	94,760	144,151	0.04%	0.06%	202,770	216,832	0.11%	0.12%

<sup>a</sup>Energy Information Agency, Alternatives to Traditional Transportation Fuels 2008, 2010

<sup>b</sup>Yborra, S., Growth of the NGV Market: Lessons Learned Roadmap for Infrastructure Development, 2008

<sup>c</sup>Cannon, J., Greening Garbage Trucks: Trends in Alternative Fuel Use, 2006

<sup>d</sup>Monahan, P., School Bus Pollution Report Card 2006, 2006

<sup>®</sup>American Public Transportation Association, 2010 Public Transportation Fact Book, 2010

<sup>f</sup>U.S. Census Bureau, Vehicle In Use Survey, 2002

<sup>9</sup>U.S. Department of Energy, Energy Efficiency and Renewable Energy, "Transportation Energy Data Book, Edition 28," 2009.



### **SEPA Natural Gas Equivalency Prices**





#### **Neighborhood Air Emissions**

#### **Neighborhood Air Emissions**

Base Case (Diesel) vs. CNG Case





- 1. Electricity generation, heating
- 2. Combined heat and power applications
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#### "Wet Gas" Region



Sources: Pace Global; Equitable Resources, MarkWest, Atlas Energy, Range Resources, and Caiman Energy.



### **Composition in Wet Gas Region**



Source: Pace Global; NiSource Gas Transmission and Storage Presentation to WVONGA Spring Meeting May 6, 2010 p.5



- 1. Electricity generation, heating
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# **5. Exports**



#### International joint venture investment in U.S. shale plays (2008-12) billion dollars



Source: EIA, April 8, 2013

#### MARCELLUS SHALE COALITION

#### **International Interest**





# **THANK YOU!**



Facied by natural gas, for a greener tomorrow.



# Some Takeaway Thoughts....

2/24/2014