ACEC Environment & Energy Committee

Natural Gas Industry Update
August 13, 2018

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President
Marcellus Shale Coalition
Long Oil and Gas Well History

- Long history of producing natural gas in Appalachia
- Fueling American homes and businesses since the mid 1800s
- Steel industry took root in western PA/along the Great Lakes in part due to natural gas availability
- All steel, glass, plastics, chemicals, fertilizers, powdered metals, & pharmaceuticals require natural gas
Our Membership
- 200+ diverse members
- Producers, midstream and suppliers

Our Focus
- Long-term development
- End use opportunities
- Addressing landowner and public issues
- Maximizing benefits to secure our region’s energy future

About MSC

Associate Members are an integral part of the MSC and the industry’s robust supply chain. More than 95% of the natural gas in Pennsylvania is produced by MSC member companies. The MSC Board of Directors consists of 35 major producer and midstream companies in the Appalachian Basin.
2008 Early MSC Focus

- Public Education
- Workforce Readiness
- Demystify Shale Gas Development
- Training and Information Sharing
- Communications
- Secure Robust Regulatory Framework

2012

- Heightened Advocacy
- Build Grassroots Engagement
- Heightened Social Media Interaction
What is the Marcellus Shale?

- A geological formation formed by accumulation of sediment into a sea almost 400 million years ago.
- Compressed to produce an organic-rich black shale.
- In parts of NY, PA, WV, OH, and MD.

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.
Feedstock: “Wet Gas” Region

Legend
- Marcellus /Utica Formation
- Wet Gas Region

Wet Gas
>1.2 MMBtu per Mcf

Dry Gas
<1.2 MMBtu per Mcf
Key Report Findings

• Pennsylvania is self-sufficient in natural gas (net exporter)

• 2020 output levels (17 billion cubic feet per day) could make the Marcellus the single largest producing gas field in the U.S.

• Marcellus could produce a quarter of U.S. natural gas by 2020.

• $1.6 billion in lease and bonus payments in 2010.
Pennsylvania Natural Gas

Net Importer to Net Exporter

2008 vs. 2016

Production v. Consumption

2008
- PA Consumption: 0.75
- PA Production: 0.2
- U.S. Production: 20.16

2016
- PA Consumption: 1.31
- PA Production: 5.25
- U.S. Production: 26.66

Trillion Cubic Feet

Source: U.S. Energy Information Administration

Marcellus Shale Coalition

MARCELLUSCOALITION.ORG | @MARCELLUSGAS
Pennsylvania: A World-Class Player in Shale Gas Production

- 2nd largest natural gas producer in U.S.
- Nearly 8,400 producing wells
- 5.36 Trillion Cubic Feet (2017)
- 20% of total U.S. natural gas production
- 33 of 67 counties with at least 1 producing well
10,447 unconventional wells*
- 576 shut in
- 760 drilling not completed
- 591 inactive

8,459 unconventional wells producing natural gas

16+ billion cubic feet/day
- 5.3 trillion+ cubic feet/year
- 37% of total U.S. shale gas production

* May 2018 (most recent data available)
PA Unconventional Shale Gas Production
Year-Over-Year Increase

Source: Marcellus Shale Coalition & PA DEP
Drilling Activity in PA

**PA Rig Count 2011 - 2018**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rig Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec '11</td>
<td>111</td>
</tr>
<tr>
<td>Dec '12</td>
<td>71</td>
</tr>
<tr>
<td>Dec '13</td>
<td>55</td>
</tr>
<tr>
<td>Dec '14</td>
<td>55</td>
</tr>
<tr>
<td>Dec '15</td>
<td>28</td>
</tr>
<tr>
<td>Dec '16</td>
<td>29</td>
</tr>
<tr>
<td>Dec. '17</td>
<td>36</td>
</tr>
<tr>
<td>July '18</td>
<td>37</td>
</tr>
</tbody>
</table>

Source: Baker Hughes
### By The Numbers

#### Top Ten Producing Counties by Volume (2017)

<table>
<thead>
<tr>
<th>County</th>
<th>Production (MCF)</th>
<th>% of PA Production</th>
<th># of Producing Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susquehanna</td>
<td>1,306,666,799</td>
<td>24%</td>
<td>1217</td>
</tr>
<tr>
<td>Washington</td>
<td>945,704,528</td>
<td>18%</td>
<td>1324</td>
</tr>
<tr>
<td>Bradford</td>
<td>709,169,357</td>
<td>13%</td>
<td>1071</td>
</tr>
<tr>
<td>Greene</td>
<td>659,887,108</td>
<td>12%</td>
<td>939</td>
</tr>
<tr>
<td>Wyoming</td>
<td>354,940,122</td>
<td>7%</td>
<td>231</td>
</tr>
<tr>
<td>Lycoming</td>
<td>344,303,678</td>
<td>6%</td>
<td>759</td>
</tr>
<tr>
<td>Tioga</td>
<td>220,607,204</td>
<td>4%</td>
<td>568</td>
</tr>
<tr>
<td>Butler</td>
<td>185,455,157</td>
<td>3%</td>
<td>394</td>
</tr>
<tr>
<td>Sullivan</td>
<td>139,942,799</td>
<td>3%</td>
<td>108</td>
</tr>
<tr>
<td>Fayette</td>
<td>79,148,683</td>
<td>1%</td>
<td>7</td>
</tr>
</tbody>
</table>
Unconventional Well Activity
2008-2018

Source: PA DEP Well Permit & Spud Data Report

Marcellus Shale Coalition
Drilling Rigs in PA

Source: Baker Hughes (April 20 ‘18)
Unconventional Natural Gas Production
By Region - 2017

- **Northwest**: 2.6%
- **Northcentral/Northeast**: 39.20%
- **Southwest**: 58%
Vital need for Infrastructure

- 24 FERC projects (Tri-State Area)
- $12.9 Billion (PA)
# Primary PA Interconnect Points

## August Bid Week Pricing (Inside FERC's Gas Market Report)

<table>
<thead>
<tr>
<th>Location</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tennessee Zone 4</td>
<td>$2.16/MMBTU</td>
</tr>
<tr>
<td>Leidy Receipts</td>
<td>$2.23/MMBTU</td>
</tr>
<tr>
<td>Dominion Appalachia</td>
<td>$2.40/MMBTU</td>
</tr>
<tr>
<td>Average Gas Sales $</td>
<td>$2.28/MMBTU</td>
</tr>
</tbody>
</table>

Average Gathering of $.80/ MMBTU (Independent Fiscal Office)
PA Price Differential

PA Price Basis Differential
August 2018

$4.19
$4.04
$2.82
$2.28

* August 2018 Monthly Bidweek Price
PA Price Differential

Natural Gas Pricing
PA vs NYMEX
2017

$3.93
$3.23
$2.39
$3.07
$2.00
$4.50
$4.00
$3.50
$3.00
$2.50
$2.00
$1.50
$1.00
$0.50
$0.00

Jan Feb March April May June July Aug Sept Oct Nov Dec

$ per MCF

Reduced monthly bidweek price received by PA producers & leaseholders

Source: Platts Inside FERC
Strong state, federal & local regulations:

- Transparency in permitting
- Staffing, permit fee increases
- Advances in water recycling and reuse
- Protective well casing standards
- Focus on best practices
- FracFocus.org
Unconventional Natural Gas Compliance
2010 - 2017

Source: 2010-2016 – PA DEP Annual Report
2017 – PA DEP Compliance Website

- Inspections
- Violations
- Enforcements
Natural Gas: Enhancing Pennsylvania’s Air Quality
Total Electric Power Generation Emissions

<table>
<thead>
<tr>
<th>Emission</th>
<th>2014 – 2015 Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen Oxide</td>
<td>↓ 19%</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>↓ 25%</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>↓ 23%</td>
</tr>
<tr>
<td>Carbon Dioxide Equivalent</td>
<td>↓ 8.5%</td>
</tr>
</tbody>
</table>

Source: PA Department of Environmental Protection
Lower Prices = Customer Savings

- Wholesale electric prices down 41% since 2008
- Natural gas prices for end-use customers down 57% - 81% since 2008
- Average annual savings > $1,200 per household
## Benefiting Consumers

### Lower Prices = Customer Savings
#### 2008 - 2016

<table>
<thead>
<tr>
<th>Utility</th>
<th>PGC Rate / mcf</th>
<th>% Change</th>
<th>Customer Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008*</td>
<td>2016*</td>
<td>2008-2016</td>
</tr>
<tr>
<td>PECO</td>
<td>$11.10</td>
<td>$3.41</td>
<td>- 69%</td>
</tr>
<tr>
<td>NFG</td>
<td>$10.34</td>
<td>$1.92</td>
<td>- 81%</td>
</tr>
<tr>
<td>PGW</td>
<td>$10.58</td>
<td>$3.22</td>
<td>- 70%</td>
</tr>
<tr>
<td>Columbia</td>
<td>$10.25</td>
<td>$3.64</td>
<td>- 64%</td>
</tr>
<tr>
<td>Equitable</td>
<td>$11.81</td>
<td>$2.72</td>
<td>- 77%</td>
</tr>
<tr>
<td>UGI</td>
<td>$11.79</td>
<td>$5.06</td>
<td>- 57%</td>
</tr>
<tr>
<td>UGI Penn</td>
<td>$10.66</td>
<td>$3.72</td>
<td>- 65%</td>
</tr>
<tr>
<td>Peoples</td>
<td>$9.53</td>
<td>$2.72</td>
<td>- 71%</td>
</tr>
</tbody>
</table>

* 1st Quarter 2008 & PUC-approved rate for 2016

* Residential heating customer using 15 mcf/month
What is Act 13 of 2012?

First comprehensive re-write of PA oil and gas act in nearly 30 years

Three major components:

- Enhanced environmental standards
  - Setbacks, permitting standards, bonding, chemical disclosure, water protection, public notice, penalties
- Uniformity of local ordinances
- Imposition and distribution of impact fee
Impact Fee Revenues to Date

<table>
<thead>
<tr>
<th>Year Distributed</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$204.2 M</td>
</tr>
<tr>
<td>2013</td>
<td>$202.5 M</td>
</tr>
<tr>
<td>2014</td>
<td>$225.8 M</td>
</tr>
<tr>
<td>2015</td>
<td>$223.5 M</td>
</tr>
<tr>
<td>2016</td>
<td>$187.7 M</td>
</tr>
<tr>
<td>2017</td>
<td>$173.3 M</td>
</tr>
<tr>
<td>2018</td>
<td>$209.6 M</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>$1.427 Billion</strong></td>
</tr>
</tbody>
</table>
benefiting PA communities

impact fee distributions
2018

- State Agency Oversight: $45.92 M
- Local Government: $114.8 M
- All Counties - Parks & Bridges: $30.61 M
- Statewide - Environmental: $18.25 M
PA Natural Gas Producers: Paying Their Fair Share
2017 Drilling Tax Revenue

Millions of Dollars

Appalachian Basin States

- NEW YORK: $0
- NEW JERSEY: $0
- WEST VIRGINIA: $69
- PENNSYLVANIA*: $209.6
- OHIO: $36.7
- DELAWARE: $0
- MARYLAND: $0

* Act 13 Natural Gas Impact Tax
Source: State Budget Offices & PA PUC
Climate Certainty

- Chapter 78a
- GP-5 and GP-5A
- Permit delays
- Post-production costs
- Local zoning
- Severance Tax/Impact Tax
- Delaware River Basin Commission
- *Briggs v Southwestern Energy*
Electricity generation, heating

Combined heat and power applications

Light and heavy duty transportation applications

Feedstock for industries and other liquids use
  - Rebirth of manufacturing

Exports
Natural Gas End Use

NATURAL GAS CONSUMPTION
2017 - BY SECTOR

- Industrial: 32%
- Electric Power: 37%
- Residential: 18%
- Commercial: 13%

Source: EIA Natural Gas Monthly – Feb. 2018
Within the next decade, Pennsylvania can take strategic steps to improve its economic performance above its current trajectory by:

– $60 billion, ~6-9% growth in annual state GDP over about 10 years, from ~$720 billion (under a business-as-usual scenario) to ~$780 billion by pursuing targeted growth actions (increase from 1.6% to 2.3% in average annual growth rate);

– >100,000 more jobs, a ~1-2% increase over about 10 years, from ~6.2 million jobs in 2025 (under a business-as-usual scenario) to ~6.3 million jobs in 2025 by pursuing targeted growth actions (increase from 0.65% to 0.85% in average annual growth rate);

– >4.5 trillion cubic feet (Tcf) increase in gas demand, a ~90% increase over 10 years, from ~5 Tcf in 2025 (under a business-as-usual scenario) to ~9.5 Tcf by pursuing targeted growth actions;

– Significant increase in state revenues – estimated to be at least $2-3 billion, supported by large expansion in state GDP and corporate activity.
Opportunities in Power Generation
The Ethane Factor

ETHYLENE CHAIN

Natural Gas → Ethane → Cracker → Intermediate Products

- PVC
- Vinyl Chloride
- Ethylene Glycol
- Styrene
- Polystyrene
- Polyethylene

Pool Liners
Window Siding
Trash Bags
Sealants
Carpet Backing
Insulation
Detergent
Flooring Pipes

Food Packaging
Bottles
Cups
Housewares
Crates

Footwear
Clothes
Diapers
Stockings
Toys
Textiles

Tires
Sealants
Paint
Antifreeze

Adhesives
Coatings
Films
Paper Coatings
Models
Instrument Lenses

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Active Cracker Projects

- Shell
- PTT
- Braskem
Opportunities Related to Crackers

1. Shell Cracker
   - Construction
   - Operations

2. Co/Byproducts

3. Supply Chain

4. Plastics Manufacturing:
   - Compounders
   - Converters
   - Intermediaries / Logistics

5. Additional Cracker(s):
   - PTT – Dilles Bottom, OH
   - Other

6. Other PetChem Facilities

7. Midstream Infrastructure
Why Did Shell Pick Monaca, PA?

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**Market Drivers**
- Growing North American PE Market

**Regional Advantages**
- Market Access
- Abundant / Cheap Ethane
- Enough Infrastructure

**Local Factors**
- Workforce: Build/Operate
  - Suitable Site:
    - Size
    - Flat
    - Size
    - Water
    - Rail
  - Welcoming Community

**Policies**
- Incentives
- OK Regulations

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"World-class resource base at the doorstep of the customer. This will give us a long-term, sustainable competitive advantage."

_Ate Visser, Vice President, Appalachia Petrochemicals, Shell Chemical LP_

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Pittsburgh Regional Alliance
- $6B+ Capital Investment
- ~3.5B Pounds of Polyethylene / Year
- 600 Full-time Employees
- 6000 During Construction Phase
Proximity to End Customers

Why Are Plastics Factories Here?

If Polyethylene Is Here
Advantages to Local PE Supply

- **Reliability**

- **Transportation Costs:**
  - Potential Savings of ~2¢ / lb.*
  - ~1.5% COGS*

- **Reduced Delivery Time:**
  - Reduced Inventory Carrying Costs

- **Transportation Options**

*PRA estimates based on available industry data
Polyethylene Grades

- High Density
- Low Density
- Linear Low Density
Thank you!

Marcelluscoalition.org