PIOGA’s Pipeline and Gas Market Development Committee consists of various stakeholders: producers, generators, pipelines, engineers, marketers, schedulers, analysts, consultants, entrepreneurs, government relations, attorneys, business and economic development professionals

Joyce Turkaly, Director Natural Gas Market Development
What has natural gas market development 2014–2015 looked like?

- Federal Issues around Gas and Electric Interoperability
- Meeting with IPAA and ANGA teams; common marketplace initiatives
- Monitoring regulation and proposed legislation
- Identifying barriers to Market Entry; highlight tariff language that may impede
- Speak at events and organize outreach
- Contribute updates for PGMD agenda
- Supporting the end-use with emphasis on manufacturing message and LNG Export
- Meeting Regional Business Development
- Speaking with PIOGA members and setting up stakeholder meetings
- Spreading the news of PIOGA to prospective members and downstream developments in PIOGA Press
Outline for Today:

- Petrochemical
- LNG Exports
- Demand Sectors
  with emphasis on Electric Generation
- Alternative Fuels (CNG)
- Barriers to Market Development
Roughly two-thirds of natural gas demand comes from Industrial and Electric Generation demand.

Chemical Industry is the largest industrial consumer of energy resources** includes coal, petroleum, natural gas, hydrothermal.
“The world needs crackers: U.S. is a good place for them” Renato Monteiro, VP Business Development, Braskem

The world needs 4–5 new world-scale crackers per year to satisfy the ethylene global demand growth **11–19 announced in PA

North American challenges
Oil price uncertainty, feedstock volatility, EPC cost escalation, export logistic bottleneck, exchange rate appreciation

North American benefits
Feedstock availability, cost advantage, robust O&G industry, conducive investment climate, stability, market economy
North American LNG Import/Export Terminals
Approved

Import Terminals

U.S.
APPROVED - UNDER CONSTRUCTION - FERC
1. Corpus Christi, TX: 0.4 Bcf/day (Cheniere – Corpus Christi LNG) (CP12-507)
APPROVED – NOT UNDER CONSTRUCTION - FERC
2. Salina, PR: 0.6 Bcf/day (Aguirre Offshore GasPort, LLC) (CP13-193)
APPROVED – NOT UNDER CONSTRUCTION - MARAD/Coast Guard
3. Gulf of Mexico: 1.0 Bcf/day (Main Pass McMoRan) Exp.
4. Offshore Florida: 1.2 Bcf/day (Hoegh LNG – Port Dolphine Energy)
5. Gulf of Mexico: 1.4 Bcf/day (TORP Technology-Bienville LNG)

Export Terminals

U.S.
APPROVED - UNDER CONSTRUCTION - FERC
6. Sabine, LA: 2.76 Bcf/day (Cheniere/Sabine Pass LNG) (CP11-72 & CP14-12)
7. Hackberry, LA: 1.7 Bcf/day (Sempoa-Cameron LNG) (CP13-25)
8. Freeport, TX: 1.6 Bcf/day (Freeport LNG Dev/Freeport LNG Expansion/Liquefaction) (CP12-509)
9. Cove Point, MD: 0.82 Bcf/day (Dominion Cove Point LNG) (CP13-113)
10. Corpus Christi, TX: 2.14 Bcf/day (Cheniere – Corpus Christi LNG) (CP12-507)
APPROVED – NOT UNDER CONSTRUCTION - FERC
11. Sabine Pasa, LA: 1.40 Bcf/day (Sabine Pass Liquefaction) (CP13-552)

Canada
APPROVED – NOT UNDER CONSTRUCTION
12. Port Hawkesbury, NS: 0.5 Bcf/day (Bear Head LNG)
13. Kitimat, BC: 3.23 Bcf/day (LNG Canada)

As of September 15, 2015
<table>
<thead>
<tr>
<th></th>
<th>Consumption (billion cubic feet per day)</th>
<th>Consumption Growth (bcf per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric power</td>
<td>24.89</td>
<td>22.44</td>
</tr>
<tr>
<td>Industrial</td>
<td>19.74</td>
<td>20.31</td>
</tr>
<tr>
<td>Residential and</td>
<td>19.25</td>
<td>22.45</td>
</tr>
<tr>
<td>commercial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>5.89</td>
<td>6.49</td>
</tr>
<tr>
<td>Total consumption</td>
<td>69.78</td>
<td>71.69</td>
</tr>
</tbody>
</table>

Source: Short-Term Energy Outlook, September 2015.

**U.S. Natural Gas Consumption**

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption (Bcf/d)</th>
<th>Annual Change (Bcf/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electric power</td>
<td>Industrial</td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Short-Term Energy Outlook, September 2015.
United States

- More than 210 natural gas pipeline systems.
- 305,000 miles of interstate and intrastate transmission pipelines.
- More than 1,400 compressor stations that maintain pressure on the natural gas pipeline network and assure continuous forward movement of supplies.
- More than 11,000 delivery points, 5,000 receipt points, and 1,400 interconnection points that provide for the transfer of natural gas throughout the United States.
- 24 hubs or market centers that provide additional interconnections.
- 400 underground natural gas storage facilities.
- 49 locations where natural gas can be imported/exported via pipelines.
- 8 LNG (liquefied natural gas) import facilities and 100 LNG peaking facilities.

Pennsylvania

- 20 Interstate natural gas pipeline systems operate within the Northeast Region; 7 within Pennsylvania.
- 46,000 miles of distribution pipelines.
- 5 Energy Hubs.
- 36 Natural Gas Distribution Companies.
- ~ 130 licensed natural gas suppliers.
- 11 Electric Distribution Companies.
- ~ 300 licensed electric suppliers.

Needed: additional midstream pipelines to get gas to downstream markets.
Electric Power Sector largest consumer of natural gas

Monthly data for 2010 through 2014 show deliveries of natural gas to the electric power sector averaged 23 billion cubic feet per day (Bcf/d), ranging from about 30 Bcf/d in the summer peak to 16 Bcf/d in the spring or fall.
Generation Deactivations

Over 20 GW of Actual & Announced Deactivations 2011-2016
FERC provided needed guidance in Order No. 787 regarding electric rules and gas rules which were in place for the 2013-2014 winter. To date the enhanced communications have been key to demand management.
Gas Infrastructure serving generation in PJM

- Algonquin Gas Transmission (Spectra Energy)
- Alliance Pipeline (Enbridge / Veresen)
- ANR Pipeline (TransCanada)
- Big Sandy Pipeline (Spectra Energy)
- Central New York Oil & Gas (Crestwood Midstream Partners)
- Columbia Gas Transmission (NiSource)
- Crossroads Pipeline (NiSource)
- Dominion Transmission (Dominion Resources)
- Dominion Cove Point (Dominion Resources)
- Eastern Shore (Chesapeake Utilities)
- Equitrans (EQT Midstream Partners)
- Guardian Pipeline (ONEOK)
- Horizon Pipeline (NGPL / Nicor-Horizon)
- Kinder Morgan Illinois (NGPL)
- KO Transmission (Duke Energy / Columbia Gas)
- Midwestern Gas Transmission (ONEOK)
- National Fuel Gas Supply Corporation (National Fuel Gas Company)
- Natural Gas Pipeline Company of America (Kinder Morgan / Myria Acquisition)
- Northern Border Pipeline (TransCanada / ONEOK)
- Panhandle Eastern (Energy Transfer Partners)
- Rockies Express (Tallgrass / Sempra / Phillips 66)
- Tennessee Gas Pipeline (Kinder Morgan)
- Texas Eastern Transmission (Spectra Energy)
- Texas Gas (Boardwalk Pipeline Partners)
- Transcontinental Pipeline (Williams)
- Vector Pipeline (Enbridge / DTE Energy)
- Ameren Illinois
- Atmos Energy
- Baltimore Gas & Electric (Exelon)
- City of Richmond (Municipal)
- Columbia Gas of Pennsylvania (NiSource)
- Columbia Gas of Virginia (NiSource)
- Delmarva Power & Light (Pepco Holdings)
- Dominion East Ohio (Dominion Resources)
- Dominion Hope (Dominion Resources)
- Duke Energy Ohio (Duke Energy)
- Easton Utilities Commission (Municipal)
- Elizabethtown Gas (AGL Resources)
- Midamerican Energy
- Mountaineer Gas Company
- National Fuel Gas Distribution
- New Jersey Natural Gas
- Nicor Gas (AGL Resources)
- North Shore Gas
- Northeast Ohio Natural Gas
- PECO Energy
- Peoples Gas Light and Coke (Integrys Energy Services)
- Peoples Natural Gas
- Philadelphia Gas Works
- Piedmont Natural Gas
- Public Service Electric & Gas
- South Jersey Gas (South Jersey Industries)
- UGI Utilities (UGI Corporation)
- Vectren Energy Delivery (Vectren Corporation)
- Virginia Natural Gas
- Washington Gas Light (WGL Holdings)
PJM’s changing resource mix

Cleared Installed Capacity

- Coal
- Gas
- Nuclear
- Demand Response
- Wind & Solar* (*Nameplate)
Almost half of all US storage is under the PJM Footprint
Gas Nominations
10 a.m. - 10 a.m.
Generators purchase gas commodity to be delivered Thursday.

Day-Ahead Market
Midnight - Midnight
Day-Ahead Markets match energy needed with generation available for Thursday.

Represented 2 hour increments

Resources "clear" the market in order of lowest to highest cost.

* Prices for renewable sources can be low or high.

Interstate Pipeline
Firm Customer
When capacity is tight, residential heating customers are prioritized.

Interruptible Customer
This may be an electric generation plant.

Combustion Turbine
Coal
Combined Cycles
Nuclear
Renewables*
Forget about “chicken and egg”
Alternative Fuels Market for Transportation

For these reasons, natural gas adoption rate will continue to increase.
- Continued low NG fuel costs
- Increased fueling infrastructure
- More NG engines & vehicles available

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>NG Market Adoption Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
</tr>
<tr>
<td>Transit Bus</td>
<td>25%</td>
</tr>
<tr>
<td>Refuse Truck</td>
<td>49%</td>
</tr>
<tr>
<td>HD Truck</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>
Barriers to entry

- Additional regulatory costs and delays
- Federal Approval of new design delays
- Unclear market signals
- Tax disadvantages; EPA Carbon Tax
- Lack of consumer incentives and education and awareness
- Anti’s
We have supply and identified markets with infrastructure slated for in-service

» What else is needed?
Working together for energy security and reliability

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