



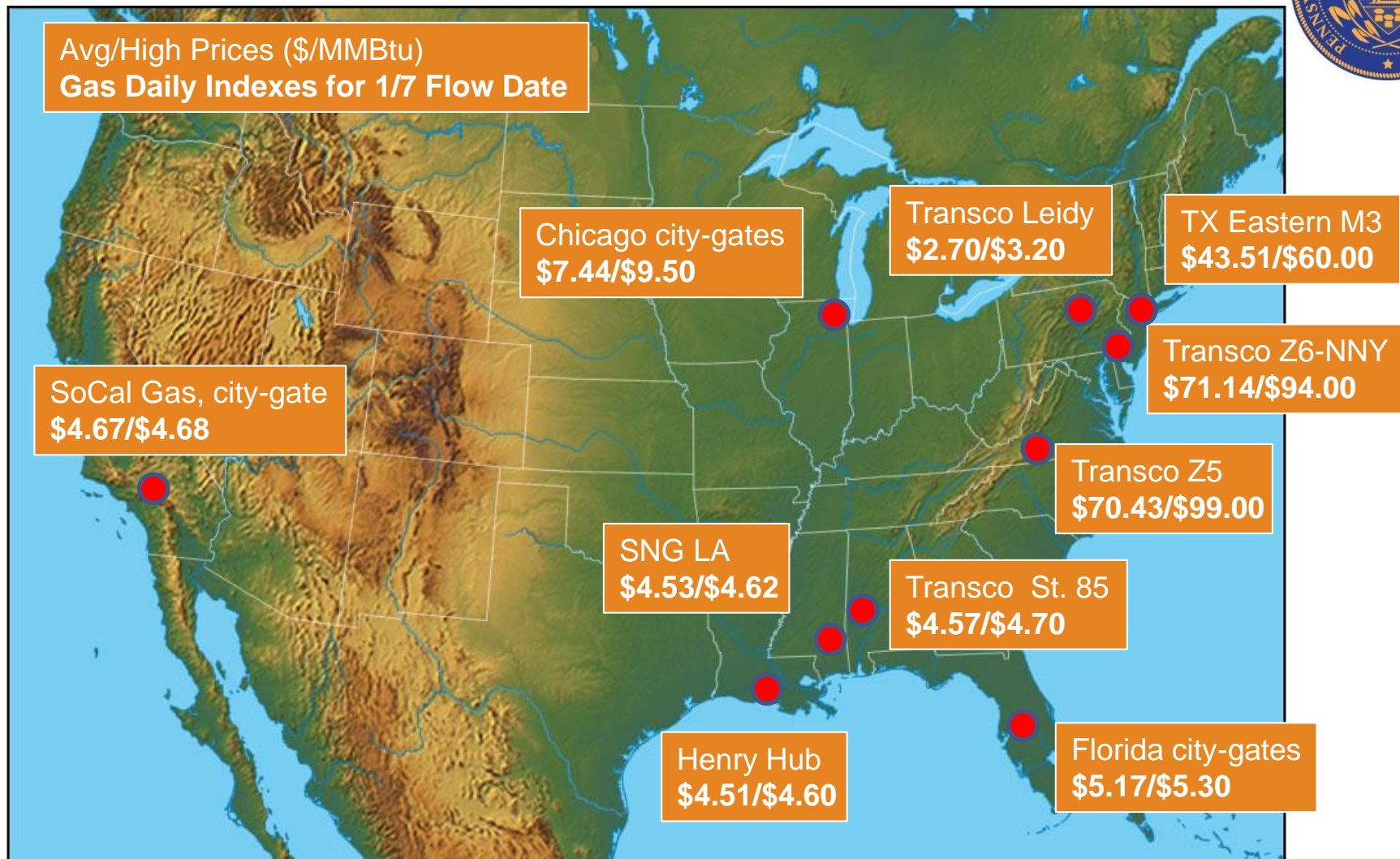
# SHALE RESOURCES - MAXIMIZING BENEFITS FOR THE U.S.

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July 11, 2016

Commissioner Robert F. Powelson  
Pennsylvania Public Utility Commission

# Basis Blowout - Jan 7, 2014





## Reductions in Purchased Gas Cost (PGC) Rates Translate into Savings for Customers (2015)

Utility	PGC Rate / mcf		% Change	Customer <sup>^</sup> Savings
	2008*	2015*		Monthly
<b>PECO</b>	\$11.10	\$3.53	68%	<b>\$113.55</b>
<b>NFG</b>	\$10.34	\$3.10	70%	<b>\$108.60</b>
<b>PGW</b>	\$10.58	\$4.17	61%	<b>\$96.15</b>
<b>Columbia</b>	\$10.25	\$4.68	54%	<b>\$83.55</b>
<b>Equitable</b>	\$11.81	\$4.22	64%	<b>\$113.85</b>
<b>UGI</b>	\$11.79	\$4.85	59%	<b>\$104.10</b>
<b>UGI Penn</b>	\$10.66	\$4.22	60%	<b>\$96.60</b>
<b>Peoples</b>	\$9.53	\$2.59	73%	<b>\$104.10</b>

\* 1st Quarter 2008 and PUC-approved rate for 2015    ^ Residential heating customer using 15 mcf/month



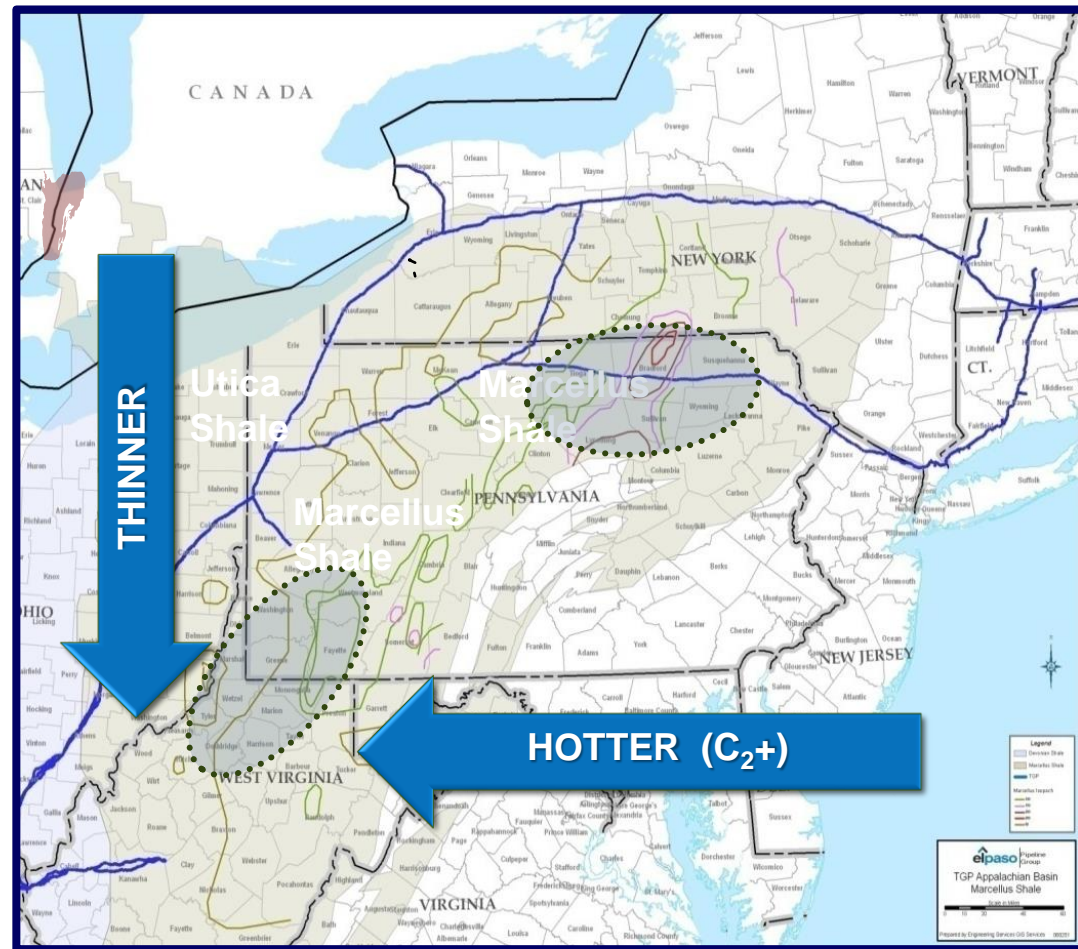
# Pipeline Development in PA

	<u>Project Cost</u>	<u>Status</u>
• Atlantic Sunrise	\$3 billion	-7(c) application pending at FERC -2016 construction begins -July 2017 in-service date
• Penn East	\$1 billion	-7(c) application pending at FERC -Spring 2017 construction begins -Early 2018 in-service date
• Northeast Energy Direct	\$3.3 billion	-7(c) application pending at FERC -January 2017 construction begins -November 1, 2018 in-service date
• Mariner East I & II	\$3 billion	-ME I- began propane shipments 2014, fully operational Q4-2015 -ME II – plans to be operational in Q4-2016
<b>TOTAL INVESTMENT</b>	<b>\$10.3 billion</b>	

# Marcellus BTU Characteristics Create Ethane Issue



- NE PA Marcellus:
  - Processing not needed
- SW PA Marcellus
  - Has higher BTU → processing is needed
- Industry solution for ethane transport needed
  - Pipelines may not accept higher BTU
  - No regional ethane market
- Traditional approach: build NGL line
  - Infrastructure does not exist



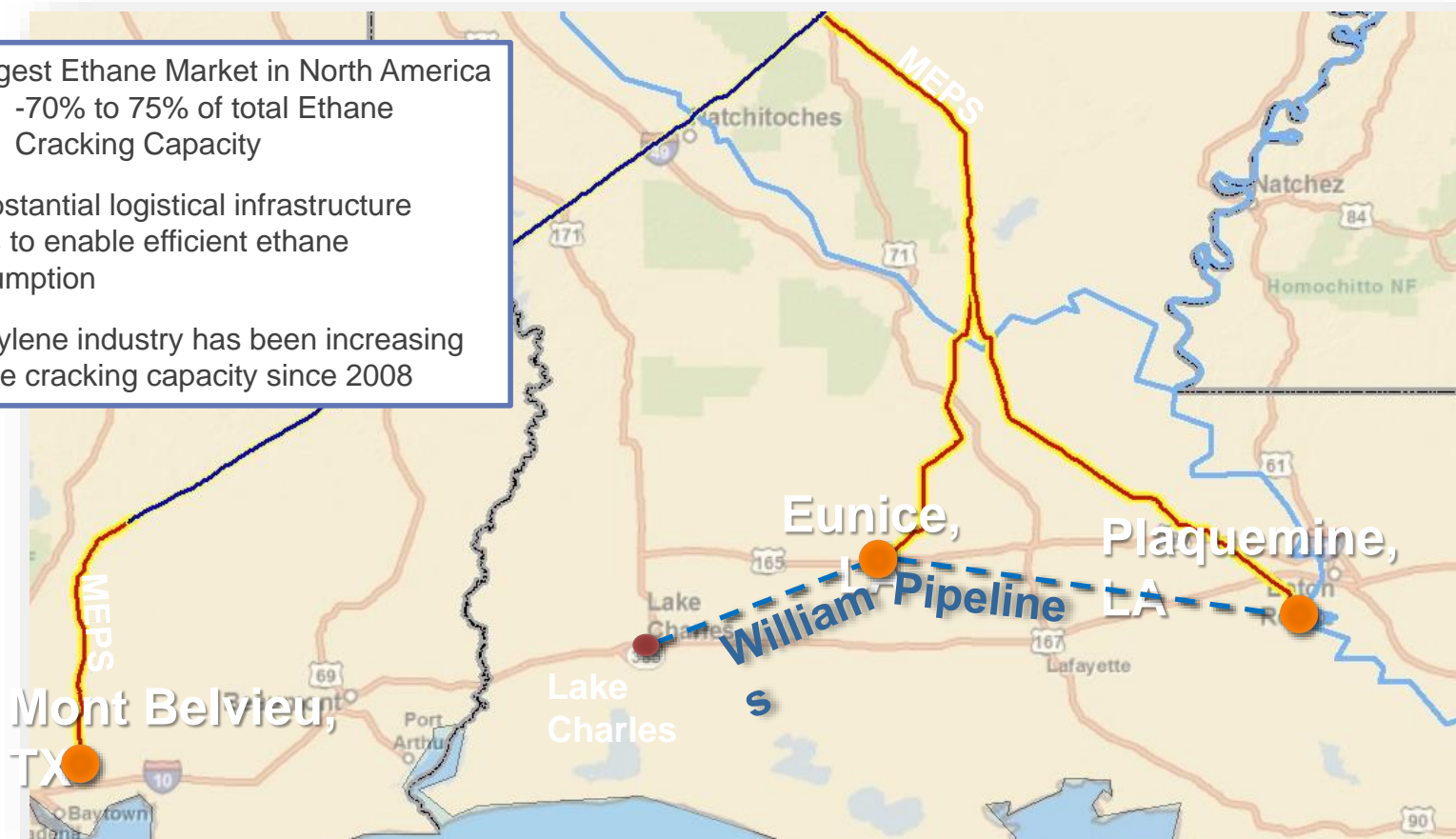
**Marcellus Characteristics**





# Gulf Coast is Premium Ethane Market

- Largest Ethane Market in North America  
-70% to 75% of total Ethane Cracking Capacity
- Substantial logistical infrastructure exists to enable efficient ethane consumption
- Ethylene industry has been increasing ethane cracking capacity since 2008



	Mt. Belvieu	Louisiana Markets
Ethane Extraction Capability	<ul style="list-style-type: none"> <li>• 197 million BPD</li> <li>• 22% of US Cap</li> </ul>	<ul style="list-style-type: none"> <li>• 361 million BPD</li> <li>• 40% of US Cap</li> </ul>

# The Ethane Solution



## Mariner West:

- Ethane from Houston, PA Plant to Sarnia, ONT
- 25 mile pipeline to Vanport, PA + modified Sunoco Logistics pipeline
- 50,000 Bbls/d

**Sarnia**

## Mariner East:

- Ethane from Houston, PA Plant to Marcus Hook site in Philadelphia + barged to Europe or GOM
- Conversion of 250 mile 8" refined products line
- 70,000 Bbls/d

**Philadelphia**

To Europe

## Cove Point LNG

- Exports of 0.77 bcfd
- 2017 in-service date

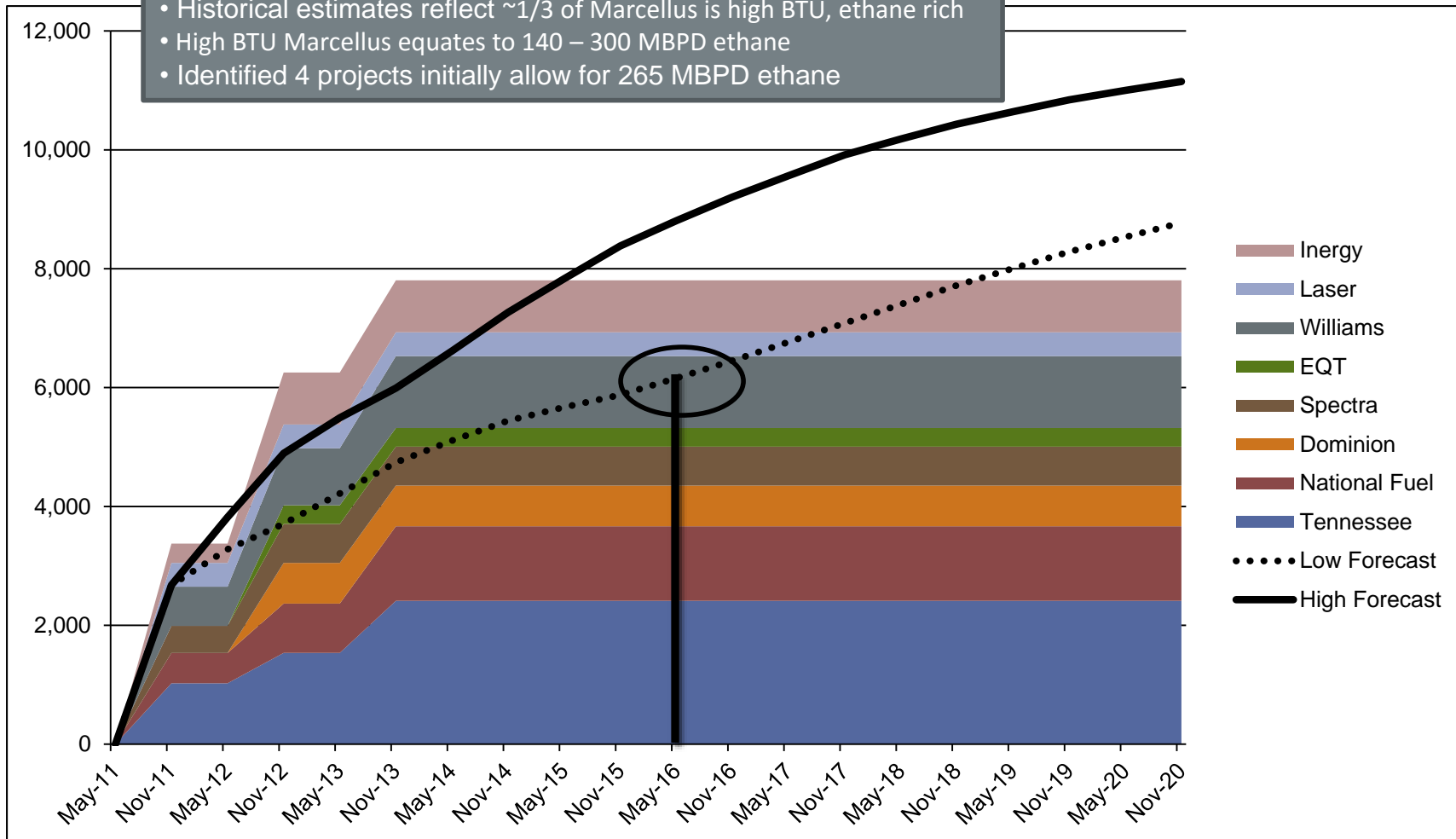
**Gulf Coast**

More than 80% of the NGL in the U.S. are processed in 2 states. Why?

# Projections for Natural Gas and Ethane in the Marcellus Tell Same Story



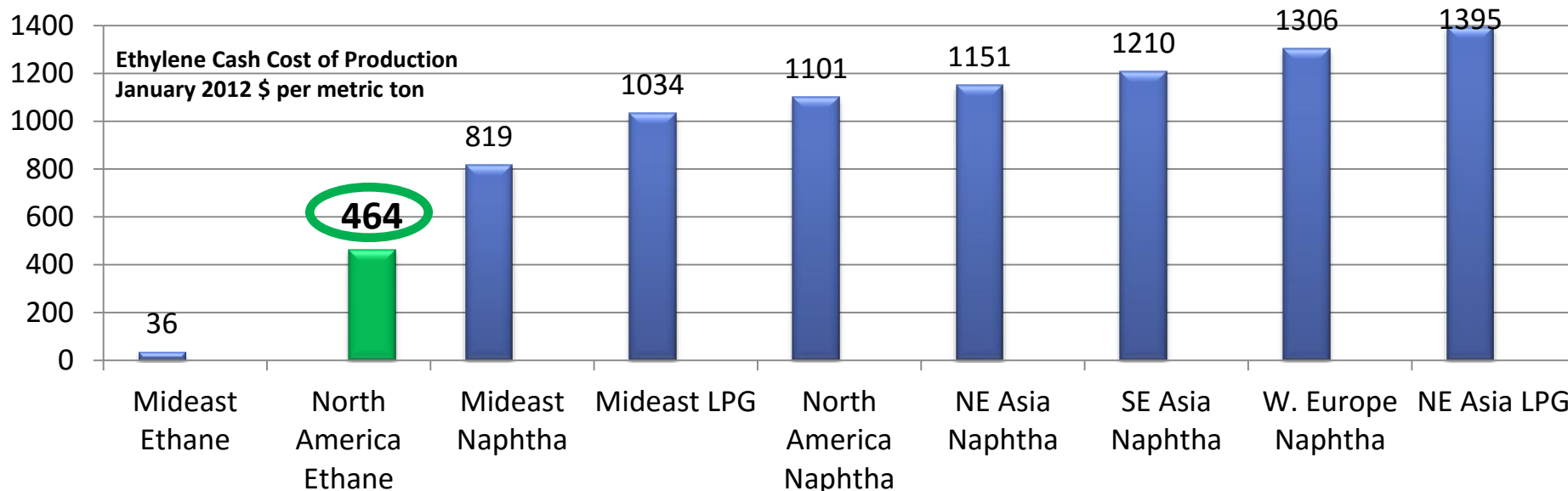
- By 2020, Marcellus grows to 8-11 Bcf/d
- Historical estimates reflect ~1/3 of Marcellus is high BTU, ethane rich
- High BTU Marcellus equates to 140 – 300 MBPD ethane
- Identified 4 projects initially allow for 265 MBPD ethane







# Midstream Development Implications: A Globally Competitive Petrochemical Industry



Due to a significant increase in North American ethane production, the U.S. chemicals industry is now one of the most cost competitive in the world.



Deal activity expected to increase thanks to a resurgent U.S. industry seeking project financing for up to 10 new world-scale cracker and derivative plants.



A projected \$33 billion debt peak in 2018 for chemical industry, and depressed margins due to U.S. shale gas will reshape companies' futures



## A Call to Action

- Encourage responsible pipeline development
- Create opportunities for enhanced communication between midstream operators and other key stakeholders
- Ensure that necessary resources are available for midstream permitting, planning, and inspection
- Maintain the protective adequacy of pipeline safety regulations
  - ✓ Reauthorization of the Pipeline Safety Act



# QUESTIONS?

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# **MACRUC 21st Annual Education Conference**

## **The Shale Revolution**





U.S. DEPARTMENT OF  
**ENERGY**

# Prudent Development of Domestic Oil and Natural Gas Resources & DOE's Natural Gas Modernization Initiative

MACRUC 21<sup>st</sup> Annual Education Conference  
Shale Revolution

**James Bradbury**

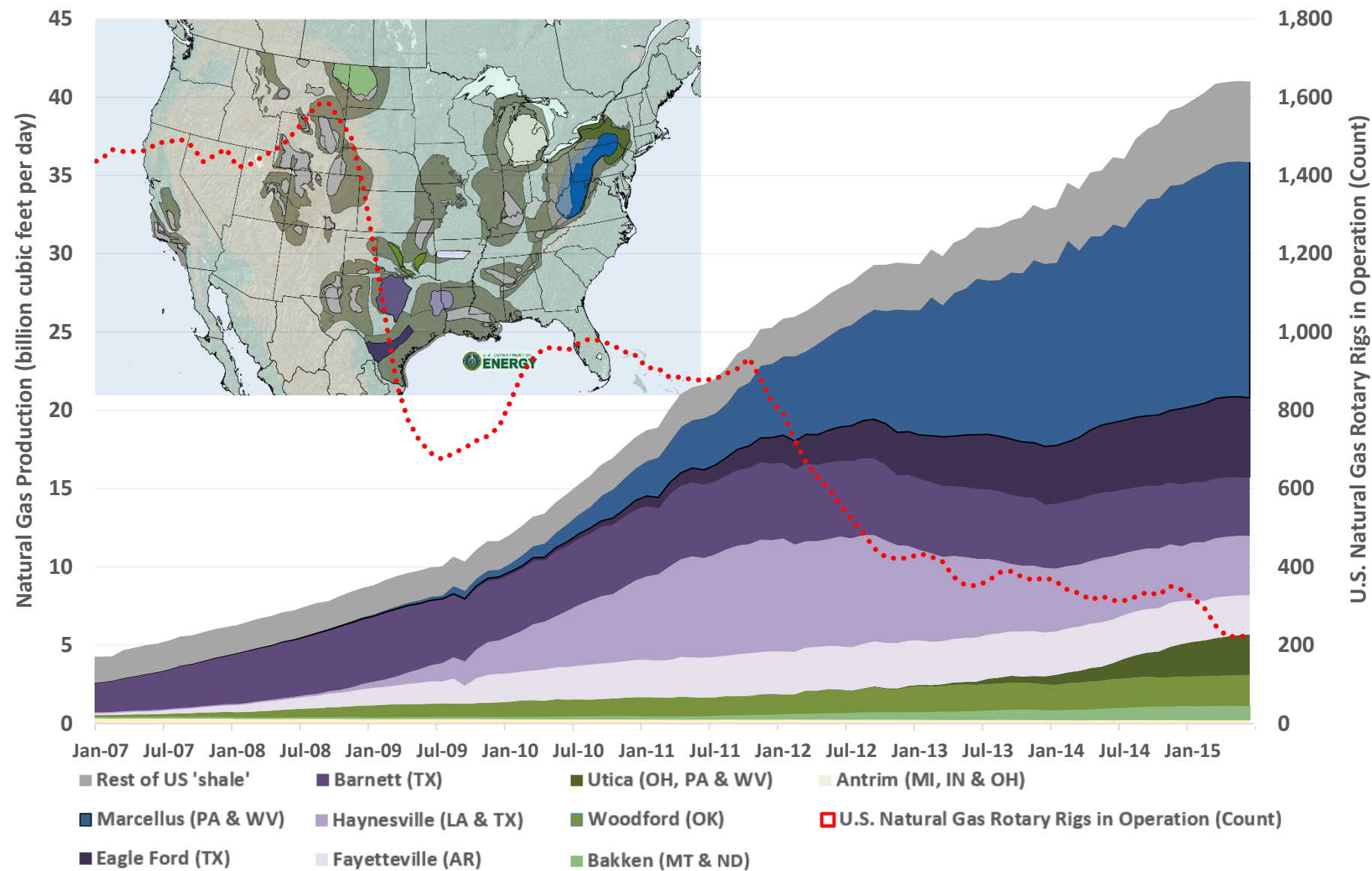
Senior Policy Adviser

Office of Energy Policy and Systems Analysis

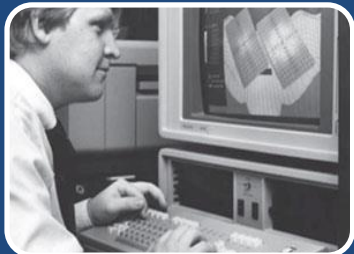
U.S. Department of Energy



# SHALE RESOURCES REMAIN THE DOMINANT SOURCE OF U.S. NATURAL GAS PRODUCTION GROWTH



# FEDERAL POLICY AND RESEARCH PROMOTES INNOVATION



## 1970s

- R&D to improve shale and other unconventional gas extraction



## 1980s-1990s

- Section 29 tax incentives
- Industry partnership to make drilling in the Barnett Shale economic



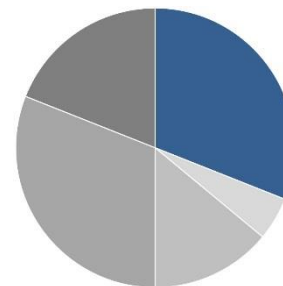
## 2010-Present

- Research continues to promote shale exploration, development, and environmental protection

# WATER QUALITY AND AVAILABILITY

## Portfolio includes:

- Developing water-based life cycle analysis
- Developing new technologies that treat produced water for reuse rather than disposal



2007 - 2013

- 32% of Investments
- 31 Projects

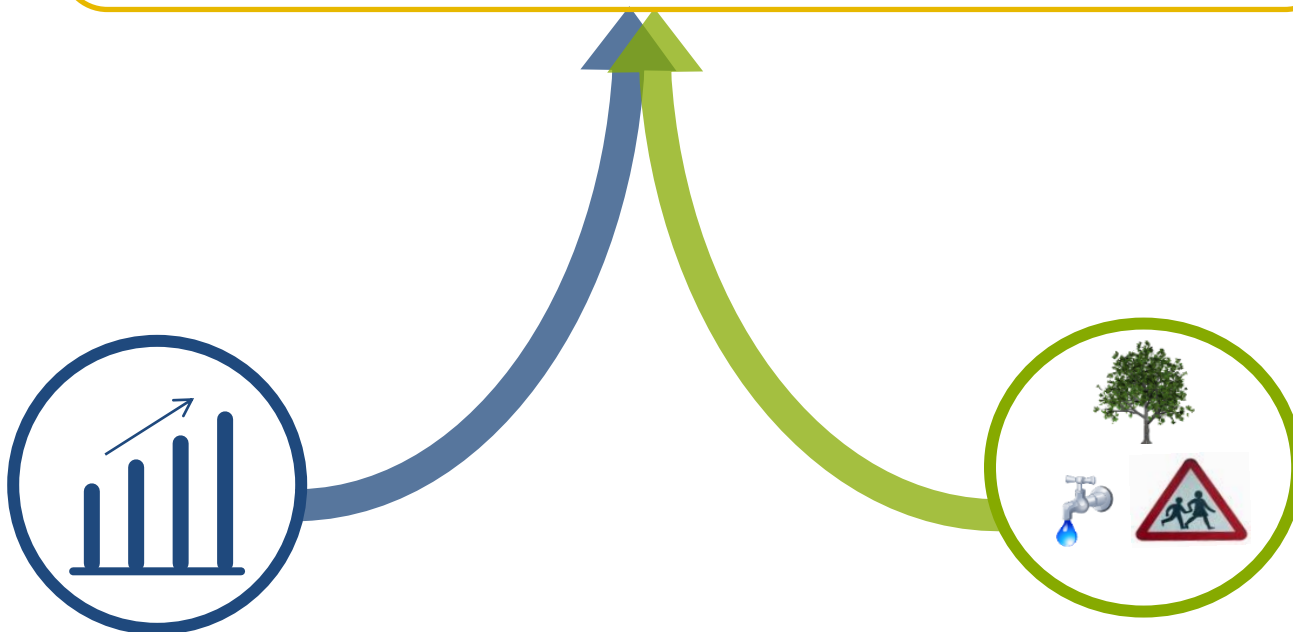
<i>Goals</i>	<i>Progress Highlights</i>	<i>Next Steps</i>
<div>Reduce fresh water use</div>	<p>Altela, Inc. to open two water treatment facilities in Pennsylvania that will enable re-use of produced water and reduced fresh water usage</p>	<ul style="list-style-type: none"> <li>• Develop technology for: <ul style="list-style-type: none"> <li>- A large scale, integrated produced water treatment system to handle multi-contaminants</li> <li>- Alternatives to water for hydraulic fracturing</li> </ul> </li> </ul>
<div>Reduce impacts on water quality with new wellbore technologies</div>	<p>Nanite, a new “smart” cement, uses nanotechnology to prevent cracking and leakage and responds to changes in temperature, stress, and fracture</p>	<ul style="list-style-type: none"> <li>• Develop technology for: <ul style="list-style-type: none"> <li>- Design of new materials</li> <li>- Testing and refinement of wellbore cements</li> </ul> </li> </ul>
<div>Increase access to data and assess impacts on water resources</div>	<p>FracFocus – public website with data on the chemical composition of hydraulic fracturing fluids – widely used as regulatory tool by oil and gas producing states. Full data downloads in machine readable format available as of spring 2015</p>	<ul style="list-style-type: none"> <li>• FracFocus 3.0: the updated version is scheduled for release in early 2016 and includes 1) improved data accuracy, 2) error trapping, 3) systems approach for chemical reporting to diminish need for trade secret claims</li> </ul>





## *Prudent Development*

The abundance of domestic oil and natural gas offers substantial supply for decades, helping reduce U.S. reliance on imported oil and promoting energy security.



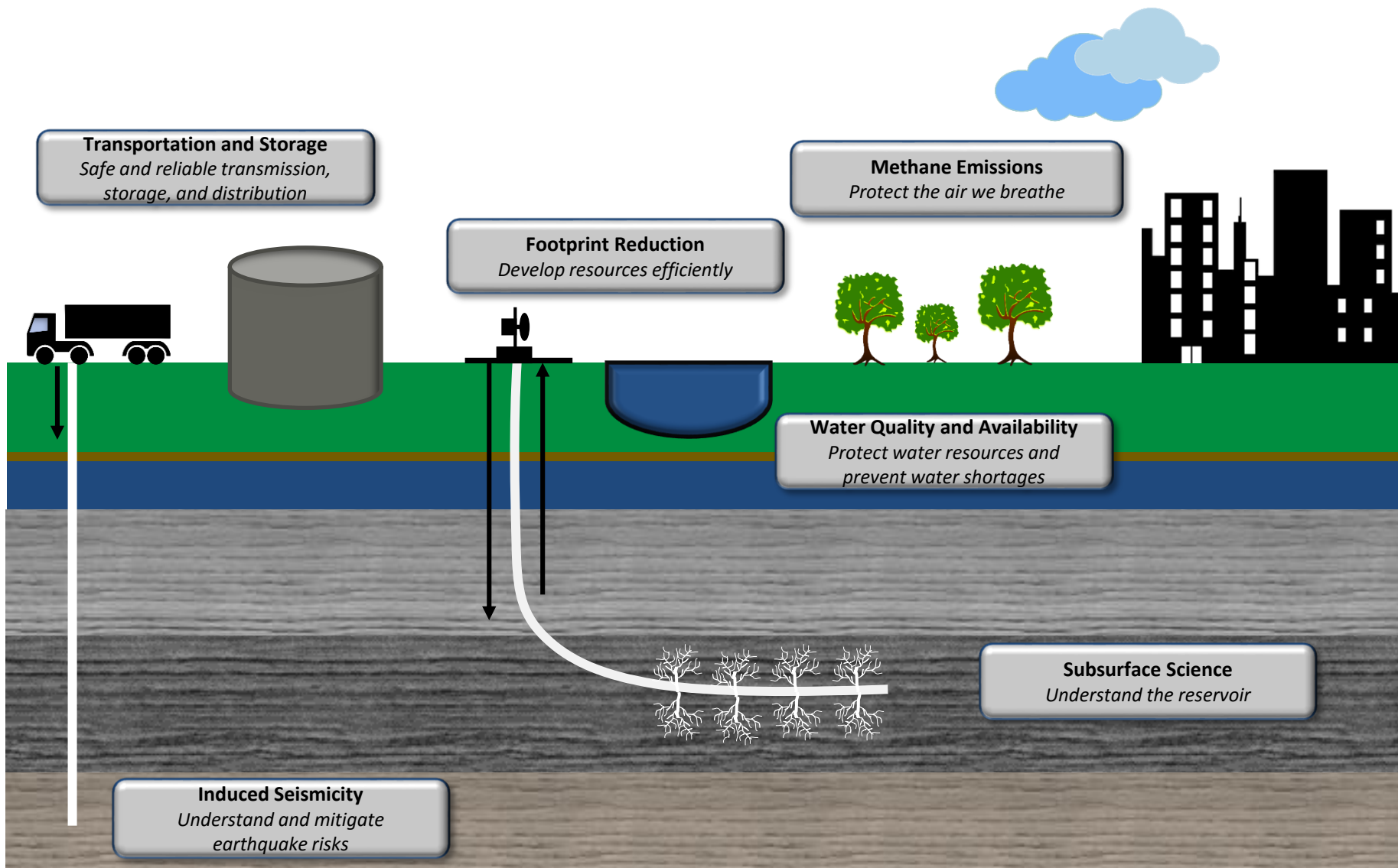
### *Maximize Public Benefits*

- *Energy security*
- *Economic growth*

### *Promote Sustainability*

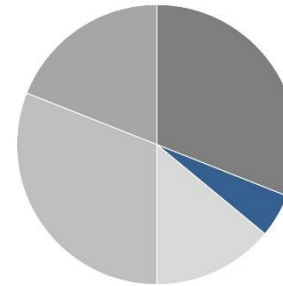
- *Environmental stewardship*
- *Public health and safety*

# RESEARCH & DEVELOPMENT SCOPE



# INDUCED SEISMICITY

- Collaborating with the state of Oklahoma, University of Oklahoma and industry to reduce seismic risk in OK
- Adding seismic monitoring stations in central Oklahoma
- Researching aspects of triggered seismicity (geological, geophysical, and engineering)

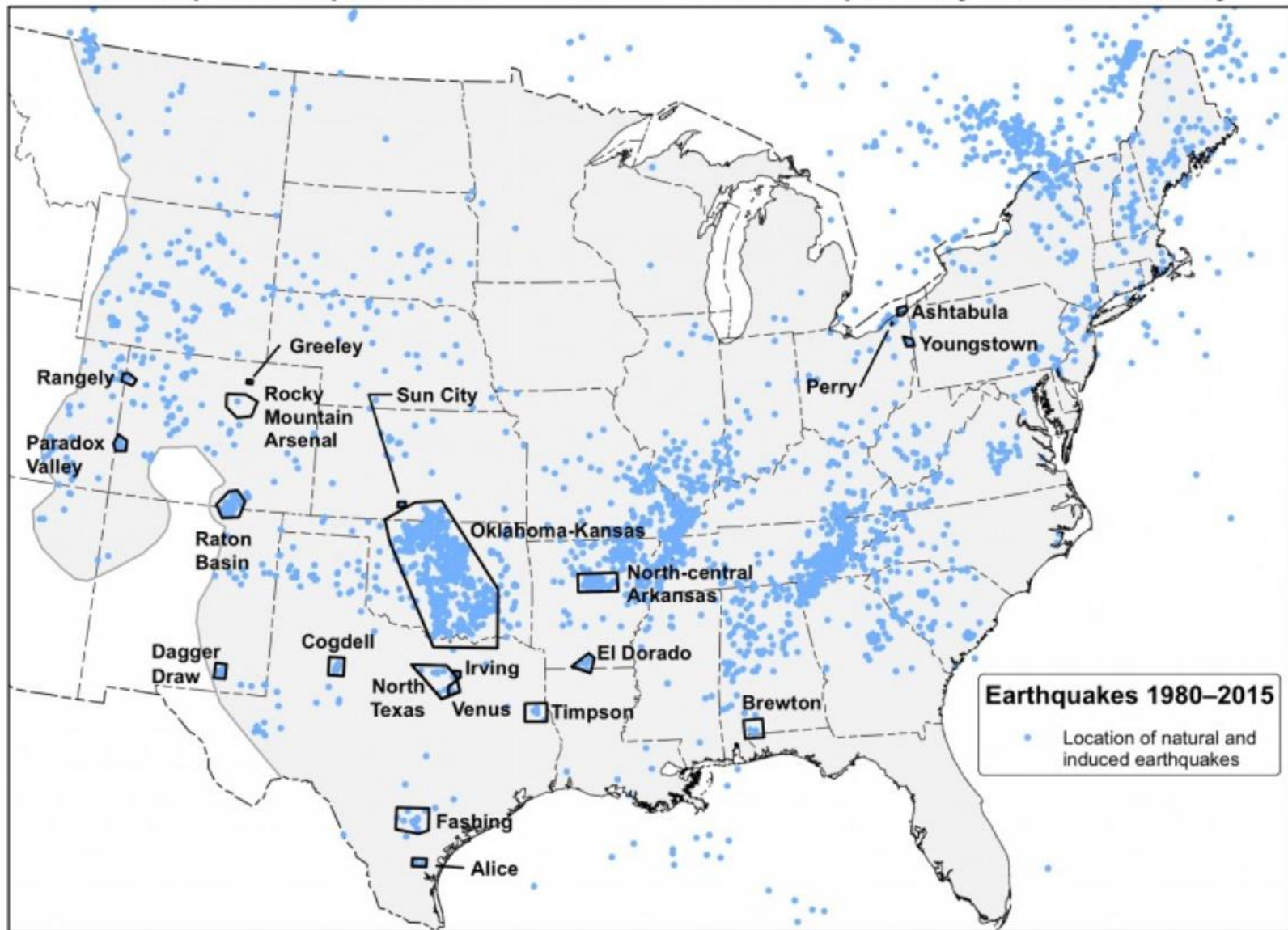


2007 - 2013

- 4% of Investments
- 5 Projects

<i>Goals</i>	<i>Progress Highlights</i>	<i>Next Steps</i>
<b>Determine relationship between fluid injection practices, regional geology and stress regime, and occurrence of earthquakes</b>	<p>UT-Austin study found that induced seismicity in the</p> <ul style="list-style-type: none"> <li>• Fort Worth Basin is associated with injection wells;</li> <li>• Eagle ford area are associated with extraction;</li> <li>• No significant seismicity in the Bakken</li> </ul>	<ul style="list-style-type: none"> <li>• Support regionally specific monitoring networks</li> <li>• Digitize state geologic survey maps with centralized access</li> <li>• Develop technology for reliable physics-based models with predictive capabilities</li> </ul>
<b>Identify waste disposal strategies that avoid triggering seismic activity</b>	<p>Seismic monitoring networks and 3-D modeling efforts, increasing the understanding of seismic response in Oklahoma</p>	<ul style="list-style-type: none"> <li>• Improve site characterization of waste water reservoirs</li> <li>• Improve real time access to disposal well water volumes and pressures</li> <li>• Determine why earthquakes occur near some injection wells but not others</li> </ul>
<b>Assess risk of induced seismicity</b>	<p>Collaborative efforts have added seismic monitoring stations in central Oklahoma have increased detection of and improved data record for seismic events</p>	<ul style="list-style-type: none"> <li>• Develop technology to improve fault and earthquake detection</li> </ul>

# USGS MAP OF EARTHQUAKES SINCE 1980 AND RECENT AREAS IMPACTED BY INDUCED SEISMICITY

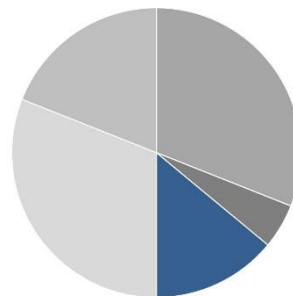




# METHANE EMISSIONS

## Portfolio includes:

- Measuring and modeling for regional trends based on field operations
- Developing advanced quantification methodology
- Life cycle analysis



2007 - 2013

- 20% of Investments
- 14 Projects

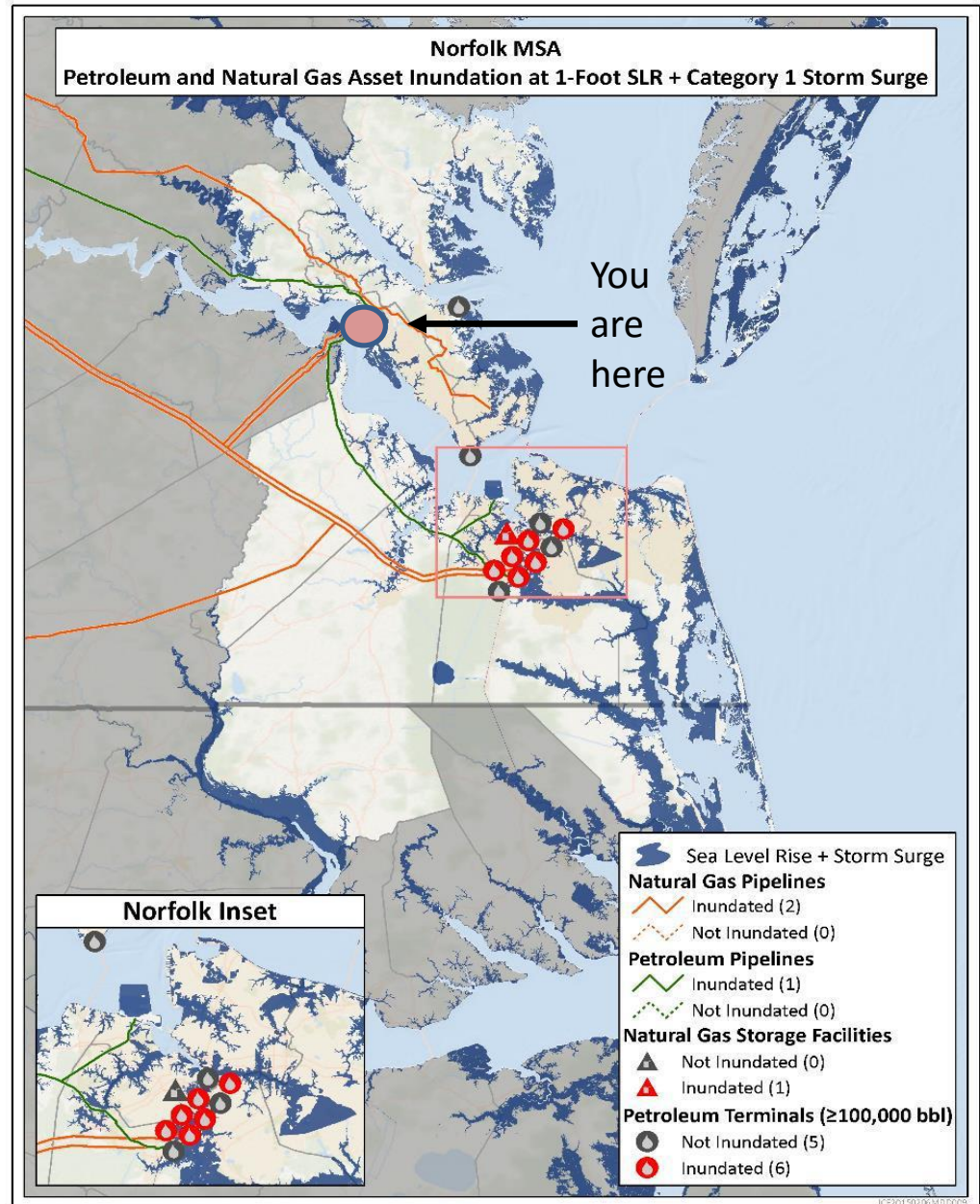
<i>Goals</i>	<i>Progress Highlights</i>	<i>Next Steps</i>
<p><b>Reduce methane emissions from the oil and gas sector by 40-45% from 2012 levels by 2025</b></p>	<p>GIS-based tool that allows operators to identify greenhouse gases associated with fluids handling and place wells in areas with less impact to the surrounding community</p>	<ul style="list-style-type: none"> <li>• Develop technology to: <ul style="list-style-type: none"> <li>- Reconcile top-down and bottom-up data disparity</li> </ul> </li> </ul>
<p><b>Develop technology and best practices that address the source and flux of air pollutants</b></p>	<p>Environmentally Friendly Drilling Program measured emissions over large areas to account for regional trends, creating safer work places, and protecting our environment</p>	<ul style="list-style-type: none"> <li>• Develop technology to: <ul style="list-style-type: none"> <li>- Standardize the research protocol for estimating methane emissions from onshore systems</li> <li>- Address fugitive and non-fugitive emissions</li> <li>- Improve midstream measurement</li> </ul> </li> </ul>
<p><b>Advance emission reductions from the oil and gas sector through collaboration</b></p>	<p>NETL's Fugitive Air Emissions Field Data yielded refined statistical models from multiple data sources to represent air quality impact from Marcellus Shale production activities, providing more accurate information on leak characteristics and emissions</p>	<ul style="list-style-type: none"> <li>• Improve methane inventory data gathering, including fugitive emission estimates</li> </ul>



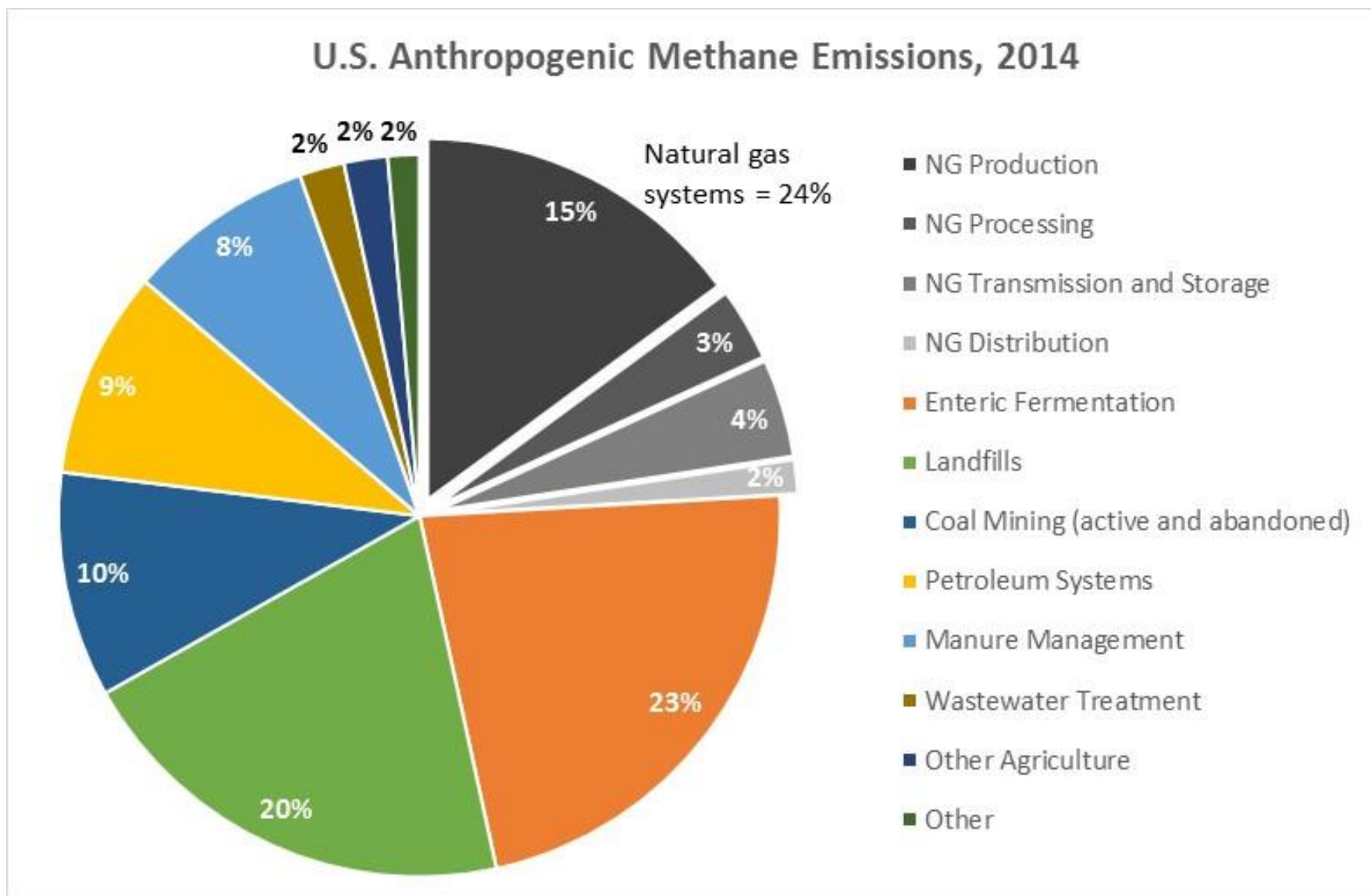
# Managing Risks from All Hazards - Resilience

*Improve resilience through research, analysis and convening*

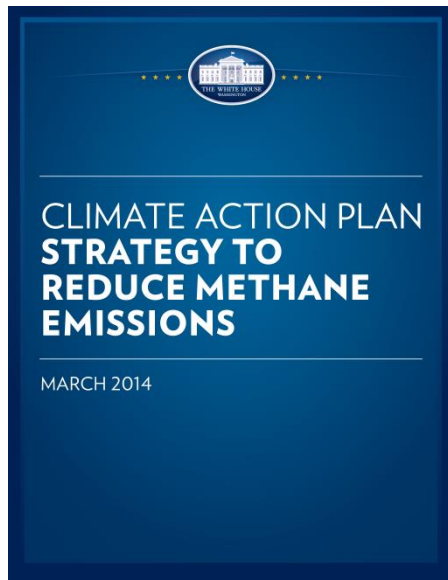
DOE is developing tools and analytical methods to help inform risk-based strategies for increasing energy sector resilience and managing risks from all hazards.



## Recent Estimates: Most CH<sub>4</sub> Emissions from O&G Production



# Climate Action Plan – Strategy to Reduce Methane Emissions



“Curbing emissions of methane is critical to our overall effort to address global climate change. ... To achieve additional progress, the Administration will”:

- Develop a comprehensive Interagency Methane Strategy (*completed March 2014*)
- *Take a* collaborative approach with state governments and the private sector to cover all methane emitting sectors
- Meet a 2025 target for the O&G sector to reduce methane emissions by 40 to 45% below 2012 levels (established January 2015)

## Interagency Methane Strategy- Three Pillars

1) Assessing current emissions data and addressing data gaps	2) Identifying Technologies and Best Practices for Reducing Emissions	3) Identifying Existing Authorities and Incentive-based Opportunities for Reducing Emissions
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## DOE's Natural Gas Modernization Initiative

- **ARPA-E** manages the \$38 million MONITOR program, which is funding 11 projects developing new low-cost methane sensing technologies for the oil and gas sector and developing as independent field test site.
- **Office of Fossil Energy** has \$12 million for programs on Methane Emissions Mitigation and Methane Emissions Quantification (FY 2016)
- **FERC** issued a Policy Statement on cost recovery for midstream natural gas infrastructure upgrades (April, 2015). Policy now in effect (October, 2015)
- **DOE-NARUC partnership** for technical assistance was announced (Feb, 2016)
- **DOE is offering technical assistance** to support EPA's voluntary Methane Challenge Program (launched in March, 2016)
- **Stakeholder action is also key**  
We continue to work with stakeholders who pursue voluntary action.





# Interagency Task Force on Natural Gas Storage Safety



- **Structure :**
  - Co-Chaired by DOE and PHMSA
  - Includes technical support from EPA, DHS, DOI, FERC, and NOAA
  - Working closely with, State of Calif., LA County and the City of LA
- **Activities:** Task Force is conducting studies and holding public workshops
  - Support the development of best practices:
    - well integrity
    - response plans
    - Public health and safe operations of storage facilities
  - Assess potential vulnerabilities to energy reliability
- **Timeline:** Results will be published later this year (~3 months)



# DOE-NARUC Natural Gas Infrastructure Modernization Partnership

- DOE role is to support the partnership through technical assistance and convening
- Chaired by Commissioner Diane X. Burman of New York, membership includes the following Commissioner appointments by President Kavulla:
  - Hon. Stan Wise, Georgia, Chair, Committee on Gas
  - Hon. Paul Roberti, Rhode Island, Chair, Subcommittee on Pipeline Safety
  - Hon. Carolene Mays-Medley, Indiana, Chair, Committee on Critical Infrastructure
  - Hon. Kara Brighton, Wyoming
  - Hon. Swain Whitfield, South Carolina
  - Hon. Julie Fedorchak, North Dakota
  - Hon. Pam Witmer, Pennsylvania
- *Focus areas will include innovative technologies and approaches to improving safety and avoiding leaks through new technologies and practices*

# Summary

- DOE Vision for the Office of Fossil Energy Research Program
  - To develop a secure and environmentally sound energy future through responsible production and delivery of our Nation's diverse oil and natural gas resources
- DOE Vision of Office of Energy Policy System Analysis
  - To modernize the Nation's natural gas pipeline transmission and distribution systems to improve safety, reliability and reduce methane emissions

## **DOE Natural Gas Infrastructure Modernization Partnership Contacts**

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**Office of Oil and Natural Gas**

**<http://www.energy.gov/qer>**

**<http://www.energy.gov/epsa/natural-gas-modernization-clearinghouse>**