Regional Economic Development Opportunities From Appalachian Basin Shale

Summary of Findings
The Economic Growth Foundation
RECS Shale Committee
JobsOhio

Nov. 13, 2015

About the report

This report was commissioned by the RECS Shale Committee with support from the Economic Growth Foundation and JobsOhio to provide economic development professionals and businesses with a better idea of the opportunities for growth in Ohio's oil and gas industry. RECS (Regional Economic Competitiveness Strategy) is an approach developed by the Regional Competitiveness Council, which was convened in 2011 as a collaboration of northeast Ohio's corporate, chamber of commerce and foundation leadership to understand the drivers of Northeast Ohio's economy with the ultimate purpose of setting goals and identifying actions to strengthen the region's economy. The report was prepared by the Center for Economic Development and the Energy Policy Center at Cleveland State University's Maxine Goodman Levin College of Urban Affairs.

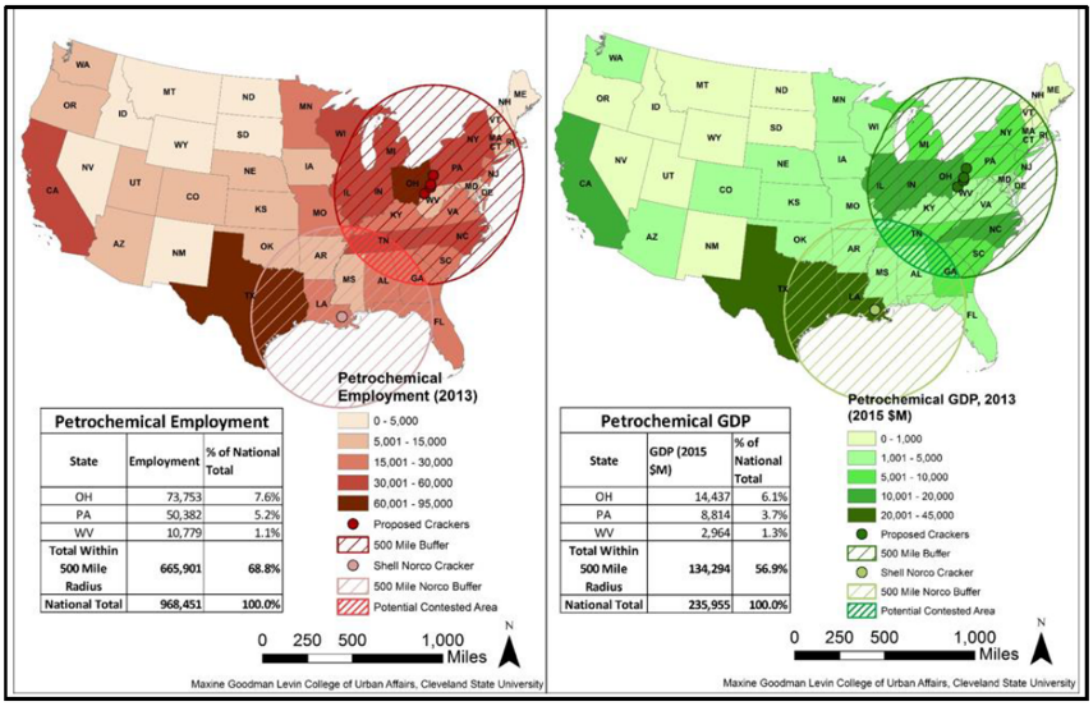
Issued in three parts: **Mapping the Opportunities for Shale Development in Ohio**, **Economics of Utica Shale in Ohio: Supply chain Analysis**, and **Economics of Utica Shale in Ohio: Workforce Analysis**. Data was acquired through a review of Ohio Department of Natural Resources, industry and company data; conference presentations; and personal interviews.

What's new in this report

The report for the first time in a publicly available document:

- Provides clear, current, transparent data all in one place showing the wide range of opportunities that shale hydrocarbons present to Ohio. This includes:
  - Overall outlook of opportunities for each phase from exploration and production, to natural gas processing, to downstream petrochemical manufacturing;
  - Opportunities within the supply chain.
  - An analysis of workforce needs and opportunities.
- Provides a projection for future Utica throughput volumes based on publicly available production data, including a projected decline curve, and including drilling projections
- Presents an evaluation of throughput (the total hydrocarbon volume flowing through the pipeline and processing system) for the next five years.
- Provides a comparison of throughput to processing capacity and projected pipeline takeaway capability.
- Provides a full analysis of the region's competitive advantages for building natural gas liquids-based petrochemical operations at the manufacturing level.
- Provides understanding of the regional demand for downstream plastics materials.

Figure 44. Concentration of Commodity Chemicals Companies in the Tri-State Region



Key Takeaways

Transformative Nature of Utica Shale

- Ohio has abundant shale resources. Ohio needs to be prepared to exploit opportunity that develops from shale production.
- Every part of shale development presents an opportunity for economic development, including drilling and production; gathering, compressing, transporting, storing, treating, separating, processing and fractionation; and downstream activities including use of natural gas in power generation, refining operations and compounding, distribution and conversion of petrochemicals into commercial plastics products.
  - Shale development will create a surplus of ethane in the region, which should attract petrochemical refining companies and manufacturing using their product.
  - Ohio's already thriving plastics and petrochemical industry should also attract investments from petrochemical and plastic manufacturers that use polyethylene and produce consumer products and plastics parts for other industries.
  - Ohio is positioned to have more than just an extractive economy where minerals are taken out of the ground and shipped elsewhere to create wealth: There are opportunities to transform extracted resources and manufacture from them products in the region, employing local workforce and building supply chain here.
- The midstream and downstream potential in Ohio is in sharp contrast to extractive economies, where value is taken out of the ground and shipped to other regions.

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Throughput Projections

2014 Throughput Projections

	Low	Most Likely	High
Natural Gas (bcf/d)	1.23	1.23	1.23
NG Liquids (bcf/d)	0.62	0.62	0.62
Ethane (mbbl/d) (1)	42.4	42.4	42.4

(1) Assuming 20% ethane rejection

2019 Throughput Projections

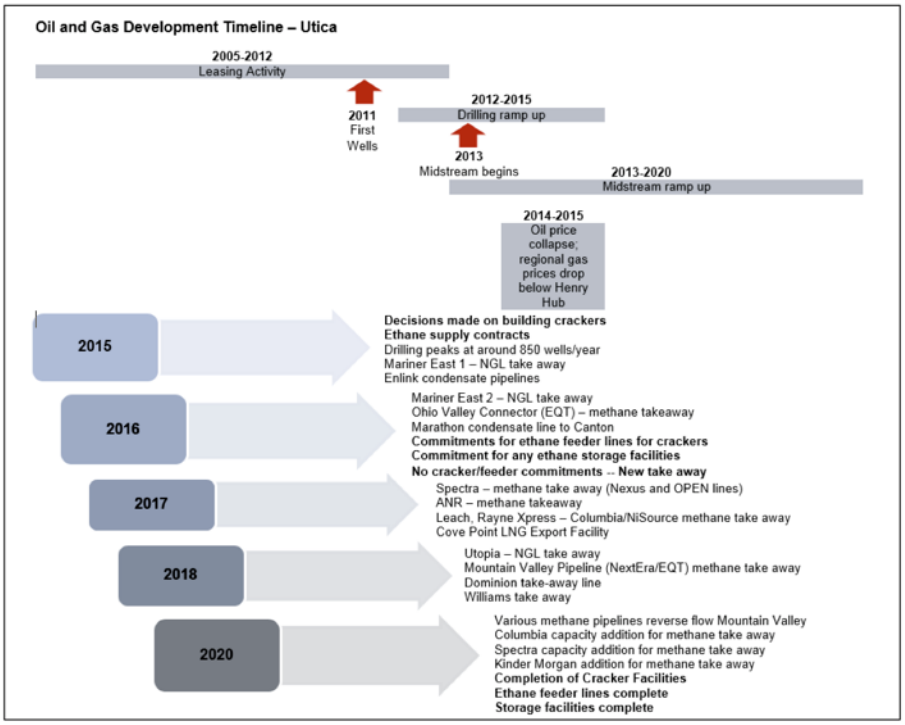
	Low	Most Likely	High
Natural Gas (bcf/d)	3.67	4.75	5.30
NG Liquids (bcf/d)	1.84	2.36	2.65
Ethane (mbbl/d) (1)	126.4	161.6	181.6

(1) Assuming 20% ethane rejection

Market cycle

- The abundance of available natural gas in Ohio has resulted in lower energy costs for Ohio industries that rely on it.
- Lower gas and NGL prices, and a corresponding slowing of drilling and exploration provides Ohio with time to:
  - Build new processing, pipeline and other infrastructure.
  - Attract new investment.
- Meanwhile, drilling is continuing for most efficient producers and infrastructure is being built, resulting in new investment by those who will benefit.

Main Nodes of Development and Critical Investment Decisions



Importance of ethane

- The surplus of ethane in the region can provide Ohio companies that need refined ethane with an inexpensive local source – enough for multiple cracker plants. This is part of the rationale for investing in a regional cracker complex.
- There is a huge opportunity to attract more companies that use ethylene or polyethylene as a feedstock.
- Any shortage of fractionation capacity can be quickly remedied once a local market for ethane is developed; moreover, the currently planned ethane take-way capacity likely will be insufficient for the amount of ethane that will be produced in the coming years in the region.
- Redundant pipelines, line packing, and flexible supply contracts can be used to ensure that Ohio ethane crackers are able to accommodate variations in supply and demand, despite a lack of cost-effective ethane storage capacity.

Table 11. Utica and Marcellus Projected Production Compared to Fractionation Capacity, 2020

	Total NGL Volume	Ethane (mbbl/d)
Industry Projected Production – wet gas	9.3 bcf/d (3.6 Utica + 5.7 Marcellus) (1)	638 (2)
Industry Projected Processing Capacity	12 bcf/d	371 (3)
Industry Projected NGL Take Away Capacity, plus local use	1,525 mbbl/d	460 (4)

(1) Blue Racer Investor Presentation – Fall 2014; Williams projects 1,400 mbbl/d
(2) Assumes 60% ethane, 6 gal/mcf, 42 gal/bbl, and 20% rejection
(3) One third of C2+ fractionation (87 mbbl/d) plus de-ethanization (C2) (284 mbbl/d)
(4) The Mariner East 1 and Utopia pipelines are dedicated to ethane and propane, with capacities of 70 and 75 mbbl/d, respectively. The Mariner East 2 pipeline expansion is projected to be 275 mbbl/d, however most of this pipeline's capacity is anticipated to be used for propane. Accordingly, all 145 mbbl/d of the propane/ethane capacity is used to make this number, but none of the 275 mbbl/d. The range of possible ethane capacity is between 315 and 735 mbbl/d.

Workforce implications

- The long-term jobs that will be created are high-paying jobs in production and within manufacturing operations that expand in response to new shale petrochemical production.
- About a third of all jobs generated in pre-drilling, drilling and operating phases have higher education requirements.
  - This includes geologists, geophysicists, engineers (especially petroleum, chemical and civil), electricians and equipment operators, chemists, hydrologists, environmental and GIS specialists, lawyers and managers – just to name a few.
- Jobs also will be created in oil and gas and their supply-chain companies across of an array of occupations requiring shorter training and work experience.
  - Seismic technicians, Landman, roadman, leasing agents, heavy equipment operators and movers, pipefitters, foreman and many others will be in high demand.
- Additionally, investment in interstate pipelines and natural gas processing plants will create a number of construction jobs during the next five years.
- Cracker plants and others who invest for the long-term will result in long-term workforce opportunities where they operate.
- Ohio has the labor pool and training capacity necessary to support these new jobs.

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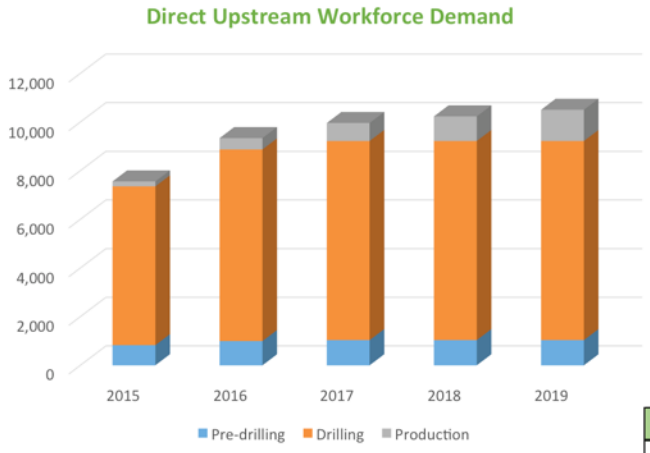
Required Workforce Projections



- In 2015, the projected upstream operations will generate another 7,260 supply-type jobs
- Main Ohio employment in support industries will be in
  - architectural and engineering;
  - wholesale trade;
  - management;
  - legal services;
  - trucking
- Ohio is missing
  - service unit operators – Oil, Gas and Mining;
  - roustabouts – oil and gas;
  - heavy and tractor-trailer truck drivers;
  - First-line supervisors of construction trades and extraction workers;
  - Derrick operators, oil and gas

- **Additional $4.7 billion of investment will be made over the next 5 years in interstate pipelines (segments in Ohio)**
- **We distributed it equally over the next 5 years**
- **Midstream construction projects might require 5,000 FTE construction jobs**

	Total	Cumulative
2015	7,558	7,558
2016	9,138	9,342
2017	9,495	9,961
2018	9,495	10,233
2019	9,495	10,505

Supply Chain Implications

- Most of the investment will not be in drilling, but in the midstream and downstream supply chain. There, Ohio can work from existing strengths in manufacturing.
- Ohio's robust downstream industries such as plastics and rubber manufacturing are an advantage to the development of mid-stream infrastructure.
- At the same time, there are a number of opportunities in Ohio to grow the supply base to service the upstream development. For example, within the natural gas liquids extraction industry, only 20 percent of the required engineering and management service employment is sourced from within the region when compared to other oil and gas states.
- Ohio's geography gives us a transportation cost advantage in providing products derived from NGLs to markets in the Midwest, Mid-Atlantic region and the Upper-South.
- Data contained in the study will help Ohio establish supply chain targets in segments important to the industry and in which we have an opportunity to grow.

About the Authors

- Iryna V. Lendel, Ph.D., is the assistant director of the Center for Economic Development at Cleveland State University, and is an economist with experience in academic and applied research for regional economic development.
- Andrew Thomas, Executive-in-Residence at the Energy Policy Center specializes in research related to oil and gas regulation and law, as well as electricity markets and regulation.