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# PETROCHEMICAL CLUSTER

## Regional Growth Opportunity

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# KEY TAKEAWAY POINTS | NORTHEAST OHIO REGION

The Northeast Ohio Region (hereafter referred to as the “Region”) has been identified as one of the premier sites for a Petrochemical Cluster to build off the existing related industries in the area. Six key takeaway points conclude why the Region is a prime location for petrochemical investment and expansion.

01

## MANUFACTURING LABOR FORCE

Out of the total labor force of 723,000 jobs in the Region; 132,000 or 18.3% are in the manufacturing sector. This percentage is more than two times higher than the national average of 7.9%

02

## GROSS REGIONAL PRODUCT

Export of products and services make up 15% of Gross Regional Product. The Region ranks as the highest in Ohio and 3<sup>rd</sup> highest in the nation, according to a Metro Area study from the Brookings Institute.

03

## CONCENTRATION ALREADY EXISTS

There is a concentration of 172 petrochemical related companies in the Region. Of those, 94 are directly related to plastics manufacturing which provides a formidable base for the ethane supply chain, and for attracting more investments and jobs to the Region.

04

## CORRELATION AMONG INDUSTRIES

There is strong correlation between the plastics industry cluster and other related industries that utilize plastics in the manufacturing process. The plastics industry consists of 12,635 jobs, but is connected and highly correlated (90-95 percentile) to 10 more industries with a total workforce of 51,911 jobs.

05

## FOREIGN DIRECT INVESTMENT

The Region is home to 138 foreign companies, with 24 of them directly related to the petroleum and chemical industries. Ohio is ranked 7<sup>th</sup> largest in the country in terms of international employment, with a total of 267,500 jobs in 2018.

06

## OPPORTUNITY ZONES

Identified Ohio Opportunity Zones in the Region provide convincing evidence for development due to the geographic access to highly developed air, rail, land, and water transportation. Wellsville, OH in Columbiana County is the highest point on the Ohio River, making it one of the prime locations for investment in the petrochemical industry cluster.

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## EXECUTIVE SUMMARY

The Northeast Ohio Region (hereafter referred to as the “Region”) is located within the Appalachian Basin with access to the Marcellus and Utica Shale deposits. Possessing a deep history of manufacturing, the Region is primed to experience economic development within its 13 counties:

- Ashtabula
- Belmont
- Carroll
- Columbiana
- Geauga
- Harrison
- Holmes
- Jefferson
- Mahoning
- Portage
- Stark
- Trumbull
- Tuscarawas

Proposed economic development focuses on the emerging petrochemical cluster of industries. This cluster includes the upstream, midstream, and downstream activities involved in the petrochemical supply and value chains. The strategic development of the petrochemical industry is analyzed according to the following structure:

- An Overview of the Regional Economy
- Analysis of the Plastics Industry Cluster
- The Petrochemical Industry Supply Chain
- Opportunities in the Region
- Current International Trade and Transportation
- Recommendations and Action Plan

The evidence discovered within the analysis has led to an action plan with the following recommendations:

1. Create a dedicated network of support organizations to develop the brand and market, and to provide support services for the Northeast Ohio petrochemical industry.
2. Improve on the strength of local clusters by increasing activity among the traded cluster groups and the petrochemical industry.
3. Promote the Region’s competitive advantages to the global marketplace by hosting and participating in global market activities and initiatives.
4. Provide focused assistance to Small and Medium Size Enterprises (SME) in the petrochemical industry, by developing connections to research and export planning.

## INTRODUCTION

The Northeast Ohio Region (hereafter referred to as the “Region”) is a 13-county area that is no stranger to industrial activity. Historically, the Region’s economy has been greatly impacted by manufacturing industries such as steel, but a new industrial focus is emerging: Petrochemical Cluster. The Petrochemical Cluster includes upstream, midstream, and downstream industries beginning with the extraction of natural gas.

The Region, located within the greater Appalachian Basin, possesses access to the natural Marcellus and Utica Shale deposits. The United States Geographic Services (USGS) estimates the entire Appalachian Basin to hold an estimated 214 trillion cubic feet of recoverable Marcellus Shale and Utica Shale. “Watching our estimates for the Marcellus rise from 2 trillion to 84 trillion to 97 trillion in under 20 years demonstrates the effects American ingenuity and new technology can have,” said USGS Director Jim Reilly. “Knowing where these resources are located and how much exists is crucial to ensuring our nation’s energy independence.”

Access to Marcellus and Utica Shale is also crucial to ensuring the strength and strategic development of the Region’s economy. The Region is prime for extracting the resource due to its location; whereas southern operations in the Gulf are fraught with natural disasters. The Region is protected due to its inland location from the east coast which minimizes disruptions from natural disasters. Additionally, the Region is easily accessible due to development of ports: air, land, and waterway.

Emerging from the extraction of natural resources is the opportunity to further develop a Petrochemical Cluster. According to the Census Bureau, there are 172 ethane-related companies in industries such as plastics and downstream chemicals with strategically planted roots in the Region. Geographic proximity to input resources and ease of access to transportation routes decreases companies’ freight and shipping expenses, while expediting time-to-market of their own end-products.

The proposed course of action will elevate the current efforts of the Petrochemical Cluster and further develop the geographic area within the Region. Strategically attracting companies within the entire petrochemical supply chain will benefit the Region’s economy. As a result, higher-skilled workers will relocate to the Region and existing talent will be retained, effectively combating the current “brain-drain” epidemic facing the area. Success will also attract Foreign Direct Investment (FDI) within the Region, ultimately reducing the amount of outsourcing along the petrochemical supply chain.

Development potential does not end with the current construction projects of the PTT Global Chemical America (PTTGCA) and Shell Pennsylvania Petrochemicals Complex (Shell) Ethane Cracker plants. There may be enough natural gas liquids (NGLs) from both shales to support 4 additional cracker plants in the Region, in addition to Shell<sup>1</sup>. Accompanied by the strategic economic development of the Petrochemical Cluster within the Region, the ease and efficiency of the current transportation system will continually improve. With these assets and opportunities already existing within the Region, the area’s economic potential can be realized.

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<sup>1</sup> Pittsburgh Business Times, *Study*, <https://www.bizjournals.com/pittsburgh>

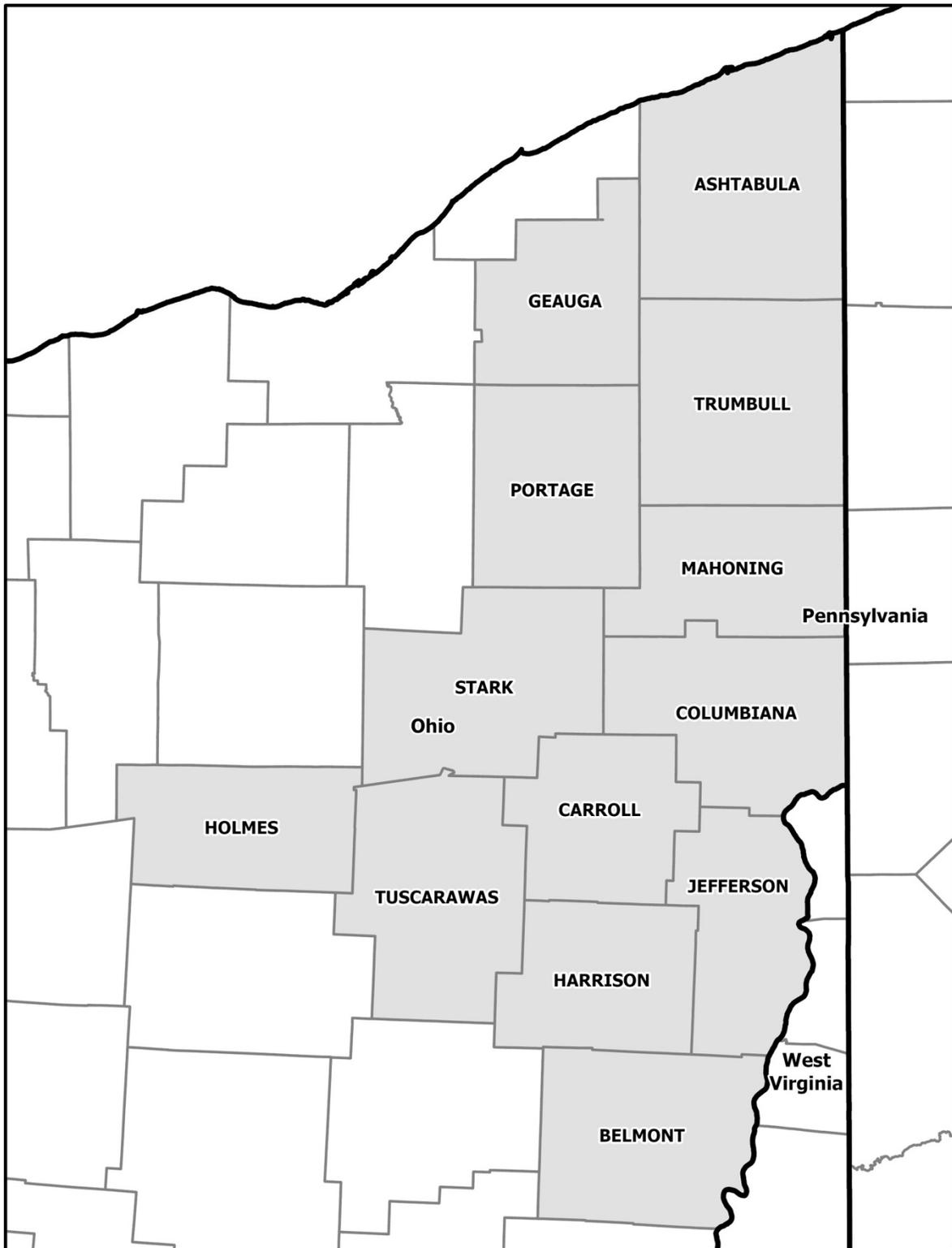


Figure 1: Northeast Ohio Region, the “Region”

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## ECONOMIC OVERVIEW FOR THE REGION

The Region consists of 13 counties along the border of Pennsylvania and West Virginia.

County	Population <sup>2</sup>	Average Household Income <sup>3</sup>	People in the Manufacturing Workforce <sup>3</sup>	Real GDP (in Billions) <sup>4</sup>
<b>Ashtabula</b>	97,493	\$43,017	9,695	\$2.49
<b>Belmont</b>	67,505	\$46,484	2,408	\$2.76
<b>Carroll</b>	27,081	\$51,748	2,515	\$1.03
<b>Columbiana</b>	102,665	\$45,498	9,168	\$2.73
<b>Geauga</b>	94,031	\$77,104	7,695	\$3.47
<b>Harrison</b>	15,174	\$46,223	1,014	\$0.73
<b>Holmes</b>	43,892	\$58,728	5,685	\$1.78
<b>Jefferson</b>	65,767	\$43,161	2,808	\$2.73
<b>Mahoning</b>	229,642	\$43,251	14,568	\$8.18
<b>Portage</b>	162,927	\$53,816	15,143	\$5.33
<b>Stark</b>	371,574	\$50,984	32,662	\$14.85
<b>Trumbull</b>	198,627	\$45,380	17,854	\$6.90
<b>Tuscarawas</b>	92,176	\$49,460	10,739	\$3.53
<b>TOTALS</b>	<b>1,568,554</b>	<b>\$50,373</b>	<b>131,954</b>	<b>\$56.51</b>

Table 1: County Data

The Region has easy access to major metropolitan areas, including Pittsburgh and Cleveland. Stark County, including Canton, Ohio and its surrounding urban area, has the largest population. Other notable regions of population within similar industrial hubs are Youngstown, Boardman/Canfield, Warren, Lisbon, Ravenna, Streetsboro, and Kent. The total population within the Region is 1.56 million with a total Gross Regional Product (GRP) of \$56.51 billion.

In analyzing Table 1, out of approximately 723,000 individuals that work within the Region, 18.3% or nearly 132,000 work in the manufacturing sector. This percentage is more than two times higher than the national average of 7.9%<sup>5</sup>.

Ohio is the 9th largest exporting state in the country. Ohio encompasses 34,156 businesses, and exports as a percent of GDP are 7.9%. Ohio has an export sales growth rate of 1.01%<sup>6</sup>. The export percentage in regard to total sales in the Region is approximately 15%.

<sup>2</sup> United States Census Bureau, *American Factfinder*, <https://factfinder.census.gov>

<sup>3</sup> Data USA, <https://datausa.io>

<sup>4</sup> Bureau of Economic Analysis, *GDP by County 2015*, <https://www.bea.gov>

<sup>5</sup> Bureau of Labor Statistics, *Employment by Major Industry Sector*, <https://www.bls.gov>

<sup>6</sup> U.S. Cluster Mapping, *Harvard School of Business*, [clustermapping.us](http://clustermapping.us)

## | KEY INDUSTRY SECTORS

The workforce is made up of approximately 723,000 employees across different industries in the Region<sup>7</sup>. The largest industries by share of employees are educational services, health care and social assistance (23% of all regional jobs), manufacturing (18%), and retail trade (12%), as shown in Figure 2. Over the past five years, these three industries, except manufacturing, have experienced positive annual growth in revenue. IBIS World industry forecasts expect to see positive annual growth in the coming years, but the educational services, health care and social assistance industries will see the most substantial increase in revenue<sup>8</sup>.

### SHARE OF JOBS BY INDUSTRY

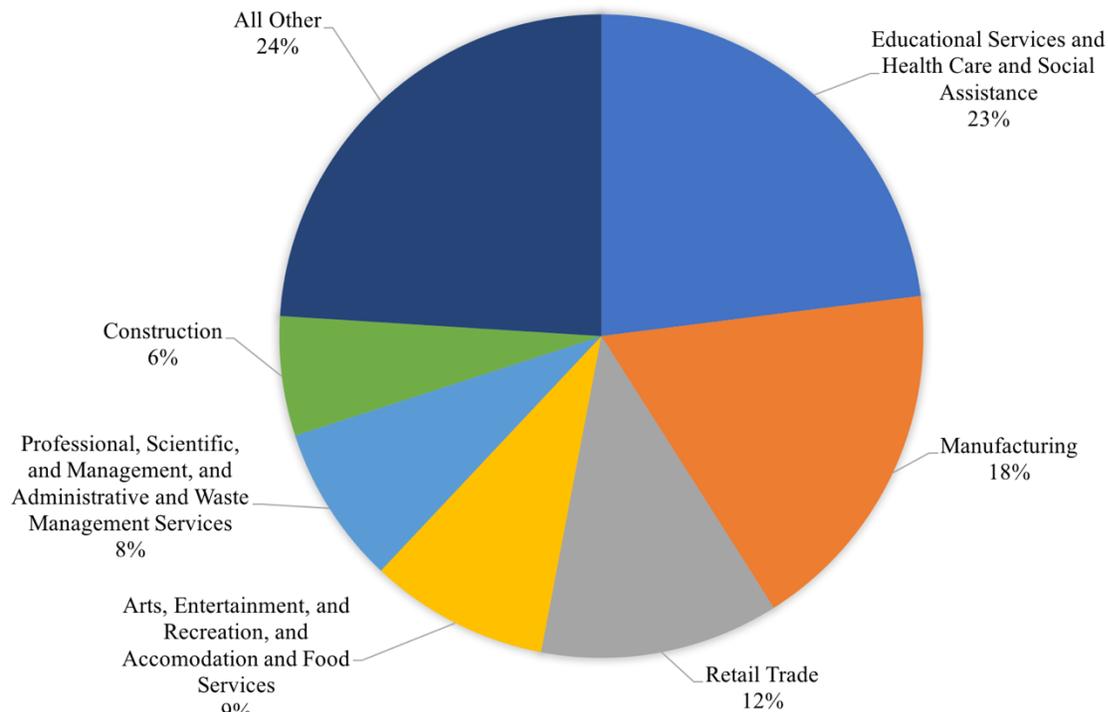


Figure 2: Share of Jobs by Industry, the Region

Figure 2 exhibits the share of employment in the Region by industry. It is evident that the manufacturing industry plays a major part in the local economy, employing over one hundred and thirty thousand people, as shown in Table 1. Manufacturing is the second largest industry by employment, exceeded only by the educational services, health care, and social assistance industries. Manufacturing enhances the quality of life in the area by supporting the residents that make up the local skilled workforce.

<sup>7</sup> Bureau of Labor Statistics, *Selected Economic Characteristics*, <https://www.bls.gov>

<sup>8</sup> IBISWorld, *U.S. Industry Reports*, <https://www.ibisworld.com>

## || MANUFACTURING INDUSTRY

Although the Region is home to many industries, its manufacturing base is one of the most important, both regionally and nationally. With deep roots in iron and steel manufacturing dating back to the 1800s, the Region has a wealth of history and experience within the manufacturing sector.

Ball State University conducts research annually on all fifty states regarding their prospective scores with Manufacturing, Logistics, Human Capital, Benefits Costs, Global Position, Productivity, Innovation, etc. In their 2019 scorecard, Ohio received a B in Manufacturing, A in Logistics, and B in Global Position. Nationwide, only five states received an A in manufacturing and only ten states received a B. Between the 2018 study and the 2019 study, Ohio increased its scores in Human Capital, Benefits Costs, and Global Position<sup>9</sup>.

The products manufactured locally are vital to domestic and international trade developments from Ohio. The Region is a critical manufacturing hub for automotive, plastics, metals, vulcanized materials, chemicals and much more. All of these industries are critically dependent on petrochemical derivatives or products.

The Region's key manufacturing subsectors are Metal Manufacturing (24%), Machinery Manufacturing (11%), and Plastics and Rubber Manufacturing (8%)<sup>10</sup>. Given the Region's history in manufacturing and its strategic location, it has been able to build a supportive industrial community. With a multitude of academically-recognized and research-driven universities, the area provides a skilled and highly educated workforce ready to innovate and produce. Additionally, the Region is a multimodal logistics and distribution hub with major water ports, international airports, national highway systems, and a network of national and regional railroads to help facilitate movement and ease of access<sup>11</sup>. Offering opportunities for new companies to collaborate and grow, the Region is an ideal location for new businesses and those looking for a strategic location for expansion.

### Manufacturing Industry Scorecard Ohio

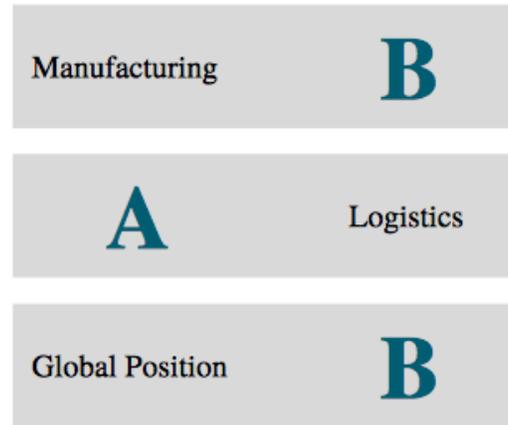


Figure 3: Ohio Manufacturing Industry Scorecard

<sup>9</sup> CBER Data Center, *Manufacturing Scorecard*, <https://cberdata.org>

<sup>10</sup> United States Census Bureau, *2016 County Business Patterns*, <https://www.census.gov>

<sup>11</sup> Northeast Ohio Trade and Economic Consortium, <http://www.neotec.org>

## SHARE OF ESTABLISHMENTS BY MANUFACTURING SUBSECTORS

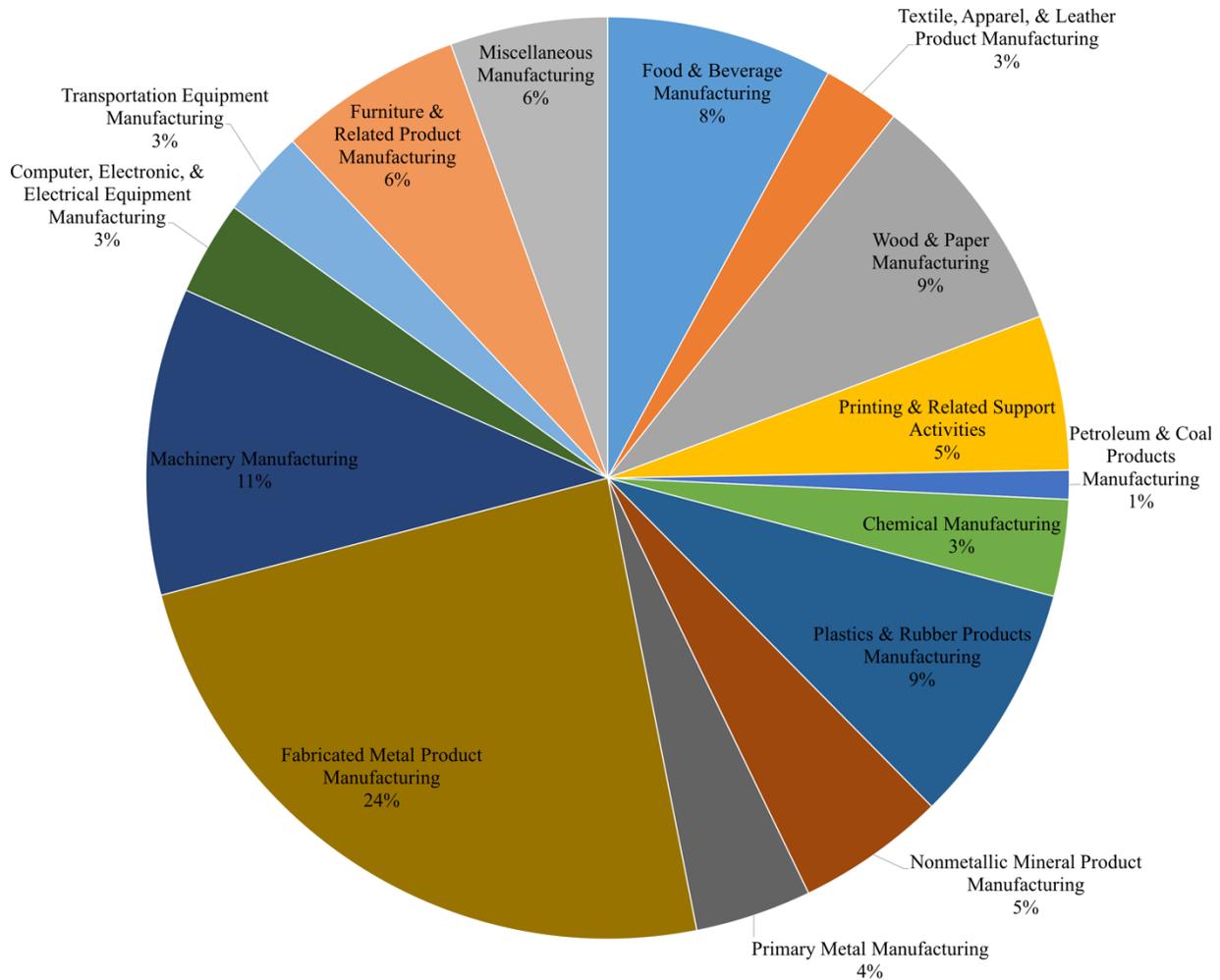


Figure 4: Share of Establishments by Manufacturing Subsectors, the Region

The manufacturing industry typically follows a business model that requires engaging in trade that extends past the local region. Approximately 5% of the companies involved with manufacturing throughout the region are producing plastic products which are tied to the production of ethylene and other plastics, and are dependent on raw material production. Direct ethane dependent industries only make up 2.94% of the existing manufacturing establishments. However, the utility and close proximity of industrial support companies make manufacturing in the Region a direct-to-market and cost-competitive solution to typical manufacturing roadblocks. Figure 5 depicts the concentration of establishments in the Region<sup>12</sup>. Reference USA provides information on the 172 industry-specific companies in the geographic region in relation to the petrochemical supply chain. Of these companies, 94 are categorized under NAICS (North American Industry Classification System) #326199; All Other Plastic Manufacturing industry, typically a code used by specialized plastics companies in the downstream production end of the petrochemical sector.

<sup>12</sup> United States Census Bureau, *Annual Business Survey*. <https://census.gov>

### CONCENTRATION OF ESTABLISHMENTS BY INDUSTRY

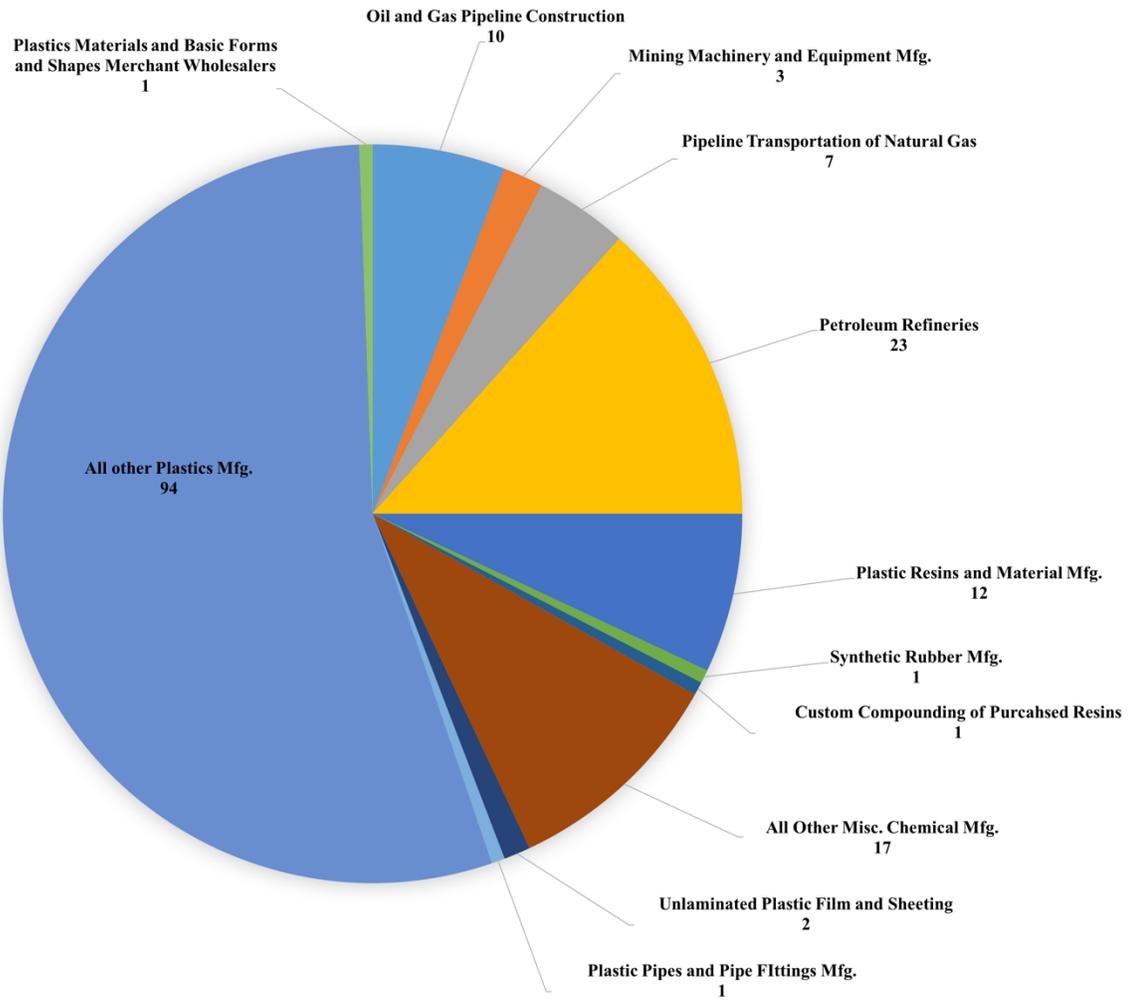


Figure 5: Concentration of Establishments by Industry, the Region

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## INDUSTRY CLUSTER SUPPORT

Clusters, defined as “a regional concentration of related industries that arise out of the various types of linkages or externalities that span across industries in a particular location”, are critical to the workings of local and national economies<sup>6</sup>. Clusters enable regions to possess competitive advantages in investments, jobs and growth. Clusters are naturally occurring and are an indicator of potential growth and productivity within a region. The importance of the local plastics cluster highlights the critical role that plastics manufacturing and production play in the industrial landscape. It also showcases the variety of products in the Region, and the extent to which the downstream plastics companies have specialized production<sup>2</sup>. To sustain the development of a new industry cluster, certain resources must be in place to promote the growth, trade and development of more significant value added in the process of creating goods.

TRADED VS. LOCAL CLUSTERS

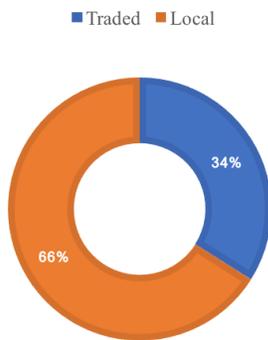


Figure 6: Traded vs. Local Clusters

TOP CLUSTERS BY EMPLOYMENT

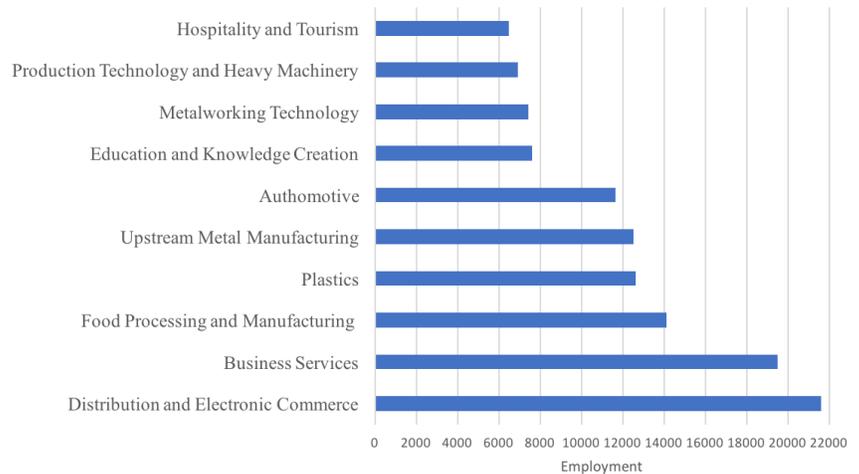


Figure 7: Top Clusters by Employment

### Traded and Local Clusters

The U.S. Cluster Mapping Project, created by the Harvard Business School, divides clusters into two categories: traded and local. Local clusters are industries within a specific region and primarily sell within their location. Traded clusters are similar industries that work together and sell in markets on a regional and international scale, and are highly correlated with stronger and growing economies.

The U.S. Cluster Mapping Project groups the 788 NAICS industries into 51 traded cluster categories. Home to 34 of the 51 traded clusters, the Region offers a tremendous competitive advantage to industries seeking qualified support and easy access across other industry clusters. These traded cluster industries have been instrumental in producing an increasing percentage of the Region’s exported GDP. Exports from the Akron and Youngstown metropolitan areas contribute 11.1% and 15.9% respectively to their GDP<sup>13</sup>.

The petrochemical cluster focuses on key traded clusters such as Oil & Gas Production, Upstream and Downstream Chemicals and, most importantly, Plastics. All four of these traded clusters are evident in the Northeast Ohio Region.

<sup>6</sup> U.S. Cluster Mapping, *Harvard School of Business*, [clustermapping.us](http://clustermapping.us)

<sup>2</sup> United States Census Bureau, *American Factfinder*, <https://www.census.gov>

<sup>13</sup> *Brookings Institute*, *Export Monitor 2018*, <https://www.brookings.edu>

Between Cluster Relatedness (BCR) measures the average relatedness between industries in two different clusters, and focuses on the relationship between employment, location of establishments, input-output flows, and occupational overlap between related clusters (see Appendix 1 for more information). The darker the line between the clusters, the more connected they are to one another.

**Plastics**

The plastics cluster in the Region is ranked 16th in the United States. Ohio is unique when it comes to the plastics cluster due to its high employment specialization. The state is the national leader in its workforce in the plastics cluster with 55,710 employees, and has the second-highest number of plastics cluster establishments at over 780 companies. The Region’s strong location quotient of 5.49 (a metric comparing the local concentration of plastics industry establishments to the national average) stands out from other areas because it is strongly export-oriented. The plastics cluster industries are over five times more concentrated in this Region than the national average.

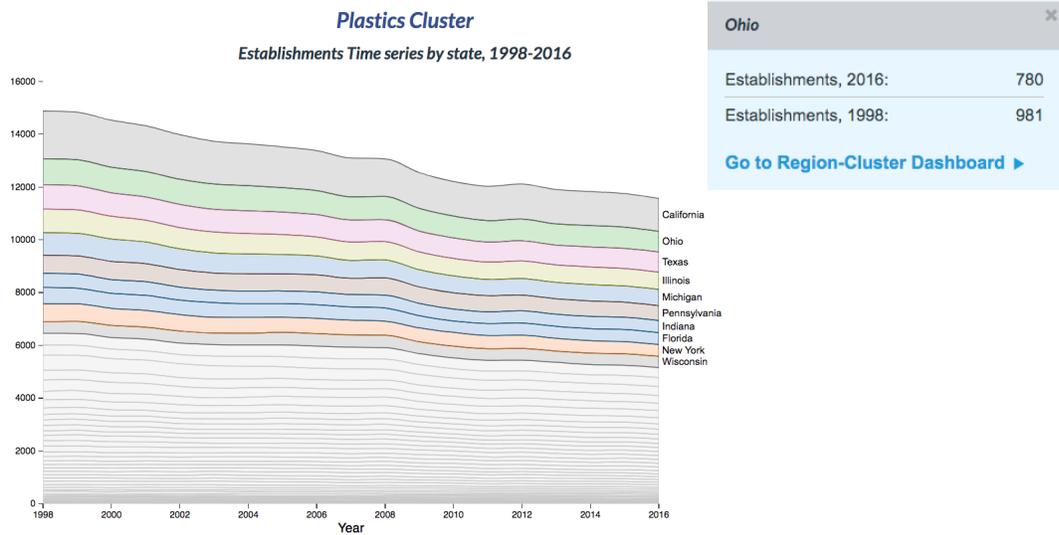


Figure 8: Plastics Cluster Establishments

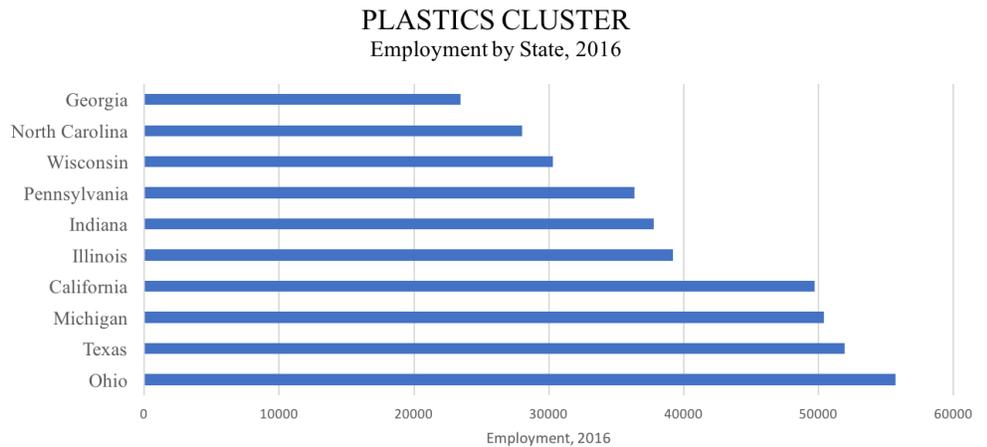


Figure 9: Plastics Cluster Employment

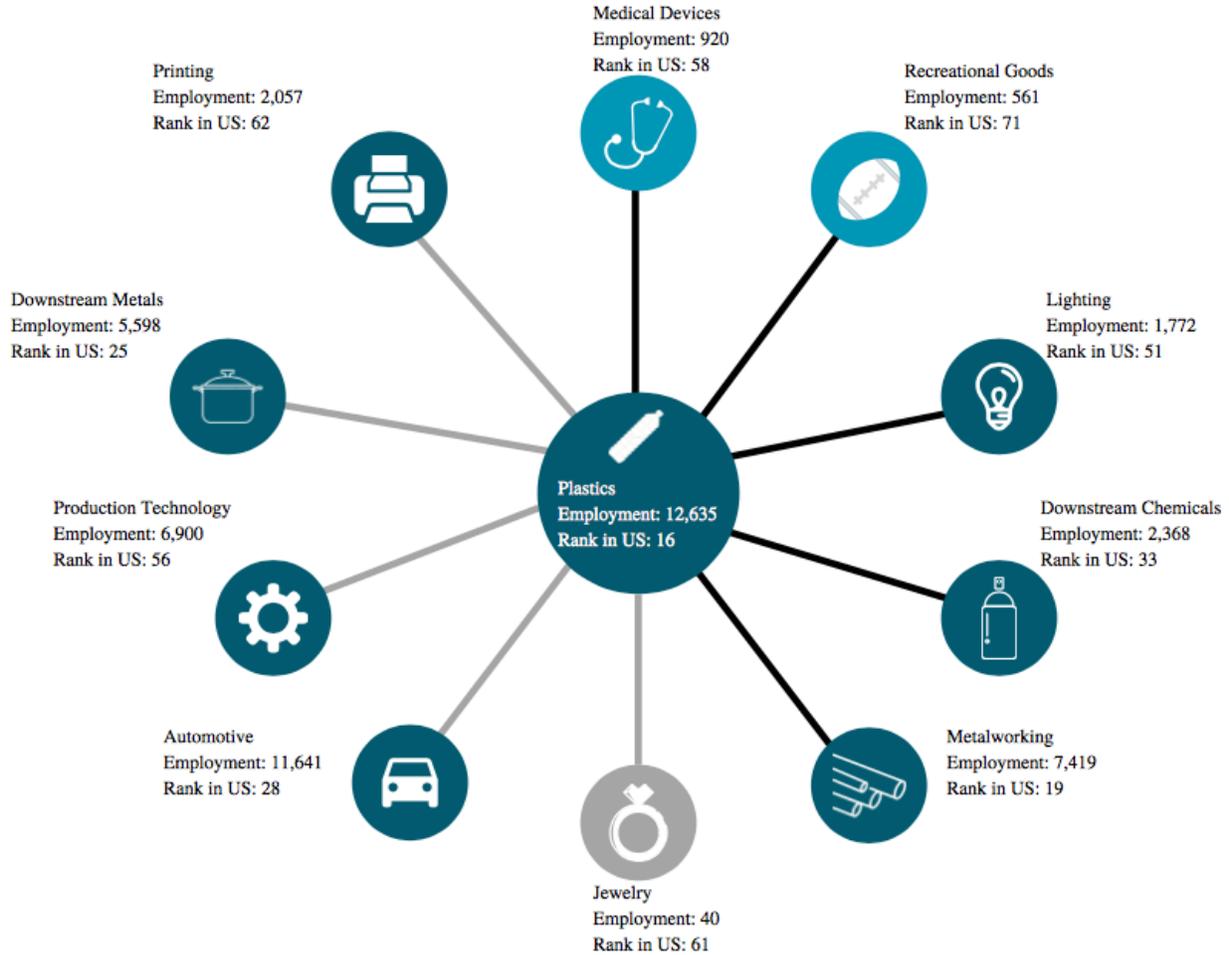


Figure 10: Plastics Cluster

The Plastics Cluster has a BCR over the 95th percentile with local industry clusters in Lighting, Downstream Chemicals, Metalworking, Recreational Goods, and Medical Devices. These five clusters have the strongest correlation to the Plastics Cluster and the most significant impact on each other. The next closely related industry clusters, with a BCR between the 90th and 94th percentile, are Printing, Downstream Metals, Production Technology, Automotive, and Jewelry. Of these ten industry clusters, it is essential to look at their individual cluster specialization ranking. Specialization is based on a region's location quotient, and the darker blue color indicates a stronger specialization. Strong clusters such as Lighting, Downstream Chemicals, and Metalworking are above the 90th percentile of specialization<sup>5</sup>. This demonstrates that there is a high concentration of the cluster in this Region compared to the national economic landscape. Figure 10 depicts the key industry clusters that are strongly connected to the Plastics Cluster, including: Lighting, Downstream Chemicals, and Metalworking<sup>6</sup>. The interrelatedness of these industries to plastics is evidence that companies seeking locations in this Region will have a robust and resilient industrial support system.

As shown in Figure 10, employment in the regional plastics sector totals 12,635 individuals. The industry clusters that are related to the plastics sector employ a total of 39,276 individuals. In total, 51,911 jobs are highly correlated to the plastics cluster.

<sup>6</sup> U.S. Cluster Mapping, *Harvard School of Business*, clustermapping.us.

## Downstream Chemicals

The Downstream Chemicals Cluster has a BCR over the 95<sup>th</sup> percentile with the Biopharma and plastics industries. This shows the related strong connection between sectors and the important impact they have on one another.

Figure 11 depicts the employment for each cluster. Regionally, Downstream Chemicals employ a total of 2,368 individuals. However, both clusters that have a strong connection with downstream chemicals with a total employment of 12,940. This shows the interconnectedness of the clusters and companies. Overall, 15,308 jobs are highly correlated to the downstream chemicals cluster.

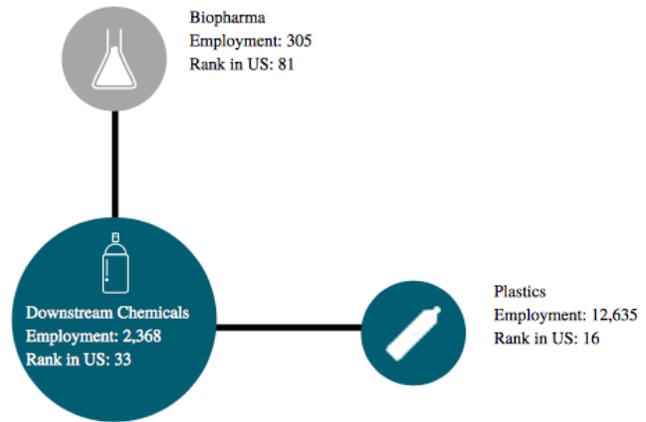


Figure 11: Chemical Cluster

## International Clusters

Internationally, clusterization provides many countries, such as Thailand, with a competitive edge in production. Figure 12 and 13 both show the port structure in Map Ta Phut Industrial Estate<sup>14</sup>. The ports are separated by industry and the industry value chains are clustered to support the rapid and cost-efficient production of goods and services to maximize trade potential.



Figure 12: Map Ta Phut Industrial Estate, Thailand Cluster

In Figure 12, PTT is shown with a cluster area developed directly on an open water port, enabling the company to quickly develop, produce and export goods in the most efficient manner. Planning its footprint around the growth of processing, has enabled the company to conduct business more efficiently and maximize competitive advantages that are only possible through strategic planning and development.

Figure 12 further explains this clustering process concerning the PTT cluster format in Bangkok, Thailand. Important to note in Figure 12 is the proximity to the open water port and the role it plays in final product exports, organized by separate product types and usage volume. A parallel can be drawn between the ease of exporting goods directly from production facilities onto the Ohio River. Intermodal facilities like the one depicted in Figure 13 and the Wellsville Intermodal Facility (Pier 48) are key assets to cluster attraction.

<sup>14</sup> Industrial Estate Authority of Thailand, <https://www.ieat.go.th>

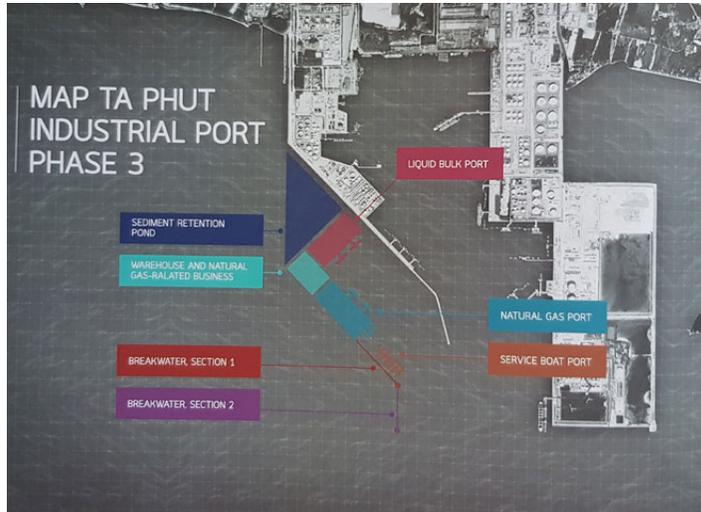


Figure 13: Map Ta Phut Industrial Port<sup>15</sup>

The major export trade routes in the local region do not involve a port on open water as that depicted in Figure 13. While this inhibits the speed to export, it enables companies to take an intermodal approach that supports national trade, and increases efficiencies and cost savings by encouraging cluster companies to consider an array of options. The significant implication of this graphic is the intentional planning of cluster trade centers to promote increased production efficiencies and support between companies across the petrochemical industry.

<sup>15</sup> Maritime Bulletin, <https://maritimebulletin.net>

## | NATIONAL PETROCHEMICAL INDUSTRY OUTLOOK

### Petrochemical Manufacturing

The Petrochemical Manufacturing industry produces the building blocks for an array of other industries. Petrochemical manufactured products are derived from petroleum or liquid hydrocarbons, which make up a multitude of chemicals with an even greater number of uses. The main list of chemicals that are produced from this process are ethylene, propylene, butylene, benzene, toluene, styrene, xylene, ethylbenzene, and cumene.

The key buying industries that utilize this list of chemicals are textile mills, plastic and resin manufacturing, soap and cleaning compound manufacturing, polystyrene foam manufacturing, and plastic bottle manufacturing. The major industries that supply this industry are oil drilling, gas extraction, and petroleum refining companies. The export percentage in terms of sales for the petrochemical manufacturing sector is 5.34%.

#### *Ethylene:*

The world's most widely used petrochemical is ethylene, the main component that makes up polyethylene. 50% of all ethylene production is polyethylene, and the most common output of ethylene chemicals is plastics. Companies accessing natural gas reserves in the Region will be focused on extracting ethane and refining ethylene, which could be used in the production of plastics, synthetic rubber, and various industrial chemical applications<sup>8</sup>.



Figure 14: Petrochemical Manufacturing Industry, U.S. Data

<sup>8</sup> IBIS World, *Industry Reports*, <https://www.ibisworld.com>

### Plastic and Resin Manufacturing

The Plastic and Resin Manufacturing industry produces plastics (polymers) and synthetic rubber derived from the ethylene that petrochemical manufacturing produces. The raw materials are sourced from the chemical manufacturing sector as well as the production of the petroleum-based feedstock industry. The buying industries include the manufacture of plastic film, sheets, bags, pipes and parts, laminated plastics and bottles. The primary activity in the plastics and resin manufacturing industry, that is highlighted in this report, is polyethylene resin manufacturing. The plastics and resin manufacturing export percentage in terms of sales is 42.35%.

## Plastic & Resin Manufacturing Industry

United States Data



Figure 15: Plastic & Resin Manufacturing Industry, U.S. Data

### Chemical Product Manufacturing

The Chemical Product Manufacturing industry in the U.S. is a customer of petrochemical manufacturing due to the raw materials that can be used in production. The key petrochemical activities that occur in this industry are custom compounding resins and manufacturing sensitized film, paper, cloth and sensitized plates. A significant supplier for the chemical product industry is plastic and resin manufacturers. They supply base resins which are used in chemical product manufacturing. Two of the major buying industries of chemical products are construction and manufacturing. This relationship closely relates to the regional economy, with small pockets of chemical and plastics companies located within short distance from many manufacturers and fabricators. The export percentage in terms of sales for chemical product manufacturing is 17.44%.

## Chemical Product Manufacturing Industry

United States Data

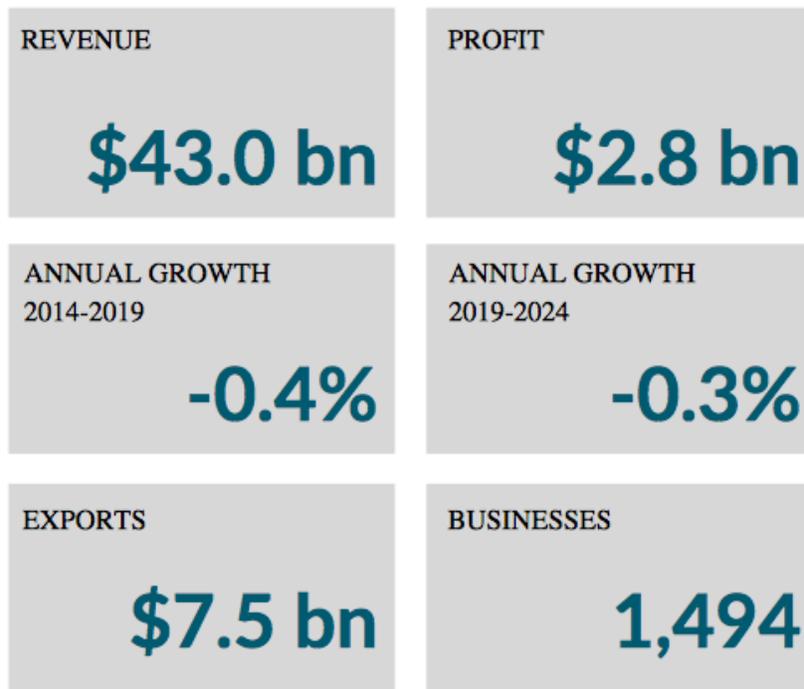


Figure 16: Chemical Product Manufacturing Industry, U.S. Data

## | INDUSTRIES RELATED TO PETROCHEMICAL

The following NAICS in Table 2 coincide with sectors related to petrochemical manufacturing, including those industries directly related to the value chain. Cracker plants typically produce propylene, paraxylene, benzene, styrene, and ethylene. The potential local ethane cracker plants, PTTGCA and Shell, will be producing ethylene, therefore the NAICS listed below are the upstream, midstream, and downstream industries related to ethylene production.

NAICS	NAICS TITLE
237120	Oil and Gas Pipeline Construction
324110	Petroleum Refineries
325211	Plastics Material and Resin Manufacturing
325212	Synthetic Rubber Manufacturing
325991	Custom Compounding of Purchased Resins
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing
325998	All Other Miscellaneous Chemical Product & Preparation Manufacturing
326111	Plastics Bag and Pouch Manufacturing
326112	Plastics Packaging Film & Sheet (Including Laminated) Manufacturing
326113	Unlaminated Plastics Film & Sheet (Except Packaging) Manufacturing
326121	Unlaminated Plastics Profile Shape Manufacturing
326122	Plastics Pipe & Pipe Fitting Manufacturing
326130	Laminated Plastics Plate, Sheet (Except Packaging) & Shape Manufacturing
326160	Plastics Bottle Manufacturing
326191	Plastics Plumbing Fixture Manufacturing
326199	All Other Plastics Product Manufacturing
333131	Mining Machinery and Equipment Manufacturing
424610	Plastics Materials, Basic Forms & Shapes Merchant Wholesalers
486210	Pipeline Transportation of Natural Gas

*Table 2: Petrochemical Industries NAICS*

## SUPPLY AND VALUE CHAIN FOR PETROCHEMICAL

The key value chain players in the petrochemical industry are raw material feed manufacturers developed by cracker facilities, which are then sold to synthetic polymer producers. These polymer producers then sell this base material to polymer compounders. Once compounded, plastics fabricators and molding companies use the polymer compounds to create finished materials ready for the market. By clustering businesses in close geographic proximity to one another, raw materials can be transformed into consumer-ready products with a considerable reduction in overall production costs due to eliminating freight expenses and increasing communication. This reduction in total expenses enables companies to pass cost savings on to consumers to become more competitive, and increases a company's response time to industry demands. The concentration of raw material production, intermediary value-added partnerships and finished goods manufacturing enables companies to reduce waste and costs. Figure 17 represents the petrochemical industries at each stage in the supply chain.

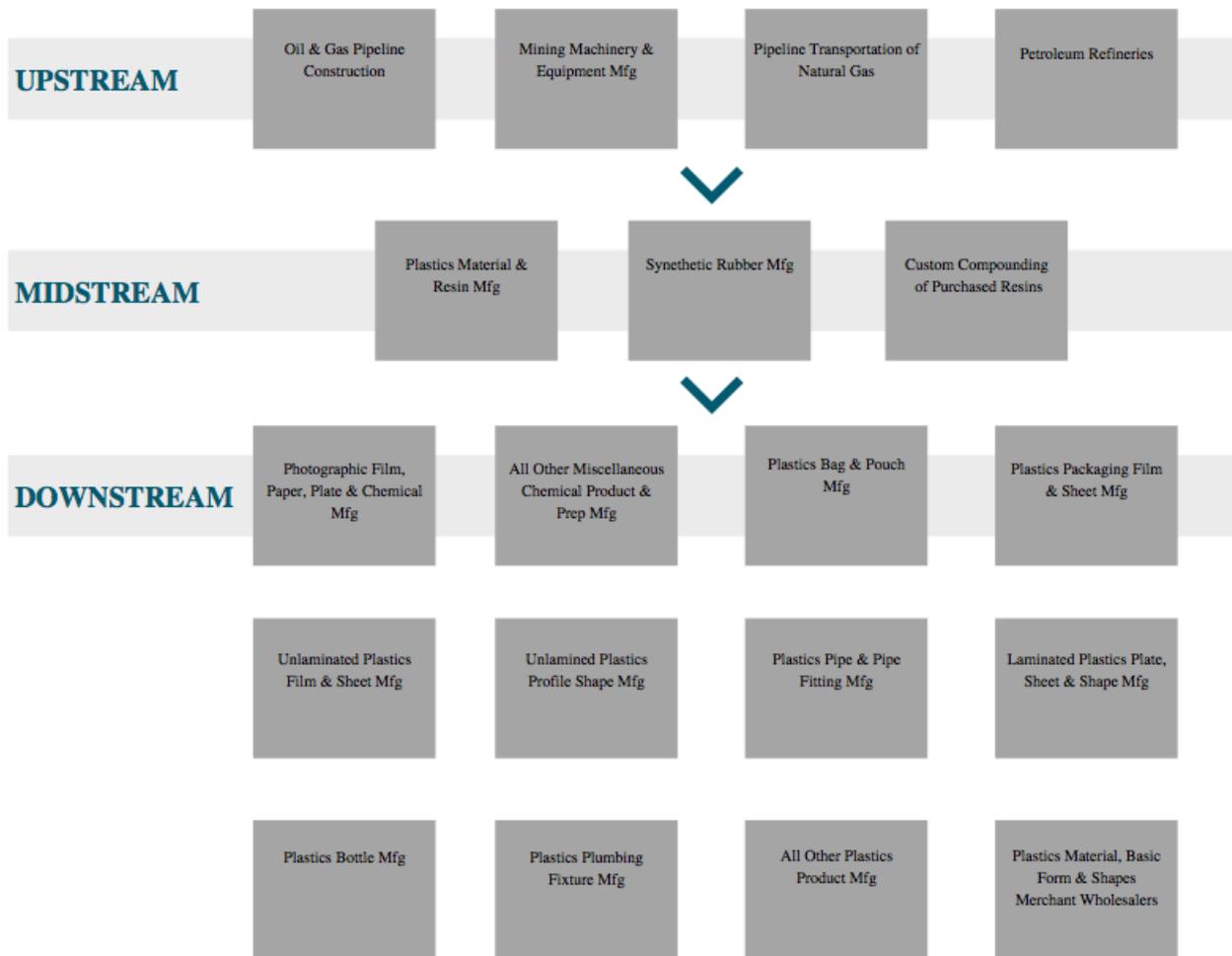


Figure 17: Petrochemical Supply Chain Industries

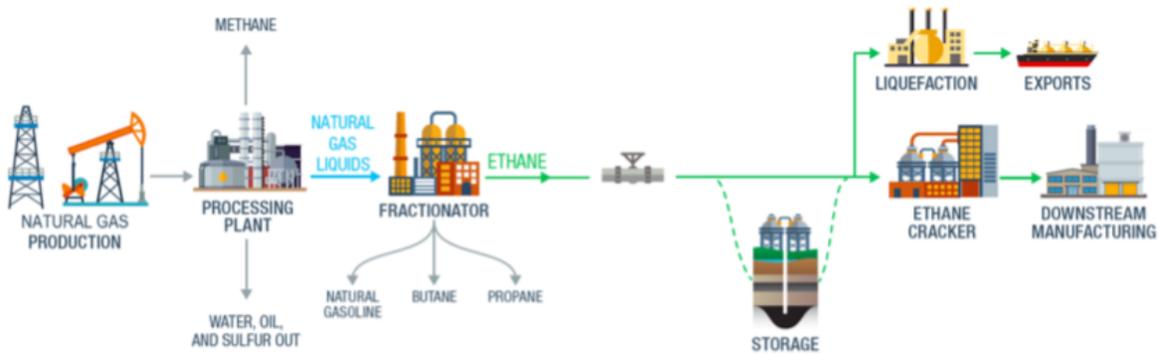


Figure 18: Ethane Value Chain<sup>16</sup>

This section focuses primarily on the upstream, midstream, and downstream companies in the Ethane Value Chain, as seen in Figure 18.

### Upstream

- Upstream industries engage in raw material extraction, exploration, and field development.
- Consists of companies that provide the petrochemical industry with natural gas and raw materials curated from the ground, such as raw ethylene and ethane pellets.

Figure 19 portrays NAICS codes by establishments in the Region. All four NAICS codes specifically deal with upstream petrochemical industries. The NAICS 237120; Oil and Gas Pipeline Construction, 333131: Mining Machinery and Equipment Manufacturing, 486210; Pipeline Transportation of Natural Gas, and 324110; Petroleum Refineries are the beginning of the processing in the petrochemical value chain. There are many establishments in these two industries in the Region. Companies in the NAICS 333131; Mining Machinery and Equipment Manufacturing are crucial to upstream petrochemical production because it supplies the equipment used in extracting the natural gases from the ground. It is critical for these companies to locate in close proximity to the extraction sites because this equipment cannot be shipped cost-effectively across the country.

## Regional Upstream Establishments (NAICS)

Oil & Gas Pipeline Construction	Mining Machinery & Equipment Mfg	Pipeline Transportation of Natural Gas	Petroleum Refineries
NAICS 237120	NAICS 333131	NAICS 486210	NAICS 324110
<b>10</b>	<b>3</b>	<b>7</b>	<b>23</b>

Figure 19: Upstream NAICS with the Number of Establishments in the Region

<sup>16</sup> U.S. Department of Energy, *Report to Congress*

## Midstream

- Includes companies engaged in the transportation, processing, and storage of material.
- Natural gases are processed and turned into Natural Gas Liquids (NGLs), resins, polymers, and synthetic compounds.
- These NGLs and polymers are compounded into sheets, tubes, laminates, specialized components, and new chemicals or plastics before fabrication.

The midstream NAICS codes that are in the petrochemical supply chain include 325211; Plastics Material and Resin Manufacturing, 325212; Synthetic Rubber Manufacturing, and 325991; Custom Compounding of Purchased Resins. These three NAICS codes fall under the plastics, rubber, and chemical industries. The raw material natural gas liquids, polymers, and synthetic compounds produce new materials that will be used by fabrication and extrusion companies, to produce solvents, chemicals, parts, goods and other ethane related products.

## Regional Midstream Establishments (NAICS)



Figure 20: Midstream NAICS with the Number of Establishments in the Region

## Midstream Transportation

Upon completion of upstream and midstream production, materials exiting the Region can be transported via pipeline or the Ohio River. One of the issues with the current cracker plant in Pennsylvania is the inability to store raw feeds efficiently. By utilizing the Mark West Facility in Jewett, Ohio, petrochemical raw feed companies can efficiently store and transport raw materials throughout Ohio and into the mass market.

The Hopedale, Ohio facility, which currently provides 180,000 barrels per day (Bbl/d) of Utica Shale fractionation, also interconnects with both the Texas Eastern Product Pipeline (TEPPCO) and the Appalachia-to-Texas Ethane Pipeline (ATEX). These 180,000 Bbl/d represent 36.37% of Mark West’s total Utica and Marcellus fractionation capacity<sup>17</sup>. Raw material can be transferred promptly to the Gulf Coast production cluster via the TEPPCO system, and local end-user companies have efficient access to sustainable raw material to begin operations before ethane cracker plant completion. “Over 95% of the country’s ethylene production capacity is located in Texas and Louisiana. Previous severe weather events along the U.S. Gulf Coast have disrupted the petrochemical supply chain’s ability to meet downstream manufacturing demand.” The lack of severe weather in the Region makes it a prime spot for downstream manufacturing because of its river access. Finished goods can be transported down the Ohio River to the Gulf without severe weather issues<sup>16</sup>.

<sup>17</sup> Mark West, *Utica*, markwest.com

<sup>16</sup> U.S. Department of Energy, *Report to Congress*



Figure 21: Navigable Rivers

**Downstream**

- The downstream portion of the supply chain includes refining, manufacturing, and marketing.
- Polymer compounds, sheet, film, and resins are fabricated or molded to create end-use products such as packaging, consumer products, and lubricants.

Twelve NAICS codes have been identified utilizing ethane inputs that are active in the downstream petrochemical supply chain. They receive their materials from the midstream companies to produce their products. These major NAICS code industries are: 325992; Photographic Film, Paper, Plates, and Chemical Manufacturing, 325998; All Other Miscellaneous Chemical Product and Preparation Manufacturing, 326111; Plastics Bag and Pouch Manufacturing, 326112; Plastics Packaging Film and Sheet Manufacturing, 326113; Unlaminated Plastics Film and Sheet Manufacturing, 326121; Unlaminated Plastics Profile Shape Manufacturing, 326122; Plastics Pipe and Pipe Fitting Manufacturing, 326130; Laminated Plastics Plate, Sheet, and Shape Manufacturing, 326160; Plastics Bottle Manufacturing, 326191; Plastics Plumbing Fixture Manufacturing, 326199; All Other Plastics Product Manufacturing, and 424610; Plastics Materials, Basic Forms, and Shapes Merchant Wholesalers.

Products made by downstream manufacturers are generally sold to distribution companies or directly to the consumer. Due to the volume that these companies must sell and the more complex nature of the products they produce, downstream companies tend to locate as close as possible to end consumers. There are currently 115 downstream establishments in the area, with a distribution network that supports quick access to the market.

**Regional Downstream Establishments (NAICS)**

Photographic Film, Paper, Plate & Chemical Mfg NAICS 325992	All Other Misc. Chemical Product & Prep Mfg NAICS 325998	Plastic Bag & Pouch Mfg NAICS 326111	Plastics Packaging, Film & Sheet Mfg NAICS 326112	Unlaminated Plastics Film & Sheet Mfg NAICS 326113	Unlaminated Plastics Profile Shape Mfg NAICS 326121
0	17	0	0	2	0
Plastics Pipe & Pipe Fitting Mfg NAICS 326122	Laminated Plastics Plate, Sheet & Shape Mfg NAICS 326130	Plastics Bottle Mfg NAICS 326160	Plastics Plumbing Fixture Mfg NAICS 326191	All Other Plastics Product Mfg NAICS 326199	Plastics Materials, Basic Forms & Shapes Merchant Wholesalers NAICS 424610
1	0	0	0	94	1

Figure 22: Downstream NAICS with the Number of Establishments in the Region

Figure 23 shows what the ethane cracker plant can produce and the percentage of each. This image illustrates the products ultimately produced from the raw chemical material feedstock from an ethane cracking plant. For ethane to become ethylene and other gases, it is cracked in the ethane cracker plant using extreme heat. The downstream production of ethylene-based products are then sold from these end-use materials to plastic fabricators and molders before entering the broader consumer product market. Innovations in the downstream plastics market are powered by direct access to materials across the petrochemical value chain. The close proximity of regional companies across the petrochemical value chain will act as an accelerator for industrial innovation and production. To fuel this progress, commitment and investment from private and public sectors are necessary.

## Ethane Cracking Downstream Products

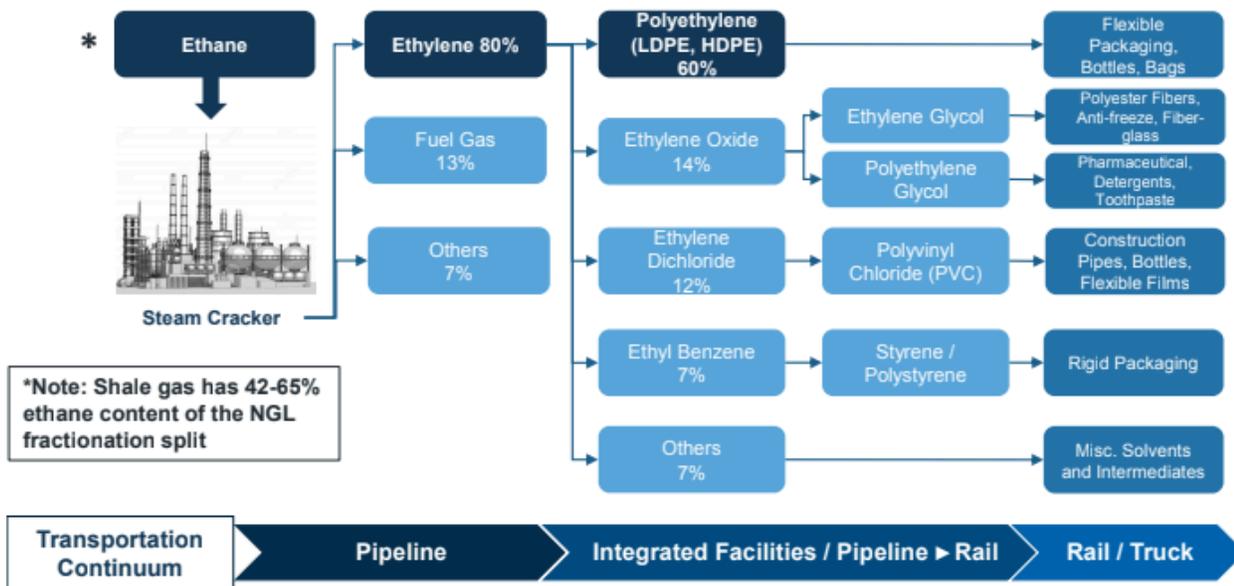


Figure 23: Ethane Cracking Downstream Products<sup>18</sup>

<sup>18</sup> Source: PLG Consulting

## | ESTABLISHMENT HEAT MAP

The heat map of Northeast Ohio in Figure 24 depicts high-density locations of establishments within a 150-mile radius from the center of the Region. The establishments on this map are related to the NAICS codes discussed throughout this report. A high density of establishments is visible in the Akron/Youngstown, Columbus, and Cleveland areas. These establishments are further defined in the GIS Map in Appendix 2, which identifies areas for potential development among the Region.

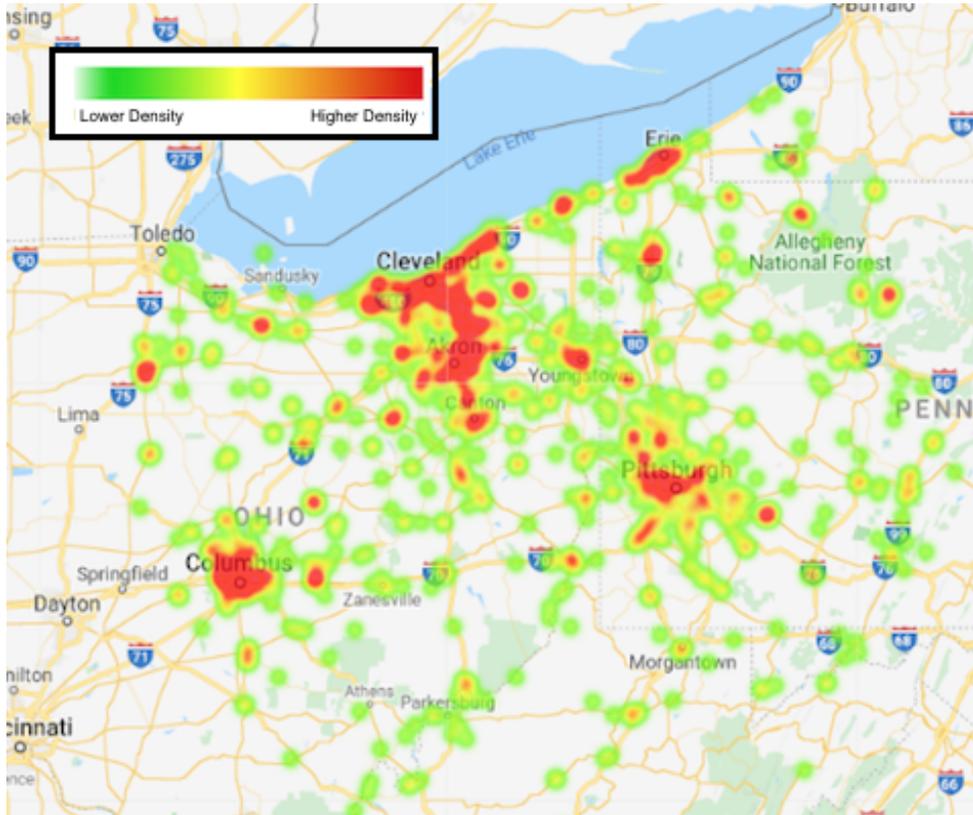


Figure 24: Establishment Heat Map of Petrochemical Industry, within 150-mile radius of the Region<sup>19</sup>

<sup>19</sup> ReferenceUSA, *Establishments in Petrochemical Industry*, <http://www.referenceusa.com>

## OPPORTUNITIES FOR THE REGION

There is a strong presence of regional companies along the entire petrochemical value chain. One-third of petrochemical activity in the United States occurs within a 300-mile radius of Pittsburgh, Pennsylvania, which is located directly west of the Region. In addition, there are multiple support industries within the 300 mile radius with the ability to enhance and quickly develop new and expanding plastics companies. The abundance of natural resources and opportunities within the Region cannot provide all the necessary assets petrochemical companies desire when approaching site selection and investigating options for new facilities. In this process, four important metrics stand out: labor force, proper utilities, professional support and logistics & transportation.

The Region is preparing to handle the demands of the petrochemical industry regarding all four metrics. Professional and technical support agencies are located throughout the area, and direct support organizations are detailed in Appendix 3 as the Regional Resources. The GIS Map in Appendix 2 and Figure 26 showcase the areas throughout the Region when transportation and utilities connect, providing the supply chain and support opportunities necessary for petrochemical companies to locate, grow, and thrive.

### Site Selection Metrics



Figure 25: Site Selection Metrics

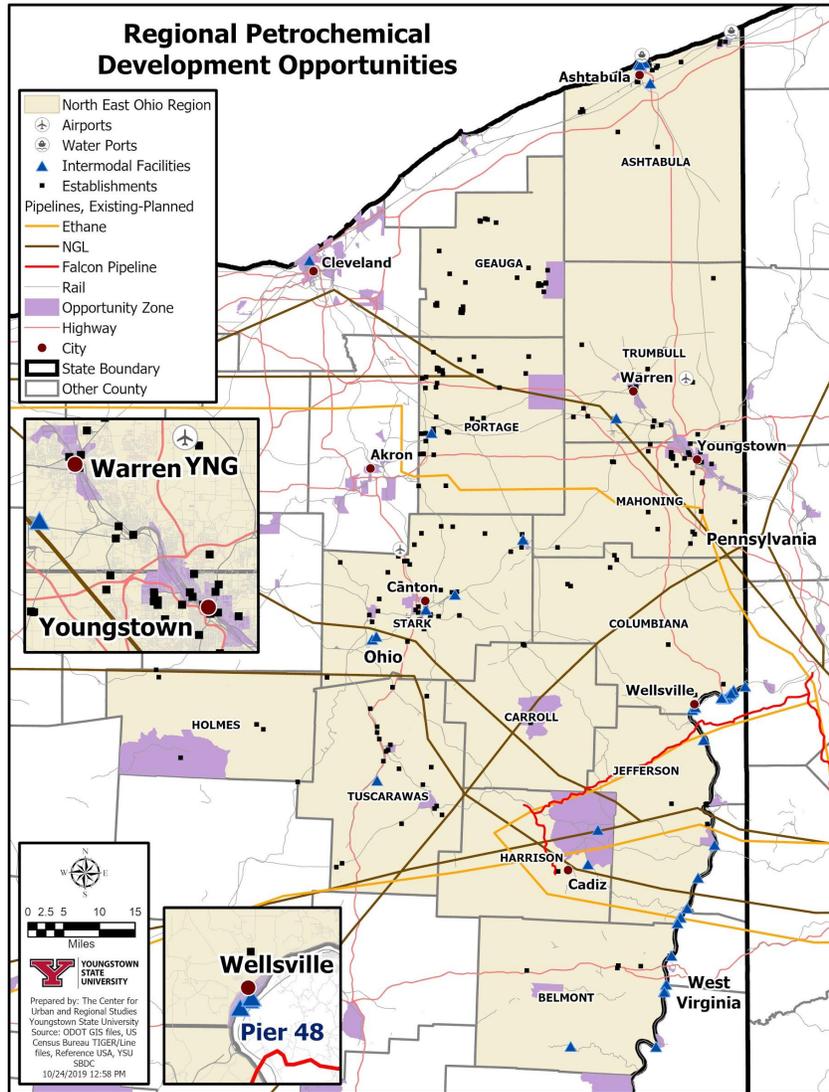


Figure 26: Regional Petrochemical Development Opportunities

The Region contains large deposits of Marcellus and Utica Shale reserves that are being mined for the production of the raw material feeds. The original capacity projections have recently been updated to 214 trillion tons of recoverable natural gas in the Appalachian Basin.<sup>20</sup> This capacity is in portions of and within close proximity to the Region. There is little risk of natural disasters in Ohio, unlike the risks involved near other natural gas reserves in Texas and the Gulf of Mexico. Infrastructural assets are prevalent in the Region, as seen in the Regional Petrochemical Development Opportunities Map (Figure 26), to support and sustain the growth of the plastics industry. Connections to the pipelines and growth within Ohio's Opportunity Zones gives companies access to direct line transportation and storage, raw materials access, and cost saving advantages on state tax opportunities. The Opportunity Zones provide a company the ability to defer some taxes and defer some or all capital gains taxes. These incentives and local transport and utility strengths have been analyzed to provide key areas for development, as mentioned in the prospective companies section. Overall, the region contains the assets necessary to enhance the development of a robust petrochemical industry cluster.

<sup>20</sup> USGS - October 3rd, 2019 release.

## PROSPECTIVE COMPANIES

To effectively and efficiently create an industry cluster, multiple companies along the value chain must play a role. Attracting synthetic polymer producers and polymer compounders to the regional area will be vital to curating a resilient petrochemical cluster. These midstream production companies can guarantee full product development across the shared strengths of the clustered companies. There are a wealth of local companies currently operating in the ethylene industry. The increase in raw materials locally, and the ease of access to many of the major markets in the United States and Canada, make the area a prime contender for plastics extrusion and fabrication companies. In an industry where the cost to ship raw materials is relatively low, midstream companies such as synthetic polymer producers have less incentive to locate near their suppliers, and tend to locate closer to their downstream users such as the plastics extrusion and fabrication companies. Figures 27, 28, and 29 target areas with the optimal assets for midstream and downstream facility development. These locations combine the opportunity zones, pipelines, intermodal transportation and port access which improves a company's ability to quickly move products throughout the Region.

### Wellsville

The opportunities in the Wellsville area are multifaceted. The largest and northernmost point on the Ohio river, the Wellsville intermodal facility exposes companies to trade from many different areas outside the Region. Decreased cost of shipping and direct access for companies expanding into exports, makes this location prime for high volume midstream manufacturers. The Columbiana County Port Authority supports many local manufacturers currently in this Opportunity Zone, and has shovel ready sites available for companies investigating expansion.

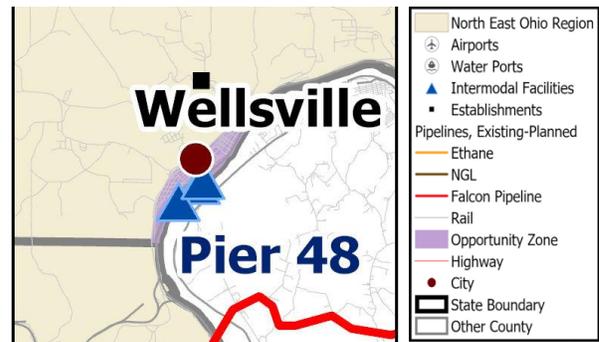


Figure 27: Wellsville, Ohio Opportunity Map

### Youngstown/Warren

The cities of Youngstown and Warren make up the backbone of the Region's industrial centers, and are strategically positioned between Cleveland and Pittsburgh as a transportation hub. There have been considerable redevelopment activities across the metropolitan areas, and groups such as the Mahoning Valley Manufacturing Coalition are devoted to the wellbeing of local manufacturers across industries. There is also a large concentration of existing establishments in the petrochemical industry in the Region. Positioned between Warren and Youngstown is one of two airports located in the Region. The Youngstown Warren Regional (YNG) airport is surrounded by AeroPark Industrial Park, with over one million square feet of space ready for development with direct access to air cargo transport.

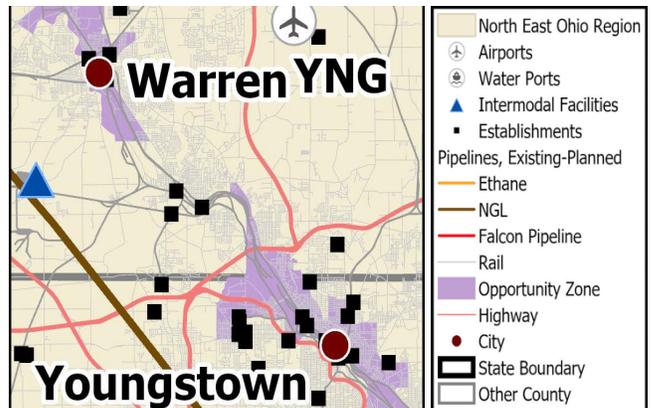


Figure 28: Youngstown & Warren, Ohio Opportunity Map

### Canton

The Canton area is strategically positioned with access to current NGL availability, the highest concentration of intermodal facilities and multiple opportunity zones. Canton is home to the second regional airport, Akron-Canton Airport (CAK), which serves over one million commercial passengers a year. CAK has a 180-acre industrial park servicing corporations, with cargo transportation forecast by CAK to reach 14,845 tons by 2019<sup>21</sup>.

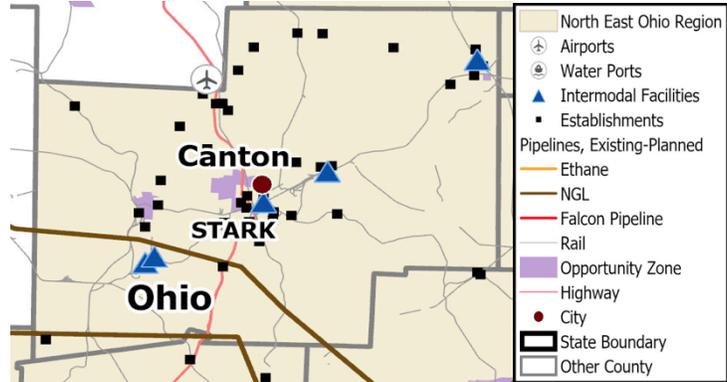


Figure 29: Canton, Ohio Opportunity Map

The regional area has many undeveloped and available industrial properties, many with vacant buildings or shovel-ready for redevelopment. The Region's rich history of manufacturing and industry provides the foundation for midstream companies looking for increased industrial capacity, and the utilities to support large manufacturers and downstream fabricators. The specific regions of the opportunity map highlight areas with the transportation capacity and system support accessible to any company locating in the area.

<sup>21</sup> CAK, *Airport Master Plan*, September 2015.

## | EXISTING COMPANIES

One of the competitive advantages in the Region is the number of existing companies in the petrochemical industry that are currently operating. There are 172 ethane-related petrochemical companies already located in the Region. These companies have strategically positioned themselves in reference to market wide demands and the abundance of resources available. See the “Industries Related to Petrochemical” section for evidence of the variety of these existing companies.

The supply chain that constitutes the petroleum and chemical manufacturing industries already exists throughout the Region. The petroleum refineries in the area provide direct access to midstream companies seeking refined products, and are in close proximity to customers and the transportation efficiencies in the Region. There are synthetic rubber manufacturers that are in neighboring Geauga and Stark counties. This is significant, as research universities like the University of Akron are engaged with the private sector in new synthetic polymer research to advance polymeric technology<sup>22</sup>. These research and development activities are evidence of the strong relationship between the existing petrochemical industry and public education in the Region.

Other industries in the Region have even higher numbers of companies that make up an essential part of their local economy. Increasing the concentration of industry players in the geographical Region will increase cost-effectiveness and industry resilience, while posing few threats to the economy. The diverse use of downstream plastics enables companies to be flexible in regional location selection, as the multitude of natural resources gives companies multiple site opportunities.

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<sup>22</sup> Ohio Development Services Agency, *Polymers: Plastic Resins, Synthetic Rubber and Related Products*, <https://development.ohio.gov>

## | WORKFORCE AND LABOR ASSETS

The Mahoning Valley Manufacturing Coalition (MVMC), with Ohio industry partners and extending into Northwestern Pennsylvania, is dedicated to the local development and retention of skilled workers throughout the Region. The training provided by the MVMC and other groups provides support to many local manufacturers. The Manufacturing Institute states:

Modern manufacturing “requires a technical workforce with math and science skills [and] production workers with increased numeracy, team building, and problem-solving abilities.”<sup>23</sup>

Through skills training, manufacturer matching programs and educational workshops, MVMC and related organizations are joining together diverse manufacturing companies and the skilled labor force.

Identifying the underlying assets of the skilled labor force in an area is crucial as companies search for optimal locations. The SkillScape study performed at Massachusetts Institute of Technology (MIT) investigates these underlying skills that enable occupational success across a variety of occupations, and where those skillsets are concentrated throughout the nation<sup>24</sup>. The five skills this study defines as essential skills of Chemical Plant System Operators are: explosive strength, repairing, equipment maintenance, chemistry, and rate control. The study closely correlates this skillset to Pump Operators, and links the skillset to others such as peripheral vision, glare sensitivity and more. These skills, as well as those related to manufacturing success, are readily present in the regional workforce in the Steubenville-Weirton, Ohio area.

CHEMICAL PLANT AND SYSTEM OPERATORS

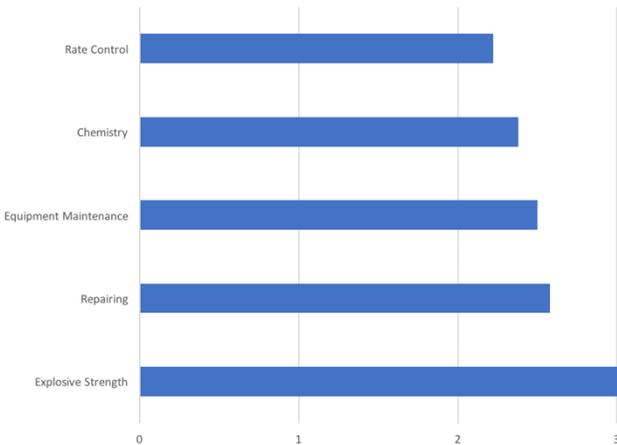


Figure 30: Chemical Plant & System Operators Skillsets

PUMP OPERATORS, EXCEPT WELLHEAD PUMPERS

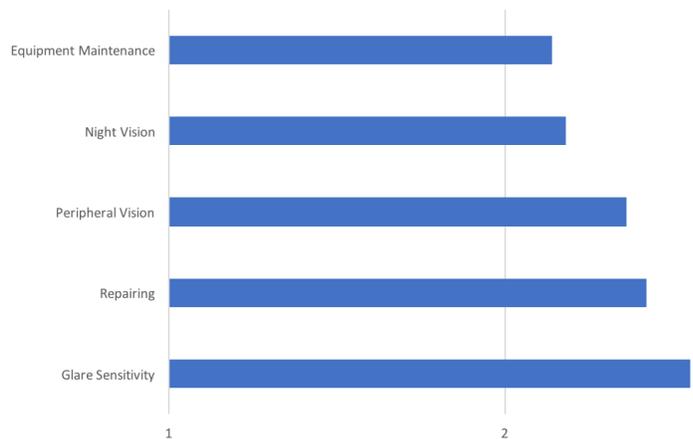


Figure 31: Pump Operators Skillsets

<sup>23</sup> Manufacturing Institute, *themanufacturinginstitute.org*

<sup>24</sup> SkillScape, *Massachusetts Institute of Technology*, <http://skillscape.mit.edu>

## || EDUCATIONAL INSTITUTIONS

There are approximately 19 colleges or universities in the Region<sup>25</sup>. Many of these institutions are research universities with a broad curriculum and diverse educational training programs. There are multiple career training and technical education organizations throughout the Region capable of answering the demands of the workforce.

In the interest of fulfilling the needs proposed by the Manufacturing Institute, many of these local organizations have created programming targeted at developing these skills. Team Consortium is one of the organizations in the Region among many others that assist institutions of higher education in designing the curriculum and creating pathways to the jobs that are coming to the area. They provide education and training support to careers specifically in STEM including energy and advanced manufacturing sectors.

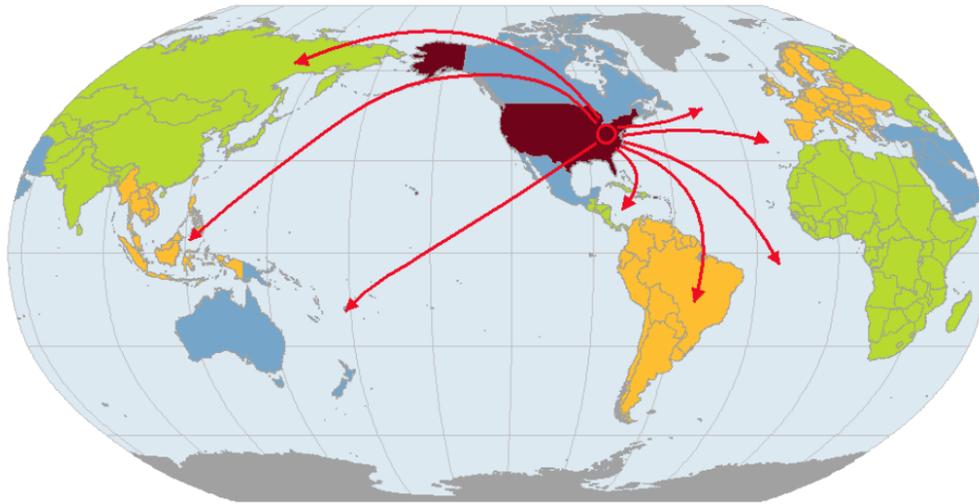
All regional educational institutions are dedicated to enriching the local workforce and instilling the skills that the petrochemical industry needs to thrive. This programming and skills training represents a willingness to support and sustain the local plastics industry and associated growth opportunities.

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<sup>25</sup> DemographicsNOW, *Gale Research*, <https://dnow.gale.com>

## | CURRENT INTERNATIONAL TRADE

Ohio ranks as the 9th largest exporting state in the United States. In 2018, Ohio exported 54.4 billion dollars of merchandise to 210 countries and territories. Between 2017 and 2018, Ohio increased exports by 8.7%. Of the top 20 exported commodities from Ohio in 2018, five of them relate to the petrochemical industry: Plastics and Articles Thereof, Rubber and Articles Thereof, Miscellaneous Chemical Products, Soap & Waxes and Organic Chemicals.



*Figure 32: Ohio Top Exports*

According to information compiled by the Observatory of Economic Complexity, the United States is responsible for 10% of the international ethylene polymer trade. The only foreign player exporting more ethylene polymers is Saudi Arabia, which is responsible for 15% of the international industry exports<sup>26</sup>. As a dominant force in the global petrochemical industry, it is crucial to maintain this standing in the U.S. and take measures necessary to encourage further industry development.

<sup>26</sup> OEC, *Ethylene Polymers*, <https://oec.world>

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## EXPORTS

To maintain a focused discussion, the products that are derived from ethane make up a large volume of exports. This section will focus on the primary material produced by the cracker plants, ethane, which can be exported. Ethane falls under the Harmonized Tariff Schedule (HTS) 2711.19.0010. When exporting ethane using water transportation, it requires either a medium or large vessel. A medium vessel's capacity is 262,000 barrels of ethane at cavern pressure. The large vessel's capacity is 800,000 barrels of ethane at cavern pressure<sup>16</sup>. Ethane is rarely transported by rail, so having port access that can handle these types of vessels is essential.

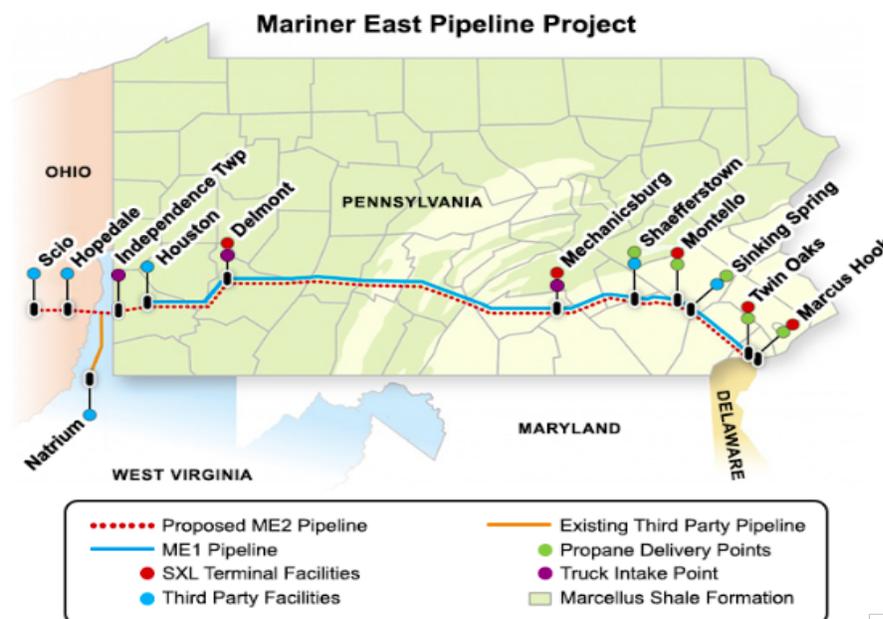


Figure 33: Mariner East Pipeline Project<sup>27</sup>

The closest refinery that can handle the medium-sized vessels is Marcus Hook, located about 20 miles southwest of Philadelphia. The NGLs are transported to Marcus Hook through the Mariner East pipeline. There are three pipelines that make up Mariner East: Mariner East 1, Mariner East 2, and Mariner East 2X. These pipelines will carry NGLs from the Utica and Marcellus Shale in Ohio and Pennsylvania, and then across the state to the Marcus Hook facility to loading facilities for export<sup>28</sup>.

Most of the NGLs that are exported from this terminal are destined for Europe. In 2015, the U.S. surpassed Norway as the top exporter of ethane in the world<sup>29</sup>. All the U.S. ethane exports from 2014 to 2015 were destined to Canada and were transported primarily through pipelines. However, in 2018, the U.S. exports of ethane were sent to 10 different countries globally. With capacity at 450,000 barrels per day, the U.S. currently exports ethane to Brazil, Canada, Mexico, India, Norway, Sweden, and the United Kingdom.

<sup>16</sup> U.S. Department of Energy, *Report to Congress*

<sup>27</sup> Natural Gas Intelligence, <https://www.naturalgasintel.com>

<sup>28</sup> NPR, *StateImpact Pennsylvania*, <https://www.npr.org>

<sup>29</sup> Talk Business and Politics, *Energy*, <https://talkbusiness.net>

**Statewide**

Through further analysis, it is possible to delineate the total exports from Ohio on a NAICS industry level, giving more visibility to each industry's trade patterns.

**3252**

Resin, Synthetic Rubber & Artificial & Synthetic Fibers & Filament export over \$1.3 billion worth of products annually from Ohio. In 2019 YTD, Ohio is the fifth-largest in volume exporter of products originating from 3252. There was a 2.92% increase in exports from 2017 to 2018 in this industry category. Figure 34 illustrates the top exporting countries in 2018 which are Canada, Mexico, Belgium, China, and Japan.

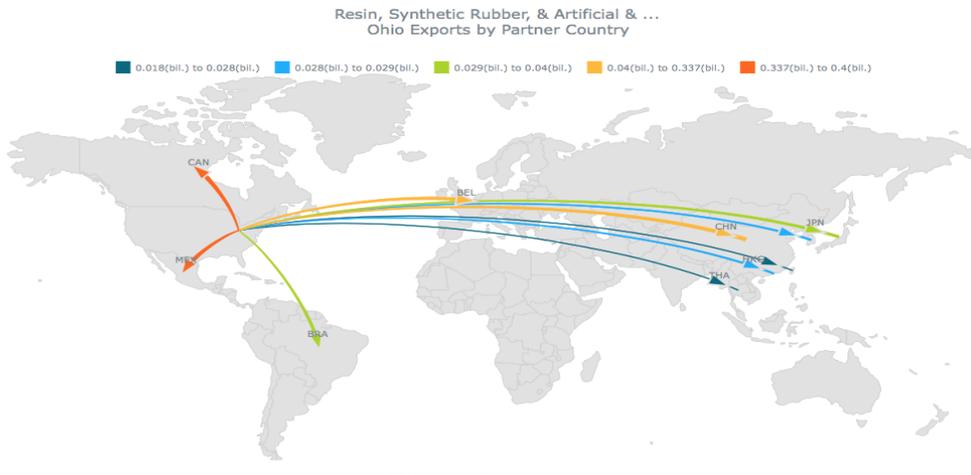


Figure 34: Ohio Top Exporting Countries, NAICS 3252

**3259**

Other Chemical Products & Preparations export over \$5 million worth of products annually from Ohio. In 2019, Ohio was the fourth largest volume exporting state within this NAICS category. Between 2017 to 2018, Ohio saw a 5.31% increase in exports in this industry alone. Figure 35 illustrates the top exporting countries in 2018, which are Canada, Mexico, France, China, and Singapore<sup>30</sup>.

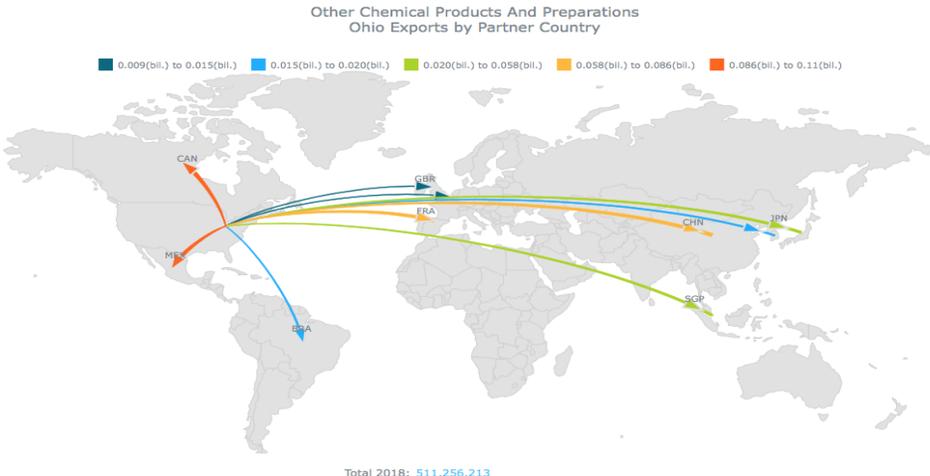


Figure 35: Ohio Top Exporting Countries, NAICS 3259

<sup>30</sup> WISERTrade, <http://www.wisertrade.org>

3261

Plastics Products exported over \$1.5 billion worth of products from Ohio to places all around the world. Ohio is the third largest in volume of exported products under this NAICS category. From 2017 to 2018, Ohio saw a 2.07% increase in exports in Plastics Products. The top countries in 2018 that imported Plastics Products from Ohio, as shown in Figure 36, are Canada, Mexico, China, Taiwan, and the United Kingdom<sup>30</sup>.

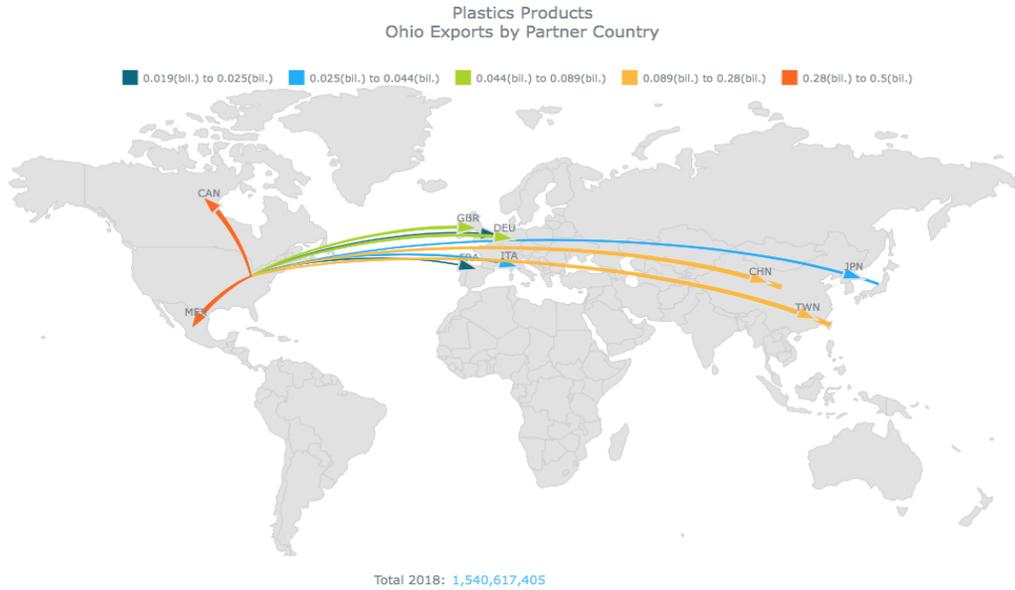


Figure 36: Ohio Top Exporting Countries, NAICS 3261

<sup>30</sup> WISERTrade, <http://www.wisertrade.org>

## || IMPORTS

### Statewide

Ohio has a trade surplus across all three subsectors totaling \$88 million. By building a petrochemical cluster in Ohio and Pennsylvania, this would help eliminate some of the imports which are mainly originating from China. Since PTTGCA and Shell are building their plants along the Ohio River, companies would be able to utilize the raw materials in the area rather than sourcing from outside the United States. Locally sourcing would help eliminate shipping costs, tariffs and lead time.

#### 3252

Resin, Synthetic Rubber, & Artificial & Synthetic Fibers & Filament imported 1.3 billion dollars of products in 2018. This category's top importing countries to Ohio are Canada, Japan, and Germany.

#### 3259

Other Chemical Products and Preparations in 2018 imported over 3 million dollars of products from other countries. China, Japan, and the Netherlands are the top countries Ohio imported products from in 2018.

#### 3261

Plastics Products imported 1.4 billion dollars of products in 2018. The main countries Ohio sourced and imported in this category from were China, Canada, and Mexico<sup>30</sup>.

### Nationwide

10% of petroleum imports in 2019 are expected to originate from Saudi Arabia<sup>8</sup>. Due to increased production in the U.S. over the last couple years, imports in the petroleum sector are expected to decrease.

## OHIO IMPORT VALUES

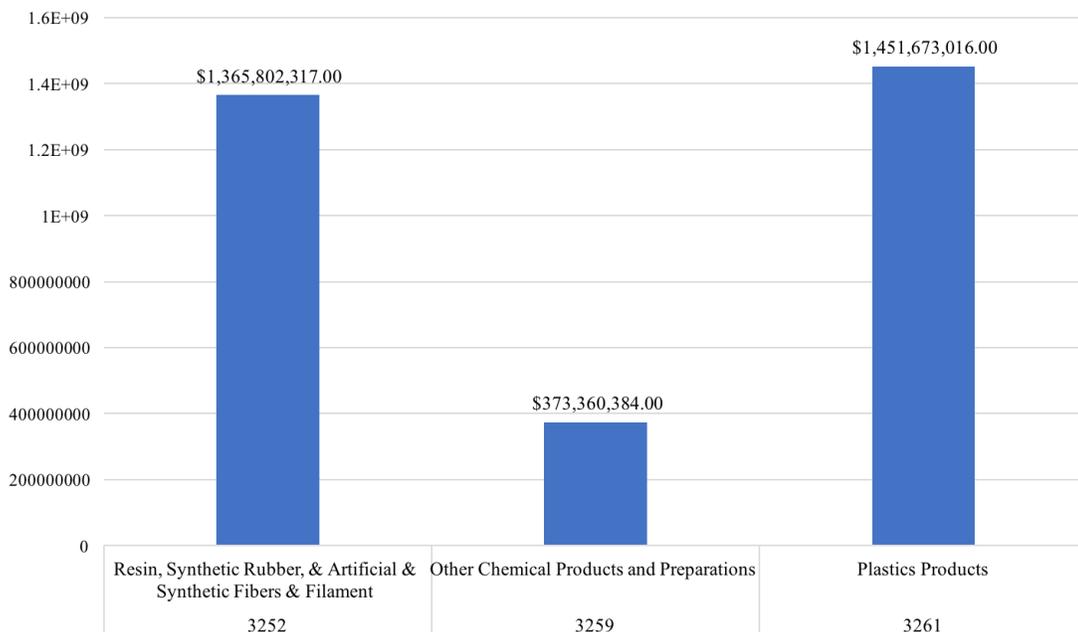


Figure 37: Ohio Import Values per NAICS, 2018 Data

<sup>30</sup> WISERTrade, <http://www.wisertrade.org>

<sup>8</sup> IBISWorld U.S. Industry Reports, <https://www.ibisworld.com>

## | FOREIGN DIRECT INVESTMENT

### Statewide

Ohio is the 7th largest state in the country in terms of international employment rate directly related to Foreign Direct Investment. Ohio has 4,297 foreign-owned establishments, representing a total of 51 countries. In June 2019, 268,068 jobs were supported by foreign-owned companies. The top countries investing in Ohio are Japan (27%), Germany (12%), Canada (9%), United Kingdom (14%), France (7%), Ireland (4%), Switzerland (4%), and Other (23%)<sup>31</sup>.

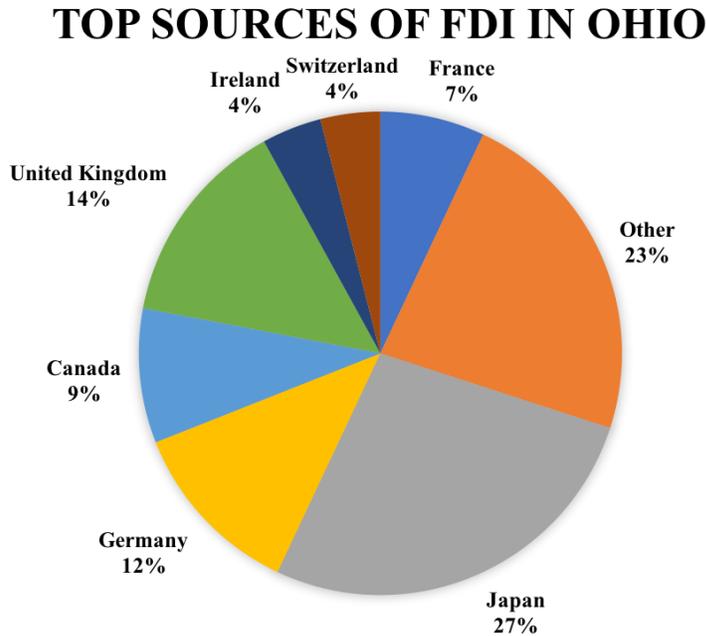


Figure 38: Top Sources of FDI in Ohio

Invest Here, Grow Here, Succeed Here was a slogan at one of Ohio's recent investment summits. There are resources in Ohio to assist foreign-owned companies in site selection, talent acquisition, navigating taxes and regulations, locating trusted partners and identifying potential resources.

### Regional

The Region currently has approximately 138 foreign direct investments, with 24 of those relating to the petroleum and chemical industry sectors.

<sup>31</sup> Ohio Research Office, *International Corporate Investment in Ohio Operations*

## | EASE OF DOING BUSINESS

The Region's history of export success and ease of access to dominant trade routes, make the area a prime location for industry clusterization and focused efforts to increase national production efficiencies.

The rail and road systems coming to and from the intermodal facilities across the Region, and peaking at the intermodal facility in Wellsville, Ohio, run extensively across the area and support the existing local industries. Figure 39, depicts the location of intermodal facilities relative to both the current road and rail systems, as well as the area of the potential PTTGCA and current Shell cracker plants.

Ohio is the fourth largest freight movement state in the United States in terms of value of goods transported<sup>32</sup>. The state ranks third for the value of goods moved by truck. Considering the multimodal freight movement between rail and water, Ohio ranks second in terms of value of goods shipped. The main driver behind Ohio ranking among the top states for freight movement, is the concentration of manufacturing. The strategic position of the region between major cities with direct access to a majority of the nation's population, makes the ease of doing business readily apparent.

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<sup>32</sup> Ohio Department of Development, *Logistics Cluster*, <https://development.ohio.gov>

## || TRANSPORTATION

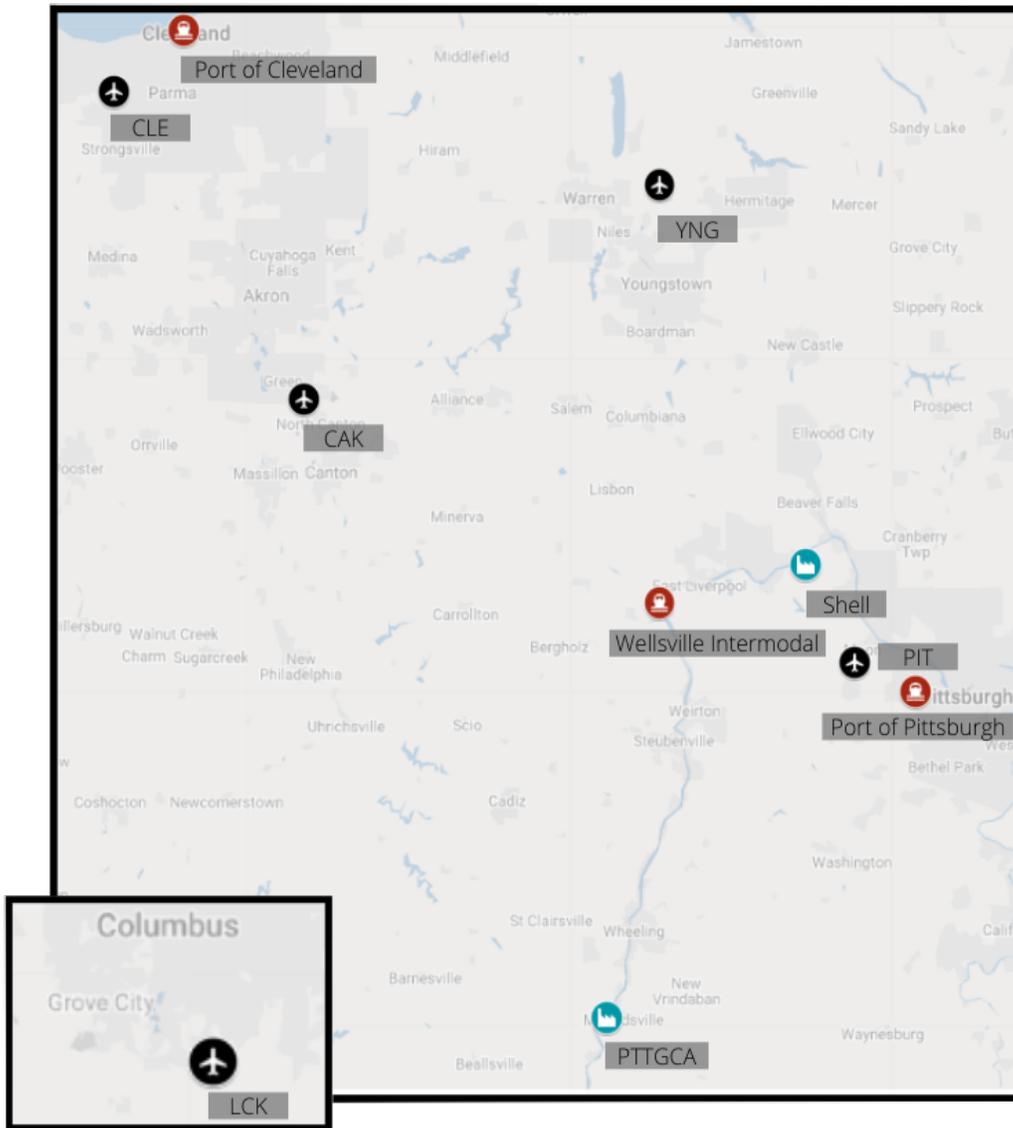


Figure 39: Transportation Map of Northeast Ohio

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### ||| MAJOR REGION ROADWAYS

Ohio, Pennsylvania, and West Virginia have excellent transportation infrastructure for trucking. Ohio has the fourth largest trucking industry in the United States, with 78% of the freight movement from Ohio to other states solely transported by truck<sup>32</sup>. In Ohio, there are approximately 123,000 miles of road, ranking seventh in the nation for the road system.

State Route 7 and State Route 11 are both four-lane highways that run longitudinally through the state. They provide highway access forty miles north via I-76 and I-80. It also includes highway access forty miles south via I-70. State Route 11 runs through Ashtabula, Trumbull, Mahoning, and Columbiana counties. State Route 7 runs through Lawrence, Gallia, Meigs, Athens, Washington, Monroe, Belmont, Jefferson, Columbiana, Mahoning, Trumbull, and Ashtabula counties.

Running east to west from Pittsburgh, Pennsylvania, to Canton, Ohio is U.S. Route 30, creating easy access across the state lines connecting the east coast to the west coast. Between Canton and East Liverpool, this roadway turns into a two-lane highway.



Figure 40: Ohio National Highway System Map<sup>33</sup>

<sup>32</sup> Ohio Department of Development, *Logistics Cluster*, <https://development.ohio.gov>

<sup>33</sup> Transportation Information Mapping System, <https://gis.dot.state.oh.us/tims>

## ||| RAILROADS

In Ohio, there are many industries that take advantage of moving freight by rail. Trucks, steel, grain, automobiles, chemicals, plastics, and petroleum are all commodities that utilize the Ohio rail system. The rail routes most utilized in the Region is the transportation between east coast ports and Chicago. Measuring the contribution of rail transportation to the gross domestic product, Ohio ranks as the fourth-largest rail industry in the nation.

Although ethane is not primarily transported by rail, other NGLs are, including propane, normal butane, and isobutane. Ethane is not transported by rail due to the cost-effectiveness that pipelines allow.

The investment by freight railroads exceeds \$250 million annually in the Ohio rail infrastructure<sup>34</sup>. These major investments in the Region bring jobs and private investment to Ohio. The projects are Heartland Corridor's Rickenbacker Intermodal Terminal and the National Gateway's North Baltimore Intermodal Facility.

Major players, CSX and Norfolk Southern, consider Ohio a center for the freight transportation system in the United States. There is also a regional railroad, Youngstown and Southern that runs between Youngstown, Ohio and Darlington, Pennsylvania.

Figure 41 details the entire Ohio network of railroads, both long-haul and short-haul, with more than 5,000 miles of active tracks. Throughout Ohio, there are 13 intermodal terminal facilities that handle rail and sea shipments.

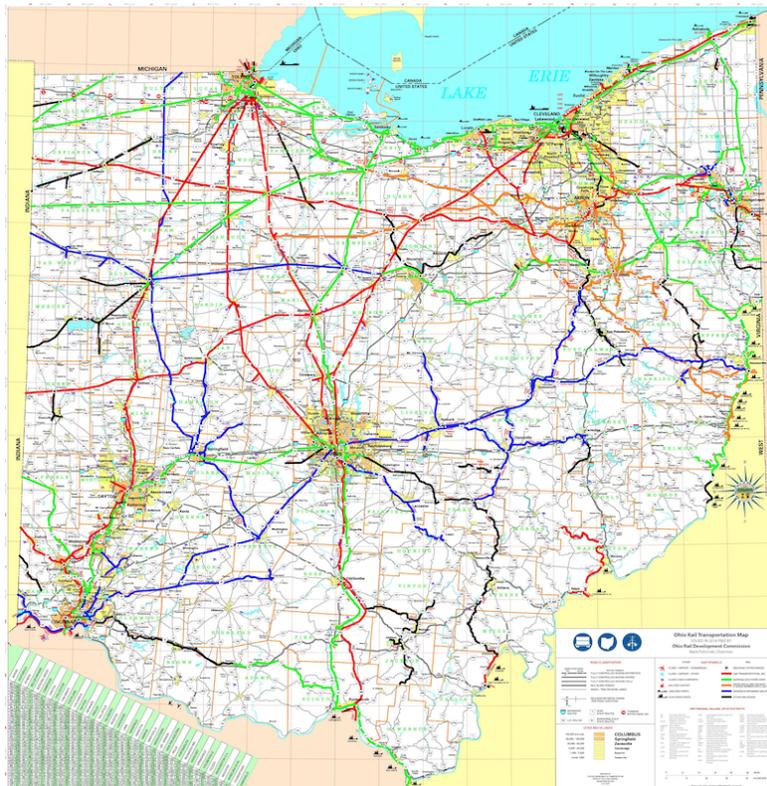


Figure 41: ODOT, Ohio Rail Map<sup>35</sup>

<sup>34</sup> Ohio Railroad Association, <http://www.ohiorailroadassociation.com>

<sup>35</sup> Ohio Department of Transportation, <http://www.dot.state.oh.us>

### Norfolk Southern Railway

The Norfolk Southern Railway operates as a Class 1 freight railroad in the United States, with 19,420 rail miles through 22 states including Ohio, Pennsylvania, and West Virginia. Norfolk Southern links both proposed ethane cracker plants and connects a significant amount of the rail access throughout the Region.

### CSX Transportation

CSX Transportation is also a United States Class 1 freight railroad. It operates in the eastern states and runs into Canada. CSX operates 21,000 miles of tracks, providing access to 70 ports.

### Youngstown and Southeastern Railroad

The Youngstown and Southeastern Railroad is a short-line railroad that operates between Youngstown, Ohio and Darlington, Pennsylvania.



Figure 42: Norfolk Southern Railway Map<sup>36</sup>

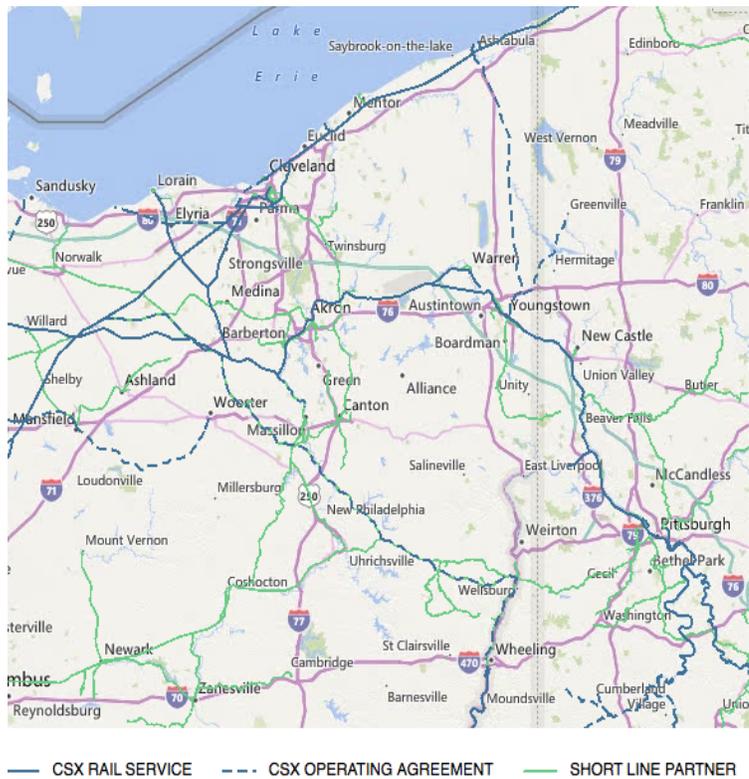


Figure 43: CSX Railway Map<sup>37</sup>

<sup>36</sup> Norfolk Southern Corporation, <http://www.nscorp.com/content/nscorp/en.html>

<sup>37</sup> CSX, <https://www.csx.com>

## ||| DEEP WATER PORT

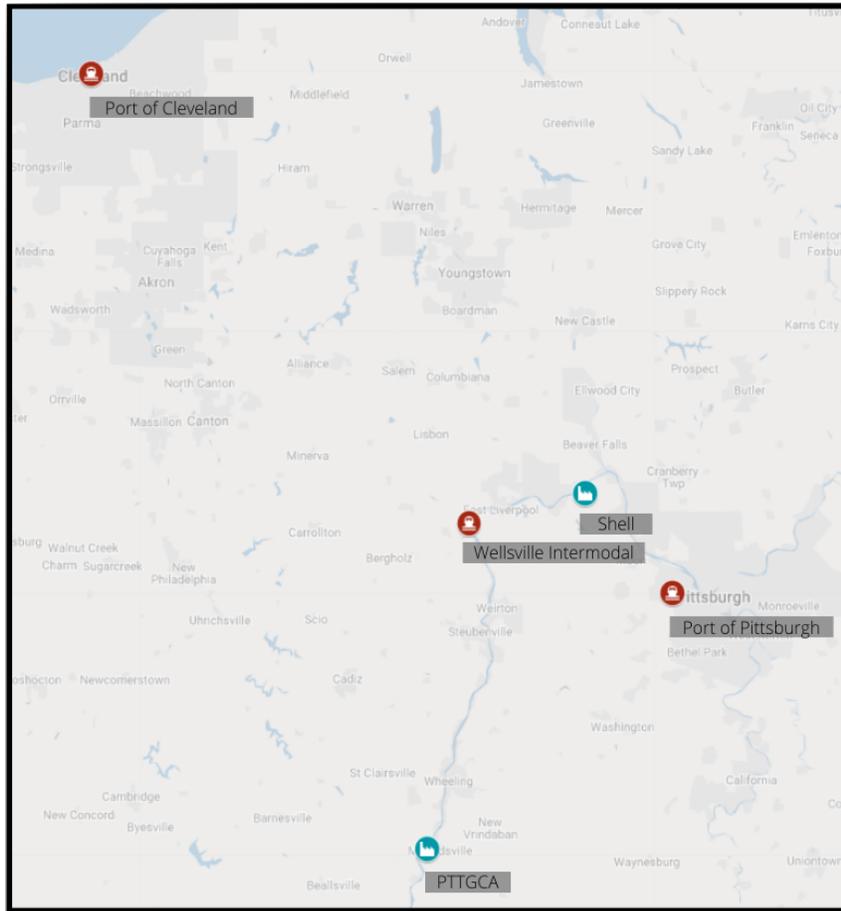


Figure 44: Port Map of Northeast Ohio and Northwest Pennsylvania

### Wellsville Intermodal Facility

Columbiana County is home to the northernmost deep-water port and intermodal facility in Ohio, with direct access to the Ohio River which then flows into the Mississippi River. The Wellsville Intermodal Facility, operated by Pier 48, also borders Pennsylvania and can provide the direct access to move large volumes of cluster production into the mass market.

Two-thirds of Ohio's borders are on navigable waters, making it the eighth largest state in terms of tonnage of maritime cargo moved<sup>38</sup>. The Wellsville Intermodal Facility is one of eleven cargo terminals along the Ohio River. The Columbiana County Port Authority possesses a 60-ton bridge crane at the deep-water port with industrial warehouse space and bulk facilities.

The Wellsville Intermodal Facility is accessible from State Route 7 and is a multimodal cargo transportation corridor. This facility is a center point for five of the six largest population markets in the U.S.<sup>39</sup> It is within a one-day drive from New York City, Chicago, Philadelphia-Baltimore-D.C., and Atlanta. This site is also part of Foreign Trade Zone #181.

<sup>38</sup> Columbiana County Port Authority, <http://www.ccpa-ohioriver.com>

<sup>39</sup> Eastgate Regional Council of Governments, *Lake and River Port Facilities*, <https://www.eastgatecog.org>

**Port of Cleveland**

Just outside the Region, the Port of Cleveland is located in Ohio within close proximity and has many advantageous services for companies. The Port of Cleveland moves containerized and non-containerized goods across the Great Lakes. It is the only port facility on the Great Lakes with direct, scheduled service to Europe. One of the services the port offers is the Cleveland-Europe Express route, which connects the Port of Cleveland to the Port of Antwerp. From the European port, companies have direct access to many national markets including Russia, Finland, Spain, the United Kingdom, and the Baltic States. This site is also Foreign Trade Zone #40 and is a grantee for other Foreign Trade Zones.

**Port of Pittsburgh**

Within close proximity to the Region, the Port of Pittsburgh consists of 200 miles of commercially navigable waterways. The port and waterways span twelve counties in Southwestern Pennsylvania, connecting the Ohio, Allegheny, and Monongahela Rivers. CSX and Norfolk Southern railroads both serve this port which is easily accessible by four interstate highways.

## ||| AIR TRANSPORTATION

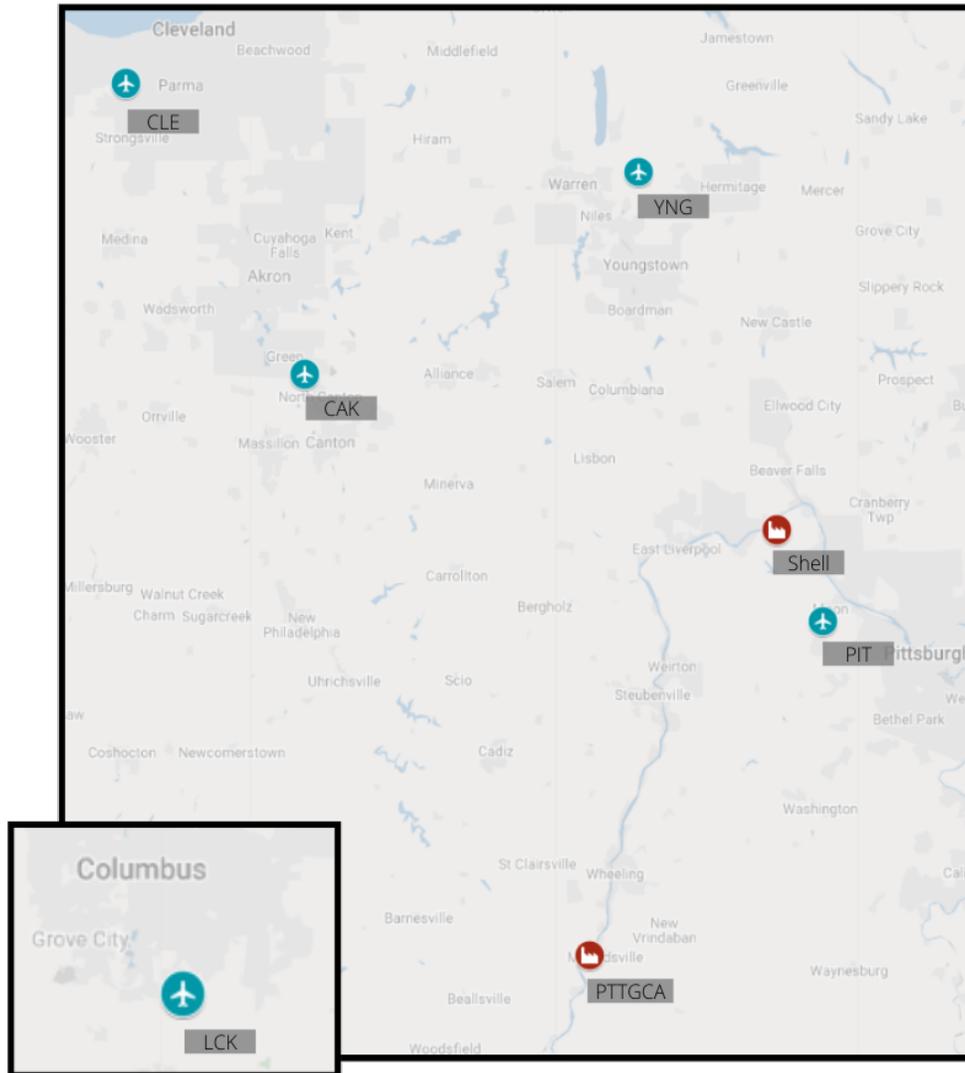


Figure 45: Airport Map of Northeast Ohio and Northwest Pennsylvania

### Akron-Canton Airport

The largest airport in the Region is in the northeastern corner of Stark county. The Akron Canton Airport (CAK) has a 180-acre industrial park and transports over one million commercial passengers a year. CAK also has airlines that service air cargo.

### Youngstown-Warren Regional Airport

The second-largest airport in the Region is the Youngstown-Warren Regional Airport (YNG) located in Vienna, Ohio. It operates as a commercial service facility that can also handle air cargo. A number of public and private airports are in operation throughout the area, and the Region is within close distance to three major air cargo facilities.

**Cleveland Hopkins International Airport**

Cleveland Hopkins International Airport (CLE) is one of the major Ohio airports within proximity to the petrochemical plants. It provides air cargo services to connect Northeast Ohio with the rest of the globe. Cargo and handling companies at CLE include: United Cargo, FedEx, UPS, USPS, Delta Airlines Cargo, Southwest, and Servisair GlobeGround.

**Pittsburgh International Airport**

Pittsburgh International Airport (PIT) is the major Pennsylvania airport that is a short drive from both petrochemical plants. It offers air cargo services by: FedEx, UPS, and Qatar Airways Cargo. Pittsburgh International Airport has become the logistics center for importing and exporting due to the service of Qatar Airways Cargo. PIT has a twice-weekly service that mainly hauls heavy electronics, high-value goods and pharmaceuticals.

**Rickenbacker International Airport**

Rickenbacker International Airport (LCK) located in Columbus, Ohio is another airport that specializes in air cargo and is within 125 miles of Belmont County. Services include corporate, general, commercial and military aviation, as well as air freight. Rickenbacker is easily accessible by major roadways.

## ||| NGL PIPELINES

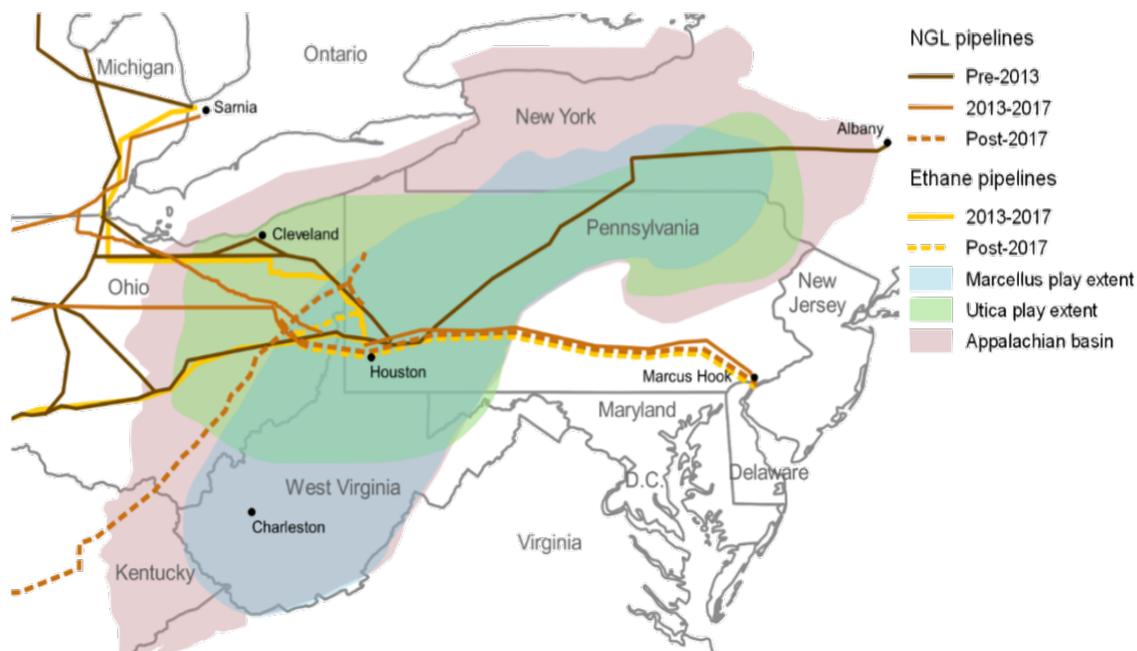


Figure 46: NGL Pipelines, Appalachian Basin

The best way to cost-effectively transport ethane is by pressurized pipelines. Rail is rarely utilized to transport ethane due to the cost-effectiveness of pipelines.

In a research report done by the Department of Energy, studies show that the Appalachian region, including Ohio, has recently seen an increase in the production of natural gas. Production is projected to grow steadily in the short-term and long-term. Along with an increase in the production of natural gas, Ohio has another unique characteristic. “Ohio is part of the Appalachian region which extracts the most ethane separately from the remaining NGLs stream and have been increasing their capacity to do so faster than national fractionation capacity overall. This process is crucial for gas processors looking to balance gas quality requirements on natural gas pipelines, and is key to satisfying local and out of region demand for ethane as a petrochemical feedstock<sup>16</sup>.”

### Sunoco Mariner East

Sunoco Mariner East is composed of several different pipelines: Mariner East 1, Mariner East 2, Mariner East 2X. All pipelines connect the Utica and Marcellus shale regions to transport NGLs, ethane, propane, and butane through Ohio and Pennsylvania to the east coast.

### Falcon Ethane Pipeline System

The Falcon Ethane Pipeline System will be 97 miles, running through Southwestern Pennsylvania, Eastern Ohio, and West Virginia. It is being built by Shell to link the Shell cracker plant in Monaca, Pennsylvania to other major ethane fractionation source points throughout the region.

<sup>16</sup> U.S. Department of Energy, *Report to Congress*

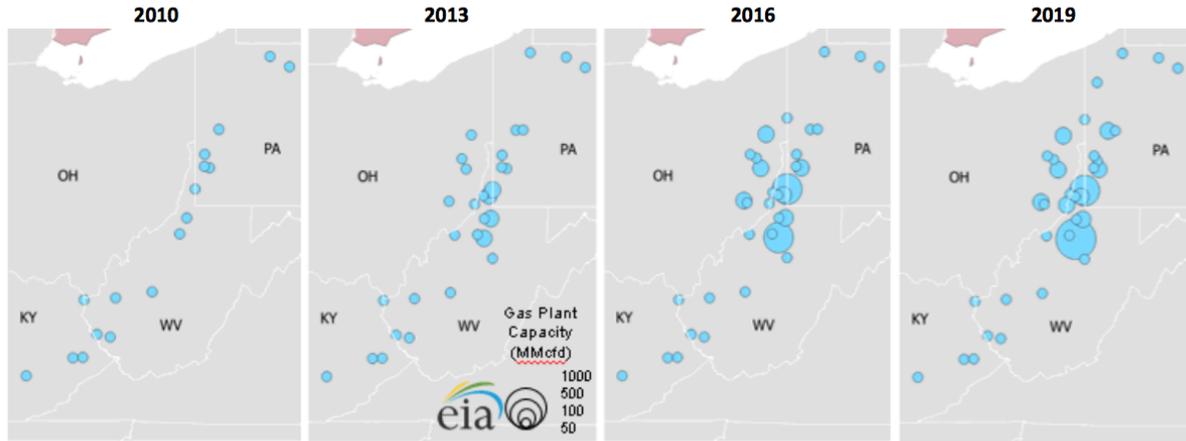


Figure 47: Gas Processing Plants located in OH, PA, WV & KY<sup>16</sup>

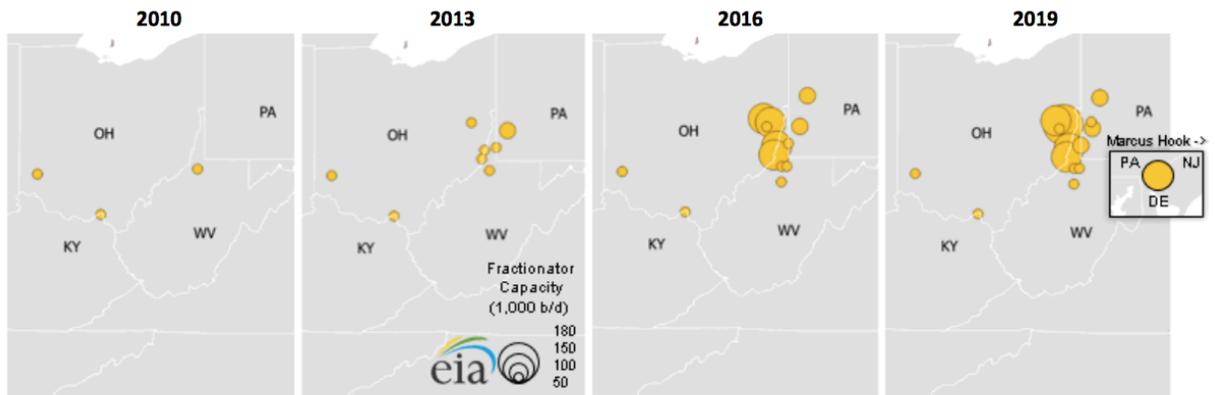


Figure 48: NGL Fractionation Plants located in OH, PA, WV<sup>16</sup>

<sup>16</sup> U.S. Department of Energy, *Report to Congress*

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## RECOMMENDATIONS

### Facilities & Physical Sites

Ohio recognizes Opportunity Zones throughout the entire state. There are 320 such zones in Ohio with an estimated 39 in the Region. Of the 88 counties in Ohio, 73 have opportunity zones that make them more attractive to businesses looking to invest<sup>40</sup>. All of the counties in the Region contain Opportunity Zones. The state of Ohio decides zone locations for potential investment by analyzing Census tract data and low-income areas that have the ability to support long term investments. These areas provide tax-incentive programs for businesses looking to invest in these zones.

Some of the areas identified have existing buildings available, and some are tracts of land ready for construction. Investors can build the size facility that is necessary for production in their industry. The purple regions in Figure 49 are the currently active Opportunity Zones throughout the Region. Current establishments in the petrochemical industry are also included in Figure 49 to show the opportunities that exist for companies already located in the Region and interested in expansion.

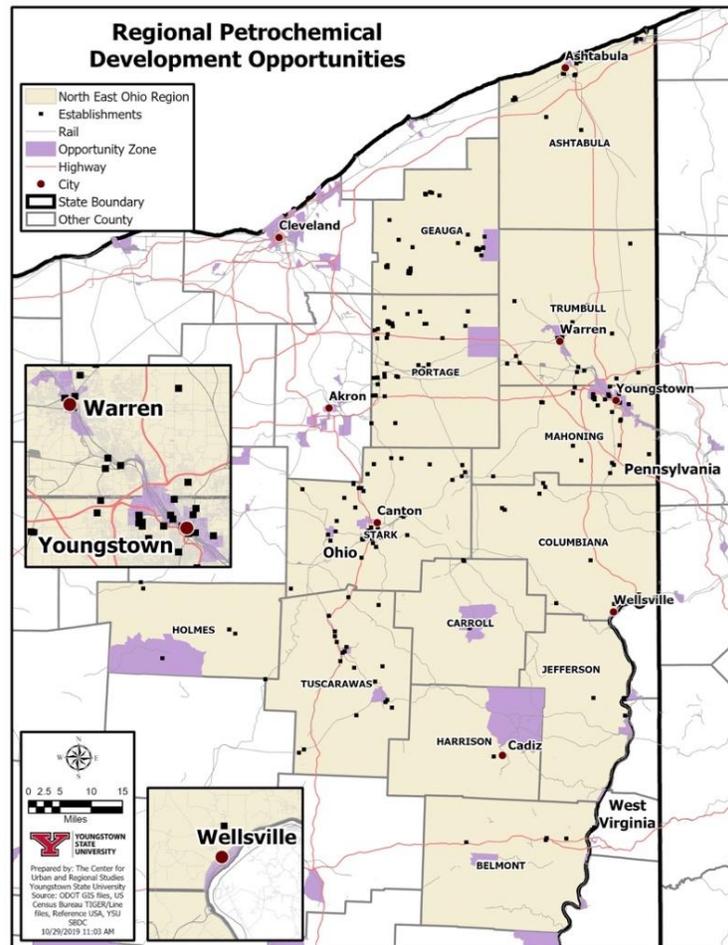


Figure 49: Regional Petrochemical Development Opportunities

<sup>40</sup> Ohio Opportunity Zones, <https://opportunityzones.ohio.gov>

## | VISION, STRATEGIES, AND ACTIONABLE ITEMS

### Vision

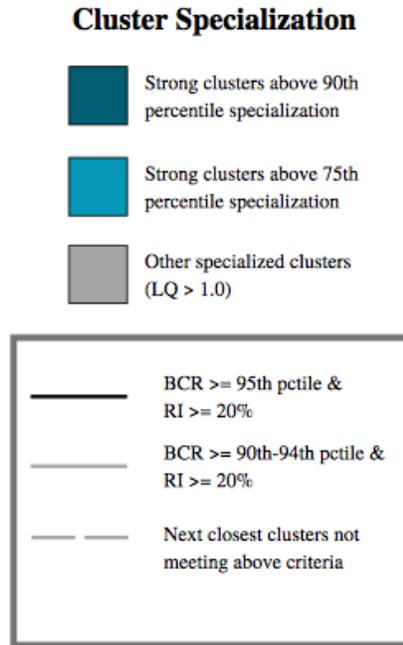
The vision is to create an ecosystem that will focus on: 1) Building a successful value & supply chain for the petrochemical and plastic industries, 2) Attracting and retaining diverse businesses and high paying jobs, 3) Attracting and retaining human capital, and 4) Implementing a proactive international strategy.

### Strategies and Actionable Items

1. Collaborate with other economic development groups, chambers of commerce, academic institutions, trade schools, industry associations, and workforce development programs to build a strong network of collaborative efforts. The following actionable steps must be considered:
  - Select development sites through close cooperation with the Columbiana County Port Authority and other agencies.
  - Identify existing supply chain improvement opportunities.
  - Build awareness and community outreach by holding conferences, seminars, etc.
  - Attract and retain target businesses.
  - Develop workforce and human capital that meets timely business demand with specific knowledge and skillsets (universities, trade schools, workforce training programs).
  - Utilize the research capabilities of The Ohio SBDC EAN at the Williamson College of Business Administration at YSU, other research institutions and company labs in the region.
2. Build on the strength of established traded clusters in the Region. The following actionable steps must be considered:
  - Document companies based on NAICS code to provide specific exporting services in the areas of research, training, networking, supply chain, global value chain, and transportation services.
  - Assist exporting companies with high potential for the expansion of new products and new markets.
  - Research emerging new clusters in the chemical and plastic sectors that are related to the Marcellus and Utica shale play, and other related sectors.
3. Market the Region to the world by conducting and participating in trade shows, buyers' missions and FDI existing companies. The following actionable items must be considered:
  - Utilize current efforts from the State of Ohio contracting offices that have a reach in more than 80 countries around the world.
  - Develop a robust website to market and promote the Region by posting all activities, success stories, and new products and technologies.
  - Lead targeted trade and buyer missions to promote the Region's companies and products by utilizing the Great Lake Governors Council and other federal and state missions.
  - Establish and improve relations with more than 172 ethane-related existing companies in the Region.
  - Rebrand regional image from "Rust Belt" to "Industrial Heartland" which will reflect the DNA of the region. This is necessary to attract and retain local, regional and national workforce talent. The rebranding will also attract Foreign Direct Investment (FDI) and talent surrounding the petrochemical cluster.

4. Focus on the SME's by building a sustainable pipeline of companies that are new to export or new to the market. The market scan shows that the majority of these companies lack the proper research and market entry strategy, and few have an existing export plan. The following actionable items must be considered:
- Provide training seminars at all levels and areas of exporting.
  - Make the state and other export service providers more visible.
  - Market various existing export programs and grants to more companies.
  - Match SME products and services with specific cities and regions around the world, by using all available market research tools and assistance from the Beeghly Fellow interns of the Ohio SBDC at Youngstown State University.

## APPENDIX 1: BCR



*Figure 50: BCR Guide*

### BCR

BCR stands for Between Cluster Relatedness. The industry cluster research compares the average similarity of companies in a particular industry within a geographically bound area, such as Mahoning County, to determine how connected the industries are.

If the connection is strong and above the 90<sup>th</sup> percentile, the industry icon will be dark blue. Strong connections in the 75-90<sup>th</sup> percentile are represented by the light blue industry icon. All other connected industries are represented by a grey industry icon.

If the connection between two related industries lies in the strongest connection range of the +95 percentile, the line connecting the two appears in bold.

The darker the line and the industry icon, the stronger the connection between industry clusters.

## APPENDIX 2: GIS MAPPING

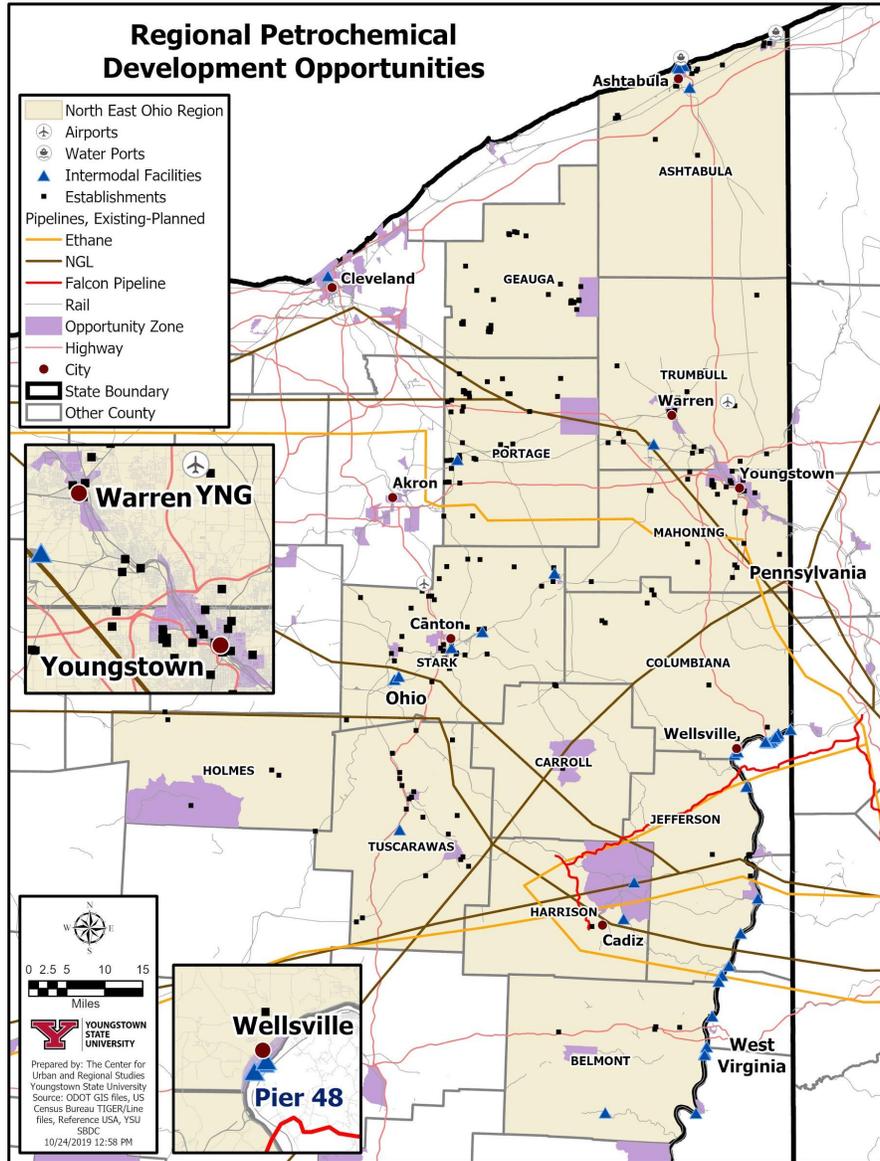


Figure 51: Regional Petrochemical Development Opportunities

## APPENDIX 3: REGIONAL RESOURCES

The Region has a plethora of resources that companies in the area can utilize to expand their business.

*JobsOhio* is designed to drive and promote capital investment and job formation. It specializes in business attraction, retention and expansion efforts. In 2018, JobsOhio had 266 projects, \$9.6 billion in capital investment, and 27,071 new jobs.

*U. S. Small Business Administration (SBA)* supports small businesses and entrepreneurs in growth and expansion. The SBA has resources and loan programs that can match clients with different financing options, including export assistance.

*Ohio Development Services Agency (ODSA)* can assist small to large businesses whether the company is established in the state and wants to expand or a company that wants to locate in Ohio. One ODSA program is SiteOhio which acts as a site selection program that partners with JobsOhio.

*Small Business Development Center (SBDC)* is an excellent resource for small to mid-sized companies. The Centers provide business consulting on financial analysis, cash flow forecasts, business loan proposals market research and more. The Ohio SBDC at YSU serves Ashtabula, Trumbull and Mahoning counties. The Kent State-Tuscarawas SBDC serves Carroll, Columbiana, Coshocton, Harrison, Holmes, Jefferson, and Tuscarawas.

*Ohio SBDC Export Assistance Network (SBDC EAN)* can assist with international market research, trade missions, identifying international customers, and training & education programs in exporting. The EAN can assist with grant funded opportunities for international trade and student interns to provide export assistance. The Ohio SBDC EAN at YSU services Ashtabula, Trumbull, Mahoning, Columbiana, Tuscarawas, Holmes, Stark, Portage, Geauga, and Carroll counties. The Ohio SBDC EAN at The Ohio State University South Centers serves Belmont, Harrison, and Jefferson.

*Procurement Technical Assistance Center (PTAC)* assists clients in seeking and competing for federal, state and local government contracts. It offers training, bid preparation assistance, bid matching services, trade events, capability statements and more. The local PTAC office covers Mahoning, Trumbull, and Columbiana counties.

*Columbiana County Port Authority* promotes economic development in Columbiana county. It also facilitates the movement of cargo on the Ohio River through the Wellsville Intermodal Facility. The Port Authority leases manufacturing plants and warehouse space, with land available for development within local industrial parks.

*Youngstown Warren Regional Chamber* is a supporter of economic development, advocacy, and business services to promote the growth of member companies in Mahoning, Trumbull, and Columbiana counties. The Chamber has a program known as “JobsNow” that advertises local jobs to reduce hiring costs for the company and attracts top talent to the region.

*Team NEO* is a business and economic development organization that focuses on 18 counties in Northeast Ohio. They support regional job creation and economic growth.

*United States Commercial Service* is located in Cleveland, Ohio. They are a department within the U.S. Government that heads trade promotion globally. They have U.S. Commercial Service trade professionals located in 75 countries that can assist with exporting and increasing global sales for U.S. companies.

*Ohio-Pennsylvania Stateline Export Initiative (OPEI)* is a group of business professionals with a mission to promote a ten-county region in Ohio (Ashtabula, Mahoning, Trumbull, Columbiana) and Pennsylvania (Erie, Crawford, Mercer, Lawrence, Beaver, Butler). OPEI recognized the similarities of the counties and the benefit of working together to expand exporting in the area.

*Mahoning Valley Manufacturer's Coalition (MVMC)* was formed to create a united voice for the local manufacturing industry. The group helps identify challenges and opportunities in manufacturing. The goal of MVMC is to develop a skilled workforce in the Mahoning Valley to meet industry demands.

*Mahoning Valley Economic Development Corporation (MVEDC)* assists in the growth of local business and the creation and retention of jobs by providing financing options to new and existing companies. The group consists of public and private interests to revitalize and diversify the Mahoning Valley. MVEDC services Mahoning, Trumbull, Ashtabula, Columbiana, Geauga, Portage, and Belmont county in Ohio through SBA and local initiatives, as well as Pennsylvania counties and beyond with federal financing programs.

*Tristate Energy & Advanced Manufacturing (TEAM) Consortium* is an organization with partners in Ohio, Pennsylvania, and West Virginia, covering a total of 27 counties. The partners include industries, higher education, workforce and economic development organizations. The mission of TEAM is to grow the energy and advanced manufacturing industries within the tristate.

*Eastgate Regional Council of Governments (Eastgate)* is an association of local governments throughout Ashtabula, Mahoning, and Trumbull counties. Eastgate provides education and funding for projects related to transportation, water and air quality, local infrastructure and land use planning.

*Business Resource Network (BRN)* assists companies by finding programs and services to promote business growth, and connects them with needed resources.

*Youngstown Business Incubator (YBI)* specializes in digital businesses, manufacturing technologies and software companies. YBI also offers special services to advance women and minority entrepreneurship.

*Minority Business Assistance Center (MBAC)* provides services to minority and disadvantaged businesses in Ashtabula, Trumbull, Mahoning, Columbiana, Jefferson, Belmont, and Monroe counties.

*America Makes* has an office and research facilities in Youngstown. It specializes in additive manufacturing and 3D Printing to increase the global competitiveness of the Region.

*Brite Energy Innovators* is located in Warren, Ohio. With a focus on energy and economic development, it has a lab to develop and test energy related devices.

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## ABOUT

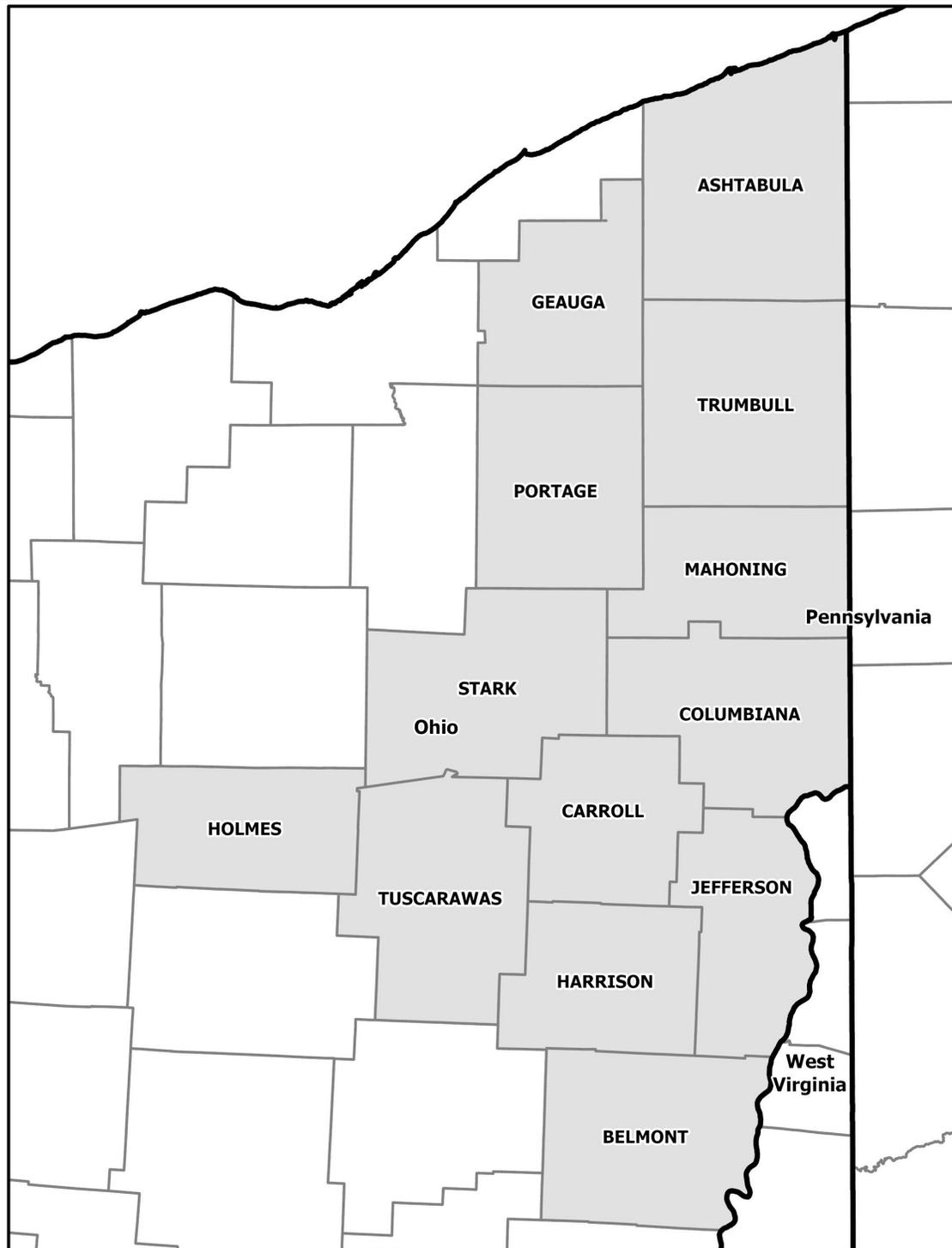
The Ohio Small Business Development Center and Export Assistance Network (Ohio SBDC EAN at YSU) are a part of Youngstown State University and its Williamson College of Business Administration.

The SBDC at YSU provides business consulting to existing and start-up companies in financial modeling analysis, cash flow forecasts, business loan proposals, market research, business planning, marketing strategies, growth assessment and more. The Center also provides business training seminars, including the SBA Emerging Leaders program. The SBDC at YSU provides business consulting to Ashtabula, Mahoning and Trumbull Counties.

The SBDC EAN at YSU assists clients with export readiness assessment, export assistance, international marketing plans, market research, export compliance education, access to export financing and grants, trade mission assistance and market export assistance in more than 80 countries. The SBDC EAN offers seminars on exporting and international trade-related topics and has a vast network of resources to assist clients with exporting needs. Counties served through the SBDC EAN at YSU include Ashtabula, Carroll, Columbiana, Geauga, Holmes, Mahoning, Portage, Stark, Trumbull and Tuscarawas.

# INDUSTRIAL HEARTLAND

## Northeast Ohio Region



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