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Economics of Utica Shale in Ohio: Supply Chain Analysis

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SUPPLY CHAIN ANALYSIS

Center for Economic Development

Energy Policy Center

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About the Center for Economic Development

The Center for Economic Development (the Center) at Cleveland State University's Maxine Goodman Levin College of Urban Affairs provides research and technical assistance to government agencies, non-profit organizations, and private industry. The Center has expertise in studying ecology of innovation, entrepreneurship, performance of economic clusters, industry analysis, economic analysis of cities and regions, economic impact, economic development strategy and policy, workforce development and evaluation of economic development initiatives. The Center has served as a designated Economic Development Administration (EDA) University Center since 1985.

The Center's professional staff includes four full-time researchers, a system analyst, associated faculty, and several graduate research assistants. The Center works with funders, partners, and clients at the national, state, regional, and local levels. All of the Center's research is summarized in publications, including working reports, journal articles, and book chapters. For more information on the Center for Economic Development, use the following link: **http://urban.csuohio.edu/economicdevelopment/**

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The Energy Policy Center (EPC) is housed within the Maxine Goodman Levin College of Urban Affairs at Cleveland State University. The mission of the EPC is to help overcome social and institutional barriers to the implementation of solutions to energy challenges by providing an objective channel for the free exchange of ideas, the dissemination of knowledge, and the support of energy-related research in the areas of public policy, economics, business and social science. For more information on the Energy Policy Center, use the following link: **http://urban.csuohio.edu/epc/**

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EXECUTIVE SUMMARY

Utica shale development presents new opportunities for Ohio companies to sell their products and services throughout the oil and gas industry supply chain. Additionally, development of the resources existing in this geological formation presents economic development opportunities for processors of natural gas liquids (NGLs) and those who use their derivatives.

Goods and services may be sold to oil and gas producers, service companies, midstream companies, and potentially to new and expanding local companies engaged in petrochemical and plastic manufacturing. The goal of this Study was to analyze the Ohio supply chain at the various stages of shale development, identifying potential opportunities for Ohio companies, and providing information for economic development entities and public policy makers, thereby helping them plan strategies for securing more economic benefits for Ohioans.

The best opportunities for supplying goods and services for oil and gas companies in Ohio exist in supporting the upstream (well field development) and midstream (building the pipeline infrastructure that connects the well field to processing plants) industries. However, while the anticipated downstream petrochemical and plastic manufacturing expansion may not provide immediate opportunities, the real prospect for commercial investments exist. Encouraging and entering these markets requires long-term planning and relationship-building.

The Study Team identified seven stages within the upstream development for purposes of evaluating supply chain opportunities: exploration, site planning and preparation, site construction, drilling, hydraulic fracturing, completion and production. A detailed classification of industries within each stage of development was used to help potential suppliers identify opportunities to conduct business with oil and gas companies. Shortages of supply present an opportunity for local companies to supply these services. To measure shortages within Ohio's supply chain for upstream industries, a comparative analysis of in-state and out-of-state supply chains for oil and gas drilling and production was used.

Extraction of Natural Gas Liquids (NGL) Industry

Major suppliers for the NGL extraction industry were classified by the Study Team into 5 groups: (1) oil and gas field services, (2) management and engineering services, (3) manufacturing, (4) transportation, and (5) utilities and wholesale. The Study Team set forth an analysis based upon comparing Ohio to the national economy less Ohio (hereinafter "benchmark" data). However, the national data are heavily influenced by states with a mature oil and gas industry (e.g. Texas, Oklahoma and Louisiana). Overall, oil and gas field services spend about 17 cents of every dollar spent in the benchmark economy. By comparison, in Ohio, similar companies consume less than 5 cents of each dollar spent within the state for locally supplied services. Engineering and management services in Ohio are used 80% less from local suppliers than in the benchmark economies. From every dollar that NGL producers spend in Ohio, they buy 0.4 cents of manufacturing products. The benchmark economies, on the other hand, consume, on average, 2.7 cents of locally manufactured products-7.5 times more than in Ohio. Likewise, the pipeline transportation industry supplies goods and services to NGL producers at a rate of about 5 times less

in Ohio than nationally. Finally, local utilities and wholesale services are used in Ohio only about half as much as is true nationally. In sum, the NGL portion of the industry is underdeveloped.

The NGL Extraction Industry in Ohio is in the process of developing its customer base. A number of Ohio industries consume NGLs and, in turn, their consumption can expand the Ohio economy by increasing the demand within their own supply chains. Among the largest consumers are petroleum refineries. In the benchmark economy, from every dollar of NGLs produced, 1.2 cents are consumed by local refineries. In Ohio, this amount is more than twice as high: from every dollar's worth of NGLs produced by this industry, local refineries buy 2.5 cents of their hydrocarbons.

There are a number of other local manufacturing sectors that buy NGLs. Manufacturing companies buy about 4.8 cents of NGL products from Ohio vendors compared to 1.9 cents in the benchmark economy. Natural gas distribution and pipeline transportation industries buy 2.6 times more NGL products locally than occurs in the benchmark economy.

With an abundance of ethane available from the local shale development, there is an opportunity to significantly strengthen and expand the connections between the NGL producers and customers.

Extraction of Natural Gas and Crude Petroleum Industry

The largest supplier to the Extraction of Natural Gas and Crude Petroleum Industry in the benchmark states is the Oil and Gas Field Machinery and Equipment Manufacturing industry. In the benchmark economy, the Extraction of Natural Gas and Crude Petroleum Industry accounts for 0.4 cents of every dollar spent by the oil and gas machinery manufacturing industry, more than 150 times greater than occurs locally. Accordingly, there is significant room for improvement in filling the supply chain for this industry by local companies.

However, the potential economic impact of the Extraction of Natural Gas and Crude Petroleum industry is not within its supply chain; it is with its customers. There is a large list of NGL consumers in Ohio. These consumers were divided by the Study Team into four categories: manufacturing companies, direct consumers in the transportation and utilities industries, transportation services (pipeline and natural gas distribution companies), and service companies within the same industry – this is called "own consumption." Manufacturing companies spent 5% of all their supplies purchased in Ohio on products from this industry. This pattern is common to manufacturing in both the Ohio and the benchmark economy. The largest difference between Ohio and the benchmark economy is in consumption of the industry's products by companies in the same industry. While in the benchmark economy these companies consume products worth 2.4 cents for every dollar spent on supplies, in Ohio, these companies consume only 1 cent. The Utica development is still very new to Ohio and the Extraction of Natural Gas and Crude Petroleum industry is expected to mature locally with an increasing presence of local producing companies. This will in turn lead to an increase in its "own consumption."

Drilling Oil and Gas Wells Industry

The biggest gaps in Ohio's supply chain for companies in the Drilling Oil and Gas Wells industry exist in oil and gas machinery equipment manufacturing, construction machinery manufacturing, cutting tools and machine tool accessory manufacturing, and support activities for oil and gas operations industries. Many companies that are large suppliers to the drilling industry are concentrated in

traditional oil and gas-producing states, such as Texas, Louisiana, Oklahoma, and Wyoming. Large service companies, like Schlumberger and Halliburton, often open regional offices in states that become significant oil and gas producers. However, some suppliers, including large manufacturing companies producing oil and gas machinery have been traditionally located in Texas and Louisiana and will not move or expand their operation. Moreover, even when those regional offices are opened, they typically focus more on services, and do not manufacture drilling equipment – that is left to the home office. Other industries that supply smaller amounts to the drilling industry but are in relatively short supply to drilling in Ohio are the Cable and Other Subscription Programming and Other Nonmetallic Minerals industries. Drilling and service companies operating in remote areas often require special communication networks from this industry to ensure reliable and quick response time, especially for emergency services.

The four major consumers of the Drilling Oil and Gas Wells industry are companies within the category of its "own industry," the coal mining industry, the extraction of natural gas liquids, the stone mining and quarrying and the extraction of natural gas and crude petroleum. On average, in Ohio, services of the Drilling Oil and Gas Wells Industry are consumed at a rate that is half of the benchmark economy.

Petrochemical Manufacturing Industry in Ohio

Suppliers to the petrochemical manufacturing industry in Ohio were divided by the Study Team into five groups of industries: feedstock suppliers, transportation, manufacturing, energy, and professional services. Across all these categories, for every dollar the Petrochemical Manufacturing industry spends on all supplies, 24 cents are spent on supplies purchased in Ohio.

The largest customers of the petrochemical manufacturing industry in Ohio are companies in three manufacturing sectors: petroleum manufacturing, petrochemical manufacturing, and plastic manufacturing. Companies in petroleum manufacturing buy products from the petrochemical industry in Ohio at a rate that is five times less than that found in the benchmark economy. Companies in the petrochemical industry buy products from other petrochemical companies in Ohio almost 8 times less than that found in the benchmark economy. Finally, the companies in plastic manufacturing buy products from the petrochemical industry in Ohio at a rate of 24 times less than that found in the benchmark economy.

Petrochemical Manufacturing Industry-Tri-State Region

In the larger region, the Tri-state area of Ohio, Pennsylvania, and West Virginia, the pattern of suppliers to the petrochemical industry is consistent with the pattern in Ohio. However, regional purchases by the petrochemical industry from suppliers are larger when compared to Ohio on its own.

The pattern of customers to the Tri-state petrochemical industry is also consistent with that seen in Ohio. The ratio of the benchmark data to the regional data – an indicator of the biggest shortages in the supply chain of the petrochemical manufacturing -- identified three particular industries: (1) the plastics bottle manufacturing industry, (2) the plastics packaging materials and unlaminated film and sheet manufacturing industry, and (3) plastics pipe and pipe fitting manufacturing. The main

feedstock of these industries is polyethylene and this product can become abundant in the region if one or several ethane crackers choose to operate in the mid-Ohio Valley.

The results of this report should enable economic development intermediaries to provide active assistance in connecting local suppliers to oil and gas producing and service companies that are headquartered out-of-state. It may also empower public policy makers to devote resources to help existing local companies expand operations and to attract new or out-of-state suppliers to Ohio.

Should an abundance of polyethylene become available due to the development of the Utica and Marcellus shale formations, there would be an opportunity to significantly expand the connections between petrochemical companies, their suppliers and customers in plastics manufacturing. Geographically co-located producers, midstream companies and petrochemical manufacturers, together with the plastics manufacturing industries, could lead to strong local linkages among these industries. This would, in turn, create opportunities in growing employment, regional gross product and per-capita income through expansion of local companies.

1. INTRODUCTION

This is one of three reports presenting the findings of the research project investigating economic development potential of the Utica/Point Pleasant (hereinafter, "Utica") oil and gas shale resources in Ohio. This project was funded by the Economic Growth Foundation together with JobsOhio, and is intended to facilitate strategic planning for the Regional Economic Competitiveness Strategy (RECS) committee of Northeast Ohio and Ohio. While the development of Utica Shale resources has slowed with the recent downturn of oil and gas prices, the industry is here to stay and will continue to draw on local shale resources, skilled labor and an assortment of product and service supplies.

The first report, *Mapping Opportunities for Shale Development in Ohio* outlines the current state of and projections for upstream and midstream industries in Ohio. It also discusses the factors potentially influencing formation of petrochemical complexes that would be capable of transforming an abundant regional ethane supply into a feedstock useful for the plastics and other downstream industries, and it considers a possible expansion of a chemical industry cluster in Ohio. A second report related to this study, *Economics of Utica Shale in Ohio: Workforce Analysis*, examines potential workforce shortages based upon projections made for three scenarios of future upstream development. That study estimates the labor force demand on upstream and midstream industries for the next five years in Ohio, and further considers the need for additional skilled labor in the event Ohio should see an expansion of a local petrochemical complex and plastics industry.

This third report examines supply chain opportunities in Ohio. The Study Team used industrial definitions used by the North American Industry Classification System (NAICS) for the petrochemical industry to evaluate industry data, and to identify opportunities for local contractors in the Ohio oil and gas industry supply chain. It identifies shortages of suppliers in Ohio when compared to similar relationships between industries found in more mature oil and gas producing clusters. The Study identifies benchmark data to characterize the patterns of supply chains that exist in traditional oil and gas development states, such as Louisiana, Texas, and Oklahoma. By comparing these supply chain patterns to Ohio, the Study Team was able to identify gaps in local supply chains, and to point to business development opportunities that will be generated by the future development of the Utica formation in Ohio.

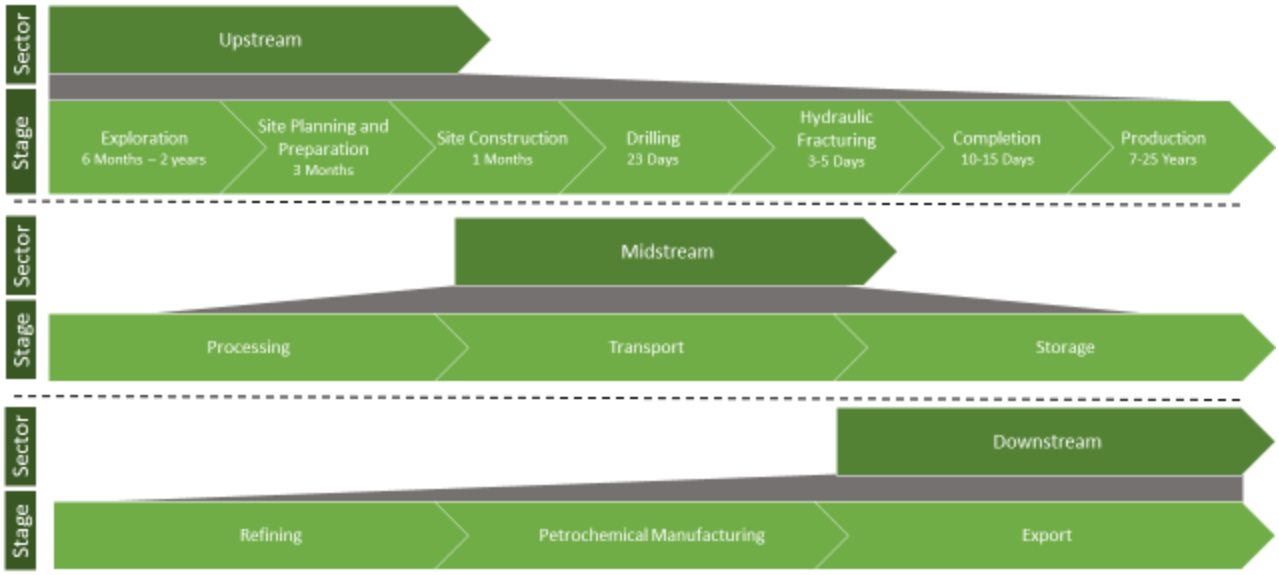
2. Supply Chain Analysis

2.1. Unconventional Oil and Gas Supply Chain

Utica shale development presents unique opportunities for Ohio companies to sell their products and services to oil and gas producers, oil and gas service companies, midstream companies and potentially to new and expanding local companies in petrochemical and plastic manufacturing. The goal of analyzing the supply chain for various stages of shale development in Ohio is to identify opportunities for Ohio companies and to provide information for economic development entities and public policy makers, thereby enabling them to secure more economic benefits for Ohioans.

To illustrate these opportunities, we expanded the framework of the well production lifetime discussed in the report *Economics of Utica Shale in Ohio: Workforce Analysis*, comparing the stages within each of three industrial sectors of the well production lifetime (see Appendix Figure A-1). In addition, we compared this timeline to the product value chain: the oil and gas upstream, midstream, and downstream industries. Identifying the stages of development within each of these three industrial sectors allows us to better understand the supply chain industries that provide goods and services to the oil and gas industry. Figure 1 outlines the three sectors and the stages of development associated with each.

Figure 1. Stages of Development within Upstream, Midstream and Downstream

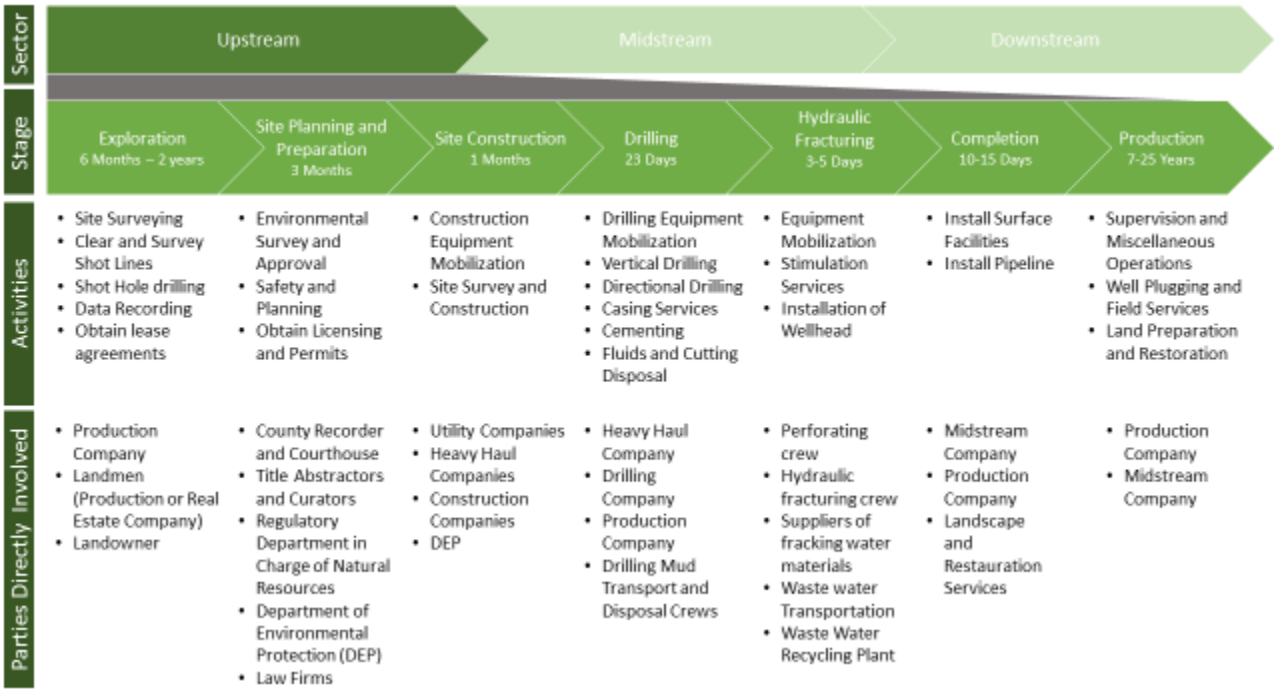


The strongest opportunities at the current stage of Utica development exist in providing products and services to upstream and midstream industries. The Utica's commercial oil and gas reserves are anchored in Ohio and these resources will be developed locally. The 2015 slowdown of upstream activities allows time for midstream companies to catch up by constructing and completing the much needed midstream infrastructure. It also provides the upstream sector with opportunities to increase sales of its products, to more fully recover cash flow and capital expenditures, and to reinvest resources to further develop the Utica Shale.

To identify supply chain opportunities in the upstream sector, each stage of upstream development was populated with activities taking place within each stage and the types of

companies that perform these activities (Figure 2).[1] Seven stages were identified within the upstream development: exploration, site planning and preparation, site construction, drilling, hydraulic fracturing, completion and production. During the exploration phase, production companies conduct geological, geophysical and land surveys to assess the likely commercial value of the site. For completion of this phase, production companies employ geological and geophysical contractors and companies specializing in land leasing. Site planning and preparation could be the lengthiest in time, often depending upon the process outlined by state regulation. During this phase, producing companies acquire drilling and other permits and confirm the mineral and property rights. Site building is usually contracted to environmental, civil engineering and construction companies for preparing a well pad, building necessary roads, and strengthening bridges if needed for moving heavy equipment. During the drilling phase, vertical and horizontal segments of the wellbore are built and secured with proper casing and tubing. Following the drilling is the completion and hydraulic fracturing process. The latter is usually done in multiple stages depending on the length of horizontal segment of a well. After the well is drilled, completed and fractured, it is connected to a gathering system by pipeline. Finally, after depletion of the reservoir, additional upstream activities are undertaken to reclaim the well site, and the well is plugged and abandoned.

Figure 2. Activities and Companies Involved in Upstream Operations



[1] This analysis was based on literature analysis and the "Marcellus and Utica Shale Databook" (references [1] through [5]).

A detailed description of the seven stages of upstream development is provided in the following paragraphs.

Exploration

The first stage within the oil and gas upstream development is exploration. This stage can take anywhere from 6 months to 2 years.[2] During this time, production companies conduct geological, geophysical, and land surveys for prospective well sites and acquire mineral rights from landowners. This stage begins with a team of surveyors and geologists employed by the production company, who stake out key sites and conduct the proper due diligence in order to provide a reasonable estimate of the potential productivity of a site. The cost of this activity varies significantly by the stage of field development. The companies who take the greatest risk are those that enter the play first. Their advantage is that they can lease large volumes of land at cheaper prices than those who enter later and they can sell property while holding onto the most productive acreage.

Once a potential site has been identified, landmen, either employed by the production company or subcontracted to local companies specializing in leasing, assemble the rights to produce from a well site by negotiating with land and mineral owners on a case-by-case basis. The cost of each site typically depends on how quickly and strategically the landmen can assemble the property rights to a site. Usually the production (also known as the "operating") company is the major actor involved in this part of the upstream development. In some cases, land lease processes are outsourced to land, legal or real estate companies.

Site Planning and Preparation

The production company's next step is to begin gathering information on the regulatory requirements, environmental conditions of the site, property rights, mineral rights, and development cost estimates. This phase requires the production company to obtain the proper permits for the well. This stage can take from 3 months to several years depending on the process outlined by state regulations. The unitization process, where producers join together all subsurface rights that are likely to be drained by the proposed well, including those that have not signed leases, may take significantly more time.

During this phase, the production company may involve an environmental firm to represent its interests in obtaining necessary regulatory permits and to make necessary surveys of environment conditions and planning regulations. Law firms will also be retained during this phase to confirm that the mineral and property rights obtained by the landmen are valid. Finally, producing companies will deploy petroleum engineers to estimate costs of drilling and production. This is typically done through a document called an "authority for expenditure."

[2] Assessments for the average time for each operation was taken from the literature, investor presentations of companies and other public sources (references [1] through [12]).

Site Construction

Site construction is usually done by a contractor. The production company often has a designated construction company selected or holds a competitive bid for the contract. Once a company is selected, access roads are built, and equipment begins to appear at the site. After the necessary equipment has arrived, the site is cleared and leveled. A water resource for hydraulic fracturing is identified and, if necessary, a pond is built. A drill pad, from which wells are drilled, is also constructed. The final stage of site construction is seeding the outer edges of the site. This prevents soil erosion during the drilling operation and for the lifetime of the well. This stage usually takes 1 month and primarily involves earth moving and heavy haul and construction companies. The production company provides oversight of the construction to ensure that things are moving on schedule.

Drilling

Most production companies do not own drilling equipment and instead contract to a company that specializes in the drilling operations. This stage begins with sending the drilling rig and supplies to the well pad. It can be divided into two distinct phases: vertical and horizontal drilling stages.

The first phase is the drilling of the vertical well. High volumes of drilling mud or sometimes air are pumped into the well during this phase of drilling to circulate the cuttings back up to the surface. Air is used in this phase to prevent contamination while drilling through the aquifer. A smaller drilling rig is usually used to install the largest diameter pipe to secure the entrance to the wellbore. Then a larger rig is brought in and installed to manage the bigger weights needed for deeper drilling and the installation of wellbore casing/tubing. Both phases use a thick water-based drilling fluid referred to as “drilling mud” to circulate the cuttings back to the surface. In addition to circulating the cuttings back to the surface, the “mud” lubricates and cools the bit as it cuts deeper.

The vertical drilling stage requires less technical skill, and may or may not be undertaken by the same company that drills the horizontal phase. The second, or horizontal, phase uses a different rig, so time and cost estimates must include the disassembly of the first rig and the mobilization and assembly of the second.

Drilling mud is typically hauled away from the site and is recycled and reused. Once the drilling is complete, production casing is installed and cemented into place. Parties involved throughout this process include heavy haul companies, which bring supplies to the site. In addition, the drilling company, the production company, and the drilling mud transport and disposal crews are all deploying staff.

Hydraulic Fracturing

Once the production casing has been cemented into place and cured for at least 24 hours, the hydraulic fracturing stage begins. Similar to how producers engage drilling contractors, a production company will typically contract a hydraulic fracturing company that specializes in the activity.

Hydraulic fracturing costs depend primarily on the length of the horizontal portion of the well, and the number of stages planned during the fracturing process. The typical horizontal length of a well in the Utica formation is 6,000 feet, and consists of 27 fracturing stages. A fracturing stage refers to a segment of a well that is fractured at one time. In order to improve fracture effectiveness, and ultimately well productivity, a well is divided and fractured in stages rather than all at once.

Before a well can be fractured, it must be cleaned out and the casing perforated. Once this has been completed, a water-based fluid is pumped into the well at high pressures, fracturing the surrounding shale deposits. A small amount of the fluid, typically 10-20%, flows back shortly after the fracturing process, and the rest is produced over time with the oil and gas. Flow-back water is an environmental concern and must be recycled or disposed of properly. Once fracturing is complete, plugs are installed to prevent oil or gas from escaping before the well is completed.

The parties typically involved in this stage include companies performing hydraulic fracturing, perforating crews, suppliers of frack water, sand and chemicals, waste water transportation, and water recycling plants (if not owned by the operator).

Completion

The final step before the well can be included into production is the completion stage. During this stage the plugs are drilled out and the "Christmas tree" is installed. The "Christmas tree" refers to the equipment that is installed on the well-head in order to control extraction of oil and gas from the well. This equipment must be able to withstand pressures from the well between 2,000 and 20,000 pounds per square inch. The final step in the well completion stage is site reclamation. This involves restoring the areas natural plant and wildlife. Some of the site reclamation work will be left for the plug and abandonment stage.

Typically the fracturing and completion phases last a total of 2 weeks. In addition to the producing company and the contractors that drill, fracture, and complete the well, well development involves companies performing landscaping and restoration services.

Production

The final stage of the upstream operations is production. Production begins after well completion and flow tests have been accomplished and a market for the hydrocarbons established. Gas production requires the installation of pipelines that gather the production in the field and carries it to processing facilities, where dehydration, separation, processing and fractionation take place. Gathering pipelines require that either the producer or the midstream company first obtain rights of way for their gathering pipelines. These easements give the midstream companies the right to "locate, install, operate, test, inspect, repair, maintain, replace, and protect one or more pipelines on property owned by others."[3] Past studies indicate that gathering lines can reach up to 25 miles for remote wells. The average well is expected to produce commercially for 7 to 25 years. With the development of new technologies for re-fracturing wells, this period of time might be significantly extended in future.

[3] U.S. Department of Transportation. http://www.transportation.gov/

Based on the analyses of processes within these seven stages and the companies performing these operations, detailed industries (with six-digit NAICS classification codes) were identified as potential suppliers for each stage of drilling and production (Figure 3 through Figure 6).[4]

Figure 3. Industrial Sectors that are Potential Suppliers for Pre-Drilling

Upstream Sectors of the Oil and Gas Industry		
Stage	**Supply Chain Opportunities (NAICS/Index Entries)**	
Exploration (6 Months – 2 years)	• 213112 Geophysical exploration for oil and gas on a contract basis • 541330 Geophysical engineering services • 541360 Seismic geophysical surveying services	• 541370 Geographic information system (GIS) base mapping services • 541712 Geological research and development laboratories or services • 561320 Temporary employment services
Site Planning and Preparation (3 Months)	• 522110 Banks, commercial or savings • 523930 Certified financial planners, investment advisory services • 531390 Landman services • 531210 Real estate brokerages (including residential, commercial) • 531320 Real estate appraisal services	• 541110 Attorneys' offices (including oil & gas, tax, real estate) • 541191 Title abstract/search companies, real estate • 541211 Certified public accountants' (CPAs) offices • 541219 Accounting services (except CPAs) • 541370 Topographic, land, hydrographic surveying services
Site Construction (1 Month)	• 213112 Drilling site preparation at oil and gas fields on a contract basis • 212321 Sand and gravel quarrying (construction grade) • 237310 Road construction • 237990 Earth retention (frack pond) system construction • 238910 Excavation contractors • 238910 Heavy equipment rental with operator - bulldozer, backhoe, crawler, etc. • 238990 Fencing contractors, installation • 423810 Construction and Mining Machinery & Equipment Merchant Wholesalers • 424910 Agricultural supplies: mulch, fertilizer, grass seed	• 444190 Fencing, construction materials suppliers • 484220 Trucking (gravel, sand, top soil, equipment) • 532412 Heavy equipment rental without operator - bulldozer, backhoe, crawler, etc. • 541330 Civil/construction engineering services • 541360 Aerial geophysical surveying services • 541370 Topographic, land, hydrographic surveying services • 561320 General labor contractors (i.e., personnel suppliers) • 561730 Tree removal, landscaping services • 811310 Heavy machinery and equipment repair and maintenance services

The detailed classification of industries within each stage of development can be used to help potential suppliers to identify opportunities to conduct business with oil and gas companies. Of course, identification of the opportunity is no guarantee that oil and gas companies will hire a local supplier. In order for local companies to become their suppliers, the companies are often asked to register in a corporate database and deal with a headquarters' procurement office; which is typically located outside of Ohio. Besides the registration, local companies are also required to have special certifications simply to be considered as a supplier.

[4] The tables contain 6-digit NAICS code industries identified with corresponding index. North American Industry Classification System - Frequently Asked Questions. June 25, 2015. U.S. Census Bureau: http://www.census.gov/eos/www/naics/faqs/faqs.html#q6

Companies that have fulfilled all requirements for suppliers are included in an approved vendors list. Supply companies are then typically provided master service agreements by the producer/operator (or by a contractor for the operator) that specifies risk allocation between a vendor and the company. These agreements are important for ascertaining party responsibility for accidents leading to damage to property or personal injury.

Figure 4. Industrial Sectors that are Potential Suppliers for Drilling

Upstream Sectors of the Oil and Gas Industry		
Stage	**Supply Chain Opportunities (NAICS)**	
Drilling (23 Days)	• 213111 Gas well drilling on a contract basis • 213112 Geological exploration for oil and gas on a contract basis • 213112 Mud service for oil field drilling on a contract basis • 213112 Cementing oil and gas well casings on a contract basis • 213112 Building, erecting, repairing, and dismantling oil and gas field rigs • 238320 Engineering structure painting (e.g., oil storage tank, water tower) • 238990 Crane rental with operator • 238990 Manufactured (mobile) home set up and tie down • 331210 Well casings made from purchased iron or steel • 332420 Water tanks, heavy gauge metal, manufacturing • 332420 Bulk storage tanks, heavy gauge metal (secure), manufacturing • 333132 Gas well machinery and equipment, including drill bits, reamers, etc. • 336211 Tank trucks (e.g., water) assembling on purchased chassis • 423320 Cement merchant wholesalers	• 423610 Generators, electrical, merchant wholesalers • 424340 Boots (safety/work) merchant wholesalers • 424690 Drilling muds merchant wholesalers • 424720 Petroleum and petroleum products merchant wholesalers (diesel fuel) • 482112 Short-line railroads • 484220 Mobile home/office towing services, local • 484220 Trucking services (equipment, drill cuttings, water) • 485510 Bus charter services • 531110 Apartment rental or leasing • 531190 Mobile (manufactured) home/office rental or leasing • 531190 Trailer/RV park or court, residential • 532120 Truck trailer rental or leasing • 532310 General rental centers (construction tools, etc.) • 532412 Oil & gas well drilling machinery and equipment rental or leasing • 532412 Crane rental or leasing without operator • 532490 Generator rental or leasing • 541330 Engineering services (geological, petroleum, environmental) • 561612 Security guard services • 561990 Support Services: Pit Liners • 562111 Garbage collection services • 562991 Portable toilet renting and/or servicing • 721110 Hotels & motels • 722320 Catering services • 812332 Protective apparel supply services • 812332 Work clothing and uniform supply services, industrial • 812332 Laundry services, industrial • 236221 Construction of Other New Nonresidential Structures • 327300 Cement Manufacturing • 333515 Cutting Tool and Machine Tool Accessory Manufacturing • 524100 Insurance Carriers

Figures 3 through 6 identify potential suppliers for each phase of upstream development using a 6-digit NAICS industry number as well as corresponding indices describing these industries. The corresponding industrial indices provide more specific details and references within each 6-digit

code by identifying associated commercial activities.[5] For example, Figure 3 lists two entries for the site construction phase with the same 6-digit NAICS code: NAICS 238910 - Excavation contractors and NAICS 238910 - Heavy equipment rental with operator - bulldozer, backhoe, crawler. These two different indices identify two distinct types of operations used for this phase of upstream work. However, different companies that perform these distinct operations are classified under the same industry NAICS code 238910 - Site Preparation Contractors.

Figure 5. Industrial Sectors that are Potential Suppliers for Hydraulic Fracturing and Well Completion

Upstream Sectors of the Oil and Gas Industry		
Stage	**Supply Chain Opportunities (NAICS/Index Entries)**	
Hydraulic Fracturing (3-5 Days)	• 212322 Silica sand quarrying and/or beneficiating • 213111 Gas well drilling on a contract basis • 213112 Building, erecting, repairing, and dismantling oil and gas field rigs • 213112 Wireline services, oil and gas field, on a contract basis • 238990 Crane rental with operator • 331210 Water pipe made from purchased iron or steel • 423610 Generators, electrical, merchant wholesalers • 424340 Boots (safety/work) merchant wholesalers • 424690 Industrial chemicals merchant wholesalers • 484220 Trucking services (hauling water, sand, chemicals, equipment) • 424720 Petroleum and petroleum products merchant wholesalers (diesel fuel) • 482112 Short-line railroads • 485510 Bus charter services • 531110 Apartment rental or leasing • 531190 Mobile (manufactured) home/office rental or leasing	• 531190 Trailer/RV park or court, residential • 532310 General rental centers (construction tools, etc.) • 532411 Water tank rental or leasing • 532412 Oil & gas well drilling machinery and equipment rental or leasing • 532412 Crane rental or leasing without operator • 532490 Generator rental or leasing • 561612 Security guard services • 561790 Pressure washing services • 562111 Garbage collection services • 721110 Hotels & motels • 722320 Catering services • 562991 Portable toilet renting and/or servicing • 812332 Protective apparel supply services • 812332 Work clothing and uniform supply services, industrial • 812332 Laundry services, industrial
Completion (10-15 Days)	• 213111 Gas well drilling on a contract basis • 212313 Crushed and broken stone mining and/or beneficiating • 213112 Building, erecting, repairing, and dismantling oil and gas field rigs • 237310 Road construction & repair 238990 - Fencing contractors, installation • 333132 Gas well machinery and equipment manufacturing • 444190 Fencing, construction materials suppliers • 484220 Trucking services (hauling wastewater/flowback, stone, equipment) • 532412 Oil & gas well drilling machinery and equipment rental or leasing	• 561730 Landscaping services • 221300 Water, Sewage and Other Systems • 236200 Construction of Other New Nonresidential Structures • 221200 Industrial Gas Manufacturing • 325188 All Other Basic Inorganic Chemical Manufacturing • 332996 Fabricated Pipe and Pipe Fitting Manufacturing • 333911 Pump and Pumping Equipment Manufacturing • 333912 Air and Gas Compressor Manufacturing

[5] *Id.*

Figure 6. Industrial Sectors that are Potential Suppliers for Production

Upstream Sectors of the Oil and Gas Industry		
Stage	**Supply Chain Opportunities (NAICS)**	
Production (7-25 Years)	• 213112 Pipe testing services, oil and gas field, on a contract basis • 237120 Pipeline, gas and oil, construction • 238190 Welding, on site, contractors • 238910 Heavy equipment rental with operator - bulldozer, backhoe, crawler, etc. • 331210 Pipe made from purchased iron or steel, manufacturing • 334514 Metering devices • 334519 Gas leak detectors • 423690 Solar cells merchant wholesalers • 423810 Construction and mining machinery & equipment merchant wholesalers • 423830 Welding machinery and equipment merchant wholesalers • 423840 Welding supplies merchant wholesalers • 424910 Agricultural supplies: mulch, fertilizer, grass seed • 484220 Trucking (gravel, sand, top soil, equipment) • 486210 Gas, natural, pipeline operation • 486910 Natural gas liquids pipeline transportation • 531390 Landman services • 532412 Welding equipment rental or leasing • 532412 Heavy equipment rental without operator - bulldozer, backhoe, crawler, etc. • 541110 Attorneys' offices (including oil & gas, tax, real estate) • 561320 General labor contractors (i.e., personnel suppliers) • 541330 Civil/construction engineering services	• 541360 Aerial geophysical surveying services • 541370 Topographic, land, hydrographic surveying services • 561730 Landscaping services • 541990 Pipeline inspection (i.e., visual) services • 236221 Construction of Other New Nonresidential Structures • 332410 Power Boiler and Heat Exchanger Manufacturing • 332420 Metal Tank (Heavy Gauge) Manufacturing • 332996 Fabricated Pipe and Pipe Fitting Manufacturing • 333132 Mining and Oil and Gas Field Machinery Manufacturing • 333611 Turbine and Turbine Generator Set Units Manufacturing • 333911 Pump and Pumping Equipment Manufacturing • 333912 Air and Gas Compressor Manufacturing • 334419 Other Electronic Component Manufacturing • 334513 Industrial Process Variable Instruments Manufacturing

Each stage of upstream development includes a large number of opportunities for local companies. It is important to identify the opportunities where the local potential supply of operations and products is limited. Shortages of supply present an opportunity for local companies within this industry to expand their services. It also presents an opportunity for trade, business and economic development organizations to encourage growth of these businesses.

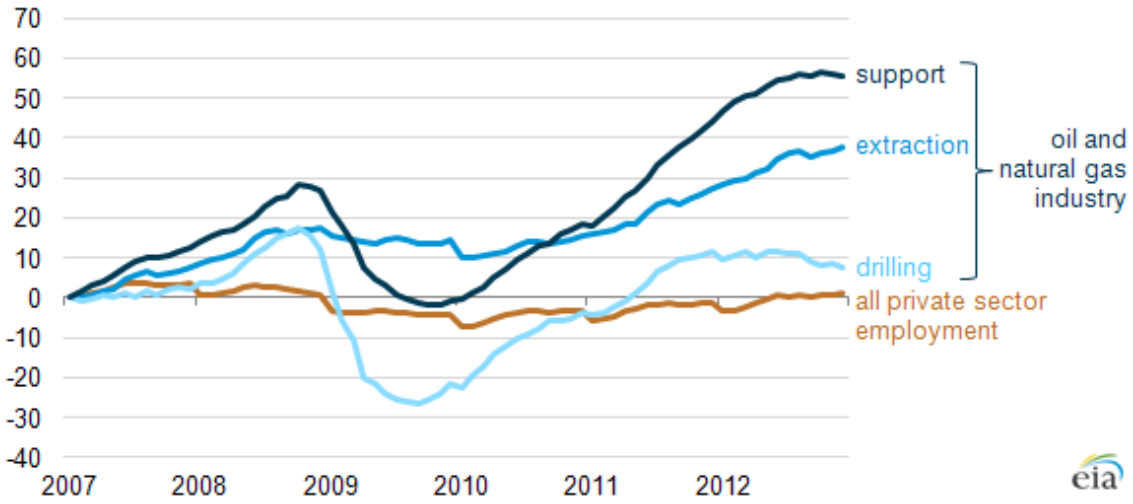
2.2. Shortages in the Upstream Supply Chain in Ohio

To measure shortages in the supply chain for upstream industries in Ohio, a comparative analysis of in-state and out-of-state supply chains for oil and gas drilling and production was used. Two matrices were constructed from IMPLAN data packages. One matrix reflects buyer-supplier relationships between industries in Ohio. The benchmark matrix was created from the U.S. IMPLAN data package by extracting the state of Ohio data from the national data matrix. As a result, the benchmark matrix represents the data of 49 states (excluding Ohio). The oil and gas industry in the United States is principally concentrated in Texas, Oklahoma, Louisiana, North Dakota, Colorado and now Pennsylvania. Totals from these states comprise nearly all of the oil

and gas industry. National data without Ohio – the benchmark in our analysis-- reflects the traditional supply chain of the oil and gas industry in states with ample local supplies of products and services for this industry.

During the time period from 2007 to the end of 2012, U.S. oil and gas industry employment was growing faster than private total employment. While the total U.S. private employment increased by 1% (or 1 million jobs) from 2007 to the end or 2012, the oil and gas industry increased by 162,000 jobs, or 40%.[6] According to EIA statements based on the Labor Department's Bureau of Labor Statistics (BLS), drilling accounted for an increase of 6,000 jobs, extraction added 53,000 jobs, and support activities for oil and gas operations employed 102,000 more people at the end of 2012 compared to 2007 (Figure 7).[7]

Figure 7. Percentage Change in Employment: the U.S. Oil and Gas Industry and Total Private Employment



Source: U.S. Bureau of Labor Statistics
Note: Total private sector employment is non-government employment, as derived from the Quarterly Census of Employment and Wages.

The data used reflects relationships between industries in Ohio and in the United States in 2013 (latest data available). While the national data represent a good benchmark in the supply chain for oil and gas industry, the Ohio data reflect only the nascent stage of Ohio's Utica development. Companies that first entered the oil and gas supply chain in Ohio in 2014 are not reflected in the Ohio data.

By comparing the list of industries supplying the industry in Ohio to a similar supply chain in the benchmark matrix, we can point to potential business opportunities in the local supply chain. This can be compared to a list of potential out of state entrants. These companies potentially can expand their business to Ohio.

There are two details that affect the results of this analysis. First, before Utica development started in Ohio, the local oil and gas industry was very small. There were very few oil and gas

[6] EIA. Oil and gas industry employment growing much faster than total private sector employment. August 8, 2013. http://www.eia.gov/todayinenergy/detail.cfm?id=12451#
[7] *Id.*

producing or service companies in Ohio, and little demand for a supply chain. Second, while significant Utica development started in 2013, the companies entering the field of Utica shale development were from outside of Ohio and obtained most of their supplies from their traditional suppliers, also from outside of Ohio. As a result, 2013 data for Ohio reflect a very small percentage of total purchases made by drilling and producing companies from local suppliers within the state. For example, from each dollar the Extraction of Natural Gas Liquids industry spent for its supplies and labor, this industry purchased products and services from Ohio worth only 7.4 cents (not including labor paid in Ohio). All other purchases of supplies for this industry – greater than 90% - were made from out-of-state companies.

Table 1 and Tables 3, 5, 7 and 9 are sorted by the volume of supplies purchased from individual industries in the benchmark data. The industries-suppliers located closer to the top of the tables are more critical as they supply larger volumes of products and services to enable each industry's operation – extraction of oil, gas, and natural gas liquids, plus drilling and petrochemical manufacturing. The larger the ratio is between the benchmark data and Ohio's data, the bigger is the local deficiency of the supply to the operation of the oil and gas industry. If this ratio is less than one, it can be interpreted as larger consumption by a certain industry in Ohio rather than nationally. However, the larger consumption does not necessarily indicate over-concentration of a certain type of supply in Ohio. It might merely reflect the inefficiency of such consumption compared to national practices.

2.3. Suppliers and Consumers of the Extraction of Natural Gas Liquids Industry in Ohio

Major suppliers for the extraction of the NGL industry could be classified in 5 groups: (1) oil and gas services companies/field services, (2) management and engineering, (3) manufacturing, (4) transportation, and (5) utilities and wholesale. In the field services group, Ohio NGL producers use 3.5 times fewer local suppliers than NGL producers in the benchmark area. Overall, the field services industry in the benchmark area spends about 17 cents of every dollar spent for local supplies, while field services companies in Ohio consume only 5 cents of local supplies out of each dollar spent within the state. Within this group of services, the major suppliers of the Extraction of Natural Gas Liquids industry, both in the benchmark data and in Ohio, are companies classified in support activities for the oil and gas operators industry (NAICS 213112). While in states with a more developed between-company linkages in the oil and gas industry (U.S. without Ohio), producers of NGL buy from about 15 cents per dollar spent on services from companies providing oil and gas support activities; for every dollar spent by NGL producers they are buying only 3.7 cents worth of services from similar Ohio companies; this is 4 times less than the national benchmark. These producers also use local drilling crews (NAICS 213111) almost half as often than those from outside of Ohio. Besides the severe shortage of supplies for support activities for the NGL producers in Ohio, the scarcity exists among other important suppliers locally. The maintenance and repair services of oil and gas structures are undertaken 70% less by local companies in Ohio than are usually purchased by similar companies in the benchmark region.

Table 1. Suppliers to the Extraction of Natural Gas Liquids Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
38	213112	Support activities for oil and gas operations	0.037562	0.150379	4.00
62	23	Maintenance and repair construction of nonresidential structures	0.009685	0.016373	1.69
461	55	Management of companies and enterprises	0.007969	0.013446	1.69
413	486	Pipeline transportation	0.002796	0.013428	4.80
161	32511	Petrochemical manufacturing	0.000952	0.011976	12.58
266	333132	Oil and gas field machinery and equipment manufacturing	0.000044	0.005623	126.74
156	32411	Petroleum refineries	0.001330	0.004798	3.61
445	5324	Commercial and industrial machinery and equipment rental and leasing	0.001672	0.003834	2.29
20	211111	Extraction of natural gas and crude petroleum	0.001451	0.002736	1.89
395	42	Wholesale trade	0.001277	0.002712	2.12
449	5413	Architectural, engineering, and related services	0.000940	0.001821	1.94
446	533	Lessors of nonfinancial intangible assets	0.000530	0.001759	3.32
49	22112	Electric power transmission and distribution	0.000851	0.001640	1.93
22	2121	Coal mining	0.000041	0.001590	39.19
187	325998	Other miscellaneous chemical product manufacturing	0.000337	0.001128	3.35
159	324191	Petroleum lubricating oil and grease manufacturing	0.000399	0.001103	2.76
162	32512	Industrial gas manufacturing	0.000462	0.000971	2.10
37	213111	Drilling oil and gas wells	0.000258	0.000964	3.74
50	2212	Natural gas distribution	0.000516	0.000952	1.85
264	33312	Construction machinery manufacturing	0.000033	0.000932	28.46

Another important group of services are engineering and management. In Ohio these services are used 1.2 times less from local suppliers than nationally. Significant resources are spent by NGL producers for purchasing manufacturing equipment and machinery. From every dollar NGL producers spend in Ohio, they are buying manufacturing products worth 0.4 cents per dollar locally. The benchmark economies, on the other hand, consume, on average, 2.7 cents -- 7.5 times more than in Ohio. The pipeline transportation industry supplies to NGLs producers about 5 times less in Ohio than nationally. Finally, utilities and wholesale services are used in Ohio about half as much by local companies as nationally. All industrial sectors with significant shortages of local suppliers are populated with companies operating in these industrial sectors and located outside of Ohio (Appendix Table A-1).

The Extraction of NGLs Industry in Ohio is also developing its customer base (Table 2). A number of Ohio industries consume products of NGLs producers and, in turn, expand the Ohio economy by increasing the demand in their own supply chains, generating additional employment

opportunities and labor income, and creating value added products. Due to the nascent state of the Ohio NGL production industry reflected in 2013 data, this is also rather modest compared to the national benchmark.

Table 2. Buyers from the Extraction of Natural Gas Liquids Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio,$	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
156	32411	Petroleum refineries	0.025374	0.011771	0.46
160	324199	All other petroleum and coal products manufacturing	0.011076	0.003365	0.30
50	2212	Natural gas distribution	0.005934	0.002957	0.50
42	221112	Electric power generation - Fossil fuel	0.003436	0.002170	0.63
159	324191	Petroleum lubricating oil and grease manufacturing	0.004471	0.001331	0.30
413	486	Pipeline transportation	0.004541	0.001010	0.22
20	211111	Extraction of natural gas and crude petroleum	0.000968	0.000925	0.96
524		Local government passenger transit	0.002547	0.000864	0.34
521		State government passenger transit	0.000000	0.000800	
161	32511	Petrochemical manufacturing	0.001770	0.000782	0.44
526		Other local government enterprises	0.001410	0.000635	0.45
519		Federal electric utilities	0.000000	0.000572	
525		Local government electric utilities	0.001281	0.000544	0.42
522		State government electric utilities	0.000000	0.000486	
523		Other state government enterprises	0.000000	0.000474	
164	32518	Other basic inorganic chemical manufacturing	0.001032	0.000411	0.40
162	32512	Industrial gas manufacturing	0.000736	0.000302	0.41
157	324121	Asphalt paving mixture and block manufacturing	0.000979	0.000287	0.29
165	32519	Other basic organic chemical manufacturing	0.000586	0.000244	0.42
158	324122	Asphalt shingle and coating materials manufacturing	0.000773	0.000237	0.31
169	325311	Nitrogenous fertilizer manufacturing	0.000683	0.000237	0.35

Table 2 and Tables 4, 6, 8, and 10 are sorted by the volume of product value consumed by industries in the benchmark economies. The industries-buyers located closer to the top of each of the aforementioned tables are more critical as they consume larger volumes of products and services created by the oil and gas industries – extraction of NGLs, natural gas, oil, drilling, and petrochemical manufacturing.

Among the largest consumers of this industry are petroleum refineries. From every dollar's worth of products produced by the Extraction of Natural Gas Liquids Industry, local refineries consume about 1.2 cents. In Ohio, this amount is more than twice as high: from every dollar's worth of products produced by this industry in Ohio, local refineries buy 2.5 cents of hydrocarbons. There are a number of other manufacturing sectors that buy this product locally. They include other

petroleum and coal product manufacturing, petroleum lubricating oil and grease manufacturing, petrochemical manufacturing, other basic organic and inorganic chemical manufacturing, and many others. Typically, from the 21 largest consumers of this industry, manufacturing companies buy about 4.8 cents of their products (or 2.5 times more) from Ohio vendors compared to 1.9 cents, on average, in other states.

Natural gas distribution and pipeline transportation industries buy 2.6 times more of NGL producers' products locally than the average nationally. More significant is the consumption of these products locally by the following consumers: electric power generation; local and state government passenger transit; federal, state and local government electric utilities; and other local and state government enterprises.

The larger consumption of products produced by NGL producers in Ohio compared to the pattern of national consumption may be biased by the small amount of this product produced in Ohio in 2013. However a limited take-away capacity available to carry the product to out-of-state locations may cause this pattern of consumption to continue.

2.4. Suppliers and Consumers of the Extraction of Natural Gas and Crude Petroleum Industry in Ohio

Table 3 reflects the pattern of suppliers of the Extraction of Natural Gas and Crude Petroleum industry in Ohio and the national industry. From the top 15 suppliers to this industry, 12 are in manufacturing sectors. The largest supplier in the benchmark states by far is oil and gas field machinery and equipment manufacturing. Nationally, on average, this industry consumes 0.4 cents of every dollar spent from the oil and gas machinery manufacturing, more than 150 times more than this industry supplies locally.

Table 3. Suppliers to the Extraction of Natural Gas and Crude Petroleum Industry in Ohio and in the U.S. less Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	US w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
266	'333132	Oil and gas field machinery and equipment manufacturing	0.0000239100	0.0037044089	154.9314
273	'333316	Photographic and photocopying equipment manufacturing	0.0000000100	0.0000014963	149.6272
170	'325312	Phosphatic fertilizer manufacturing	0.0000000100	0.0000010940	109.396
262	'333111	Farm machinery and equipment manufacturing	0.0000000900	0.0000083854	93.17096
290	'333921	Elevator and moving stairway manufacturing	0.0000000300	0.0000020045	66.81707
286	'333618	Other engine equipment manufacturing	0.0000010400	0.0000669714	64.39558
318	'334514	Totalizing fluid meter and counting device manufacturing	0.0000001500	0.0000091201	60.80089
426	'5152	Cable and other subscription programming	0.0000003500	0.0000172784	49.36687
22	'2121	Coal mining	0.0000009800	0.0000472133	48.17681
70	'311221	Wet corn milling	0.0000002400	0.0000097049	40.43699
294	'333991	Power-driven handtool manufacturing	0.0000038800	0.0001413843	36.43926
283	'333611	Turbine and turbine generator set units manufacturing	0.0000000100	0.0000003525	35.24753
264	'33312	Construction machinery manufacturing	0.0000176400	0.0006154665	34.89039
32	'212325	Other clay, ceramic, refractory minerals mining	0.0000000100	0.0000003354	33.53777
168	'32522	Artificial and synthetic fibers and filaments manufacturing	0.0000000400	0.0000013325	33.31301

Other manufacturing sectors that are among the largest suppliers to the oil and gas industry are those producing different types of heavy industrial equipment. They include farm machinery and equipment manufacturing, elevator and moving stairway manufacturing, other engine equipment manufacturing, totalizing fluid meter and counting device manufacturing, power-driven hand tool manufacturing, turbine generator manufacturing, and construction machinery manufacturing. Out-of-state companies from these sectors are listed in Appendix Table A-2.

The Extraction of Natural Gas and Crude Petroleum industry has a large list of consumers in Ohio. The pattern of consumption is similar to the national benchmark: most of the values in the United States to Ohio ratio are close to 1 (Table 4). The pattern of consuming industries in Ohio is very similar to that of the consumers in the benchmark data.

Table 4. Buyers from the Extraction of Natural Gas and Crude Petroleum Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
156	32411	Petroleum refineries	0.258544	0.307015	1.19
160	324199	All other petroleum and coal products manufacturing	0.112857	0.087473	0.78
50	2212	Natural gas distribution	0.060465	0.077695	1.28
42	221112	Electric power generation - Fossil fuel	0.035014	0.057604	1.65
159	324191	Petroleum lubricating oil and grease manufacturing	0.045559	0.035506	0.78
413	486	Pipeline transportation	0.046273	0.026083	0.56
20	211111	Extraction of natural gas and crude petroleum	0.009868	0.023898	2.42
524		Local government passenger transit	0.025951	0.022530	0.87
521		State government passenger transit	0.000000	0.020008	
161	32511	Petrochemical manufacturing	0.018039	0.019914	1.10
526		Other local government enterprises	0.014365	0.016386	1.14
519		Federal electric utilities	0.000000	0.014313	
525		Local government electric utilities	0.013049	0.013885	1.06
522		State government electric utilities	0.000000	0.012159	
523		Other state government enterprises	0.000000	0.011867	
164	32518	Other basic inorganic chemical manufacturing	0.010517	0.011027	1.05
169	325311	Nitrogenous fertilizer manufacturing	0.006958	0.008308	1.19
157	324121	Asphalt paving mixture and block manufacturing	0.009978	0.008072	0.81
162	32512	Industrial gas manufacturing	0.007502	0.007974	1.06
165	32519	Other basic organic chemical manufacturing	0.005971	0.006927	1.16
158	324122	Asphalt shingle and coating materials manufacturing	0.007879	0.006689	0.85
163	32513	Synthetic dye and pigment manufacturing	0.005381	0.006004	1.12

All consumers could be divided into four categories: manufacturing companies, direct consumers in transportation and utilities, transportation services (pipeline and natural gas distribution companies), and service companies within the same industry – so-called "own consumption." Manufacturing companies buy petrochemical products from this industry worth about 5 cents for each dollar, a pattern similar both in Ohio and nationally. The largest difference is in consumption by companies within the same industry. While these companies nationally consume products worth 2.4 cents for every dollar spent locally, in Ohio, these companies consume only 1 cent.

Major service companies for producers classified within the Extraction of Natural Gas, NGLs, and crude petroleum are drilling crews. The drilling companies are classified within the Drilling Oil and Gas Wells Industry shown with its line of suppliers and consumers in Tables 5 and 6.

2.5. Suppliers and Consumers of the Drilling Oil and Gas Wells Industry in Ohio

The 15 principal supply industries for the average oil and gas drilling company are listed in Table 5. Columns of "Ohio" and "U.S. without Ohio" represent the value of purchases by the oil and gas drilling industry from various suppliers for each dollar this industry spent in Ohio. The last column, the ratio of "U.S. without Ohio" to "Ohio," represents a scale by which companies from outside of Ohio surpass Ohio companies in buying their supplies locally within each supply industry. The higher this ratio is, the greater is the supply chain gap represented by a specific industry.

Table 5. Suppliers to the Drilling Oil and Gas Wells Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
38	213112	Support activities for oil and gas operations	0.098693	0.145399	1.47
447	5411	Legal services	0.020364	0.018741	0.92
395	42	Wholesale trade	0.005687	0.004547	0.80
461	55	Management of companies and enterprises	0.004535	0.002917	0.64
156	32411	Petroleum refineries	0.004467	0.004789	1.07
62	23	Maintenance and repair construction of nonresidential structures	0.003935	0.002536	0.64
445	5324	Commercial and industrial machinery and equipment rental and leasing	0.003139	0.002701	0.86
40	213113, 213115	Other nonmetallic minerals services	0.003115	0.002073	0.67
449	5413	Architectural, engineering, and related services	0.002878	0.002108	0.73
468	56171-2, 56174-9	Services to buildings	0.002751	0.001941	0.71
433	5215221	Monetary authorities and depository credit intermediation	0.002568	0.001801	0.70
436	5239	Other financial investment activities	0.002357	0.002400	1.02
280	333515	Cutting tool and machine tool accessory manufacturing	0.001184	0.002890	2.44
264	33312	Construction machinery manufacturing	0.000215	0.003448	16.07
266	333132	Oil and gas field machinery and equipment manufacturing	0.000119	0.005422	45.63

The biggest shortages in the supply chain for drilling companies exist in oil and gas machinery equipment manufacturing (industry corresponding to NAICS 333132), construction machinery manufacturing (NAICS 33312), cutting tools and machine tool accessory manufacturing (333515), and support activities for oil and gas operations industries (NAICS 213112). For example, for every dollar spent for all supplies, drilling companies buy 9.8 cents of their goods and services from companies providing support activities for oil and gas operations in Ohio. At the same time, average drilling companies located outside of Ohio (and largely representative of oil states) buy goods and services from support activities for oil and gas operations worth 15.5 cents – almost twice as much as in Ohio. Non-Ohio drilling companies surpass Ohio drilling companies in buying local supplies from the support activities for oil and gas operations industry by almost 1.5 times.

Other industries that supply relatively smaller amounts are also in significantly short supply in Ohio: cable and other subscription programming (NAICS 5152) – ratio 17.0 – and the other nonmetallic minerals (NAICS 212399) – ratio 11.5. Appendix Table A-3 lists out-of-Ohio companies within the industries representing the largest supply chain gap in Ohio.[8]

Similar to other industries discussed in this chapter, the drilling industry sells its services to other industries and in turn, becomes part of the supply chain to other industries in Ohio (Table 6).

Table 6. Buyers from the Drilling Oil and Gas Wells Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
37	213111	Drilling oil and gas wells	0.0006772	0.0009339	1.38
22	2121	Coal mining	0.0002728	0.0005303	1.94
21	211112	Extraction of natural gas liquids	0.0002578	0.0009641	3.74
30	21231	Stone mining and quarrying	0.0002512	0.0005211	2.07
414	487, 488	Support activities for transportation	0.0001872	0.0003051	1.63
20	211111	Extraction of natural gas and crude petroleum	0.0001389	0.0006508	4.69
456	5417	Scientific research and development services	0.0000024	0.0000050	2.04
461	55	Management of companies and enterprises	0.0000002	0.0000004	2.23

The four major consumers of the drilling industry are mining companies, including those within the category "own industry" (NAICS 213111 – drilling of oil and gas wells), the coal mining industry (NAICS 2121), the extraction of natural gas liquids (NAICS 211112), the stone mining and quarrying industry (NAICS 21231) and the extraction of natural gas and crude petroleum industry (NAICS 211111). On average, drilling services are consumed nationally at a rate 38% higher than that for local companies. For example, the extraction of natural gas liquids industry buys services from the drilling companies located in Ohio at the amount of less than 0.026 cents. For comparison, in the United States, the extraction of natural gas liquids industry buys services provided by the drilling industry for 0.1 cents – 3.7 times more than in Ohio. An even larger difference in consumption of drilling services is found within the extraction of natural gas and crude petroleum industry. In Ohio, this industry buys drilling services worth 0.014 cents while, on average, for the United States consumption is 4.7 times larger – 0.65 cents.

[8] While some supply industries for drilling are similar to suppliers for NGL producers, Appendix Table A-10 lists out-of-Ohio companies only for industries NAICS 333515 - cutting tool and machine tool accessory manufacturing and NAICS 213112 - support activities for oil and gas operations. Companies in industries NAICS 333132 - oil and gas field machinery and equipment manufacturing and NAICS 33312 - construction machinery manufacturing – are already listed in Appendix Tables A-8 and A-9.

2.6. Suppliers and Consumers of the Petrochemical Manufacturing Industry in Ohio

In the downstream segment of the oil and gas industry, for every dollar the Ohio Petrochemical Manufacturing industry spends on all supplies and workforce, 24 cents is spent on supplies purchased in Ohio and 76 cents is spent on supplies purchased outside of Ohio. The Ohio supplies are purchased from the wide range of manufacturing, feedstock, and energy producing companies. The largest suppliers to this industry are listed in Table 7.

Table 7. Suppliers to the Petrochemical Manufacturing Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
161	32511	Petrochemical manufacturing	0.064977	0.462116	7.11
156	32411	Petroleum refineries	0.041328	0.104676	2.53
165	32519	Other basic organic chemical manufacturing	0.025410	0.060336	2.37
395	42	Wholesale trade	0.023582	0.029126	1.24
20	211111	Extraction of natural gas and crude petroleum	0.018039	0.019914	1.10
50	2212	Natural gas distribution	0.015913	0.017210	1.08
409	482	Rail transportation	0.006537	0.011617	1.78
411	484	Truck transportation	0.006813	0.006600	0.97
166	325211	Plastics material and resin manufacturing	0.002567	0.004425	1.72
461	55	Management of companies and enterprises	0.004282	0.004258	0.99
49	22112	Electric power transmission and distribution	0.003330	0.003751	1.13

All suppliers to the petrochemical manufacturing industry in Ohio could be divided into five groups of industries: feedstock suppliers, transportation, manufacturing, energy, and professional services. Energy and professional services supplies consumed locally by Ohio petrochemical companies are consistent with the national benchmark (ratio is close to 1). Feedstock suppliers include such industries as the extraction of natural gas and crude petroleum and wholesale trade. On average, extraction services are consumed nationally at a rate 10% higher than that for local companies; the wholesale trade services are consumed nationally at a rate 24% higher than that locally. Ohio petrochemical companies consume transportation services at a rate 36% less than that for the national companies, and they buy from other manufacturers locally 4.7 times less than in the benchmark states. Ohio's main manufacturing suppliers include four industries that are also included in the NAICS industrial profile of chemical commodities industries discussed in the chapter entitled "Prospects for forming downstream cluster in Ohio" in the previous report on this study:[9] petrochemical manufacturing (NAICS 32511), petroleum refineries (NAICS 32411), other basic organic chemical manufacturing (NAICS 32519), and plastics material and resin manufacturing (NAICS 325211). Out-of-Ohio petrochemical manufacturing companies are listed in Appendix Table A-4.

[9] *Mapping the Opportunities for Shale Development in Ohio*. Cleveland State University. June 2015.

The largest customers of the petrochemical manufacturing industry are companies in three manufacturing sectors: petroleum manufacturing, petrochemical manufacturing, and plastic manufacturing (Table 8). Companies in petroleum manufacturing buy the production of the petrochemical industry in Ohio at an amount five times less than in the benchmark region. On average in the U.S., the largest consumers of products produced by the petrochemical manufacturing industry are companies within the same industry. There are very strong sell-buy linkages within this industry. Companies sell to each other services, compounding solutions and intermediary products. Companies in the petrochemical industry buy the products among petrochemical companies in Ohio almost 8 times less than in the benchmark region. Finally, the companies in plastic manufacturing buy the products of the petrochemical industry in Ohio 24 times less than similar companies nationally.

Table 8. Buyers from the Petrochemical Manufacturing Industry in Ohio and in the U.S. without Ohio

IMPLAN Sector	NAICS Code	IMPLAN Description	Ohio, $	U.S. w/o Ohio, $	U.S. w/o Ohio to Ohio Ratio
161	32511	Petrochemical manufacturing	0.064977	0.462116	7.11
167	325212	Synthetic rubber manufacturing	0.061032	0.434492	7.12
165	32519	Other basic organic chemical manufacturing	0.047403	0.375818	7.93
166	325211	Plastics material and resin manufacturing	0.038661	0.299813	7.75
159	324191	Petroleum lubricating oil and grease manufacturing	0.026191	0.133462	5.10
187	325998	Other miscellaneous chemical product manufacturing	0.015407	0.123559	8.02
160	324199	All other petroleum and coal products manufacturing	0.024041	0.119260	4.96
185	325991	Custom compounding of purchased resins	0.004053	0.056841	14.02
177	32551	Paint and coating manufacturing	0.004788	0.056130	11.72
190	326122	Plastics pipe and pipe fitting manufacturing	0.001949	0.049478	25.38
178	32552	Adhesive manufacturing	0.003769	0.041717	11.07
194	326160	Plastics bottle manufacturing	0.001268	0.041014	32.35
195	326190	Other plastics product manufacturing	0.002265	0.036924	16.30
168	32522	Artificial and synthetic fibers and filaments manufacturing	0.001804	0.036558	20.27
188	32611	Plastics packaging materials and unlaminated film and sheet manufacturing	0.001272	0.035318	27.76

In Ohio, for every dollar the petrochemical manufacturing industry's product sells in Ohio, a product worth 6.5 cents is purchased by other companies in this industry, 6.1 cents is purchased by the synthetic rubber manufacturing, 4.7 cents is purchased by companies in other basic organic chemical manufacturing and 3.9 cents is purchased by the plastic material and resin manufacturing.

2.7. Suppliers and Consumers of the Petrochemical Manufacturing Industry in Tri-State Region

In the larger region, the Tri-state area of Ohio, Pennsylvania, and West Virginia, the pattern of suppliers to the petrochemical industry (Table 9) is consistent with the pattern in Ohio (Table 7). However, regional purchases by the petrochemical industry from every individual supplier are larger when compared to Ohio. For example, for every dollar spent by the petrochemical manufacturing industry in the Tri-state region, petrochemical companies buy from other companies in this industry supplies worth 16.5 cents compared to 6.5 cents this industry buys while assessed in one state – Ohio. While the petrochemical industry in the Tri-state region buys products worth 16.5 cents, this industry nationally (i.e. U.S. less Tri-state region) buys products worth 47.3 cents. This indicates that despite the fact that the Tri-state region has a high concentration of companies in downstream industries, there is significant room for improvement.

Table 9. Suppliers to the Petrochemical Manufacturing Industry in Tri-State Region and in the U.S. less Tri-State Region

IMPLAN Sector	NAICS Code	IMPLAN Description	OH-PA-WV, $	U.S. less OH-PA-WV, $	U.S. less OH-PA-WV to OH-PA-WV Ratio
161	32511	Petrochemical manufacturing	0.165294	0.473703	2.87
156	32411	Petroleum refineries	0.045515	0.107200	2.36
165	32519	Other basic organic chemical manufacturing	0.024621	0.061905	2.51
395	42	Wholesale trade	0.024234	0.029331	1.21
20	211111	Extraction of natural gas and crude petroleum	0.013923	0.020231	1.45
50	2212	Natural gas distribution	0.014765	0.017332	1.17
409	482	Rail transportation	0.007828	0.011765	1.50
411	484	Truck transportation	0.006787	0.006593	0.97
166	325211	Plastics material and resin manufacturing	0.003621	0.004446	1.23
461	55	Management of companies and enterprises	0.004452	0.004248	0.95
70	311221	Wet corn milling	0.000143	0.003777	26.33
49	22112	Electric power transmission and distribution	0.003228	0.003775	1.17
407	454	Retail - Nonstore retailers	0.003952	0.003675	0.93
526		Other local government enterprises	0.002389	0.003334	1.40

Similarly, for every dollar spent by the petrochemical industry in the Tri-state area, the next largest supply industry, petroleum refineries, sells products and services worth 4.6 cents. In Ohio, as a single-state region, the petrochemical industry supplies products and services worth 4.1 cents, while nationally (U.S. without Tri-state area) the petroleum refineries industry supplies products and services worth 10.7 cents. This difference indicates that, in the Tri-state region, there is still a shortage of petroleum refineries. Similar shortages in the supply chain for the petrochemical industry in the Tri-state region exists in other basic organic chemical manufacturing, the extraction of natural gas and crude petroleum, and the plastic materials and resin manufacturing. Among the largest suppliers to petrochemical manufacturing in non-manufacturing industries are the wholesale trade industry, rail transportation and electric power

transmission and distribution. The companies that can potentially fill the gaps in the Tri-state region supply chain to the petrochemical industry are listed in Appendix Tables A-5 – A-15.

The pattern of customers to the Tri-state petrochemical industry is also consistent with that in Ohio (Table 10). The largest ratio of the benchmark data to the regional data – an indicator of the biggest shortages in the supply chain of the petrochemical manufacturing-- identifies three particular industries: NAICS 326160 – the plastics bottle manufacturing industry (ratio 11.27), NAICS 32611 – the plastics packaging materials and unlaminated film and sheet manufacturing industry (ratio 9.79), and NAICS 326122 - plastics pipe and pipe fitting manufacturing (ratio 9.03). The main feedstock of these industries is polyethylene and this product might become abundant in the region if one or several ethane crackers choose to operate in mid-Ohio Valley.

Table 10. Buyers from the Petrochemical Manufacturing Industry in Tri-State Region and in the U.S. less Tri-State Region

IMPLAN Sector	NAICS Code	IMPLAN Description	OH-PA-WV, $	U.S. less OH-PA-WV, $	U.S. less OH-PA-WV to OH-PA-WV Ratio
161	32511	Petrochemical manufacturing	0.165294	0.473703	2.87
167	325212	Synthetic rubber manufacturing	0.150421	0.431887	2.87
165	32519	Other basic organic chemical manufacturing	0.118246	0.378809	3.20
166	325211	Plastics material and resin manufacturing	0.097687	0.316757	3.24
160	324199	All other petroleum and coal products manufacturing	0.057866	0.140919	2.44
159	324191	Petroleum lubricating oil and grease manufacturing	0.061621	0.137045	2.22
187	325998	Other miscellaneous chemical product manufacturing	0.039253	0.126731	3.23
185	325991	Custom compounding of purchased resins	0.010957	0.060168	5.49
177	32551	Paint and coating manufacturing	0.012349	0.056566	4.58
190	326122	Plastics pipe and pipe fitting manufacturing	0.005663	0.051141	9.03
194	326160	Plastics bottle manufacturing	0.003942	0.044429	11.27
178	32552	Adhesive manufacturing	0.009870	0.043357	4.39
195	326190	Other plastics product manufacturing	0.006086	0.038711	6.36
188	32611	Plastics packaging materials and unlaminated film and sheet manufacturing	0.003822	0.037429	9.79
168	32522	Artificial and synthetic fibers and filaments manufacturing	0.005303	0.036607	6.90

3. Conclusions and Future Research

Ohio has significant gaps in supplying goods and services to producing, service and midstream companies in Utica play. Ohio and the Tri-State region also have supply chain gaps for the downstream petrochemical industry (Table 11). The supply chain shortages are identified using the coefficients measuring number of times the supply provided by an industry is larger in the benchmark area (U.S. less Ohio) than the supply provided by the same industry in Ohio. For example, the Support Activities for the Oil and Gas Operations industry supplies 4 times more to the NGL Extraction industry in the U.S-less-Ohio region than this industry supplies to NGL extraction companies in Ohio. This also can be interpreted that in Ohio, NGL extraction companies buy four times less supplies from Ohio companies providing support activities to oil and gas operation than in the benchmark area.

Moreover, the Support Activities for Oil and Gas Operations industry provides the largest share of all supplies bought by the NGL Extraction industry in the benchmark region (#1 supplier measured by the cost of supplies). These facts are identified in Table 11 as an indicator "4.0 (1)" in the cross-section on the industry line "The Support Activities for Oil and Gas Operations" and a column "NGL Extraction." Three out of four segments listed in the table – drilling, NGL extraction, and oil and gas extraction – illustrate the prevalence of the supply chain industries in the benchmark region (U.S. less Ohio) compared to Ohio. The fourth segment – Petrochemical industry supply chain – compares the benchmark region identified as the U.S. less Tri-state area and the Tri-state area, with the Tri-state area defined as Ohio, Pennsylvania and West Virginia together.

Table 11 illustrates the industries that are atop the supply list for each segment of the oil and gas upstream to downstream value chain. Within each segment the supplying industries are ranked by the amount of purchases made by each segment of the value chain from supplying industries made in the benchmark region. For example, the Oil and Gas Extraction spends the most by purchasing from the industries Oil and Gas Field Machinery and Equipment Manufacturing (#1 by the cost of supplies) and Construction Machinery Manufacturing (#2). Both of these industries sell to the oil and gas extraction companies in the benchmark region 155 and 35 times more than the same local manufacturing industries supply to oil and gas extraction companies in Ohio.

All supply industries to oil and gas drillers, producers and petrochemical manufacturers can be divided into four main industrial supply groups: (1) Oil and Gas Extraction, Utilities and Construction industries, (2) Manufacturing industries, (3) Wholesale and Transportation industries and (4) Professional Services. Among the industries of the first industrial supply group – Oil and Gas Extraction, Utilities and Construction industries – Ohio Utica players experience the biggest shortages in the Support Activities for Oil and Gas Operations (NAICS 213112). This industry supplies significant amount of services not only to the NGL Extraction, but also to Oil and Gas Drilling. Two more industries, the Coal Mining (NAICS 2121) and the Other Clay, Ceramic, Refractory Minerals Mining (NAICS 212325) are in short supply in Ohio. The Coal Mining and the Other Clay, Ceramic, Refractory Minerals Mining supply smaller amounts of products to oil and gas extraction companies (#5 and #15 supplies, respectively) but are significantly less represented in Ohio than in the benchmark area (sell 48 and 34 times less, respectively). The oil coal mining companies also supply to the NGL Extraction selling 39 times less in Ohio than that in the benchmark region.

Table 11. Shortages in Supply Chain across Oil and Gas Value Chain Segments in Ohio/Tri-State Area

IMPLAN Sector	NAICS Code	IMPLAN Description	Oil & Gas Value Chain Segment			
			O&G Drilling	O&G Extraction	NGL Extraction	*Petro-chemical
		O&G Extraction, Utilities and Construction				
20	211111	Extraction of natural gas and crude petroleum			1.9 (9)	1.45 (5)
22	2121	Coal mining		48.2 (5)	39.2 (14)	
32	212325	Other clay, ceramic, refractory minerals mining		33.5 (15)		
37	213111	Drilling oil and gas wells			3.7 (18)	
38	213112	Support activities for oil and gas operations	1.5 (1)		4.0 (1)	
49	22112	Electric power transmission and distribution			1.9 (13)	1.2 (12)
50	2212	Natural gas distribution			1.9 (19)	1.1 (6)
62	23	Maintenance & repair construction of nonresidential structures	0.6 (10)		1.7 (2)	
		Manufacturing				
70	311221	Wet corn milling		40.4 (7)		26.3 (11)
156	32411	Petroleum refineries				2.5 (2)
156	32411	Petroleum refineries	1.1 (4)		3.6 (7)	
159	324191	Petroleum lubricating oil and grease manufacturing			2.8 (16)	
161	32511	Petrochemical manufacturing			12.6 (5)	2.9 (1)
162	32512	Industrial gas manufacturing			2.1 (17)	
165	32519	Other basic organic chemical manufacturing				2.5 (3)
166	325211	Plastics material and resin manufacturing				1.2 (9)
168	32522	Artificial and synthetic fibers and filaments manufacturing		33.3 (12)		
170	325312	Phosphatic fertilizer manufacturing		109.4 (13)		
187	325998	Other miscellaneous chemical product manufacturing			3.4 (15)	
262	333111	Farm machinery and equipment manufacturing		93.2 (9)		
264	33312	Construction machinery manufacturing	16.1 (6)	34.9 (2)	28.5 (20)	
266	333132	Oil and gas field machinery and equipment manufacturing	45.6 (3)	154.9 (1)	126.7 (6)	
273	333316	Photographic and photocopying equipment manufacturing		149.6 (11)		
280	333515	Cutting tool and machine tool accessory manufacturing	2.4 (8)			
283	333611	Turbine and turbine generator set units manufacturing		35.2 (14)		
286	333618	Other engine equipment manufacturing		64.4 (4)		
290	333921	Elevator and moving stairway manufacturing		66.8 (10)		
294	333991	Power-driven handtool manufacturing		36.4 (3)		
318	334514	Totalizing fluid meter and counting device manufacturing		60.8 (8)		
		Wholesale & Transportation				
395	42	Wholesale trade	0.8 (5)		2.1 (10)	1.2 (4)
409	482	Rail transportation				1.5 (7)
413	486	Pipeline transportation			4.8 (4)	
		Professional Services				
426	5152	Cable and other subscription programming		49.4 (6)		
445	5324	Commercial & industrial machinery & equipment rental	0.9 (9)		2.3 (8)	
446	533	Lessors of nonfinancial intangible assets			3.3 (12)	
449	5413	Architectural, engineering, and related services	0.7 (12)		1.9 (11)	
461	55	Management of companies and enterprises	0.6 (7)		1.7 (3)	1.0 (10)

*Petrochemical industry supply chain shortages were assessed for the Tri-state region; other segments of the O&G supply chain are assessed for Ohio.

Other industries of the first group supply to NGL Extraction nationally at a significantly higher rate than that locally. Natural gas distribution and electric power transmission services are consumed nationally at a rate 90% higher than that for local companies; maintenance and repair of nonresidential structures services are consumed nationally at a rate 70% higher than that locally.

In the second supply group – Manufacturing – industries in the shortest supply in Ohio are the Oil and Gas Field Machinery and Equipment Manufacturing (NAICS 333132) and the Construction Machinery Manufacturing (NAICS 33312). Both industries are atop the supply chain list to the Oil and Gas Drilling, NGL Extraction and Oil and Gas Extraction. The Ohio NGL Extraction companies are experiencing short supply in a number of manufacturing industries in a group of petroleum and chemical manufacturing (NAICS 324-325). The Ohio Oil and Gas Extraction industry is missing significant supplies in machinery manufacturing (NAICS 333).

The Wholesale and Transportation supply group has the largest shortages to the NGL Extraction in the Wholesale Trade (NAICS 42) and the Pipeline Transportation (NAICS 486). The downstream production (Petrochemical industry) is missing significant regional supplies due to shortages in the wholesale services and rail transportation in the Tri-state region.

In the fourth supply group – Professional Services – the largest shortages of supplies exist for the NGL Extraction. Management services (NAICS 55), providers of agreements for which royalty payments or licensing fees are paid to the asset holders (Lessors of nonfinancial intangible assets NAICS 533), architectural and engineering services (NAICS 5413), and machinery rental and leasing services (NAICS 5324) are in short supply to NGL Extraction in Ohio.

Companies that have potential to expand their business to Ohio and the Tri-state region are listed in the appendices to this report. Before targeting these companies for expansion in Ohio, it would be useful to conduct interviews with Ohio companies across the oil and gas value chain and discuss the differences between suppliers they are using locally and from other states. This will enrich the data-based analysis with qualitative characteristics of suppliers and help targeting proper companies for relocation or expansion within the state. Additional research could be undertaken to shorten the list of potential suppliers that are currently operating outside of Ohio (Tri-state region), but who may have an interest in Ohio. Once identified, such companies could be approached and encouraged to expand their services into Ohio. To identify such companies, the research should look at the current expansion of capital data and investigate what companies have multi-state operations outside of Ohio and the Tri-state region. Depending on the type of supplies and the scale of the company's sales in the region, one or multiple branches could be opened in Ohio.

Another strategy for narrowing the list of targeted companies could be to develop knowledge about the specific resources these companies value most. This resource could be access to water transportation for polyethylene manufacturing companies or other companies that need to transport large and heavy equipment. It could be the amount of skilled labor or access to nearby markets of specialty chemicals. The specific resource could also be the existence of companies needing off-spec goods or feedstock that would provide such a special market opportunity for suppliers considering moving to Ohio.

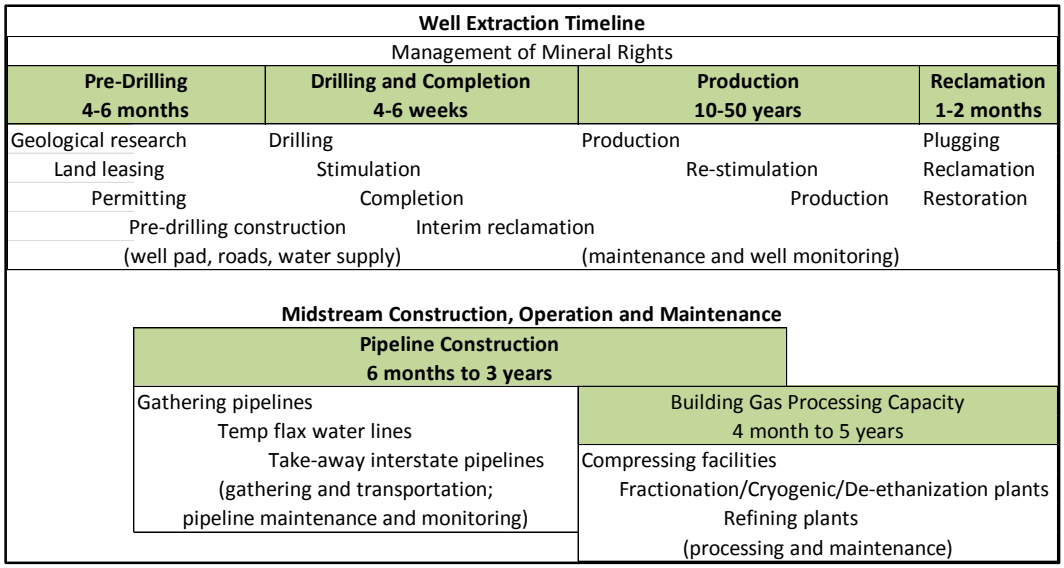
It might be useful to more carefully investigate opportunities for producing products that are identified as co- or by-products of the chemical transformation process. High costs, usually associated with small quantities, often require these co-products to be added to chemical

solutions, and keep this group of chemicals apart from cheaper traditional large-volume products, such as ethylene and propylene.

Answers to these and similar questions will help economic development experts devise best strategies for strengthening the regional supply chain for upstream and midstream oil and gas industries. Local business opportunities created in Utica-related industries will also enable value to be added to the extraction of hydrocarbons by generating more jobs, payroll, regional gross product and wealth. It may also create additional opportunities to supply a large cluster of petrochemical and plastic manufacturing downstream of the oil and gas extraction and processing industries. The expansion of a downstream petrochemical industry in Ohio could catalyze an already-robust Ohio plastics manufacturing industry, and lead to significant new supply chain opportunities in Ohio.

APPENDIX A

Figure A-1. Well Extraction Timeline



Appendix Table A-1. Suppliers for gaps in delivering local goods and services to the extraction of natural gas liquids industry (companies from outside Ohio)[10]

NAICS	Company Name	City	State	Employment
333132	FMC Technologies Inc	Houston	TX	2,000
333132	CCC Group Inc	San Antonio	TX	1,500
333132	UOP LLC	Des Plaines	IL	1,300
333132	Dril-Quip Inc	Houston	TX	900
333132	Cameron Drilling & Production	Houston	TX	800
333132	Weir Specialty Pumps	Salt Lake City	UT	800
333132	Baker Hughes	Claremore	OK	650
333132	Daniel Measurement Svc	Houston	TX	500
333132	FMC Technologies Fluid Control	Stephenville	TX	500
333132	Lufkin Foundry	Lufkin	TX	450
333132	GE Oil & Gas	Pineville	LA	420
333132	Baker Hughes	Broken Arrow	OK	380
333132	KF Industries	Oklahoma City	OK	300
333132	Mertz Manufacturing LLC	Ponca City	OK	300
333132	Oil States Industries Inc	Houston	TX	300
333132	Vallourec Drilling Products	Houston	TX	300
333132	Harbison-Fischer Mfg Co	Crowley	TX	278
333132	E Production Solutions	Kingwood	TX	250
333132	Houston Sigma Technology	Sugar Land	TX	238
333132	Teledyne OIL & Gas	Daytona Beach	FL	200
33312	ATI Flat Rolled Products	Brackenridge	PA	2,750

[10] Note that companies listed in Appendix Tables A-1 through A-4 represent headquarter locations and may have branch locations within Ohio.

NAICS	Company Name	City	State	Employment
33312	ATI Flat Rolled Products	Leechburg	PA	2,077
33312	Valmont Structures Inc	Valley	NE	1,500
33312	Valmont Tubing	Valley	NE	1,500
33312	Keystone Steel & Wire Co	Peoria	IL	1,300
33312	Tenaris	Blytheville	AR	1,200
33312	Tmk Ipsco Koppel Tubulars Corp	Koppel	PA	649
33312	Arcelor Mittal	Georgetown	SC	630
33312	Coleman Cable Inc	Bremen	IN	600
33312	Curtis Maruyasu America Inc	Lebanon	KY	600
33312	Wiremold/Legrand	West Hartford	CT	500
33312	ATI Flat Rolled Products	Midland	PA	500
33312	Wheatland Tube Co	Wheatland	PA	500
33312	Tenaris Hydril	Houston	TX	500
33312	Texas Steel Conversion Inc	Houston	TX	500
33312	Chicago Tube & Iron Co	Romeoville	IL	450
33312	Gerdau Michigan	Monroe	MI	450
33312	ATI Flat Rolled Products	Leechburg	PA	450
33312	Sho-Rack By Kaspar	Shiner	TX	450
33312	Hanna Steel Corp	Hoover	AL	400
486	Williams Co Inc	Houston	TX	4,000
486	ANR Pipeline Co	Houston	TX	3,000
486	Plains GP Holdings LP	Houston	TX	2,000
486	Shell Pipeline Co LP	Houston	TX	1,800
486	Williams Gas Pipeline Transco	Tulsa	OK	1,500
486	KB Pipeline Co	Portland	OR	1,500
486	Tennessee Gas Pipeline Co LLC	Houston	TX	1,500
486	Nu Star GP Holdings LLC	San Antonio	TX	1,200
486	Enterprise Products Prtnrs LP	Houston	TX	1,100
486	ONEOK Wes Tex Transmission LLC	Tulsa	OK	1,000
486	ONEOK Partners LP	Tulsa	OK	970
486	Williams Co Inc	Tulsa	OK	920
486	Watkins Construction Co LLC	Corsicana	TX	900
486	Plains All American Pipeline	Houston	TX	801
486	Alyeska Pipeline Svc Co	Anchorage	AK	800
486	Sea Robin Pipeline Co	Houston	TX	800
486	Kinder Morgan Inc	Houston	TX	760
486	Magellan Midstream Partners LP	Tulsa	OK	600
486	Plains Pipeline LP	Duncan	OK	600
486	Columbia Gas Transmission LLC	Houston	TX	600
32411	Chevron Corp	San Ramon	CA	10,976
32411	BP America Inc	Houston	TX	5,000
32411	Exxon Mobil Downstream	Fairfax	VA	3,500
32411	Shell Oil Co	Houston	TX	3,200
32411	Phillips 66 Refinery	Ponca City	OK	2,000
32411	Valero Energy Corp	San Antonio	TX	2,000
32411	Valero Marketing & Supply Co	San Antonio	TX	2,000
32411	Premcor Inc	Old Greenwich	CT	1,770

NAICS	Company Name	City	State	Employment
32411	Anadarko Petroleum Corp	The Woodlands	TX	1,500
32411	Exxon Mobil Refinery	Baton Rouge	LA	1,300
32411	Phillips 66 Sweeny Refinery	Old Ocean	TX	1,300
32411	Chevron Pascagoula Refinery	Pascagoula	MS	1,290
32411	Chalmette Refinery LLC	Chalmette	LA	1,200
32411	Flint Hills Resources	Rosemount	MN	1,200
32411	Sunoco Philadelphia Refinery	Philadelphia	PA	1,100
32411	Marathan Petroleum Co	Catlettsburg	KY	1,000
32411	Phillips 66 Refinery	Linden	NJ	1,000
32411	Marathon Catlettsburg Refinery	Catlettsburg	KY	900
32411	Flint Hills Resources	Corpus Christi	TX	900
32411	Valero Port Arthur Refinery	Port Arthur	TX	850
213111	Jones Drilling Haner	Duncan	OK	5,000
213111	Technip USA Holdings Inc	Houston	TX	1,600
213111	Technip Stone & Webster	Houston	TX	1,000
213111	Helmerich & Payne	Dickinson	ND	800
213111	Nomac Drilling	Edmond	OK	686
213111	Ensign United States Drilling	Bakersfield	CA	600
213111	Nabors Industries LTD	Houston	TX	500
213111	Transocean Inc	Houston	TX	500
213111	Cyclone Drilling Inc	Gillette	WY	480
213111	NOV Tuboscope	Houston	TX	475
213111	Helmerich & Payne Inc	Tulsa	OK	400
213111	Canrig Drilling Technology	Houston	TX	400
213111	Nabors Alaska Drilling Inc	Anchorage	AK	375
213111	Technip Stone & Webster	Claremont	CA	350
213111	Diamond Offshore Drilling Inc	Houston	TX	320
213111	Golden State Drilling Inc	Bakersfield	CA	301
213111	Gbk Corp	Tulsa	OK	300
213111	Kaiser-Francis Gulf Coast	Tulsa	OK	300
213111	Aqua Transfer & Oilfield Sltns	Canonsburg	PA	300
213111	Canrig Drilling Technology	Magnolia	TX	300

Source: Reference USA

Appendix Table A-2. Suppliers for gaps in delivering local goods and services to the extraction of natural gas and crude oil industry (companies from outside Ohio)[11]

NAICS	Company Name	City	State	Employment
333316	Polaroid Corp	Hopkins	MN	2,000
333316	Eastman Kodak Co	Windsor	CO	1,700
333316	Eastman Kodak Co	Rochester	NY	1,700
333316	Noritsu America Corp	Buena Park	CA	510
333316	Polaroid Corp	New Bedford	MA	470
333316	Zink Imaging Mfg	Whitsett	NC	360
333316	Kodak Polychrome Graphics	Columbus	GA	350
333316	Panavision Inc	Woodland Hills	CA	325
333316	Osram Sylvania	Winchester	KY	250
333316	R R Donnelley	Charlotte	NC	200
333316	Chapman/Leonard Studio Equip	North Hollywood	CA	160
333316	Strong International Inc	Omaha	NE	160
333316	L-3 Photonics	Carlsbad	CA	150
333316	Lucht Inc	Minneapolis	MN	125
333316	Savage Universal Corp	Chandler	AZ	120
325312	Rentech Nitrogen Partners LP	Pasadena	TX	212
325312	Simplot Phosphates LLC	Rock Springs	WY	210
325312	Simplot Phosphates LLC	Vernal	UT	143
325312	J R Simplot Co Agri Business	Boise	ID	95
325312	Morgro Inc	Murray	UT	17
325312	WESTCO	Torrington	WY	10
325312	J R Simplot Co Agri Business	French Camp	CA	6
325312	Kugler Co	Ulysses	KS	6
325312	P C S Phosphate	Aurora	NC	6
325312	Optic Fertilizer Inc	Gibbon	NE	5
325312	Exxon Mobil	Depue	IL	2
333111	Deere & Co	Moline	IL	1,600
333111	John Deere Waterloo Works	Waterloo	IA	1,300
333111	CTB Inc	Milford	IN	1,300
333111	John Deere Des Moines Works	Ankeny	IA	1,200
333111	CNH America	Grand Island	NE	1,050
333111	Bobcat Co	Bismarck	ND	1,001
333111	Hunter Industries Inc	San Marcos	CA	1,000
333111	Bush Hog Inc	Selma	AL	750
333111	Landoll Corp	Marysville	KS	750
333111	CNH Burr Ridge Headquarters	Burr Ridge	IL	701
333111	John Deere Engine Works	Waterloo	IA	700
333111	Hog Slat Inc	Newton Grove	NC	600
333111	Kinze Manufacturing Inc	Williamsburg	IA	540
333111	Peterson Cat	San Leandro	CA	500
333111	Bauer Built Mfg Inc	Paton	IA	500

[11] NAICS industry 333132 is also a supplier for gaps in delivering local goods and services to the extraction of natural gas and crude oil industry, however is omitted to avoid repetition. See Appendix Table A-1.

NAICS	Company Name	City	State	Employment
333921	Thyssen Krupp Elevator	Middleton	TN	700
333921	KONE Inc	Moline	IL	310
333921	Bruno Independent Living Aids	Oconomowoc	WI	300
333921	GAL Manufacturing Corp	Bronx	NY	275
333921	Thyssen Krupp Access	Grandview	MO	250
333921	Bagby Elevator Co Inc	Mobile	AL	200
333921	KONE Inc	Coal Valley	IL	190
333921	Thyssen Krupp Elevator	Walnut	MS	175
333921	Amtech Elevator Svc	Los Angeles	CA	150
333921	Schindler Elevator Corp	San Leandro	CA	150
333921	KONE Inc	Itasca	IL	150
333921	Alimak Hek Inc	Webster	TX	115
333921	KONE Inc	Long Island City	NY	112
333921	Thyssen Krupp Elevator	Charlotte	NC	110
333921	Essmueller Co	Laurel	MS	100
333618	Cummins Diesel Intl	Columbus	IN	3,000
333618	Cummins Power Generation Inc	Minneapolis	MN	1,500
333618	Briggs & Stratton Corp	Murray	KY	1,100
333618	Briggs & Stratton Corp	Poplar Bluff	MO	1,100
333618	Briggs & Stratton Corp	Auburn	AL	900
333618	Briggs & Stratton Corp	Fort Pierce	FL	900
333618	Briggs & Stratton Power Prods	Mcdonough	GA	900
333618	Briggs & Stratton Corp	Bessemer	MI	900
333618	Briggs & Stratton Power Prods	Newbern	TN	900
333618	Briggs & Stratton Coml Power	Milwaukee	WI	900
333618	Briggs & Stratton Corp	Menomonee Falls	WI	900
333618	Briggs & Stratton Corp	Milwaukee	WI	900
333618	Briggs & Stratton Power Prods	Wauwatosa	WI	800
333618	Briggs & Stratton Corp	Statesboro	GA	600
333618	Ford Motor Co	Romeo	MI	600
334514	Hutchinson Technology Inc	Hutchinson	MN	800
334514	Hutchinson Technology Inc	Eau Claire	WI	750
334514	Thomas G Faria Corp	Uncasville	CT	350
334514	Dwyer Instruments Inc	Michigan City	IN	350
334514	Danaher Specialty Products	Elizabethtown	NC	250
334514	Hutchinson Technology Inc	Plymouth	MN	205
334514	Brooks Instrument LLC	Hatfield	PA	200
334514	Mc Crometer Inc	Hemet	CA	175
334514	W M Berg Inc	Cudahy	WI	170
334514	Engineered Fluid Inc	Centralia	IL	150
334514	Liquid Controls LLC	Lake Bluff	IL	150
334514	Vermont Thread Gage	Franklin	KY	130
334514	AMETEK Rotron	Whitsett	NC	130
334514	Mueller Systems LLC	Cleveland	NC	120
334514	Marposs Corp	Auburn Hills	MI	105
333991	Robert Bosch LLC	Charleston	SC	2,200
333991	Robert Bosch LLC	Anderson	SC	1,380

NAICS	Company Name	City	State	Employment
333991	Husqvarna Outdoor Products	Nashville	AR	1,200
333991	Robert Bosch Tool Corp	Peoria	IL	600
333991	OWT Industries Inc	Pickens	SC	500
333991	Robert Bosch LLC	Broadview	IL	450
333991	Robert Bosch Tool Corp	Mt Prospect	IL	430
333991	Apex Tool Group	Lexington	SC	415
333991	Robert Bosch Tool Corp	Lincolnton	NC	340
333991	Ireland Concrete Construction	Williston	VT	300
333991	Eagle Manufacturing Co LLC	Florence	KY	260
333991	Robert Bosch LLC	Atlanta	GA	200
333991	Ingersoll-Rand Tools	Southern Pines	NC	200
333991	Robert Bosch Tool Corp	Lincolnton	NC	200
333991	Interstate Brick Co	West Jordan	UT	200

Source: Reference USA

Appendix Table A-3. Suppliers for gaps in delivering local goods and services to the drilling industry (companies from outside Ohio)[12]

NAICS	Company Name	City	State	Employment
333515	Kennametal Inc	Rogers	AR	700
333515	Kennametal Inc	Latrobe	PA	620
333515	Kennametal Inc	Johnson City	TN	403
333515	Kennametal Inc	Bedford	PA	400
333515	Cooper Tools	Apex	NC	300
333515	Kennametal Stellram	La Vergne	TN	265
333515	Symmetry Medical	New Bedford	MA	250
333515	Cloeren Inc	Orange	TX	220
333515	Kennametal Firth Sterling	Madison	AL	200
333515	Reiff & Nestor Co	Lykens	PA	175
333515	Kennametal Inc	Weldon	NC	172
333515	Stanley LA Bounty Mfg Inc	Two Harbors	MN	160
333515	Zenith Cutter	Loves Park	IL	150
333515	Kennametal Inc	Greenfield	MA	150
333515	Kennametal Inc	Asheboro	NC	150
333515	Tivoly INC	Derby Line	VT	150
333515	Tidland Corp	Camas	WA	150
333515	Kennametal Firth Sterling	Grant	AL	135
333515	Kennametal Inc	Gurley	AL	135
333515	Kennametal Inc	Windsor Locks	CT	135
333515	Kennametal Inc	Traverse City	MI	135
333515	Kennametal Inc	Fallon	NV	135
333515	Kennametal Inc	Fort Mill	SC	135
333515	Hannibal Carbide Tool Inc	Hannibal	MO	130

[12] NAICS industries 333132 and 33312 are also suppliers for gaps in delivering local goods and services to the drilling industry, however are omitted to avoid repetition. See Appendix Table A-1.

NAICS	Company Name	City	State	Employment
333515	Vermont Precision Tools	Swanton	VT	130
333515	Kennametal Inc	Chilhowie	VA	125
333515	Fletcher-Terry Co LLC	East Berlin	CT	120
333515	Kennametal Inc	New Market	VA	120
333515	Garr Tool Co	Alma	MI	118
333515	Kennametal Stellite LP	Goshen	IN	102
213112	Schlumberger Technology Corp	Sugar Land	TX	3,000
213112	Ameron International Corp	Pasadena	CA	2,300
213112	Shell Exploration & Production	Houston	TX	1,800
213112	GE Oil & Gas	Houston	TX	1,600
213112	Pioneer Natural Resources Co	Irving	TX	1,400
213112	Chevron Corp	Houston	TX	1,300
213112	Lariat Services Inc	Fort Stockton	TX	1,200
213112	Conoco Phillips Alaska	Prudhoe Bay	AK	1,000
213112	Samson Energy Co LP	Tulsa	OK	800
213112	National Oilwell Varco	Houston	TX	800
213112	National Oilwell Varco	Houston	TX	800
213112	Southwestern Energy Co	Spring	TX	800
213112	Gulf Marine Fabricators LP	Ingleside	TX	750
213112	Devon Energy Corp	Oklahoma City	OK	701
213112	Conoco Phillips Alaska Inc	Anchorage	AK	700
213112	NOV Tuboscope	Houston	TX	700
213112	Laclede Development Co	St Louis	MO	682
213112	National Oilwell Varco	Orange	CA	650
213112	Denbury Resources Inc	Plano	TX	600
213112	SBM Atlantia Offshore	Houston	TX	600
213112	Sbm Offshore	Houston	TX	600
213112	Cal Dive Intl Inc	Broussard	LA	520
213112	Yates Petroleum Corp	Artesia	NM	501
213112	C&J Energy Svc	Compton	CA	500
213112	Holly Corp	Artesia	NM	500
213112	Devon Energy Production Co LP	Oklahoma City	OK	500
213112	WPX Energy Inc	Tulsa	OK	500
213112	EOG Resources Inc	Houston	TX	500
213112	EXCO Resources Inc	Dallas	TX	500
213112	California Resources Corp	Los Angeles	CA	450

Source: Reference USA

Appendix Table A-4. Suppliers for gaps in delivering local goods and services to the petrochemical manufacturing industry (companies from outside Ohio)

NAICS	Company Name	City	State	Employment
32519	United States Enrichment Corp	Paducah	KY	1,200
32519	Nuclear Fuel Svc Inc	Erwin	TN	700
32519	American Centrifuge Enrchmnt	Bethesda	MD	608
32519	American Centrifuge Hldng LLC	Bethesda	MD	608
32519	United States Enrichment Corp	Bethesda	MD	608
32519	United States Enrichment Corp	Oak Ridge	TN	608
32519	Gelita USA Inc	Sergeant Bluff	IA	300
32519	Huntsman Corp	The Woodlands	TX	300
32519	POET LLC	Sioux Falls	SD	250
32519	Chem Design Products Inc	Marinette	WI	230
32519	United States Enrichment Corp	Oak Ridge	TN	215
32519	Axiall Corp	Aberdeen	MS	210
32519	Chem-TREND LP	Howell	MI	203
32519	Solazyme Inc	S San Francisco	CA	200
32519	Rousselot	Peabody	MA	200
32519	ADM	Southport	NC	200
32519	Cp Kelco Us Inc	Okmulgee	OK	200
32519	Cp Kelco Us Inc	San Diego	CA	190
32519	Nutra Sweet Co	Augusta	GA	185
32519	Kaneka Texas Corp	Pasadena	TX	185
32519	Hawkins Industrial Group	Minneapolis	MN	150
32519	Occidental Chemical Corp	Convent	LA	130
32519	Georgia-Pacific Corp	Conway	NC	125
32519	Merisant	Manteno	IL	120
32519	OCI Beaumont LLC	Nederland	TX	119
482	Metro-North Railroad	New York	NY	5,000
482	BNSF Railway Co	Fort Worth	TX	4,900
482	BNSF Railway Co	San Bernardino	CA	4,000
482	Burlington Northern Santa Fe	Temple	TX	4,000
482	Union Pacific Railroad Co	Omaha	NE	3,500
482	Norfolk Southern	Staunton	IL	2,800
482	Norfolk Southern	Atlanta	GA	2,300
482	Burlington Northern Inc	Alliance	NE	2,000
482	Csx Environmental	Nashville	TN	2,000
482	Union Pacific Railroad Co	Omaha	NE	1,840
482	CSX Transportation	Richmond	VA	1,500
482	Maine Central Railroad Co	North Billerica	MA	1,100
482	Long Island Rail Road Co	Jamaica	NY	1,000
482	National Railroad Pass Corp	Seattle	WA	1,000
482	Norfolk Southern	Bluefield	WV	1,000
482	Mittal Steel USA	Coatesville	PA	999
482	Norfolk Southern	Fort Wayne	IN	950
482	Conrail	Altoona	PA	930
482	Metra	Chicago	IL	910

NAICS	Company Name	City	State	Employment
482	Norfolk Southern	Roanoke	VA	900
482	BNSF Railway Co	Denver	CO	600
482	Alton & Southern Railway Co	East St Louis	IL	550
482	Kansas City Southern Rlwy Co	Shreveport	LA	550
482	Belt Railway Co Of Chicago	Chicago	IL	520
482	BNSF Railway Co	Chicago	IL	500
325211	Bayer Material Science LLC	Pittsburgh	PA	1,800
325211	Dow Chemical Co	Philadelphia	PA	1,100
325211	Innocor Inc	Miami	FL	1,000
325211	3M Co	Decatur	AL	930
325211	Nan Ya Plastics Corp	Lake City	SC	901
325211	Teknor Apex Co	Pawtucket	RI	800
325211	Degussa-Huls Corp	Theodore	AL	700
325211	DAK Americas LLC	Wilmington	NC	700
325211	DAK Americas LLC	Gaston	SC	600
325211	Bayer Material Science LLC	New Martinsville	WV	600
325211	AM Topp Corp	Livingston	NJ	400
325211	Plastics Engineering Co	Sheboygan	WI	400
325211	Nan Ya Plastics Corp	Wharton	TX	360
325211	Maax USA Corp	Plymouth	IN	350
325211	Diversified Plastics Corp	Nixa	MO	350
325211	RTP Co	Winona	MN	325
325211	Landec Corp	Menlo Park	CA	300
325211	Nan Ya Plastics Corp	Batchelor	LA	300
325211	Clariant Corp	Charlotte	NC	300
325211	Nova Chemicals	Monaca	PA	300
325211	Whirley Industries Inc	Warren	PA	300
325211	Ineos Americas LLC	League City	TX	300
325211	Solvay America	Houston	TX	300
325211	Poly One Corp	Dyersburg	TN	299
325211	Clariant Corp	Martin	SC	275

Source: Reference USA

Potential Downstream Consumers of Polyethylene

The research team conducted a search of potential consumers of polyethylene that could be produced at the cracker facilities proposed in Ohio, Pennsylvania, and West Virginia. The potential consumers were chosen by looking in three different geographic areas: within the Ohio, Pennsylvania, and West Virginia region (for expansion of the consumers' businesses); within the 26 states that are less than 500 miles from the proposed cracker sites; and within the entire United States.

NAICS Profile Search

A NAICS profile of the petrochemical manufacturing industry, comprising of the six four digit NAICS codes seen in Appendix Table A-5, was created. Using the Reference USA directory, companies that fell within the NAICS profile were retrieved and ranked by employment and sales.

Appendix Tables A-6 and A-7 show the top 20 firms with at least 100 employees that match the NAICS profile within the Ohio, Pennsylvania, and West Virginia region. Appendix Table A-6 displays the top 20 firms ranked by employment, while Appendix Table A-7 displays the top 20 firms ranked by sales. These firms represent those that are already located within the region, and thus could potentially look to expand their operations with the introduction of a cracker facility.

Appendix Table A-5. NAICS profile of the petrochemical manufacturing industry

NAICS Code	Description
3251	Basic Chemical Manufacturing
3252	Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
3255	Paint, Coating, and Adhesive Manufacturing
3259	Other Chemical Product and Preparation Manufacturing
3261	Plastics Product Manufacturing

Appendix Table A-6. Top 20 Petrochemical companies within OH, PA, and WV, ranked by employment

Company Name	City	State	Employment
Air Products & Chemicals Inc	Allentown	PA	4,500
Du Pont Washington Works	Washington	WV	2,400
Armstrong Holdings Inc	Lancaster	PA	2,000
Sherwin-Williams Co	Cleveland	OH	2,000
Bayer Material Science LLC	Pittsburgh	PA	1,800
Ashland Performance Materials	Dublin	OH	1,500
Lubrizol Corp	Wickliffe	OH	1,500
Scotts Miracle-Gro Co	Marysville	OH	1,500
Keystone Powdered Metal Co	St Marys	PA	1,300
Lubrizol Laboratories	Wickliffe	OH	1,250
PPG Industries Inc	Pittsburgh	PA	1,200
Dow Chemical Co	Philadelphia	PA	1,100
HFI LLC	Canal Winchester	OH	1,001
Dart Container Corp	Leola	PA	1,000
United States Enrichment Corp	Piketon	OH	1,000
Armstrong World Industries Inc	Lancaster	PA	900
D&H Distributing Co	Harrisburg	PA	900
Global Tungsten & Powders	Towanda	PA	900
Lyondell Basell Industries	Newtown Square	PA	900
Plastek Group	Erie	PA	900

Source: Reference USA

Appendix Table A-7. Top 20 Petrochemical companies within OH, PA, and WV, ranked by sales

Company Name	City	State	Sales ($M)
Calumet Penreco	Karns City	PA	$ 1,901.9
Dow Chemical Co	Philadelphia	PA	$ 1,407.4
Henkel Corp	Westlake	OH	$ 1,211.9
Lubrizol Laboratories	Wickliffe	OH	$ 1,112.4
Bayer Material Science LLC	New Martinsville	WV	$ 889.6
Global Tungsten & Powders	Towanda	PA	$ 742.6
Lyondell Basell Industries	Newtown Square	PA	$ 742.6
Construction Specialties Inc	Muncy	PA	$ 690.9
Moderne Glass Co	Aliquippa	PA	$ 621.6
LORD Corp	Saegertown	PA	$ 570.3
Du Pont	Circleville	OH	$ 498.4
Bedford Reinforced Plastics	Bedford	PA	$ 497.3
Prime Conduit Inc	Cleveland	OH	$ 480.7
Johnson Controls Inc	Bryan	OH	$ 470.9
Univar USA	Morrisville	PA	$ 456.2
Lubrizol Corp	Avon Lake	OH	$ 449.3
Titanium Metals	Toronto	OH	$ 445.4
Emerald Hilton Davis	Cincinnati	OH	$ 425.0
Braskem America	Kenova	WV	$ 416.1
Armstrong Holdings Inc	Lancaster	PA	$ 412.5

Source: Reference USA

Appendix Tables A-8 and A-9 show the top 30 firms that match the NAICS profile and are located within a 500 mile radius of the proposed crackers. The geographic area created by this 500 mile radius covers parts of 26 states (including Ohio, Pennsylvania, and West Virginia). Table A-8 displays the top 30 firms ranked by employment, while Table A-9 displays the top 30 firms ranked by sales. These firms represent those that may be willing to either expand or open branch operations within the Ohio, Pennsylvania, and West Virginia region.

Appendix Table A-8. Top 30 Petrochemical companies within 500 miles of proposed crackers, ranked by employment

Company Name	City	State	Employment
General Motors Technical Ctr	Warren	MI	17,096
Eastman Chemical Co	Kingsport	TN	8,000
Air Products & Chemicals Inc	Allentown	PA	4,500
Monsanto Co	St Louis	MO	4,000
BP Chemical Co	Warrenville	IL	4,000
B&W Technical Svc Y-12 LLC	Oak Ridge	TN	4,000
Pfizer Inc	Groton	CT	3,800
Cristal USA	Cockeysville	MD	3,600
Hospira Inc	Lake Forest	IL	3,000
Dow Chemical Co	Midland	MI	3,000
Berry Plastics	Schaumburg	IL	2,940
Berry Plastics Group Inc	Evansville	IN	2,800
Sonoco Adhesives Div	Hartsville	SC	2,500
Sonoco Plastics Inc	Hartsville	SC	2,500
Georgia-Pacific Corp	Green Bay	WI	2,500
Caterpillar Inc	Peoria	IL	2,500
Du Pont Washington Works	Washington	WV	2,400
Automotive Components Holdings	Saline	MI	2,400
INVISTA	Seaford	DE	2,100
Rubbermaid Home & Family Prods	Huntersville	NC	2,000
Linde North America Inc	New Providence	NJ	2,000
Sherwin-Williams Co	Cleveland	OH	2,000
Precision Global	Rye Brook	NY	2,000
Armstrong Holdings Inc	Lancaster	PA	2,000
Berry Plastics Corp	Evansville	IN	1,900
Acuity Specialty Products Inc	Atlanta	GA	1,800
Bayer Material Science LLC	Pittsburgh	PA	1,800
International Paper Co	Franklin	VA	1,800
Du Pont	Grifton	NC	1,750
Momentive Performance Mtrls	Waterford	NY	1,700

Source: Reference USA

Appendix Table A-9. Top 30 Petrochemical companies within 500 miles of proposed crackers, ranked by sales

Company Name	City	State	Sales
General Motors Technical Ctr	Warren	MI	$13,078,440,000
BP Chemical Co	Warrenville	IL	$12,405,640,000
United States Enrichment Corp	Paducah	KY	$2,703,473,000
Sonoco Adhesives Div	Hartsville	SC	$2,218,486,000
INVISTA	Seaford	DE	$2,169,519,000
PCS Phosphate	Aurora	NC	$1,920,043,000
Calumet Penreco	Karns City	PA	$1,901,907,000
Solutia Inc	Indian Orchard	MA	$1,874,258,000
Dow Chemical Co	Piscataway	NJ	$1,764,530,000
Du Pont	Grifton	NC	$1,627,971,000
Dow Corning Corp	Carrollton	KY	$1,471,708,000
Pfizer Inc	Groton	CT	$1,455,200,000
Dow Chemical Co	Philadelphia	PA	$1,407,393,000
American Water Heater Co	Johnson City	TN	$1,320,811,000
Nuclear Fuel Svc Inc	Erwin	TN	$1,244,707,000
Nan Ya Plastics Corp	Lake City	SC	$1,239,819,000
Henkel Corp	Westlake	OH	$1,211,853,000
Solutia Inc	Anniston	AL	$1,202,868,000
Berry Plastics	Schaumburg	IL	$1,160,000,000
B&W Technical Svc Y-12 LLC	Oak Ridge	TN	$1,157,332,000
BASF-Chemical Co	Tarrytown	NY	$1,141,000,000
Lubrizol Laboratories	Wickliffe	OH	$1,112,394,000
International Paper Co	Franklin	VA	$1,087,086,000
United States Enrichment Corp	Oak Ridge	TN	$1,081,117,000
Vi-Jon Inc	Smyrna	TN	$1,072,832,000
Henkel Corp	Madison Heights	MI	$1,047,340,000
Solutia Inc	Trenton	MI	$1,044,118,000
BP Chemical Co	Decatur	AL	$1,037,675,000
DAK Americas LLC	Wilmington	NC	$1,009,772,000
Dart Container Solo	North Andover	MA	$988,560,000

Source: Reference USA

Appendix Tables A-10 and A-11 show the overall top 30 firms in the United States that fit the NAICS profile. Table A-10 displays the top 30 firms ranked by employment, while Table A-11 displays the top 30 firms ranked by sales. These firms represent those that could potentially open branch operations within the Ohio, Pennsylvania, and West Virginia region.

Appendix Table A-10. Top 30 Petrochemical companies within the United States, ranked by employment

Company Name	City	State	Employment
General Motors Technical Ctr	Warren	MI	17,096
Eastman Chemical Co	Kingsport	TN	8,000
Air Products & Chemicals Inc	Allentown	PA	4,500
Monsanto Co	St Louis	MO	4,000
BP Chemical Co	Warrenville	IL	4,000
B&W Technical Svc Y-12 LLC	Oak Ridge	TN	4,000
Pfizer Inc	Groton	CT	3,800
Cristal USA	Cockeysville	MD	3,600
Hospira Inc	Lake Forest	IL	3,000
Koch Industries Inc	Wichita	KS	3,000
Dow Chemical Co	Midland	MI	3,000
Honeywell Federal Mfg & Tech	Kansas City	MO	3,000
ICON Health & Fitness Inc	Logan	UT	3,000
Berry Plastics	Schaumburg	IL	2,940
Derek Steele Co	Richland Center	WI	2,900
Berry Plastics Group Inc	Evansville	IN	2,800
B&W Technical Svc Pantex	Amarillo	TX	2,600
Sonoco Adhesives Div	Hartsville	SC	2,500
Sonoco Plastics Inc	Hartsville	SC	2,500
Freescale Semiconductor Inc	Austin	TX	2,500
Georgia-Pacific Corp	Green Bay	WI	2,500
Caterpillar Inc	Peoria	IL	2,500
Du Pont Washington Works	Washington	WV	2,400
Automotive Components Holdings	Saline	MI	2,400
Ameron International Corp	Pasadena	CA	2,300
INVISTA	Seaford	DE	2,100
Tropicana Products Inc	Bradenton	FL	2,000
Rubbermaid Home & Family Prods	Huntersville	NC	2,000
Linde North America Inc	New Providence	NJ	2,000
Sherwin-Williams Co	Cleveland	OH	2,000

Source: Reference USA

Appendix Table A-11. Top 30 Petrochemical companies within the United States, ranked by sales

Company Name	City	State	Sales
Marathon Garyville Refinery	Garyville	LA	$21,895,808,000
Flint Hills Resources	Corpus Christi	TX	$15,749,587,000
Chevron Oronite Co LLC	Belle Chasse	LA	$15,327,065,000
General Motors Technical Ctr	Warren	MI	$13,078,440,000
Chevron Pascagoula Refinery	Pascagoula	MS	$12,781,819,000
BP Chemical Co	Warrenville	IL	$12,405,640,000
Murphy Oil USA	Meraux	LA	$9,123,253,000
Eastman Chemical Co	Texas City	TX	$8,749,770,000
Valero Mc Kee Refinery	Sunray	TX	$7,874,793,000
World-Pak Corp	Lolita	TX	$5,599,430,000
CVS Caremark Prescription Svc	San Antonio	TX	$4,095,598,000
Syngenta	St Gabriel	LA	$3,234,330,000
BASF-Chemical Co	Geismar	LA	$3,166,331,000
Chevron Kapolei Refinery	Kapolei	HI	$3,069,548,000
United States Enrichment Corp	Paducah	KY	$2,703,473,000
Chevron Phillips Chemical Co	Houston	TX	$2,628,734,000
Lubrizol Corp	Deer Park	TX	$2,628,734,000
FMC Corp	Green River	WY	$2,468,797,000
Haltermann Custom Production	Houston	TX	$2,362,438,000
Eastman Chemical Co	Longview	TX	$2,277,532,000
Derek Steele Co	Richland Center	WI	$2,224,472,000
Sonoco Adhesives Div	Hartsville	SC	$2,218,486,000
INVISTA	Seaford	DE	$2,169,519,000
Cardinal Health	San Diego	CA	$2,021,821,000
PCS Phosphate	Aurora	NC	$1,920,043,000
Calumet Penreco	Karns City	PA	$1,901,907,000
Solutia Inc	Indian Orchard	MA	$1,874,258,000
Dow Chemical Co	Piscataway	NJ	$1,764,530,000
South Coast Terminals Inc	Houston	TX	$1,679,955,000
Du Pont	Grifton	NC	$1,627,971,000

Source: Reference USA

Polyethylene-Derived Product Search

In addition to examining the companies that fit the NAICS profile, the research team conducted a search of companies that specialize in the production of polyethylene-derived goods. Using the IQS manufacturer directory, such companies were retrieved and employment and sales information was obtained using Reference USA.

Appendix Tables A-12 and A-13 show the top 20 firms that are located within the Ohio, Pennsylvania, and West Virginia region, ranked by employment in Appendix Table A-12 and ranked by sales in Appendix Table A-13. These firms represent those that are already located within the region, and thus could potentially look to expand their operations with the introduction of a cracker facility.

Appendix Table A-12. Top 20 Petrochemical companies within OH, PA, and WV, ranked by employment (IQS Directory)

Company Name	City	State	Category	Employment
Crane Plastics Manufacturing Ltd	Columbus	OH	Plastic Extrusions	750
Lauren Manufacturing	New Philadelphia	OH	Plastic Extrusions	350
Dinesol Plastics Inc.	Niles	OH	Plastic Molding	325
Plaskolite Inc.	Columbus	OH	Polyethylene	300
Drug Plastics & Glass Co. Inc.	Boyertown	PA	Plastic Molding	275
Vycom Plastics	Scranton	PA	Plastic Extrusions	270
C&J Industries	Meadville	PA	Plastic Molding	225
Ferriot Inc.	Akron	OH	Plastic Molding	200
Ferro Corporation	Cleveland	OH	Polyethylene	160
Dawn Enterprises	Valley View	OH	Plastic Extrusions	150
Saint-Gobain Performance Plastics	Akron	OH	Plastic Extrusions	140
Boardman Molded Products Inc.	Youngstown	OH	Plastic Molding	125
Creative Extruded Products Inc.	Tipp City	OH	Plastic Extrusions	120
Graham Packaging Company LP	York	PA	Plastic Containers	120
Deimling/Jeliho Plastics Inc.	Amelia	OH	Plastic Molding	105
Malish Plastics	Willoughby	OH	Plastic Extrusions	100
Westlake Plastics Company	Lenni	PA	Polyethylene	100
Boltaron Performance Products LLC	Newcomerstown	OH	Polyethylene	93
Bardot Plastics Inc.	Easton	PA	Plastic Molding	90
Engineered Plastics Inc.	Lake City	PA	Plastic Molding	90

Source: IQS, Reference USA

Appendix Table A-13. Top 20 Petrochemical companies within OH, PA, and WV, ranked by sales (IQS Directory)

Company Name	City	State	Category	Sales ($M)
Ferro Corporation	Cleveland	OH	Polyethylene	$ 142.4
Crane Plastics Manufacturing Ltd	Columbus	OH	Plastic Extrusions	$ 122.0
Vycom Plastics	Scranton	PA	Plastic Extrusions	$ 111.1
Dinesol Plastics Inc.	Niles	OH	Plastic Molding	$ 94.3
York Imperial Plastics Inc.	York	PA	Plastic Molding	$ 73.1
MTM Molded Products Company	Dayton	OH	Plastic Containers	$ 70.3
Dawn Enterprises	Valley View	OH	Plastic Extrusions	$ 61.6
FPI Industries Inc.	Arnold	PA	Plastic Fabrication	$ 50.8
Lancaster Container Inc.	Lancaster	PA	Plastic Containers	$ 49.7
Graham Packaging Company LP	York	PA	Plastic Containers	$ 48.1
Saint-Gobain Performance Plastics	Akron	OH	Plastic Extrusions	$ 40.6
C&J Industries	Meadville	PA	Plastic Molding	$ 34.8
Boltaron Performance Products LLC	Newcomerstown	OH	Polyethylene	$ 27.0
Bardot Plastics Inc.	Easton	PA	Plastic Molding	$ 24.2
Engineered Plastics Inc.	Lake City	PA	Plastic Molding	$ 24.2
Malish Plastics	Willoughby	OH	Plastic Extrusions	$ 23.6
C-Lec Plastics Inc.	Philadelphia	PA	Polyethylene	$ 23.0
Lehigh Valley Plastics Inc.	Bethlehem	PA	Plastic Fabrication	$ 21.5
Formtech	Stow	OH	Plastic Extrusions	$ 20.9
Boardman Molded Products Inc.	Youngstown	OH	Plastic Molding	$ 20.8

Source: IQS, Reference USA

Appendix Tables A-14 and A-15 show the top 20 firms that are located within a 500 mile radius of the proposed cracker facilities, excluding those in Ohio, Pennsylvania, and West Virginia, ranked by employment in Table A-14 and ranked by sales in Table A-15. These firms represent those that may be willing to either expand or open branch operations within the Ohio, Pennsylvania, and West Virginia region.

Appendix Table A-14. Top 20 Petrochemical companies within 500 miles of proposed crackers, ranked by employment (IQS Directory)

Company Name	City	State	Category	Employment
Beach Mold & Tool Inc.	New Albany	IN	Plastic Molding	1,500
Zeus	Orangeburg	SC	Plastic Extrusions	1,000
Custom-Pak Inc.	Clinton	IA	Plastic Containers	800
Formosa Plastics Corporation USA	Livingston	NJ	Polyethylene	650
AMTEC Molded Products	Elgin	IL	Plastic Molding	400
Fabrik Molded Plastics Inc.	McHenry	IL	Plastic Molding	350
Dickten Masch Plastics LLC	Nashotah	WI	Plastic Molding	350
Koller-Craft	Fenton	MO	Plastic Molding	300
Nike IHM Inc.	St Charles	MO	Plastic Extrusions	300
Caplugs	Buffalo	NY	Plastic Extrusions	300
EVCO Plastics	De Forest	WI	Plastic Molding	300
Comar LLC	Buena	NJ	Plastic Molding	260
Century Mold Co. Inc.	Rochester	NY	Plastic Molding	250
GW Plastics Inc.	Bethel	VT	Plastic Molding	250
Reiss Manufacturing Inc.	Blackstone	VA	Plastic Extrusions	220
Sturgis Molded Products	Sturgis	MI	Plastic Molding	204
Capsonic Group	Elgin	IL	Plastic Molding	200
Silgan Plastic Closure Solutions	Downers Grove	IL	Plastic Containers	200
Decatur Plastic Products Inc.	North Vernon	IN	Plastic Molding	200
Soroc Products	Burton	MI	Plastic Fabrication	200

Source: IQS, Reference USA

Appendix Table A-15. Top 20 Petrochemical companies within 500 miles of proposed crackers, ranked by sales (IQS Directory)

Company Name	City	State	Category	Sales ($M)
Zeus	Orangeburg	SC	Plastic Extrusions	$ 289.3
BASCO Inc.	University Park	IL	Plastic Containers	$ 155.1
Accurate Plastics Inc.	Yonkers	NY	Polyethylene	$ 105.8
Midland Manufacturing Company Inc.	Monroe	IA	Plastic Containers	$ 102.0
Fabrik Molded Plastics Inc.	McHenry	IL	Plastic Molding	$ 101.3
Acromatic Plastics	Leominster	MA	Plastic Molding	$ 100.1
Capsonic Group	Elgin	IL	Plastic Molding	$ 82.0
FLN-MAR Rubber & Plastics Inc.	Holyoke	MA	Plastic Fabrication	$ 73.5
Comar LLC	Buena	NJ	Plastic Molding	$ 72.8
Shelving Inc.	Auburn Hills	MI	Plastic Containers	$ 65.1
Decatur Plastic Products Inc.	North Vernon	IN	Plastic Molding	$ 61.6
Soroc Products	Burton	MI	Plastic Fabrication	$ 60.1
L-S Industries Inc.	Knoxville	TN	Plastic Fabrication	$ 59.9
Micromold Products Inc.	Yonkers	NY	Plastic Fabrication	$ 59.3
Aurora Technologies Inc.	Pacific	MO	Polyethylene	$ 56.0
Custom-Pak Inc.	Clinton	IA	Plastic Containers	$ 53.9
Par 4 Plastics	Marion	KY	Plastic Molding	$ 53.9
Kaplan Container	East Rochester	NY	Plastic Containers	$ 51.8
SKS Bottle & Packaging Inc.	Watervliet	NY	Plastic Containers	$ 51.8
Agape Plastics Inc.	Grand Rapids	MI	Plastic Molding	$ 51.1

Source: IQS, Reference USA

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