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1. BACK TO THE FUTURE

This whitepaper provides a near-term market overview for petrochemical industry in the Northeast Region of the United States (U.S.) It also includes an update of current and proposed projects, a perspective on regional challenges to petrochemical sector expansion, an update on the Appalachian Natural Gas Liquids Storage Hub and a construction cost analysis.

Petrochemical manufacturing began in Appalachia in the 1920's with the first major commercial ethylene plant at Clendenin, West Virginia (WV), built by Carbide and Carbon Chemicals Corporation, the precursor to Union Carbide Corporation acquired by The Dow Chemical Company in 2001. The plant was linked to a single-reactor, 10,000 lbs/day chlorohydrin unit.

The technology to produce ethylene was based on discoveries by George Curme in 1919 that laid the foundation of the modern chemical industry. "The system developed at Clendenin is the precursor for thousands of plants built later to separate light hydrocarbon components in natural gasoline, as well as to manufacture ethylene, propylene, and other light olefins," says Peter Spitz's in Petrochemicals: The Rise of an Industry.

Between 1921 and 1939, annual production of synthetic, petroleum-based, organic chemicals rose from 21 million pounds to 3 billion pounds, Spitz says. Throughout the 1920s, Union Carbide was producing ethylene, ethylene oxide, and ethylene glycol near Charleston, WV. By 1934, the company made 50 derivatives from petroleum-based ethylene and propylene.

Indeed, a fun fact is that in 1859, Edwin Drake drilled the first oil well in the U.S. in Titusville, Pennsylvania (PA) that launched the petroleum industry in the U.S. During the second half of the 19th century, PA was the most oil-productive state in the country. All that changed on January 10th, 1901. After a long succession of disappointments and failure, the first Texas gusher near Beaumont flowed at an initial rate of nearly 100,000 barrels per day, more than all the other producing wells in the U.S. combined!

After World War II, the local industry reached its peak employment by 1950 and then started slowly declining as raw materials eventually dwindled in the northeast region. Many of the chemicals produced during the war became commodity chemicals, with demand for production volumes larger than the region could support. The Kanawha Valley, WV, plants shifted to smaller-volume specialty chemicals and agricultural chemicals.

Petrochemical production grew in US Gulf Coast (USGC) region where oil and space were plentiful. There it flourishes with abundant supplies of hydrocarbon raw materials and a vast network of pipelines and natural gas liquids storage structures. Indeed, the production from much of the industry’s recent wave of shale-related investment is destined for Texas and Louisiana, with numerous projects completed, planned, or underway.

Ah, but the story is still being written, as expansive discoveries of Marcellus and Utica shale extending from New York through Pennsylvania, Ohio, and West Virginia has prompted announcements of new crackers in the area. This paper will explore the potential of shale gas as a game changer to ignite a second petrochemical hub of supply chain in the U.S.
2. MARKET OVERVIEW – BUILDING AN INDUSTRY

2.1. Shale Gas Fueling U.S. Competiveness in Global Petrochemicals

Shale gas resources in the U.S. has reversed the competitive dynamics of the chemical industry in the U.S. compared with a decade ago. No longer disadvantaged by high natural gas pricing relative to foreign competitors, more than half of new U.S. polyethylene resin supplies are expected to be exported to markets in Asia, Latin America, and Europe.

Two massive shale formations (Marcellus and Utica) follow the Appalachian mountain chain from Quebec down through Kentucky. These formations, the world’s largest known gas reserves, lie dormant until recent advancements in unconventional drilling technology made extraction of hydrocarbons economical (termed “unconventional drilling”).

Production of natural gas is driven by demand for pipeline supplies of dry natural gas for fuel and power and, increasingly, exports. According to the Energy Information Administration (EIA), northeast region natural gas production at 20 billion cubic feet (BCF) per day in 2017 is expected to double in the next 35 years, accounting for 40% of total U.S. natural gas production.

EIA forecasts dry natural gas production in the eastern region of the U.S. to grow by a third between 2015 and 2025.

Figure 1 - Natural Gas Production Outlook in the Eastern United States

According to EIA, the U.S. will become a net exporter of natural gas this year.

Demand for natural gas is growing on the USGC by some 20%/year due to the commissioning of LNG export facilities, stronger industrial demand and the increases in pipeline exports to Mexico. This demand is also being met by recent shale gas activity in the West Texas Permian Basin, Woodford Basin and Eagle Ford Basin, all of which have good connectivity to the Gulf Coast ethylene cracker market.
2.2. Natural Gas Liquids

Near the wellhead, pipeline quality natural gas, which is primarily methane, is separated by fractionation from natural gas liquids (NGLs) which have their own value as chemical feedstock (ethane and some propane) and fuel (propane and butane).

Figure 2. From Natural Gas to NGL Products

Source: MarkWest

The U.S. produces 25% of all the world’s NGLs, and more than 25% of the U.S. supply comes from the northeast, according to the American Chemical Council (ACC).

Between 2026 and 2030, NGL production to meet US demand is expected to reach nearly 6.3 million barrels per day (b/d), of which more than 1 million b/d of NGL is sourced from the Marcellus and Utica Shale plays.

“Increased natural gas production in the northeast region could yield an additional 1.1 to 1.3 billion b/d of NGL by 2022, says Martha Moore, Senior Director of Economics and Policy Analysis at ACC.

In the northeast quad-state Appalachia area of Pennsylvania, Ohio, Kentucky and West Virginia, production of NGLs has grown almost 10-fold over the past four years. According to Warren Wilczewski, EIA Industry Economist, it could have been even higher.

A significant advantage to northeast region natural gas is that up to 40% of natural gas produced in the Marcellus and Utica Shale plays is rich in NGL (termed "wet"); and more than 70% of the NGL is ethane and propane. This is unique to the region.

Ethylene is the most-produced petrochemical building block. Ethane has the highest conversion yield to ethylene, about 78%, which means that means one pound of ethane cracked equals about 0.78 pounds of ethylene. Ethylene is the starting point for four very mature end products: polyethylene (three types: LDPE, LLDPE, and HDPE), ethylene oxide, ethylene dichloride (the precursor to vinyl chloride monomer), and ethylbenzene (the precursor to styrene).

Figure 3. Mapping the Utica Shale

Source: CSU
Where are the NGL’s from the northeast going?

Early pipeline projects focused on moving product to existing petrochemical demand centers in the USGC, Canada and Europe. In 2014 the 1,230-mile Appalachia-to-Texas Express (“ATEX”) pipeline began moving ethane produced in the Marcellus/Utica Shale areas of PA, WV and Ohio to ethylene production facilities in the Gulf Coast.

Also in 2014 the Sunoco Logistics Mariner East 1 Project refurbished existing pipeline and added 50 miles of new pipeline to carry 70,000 b/d of NGLs from Western PA to Marcus Hook for both domestic distribution and export.

Researchers at West Virginia University agree with Moore’s projection of NGLs from the Marcellus and Utica Shale plays by 2020. Of that, 650,000 to 750,000 b/d is ethane.

While the region is exporting its ethane to Canada, the USGC and Europe, lack of pipelines restricts what is sold, and the balance of at least 150,000 b/d is downgraded in value as it is mixed with the natural gas that supplies homes and businesses for heating and cooking.
If all this “rejected” ethane could be used to make plastic instead, the region would have more than enough feedstock for several big chemical plants without an increase in drilling activity, Wilczewski said.

Propane from Marcellus and Utica Shale plays can be used as a heating fuel source; a petrochemical feedstock to produce propylene through a process known as propane dehydrogenation (PDH); or as cracker feedstock. Propylene can be converted into polypropylene, a versatile and high-growth plastic resin.

### 2.3. Ethane Availability as Feed to Crackers

After factoring in growth in pipeline shipments of ethane out of the region, an estimated 350,000 to 400,000 b/d of ethane remains available for petrochemical feedstock within the quad-state region – enough feedstock for 5-6 crackers.

This is supported by the IHS Markit report Prospects to Enhance Pennsylvania’s Opportunities in Petrochemical Manufacturing commissioned by Team Pennsylvania Foundation (Team PA). Between 2026 and 2030, the expected ethane production from the Marcellus and Utica shale plays will be enough to support up to four world-scale ethane crackers, in addition to Shell Pennsylvania Chemicals and the current export of ethane outside the region by pipeline.

In a panel at the PCU June conference, Ron Whitfield, Vice President, Applied Economics at IHS Markit; Denise Brinley, Special Assistant to the Secretary, Strategic Industry Initiatives, PA Department of Community & Economic Development; and Ryan Unger, President & CEO, Team Pennsylvania, shared that “Other markets want our ethane. Pennsylvania is currently exporting 100% of our ethane. As additional production occurs, we must be ready, or it will simply be exported out of the state.” The real-time opportunity risk is that prolonged regulatory and feasibility studies can result in forfeiting the economic development potential of the northeast region.
Consuming near the source can avoid pipeline transport cost to the Gulf Coast at approximately $0.15 to $0.24 per gallon.

2.4. U.S. Polyethylene in the Global Market

Driven by an abundance of a 30-year supply of U.S. shale gas that can be profitably produced at $4.00 per million BTUs or less, some 10.3 million tonnes of ethylene capacity will enter the U.S. market before the end of 2019, representing an increase of 36% of existing U.S. capacity.

New investment in U.S. ethylene and derivative polyethylene capacity will push North American polyethylene production to over 54 billion pounds per year by 2020, exceeding domestic demand and driving huge growth in export volumes.

“The recent relative stability in oil coupled with a renewed sense of optimism on long-term global demand growth is spurring a new round of project announcements and activity,” says Joseph Chang, Global Editor of ICIS Chemical Business. By demand, Chang is referring to global growing demand for polyethylene from customers producing performance films, high-pressure pipe, and packaging. As depicted in figure 5, western PA competes favorably in the global market.
IHS Markit estimates 73% of polyethylene demand and 67% of polypropylene demand in the U.S. and Canada falls within a 700-mile region of southwestern Pennsylvania. The U.S. can meet its domestic demand with a good margin in additional production capacity to spare. With proximity to East Coast ports serving Europe, products produced in the region will be competitive on a global basis; the export potential is high.

Family sustaining jobs are the foundation for economic growth, notes the Honorable Mike Turzai Speaker, Pennsylvania House of Representatives in his keynote address to Petrochemical Update’s Northeast US Petrochemical Construction Conference held in Pittsburgh in June this year.

Denis Davin, Secretary, Pennsylvania Department of Community and Economic Development, sends a “wake up” call to the state administration to act with a sense of urgency to seize this dynamic, time-sensitive window in history. According to Davin, Pennsylvania’s role as the next U.S. leader in natural gas, petrochemicals, and plastics manufacturing is at risk to a default mode of exporting NGLs outside of PA, unless steps are taken to build the necessary infrastructure to support a second petrochemical sector hub in the US.
“The advantages for the Appalachia chemicals and plastics industry are huge. The area has proximity to abundant NGL resources in the Marcellus/Utica and Rogersville shales,” Moore said. The region also has proximity to manufacturing markets in the Midwest and along the East Coast and Canada.

Tracking new petrochemical project announcements motivated by the shale advantage since 2010, ACC’s database now lists 310 projects valued at $185 billion, including new factories, expansions and restarts of facilities shuttered during the recession. The investment will translate into an estimated 821,000 permanent new jobs by 2025. “This is the equivalent of 40% of the replacement value for the entire U.S. chemical industry stock,” Moore said.

ACC says “fully 62% is foreign direct investment, or includes a foreign partner. The fact that such large numbers of firms based abroad are choosing to source their chemistry in the U.S. is unprecedented in recent history and a testament to the value and affordability of America’s shale gas and ethane supplies. The U.S. is capturing market share from the rest of the world, and no other country or continent has as bright an outlook when it comes to natural gas.”

In a 10-county regional GPD of $136 B, one cracker project represents $4B, or a 3% increase in GPD. A petrochemical complex is a 30-50-year asset with ongoing operating and maintenance expenses (i.e., compressed gases; process chemicals; turnarounds; routine maintenance and repair; site security and logistics.)

The creation of a second petrochemical hub provides supply-chain redundancy for the nation which now relies primarily on production from a region susceptible to hurricanes and tornados. Although most projects since 2010 have been built along the USGC, the Appalachia region is an opportunity to strengthen the U.S. economy by providing employment and supply diversity, Moore said.

Recently Hurricane Harvey shut down roughly a quarter of the nation’s refinery capacity and more than a dozen petrochemical plants halted operations. Ports were closed and key fuel pipelines serving the Midwest and northeast regions were partially or completely shut down. Industrial Information Resources (IRR) is tracking 42 capital projects worth $7.4 billion now in the construction phase and 19 capital projects worth nearly $2.6 billion expected to start construction before year end in Harris County, TX. These projects will compete with rebuild efforts in infrastructure, commercial and residential sectors, driving up costs and causing labor shortages. “Labor shortages pose a long-term issue,” said IIR’s Anthony Salemme. “There are already shortages in mechanical crafts, and now there will be shortages in the soft crafts like painting, insulation and laborers.”
2.6. The Ripple Effect

As business activity and hiring increase, household earnings will also grow, supporting additional spending and reenergizing local economies in the quad-state region. Other manufacturing and services in the region will grow in direct response to the economic activity generated by petrochemical industry growth. A 50-year asset supercharges growth in sectors such as plastic compounding; food service; housing; restaurants; pharmacies; retail; insurance, financial services; medical facilities; as well as a myriad of service companies to maintain the plant, such as pipe fabricators and welding suppliers. **The job multiplier is at least 3-5 jobs for every permanent job at the asset.**

The availability of locally-produced resin will likely encourage new downstream plastics processors to locate in the region, although existing compounders will not be incentivized to re-locate.

“I believe the Shell investment sends a strong signal that this is a good place for investment for the same reasons Shell chose Pennsylvania: cheap and abundant ethane, proximity to their end customers and a supportive business climate, which are the same things we will be touting to other companies as we encourage them to invest here,” said David Ruppersberger, President of the Pittsburgh Regional Alliance.

A “tremendous” amount of planning is underway for the facilities that will spring up around the Shell cracker, says Charlie Schliebs, Corporate Secretary of the Pittsburgh Energy Innovation Center (EIC) and managing Director of Stone Pier Capital Advisors.

Schliebs said other potential suppliers and service providers to the cracker were also engaged in planning. Plastics-manufacturing facilities will follow in a few years, he said, pointing out they will only be built once Shell begins producing pellets at least five years from now.

As noted by ACC in its report The Potential Economic Benefits of an Appalachian Petrochemical Industry released in May 2017, if companies continue to invest in and build the petrochemical industry in the region, an Appalachian petrochemical hub could generate the impacts in the quad-state region noted in table 1 below.
ACC’s report projects generation of 100,000 permanent jobs, including 25,700 new chemical and plastic products manufacturing jobs, 43,000 jobs in supplier industries, and 32,000 ‘payroll-induced’ jobs in communities where workers spend their wages.

The new investment could also lead to $2.9 billion in new federal, state, and local tax revenue annually.

| Potential Economic Impacts of An Appalachian Chemical Industry (Permanent, By 2025) |
|-------------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| $32.4 billion in petrochemicals, resins and derivatives | $23 billion in chemicals + plastic resins | 25,664 direct jobs (chemical and plastics products manufacturing) | $1.7 billion direct | $1.7 billion in federal tax revenue annually |
| $3.4 billion in plastic products | $5.4 billion in plastics compounding + plastics products | 43,042 indirect (supply chain) jobs | $3.0 billion indirect (supply chain) | $1.2 billion in state and local tax revenue annually |
| TOTAL: $35.8 billion | TOTAL: $28.4 billion | TOTAL: 100,818 jobs | TOTAL: $6.2 billion | TOTAL: $2.9 billion |

Table 1. Potential Economic Impacts of an Appalachian Chemical Industry  

Source: ACC

Too good to be true? So, where’s the catch?

ACC is clear that this hypothetical scenario in the report requires a robust storage and distribution system for NGLs that is the backbone of the chemical manufacturing industry. “Without existing infrastructure, it’s difficult for the region to attract NGL consumers such as manufacturing facilities. At the same time, the absence of an established NGL-customer base makes it difficult for pipeline developers to secure loans.” A second pre-requisite to growth is an additional 500 miles of pipelines along the Ohio River. IHS Markit also makes an equally compelling recommendation regarding the need for pipeline and other infrastructure across the Commonwealth of Pennsylvania.

2.7. Partnerships Catalyze Petrochemical Sector Development

With an urgency and proactive approach to the “seize the moment,” regional economic development coalitions and partnerships are playing a key role in awareness, communications, and finding solutions to pave the way for Petrochemical sector growth.

“If the community/leaders don’t want it... it will not happen!”

Ohio River Corridor

In Spring 2017
The **Tri-State Shale Coalition** formed in October 2015 is dedicated to workforce development, infrastructure, innovation, and marketing. After years of competing against one another to land large petrochemical projects, Pennsylvania, West Virginia and Ohio now host annual summits to share best practices around economic development. As part of the agreement, the states work together to support infrastructure, such as pipelines, railroads, and roadways, that are critical for shipping natural gas and related products. In addition, they encourage state-supported universities to collaborate on research to find end uses for natural gas products.

The **Appalachian Regional Commission (ARC)** established by Congress in 1965 is composed of the governors of the 13 Appalachian states; multi-county local development districts and a federal co-chair appointed by the nation's President. ARC has funded a supply chain project involving four Manufacturing Extension Partnerships (MEP) in the Marcellus-Utica region. In each region the MEP provides products, services and assistance dedicated to the productivity, growth and global competitiveness of small and medium-sized manufacturing companies that represent 90% of job growth for high-paying jobs. For every new manufacturing job created or retained, 3 to 5 supporting jobs are created.

**MAGNET**, Manufacturing Advocacy & Growth Network in Northeast Ohio, is a MEP Affiliate that combines collaborative partnerships with an array of regional stakeholders to innovate new products and processes and adapt new technologies. Three priority initiatives are the additive manufacturing (3D printing), robotics and the Internet of Things, says Ethan Karp, President & CEO, of MAGNET.

The Pittsburgh **Regional Alliance (PRA)** is behind the Power of 32 Site Development, a $49 million fund helping to close infrastructure financing gaps and concentrating its investments on eligible sites in the 32-county Greater Pittsburgh economic region, covering southwest Pennsylvania, southeast Ohio, and northwest West Virginia. Patty Horvatch, PRA Vice President Business Investment, is optimistic that companies may choose to build regional offices or headquarters in the area.

The **Pittsburgh Energy Innovation Center (EIC) Institute** partners with industry and trades in all aspects on a spacious 6.9-acre campus downtown Pittsburgh. An independent 501.c.3 non-profit, EIC Institute is transforming how humans interact with energy and technology. It develops and delivers workforce training for the energy industry; fosters collaboration and advances in energy best practices and incubates new energy technologies for commercialization.

The **Ohio Chemistry Technology Council** represents chemical manufacturers, distributors, engineering firms and consulting firms that work significantly within the industry.

In WV, the Polymer Alliance Zone©, Nic. (PAZ) has one of the highest concentrations of technology, specialty and engineering polymers production in the world.

![Figure 9. Community Commitment to Growth](source: ANI Spring)
The Appalachian Partnership Initiative (API) is comprised of public- and private-sector leaders focused on funding, policy leadership, and access to resources and information to prepare students and workforce to take advantage of new opportunities in advanced manufacturing, energy production, health care, higher education, and technology.

Launched in 2014 with a five-year, $20 million funding commitment from Chevron, API is a partnership guided by the shared vision of the Allegheny Conference on Community Development, Claude Worthington Benedum Foundation, Chevron, and The Grable Foundation.

API’s mission is to increase access to science, technology, engineering and mathematics (STEM) education, workforce training, and career awareness. Its strategy is to engage, mobilize, and catalyze a community of public- and private-sector leaders in education, workforce development, business, nonprofit foundations, and government to work together to create multiple pathways for residents to access education, training, and career opportunities.

Figures 9, 10 and 11 below are sourced from the Appalachia Partnership Initiative Progress Report, April 2017.

"The Benedum Foundation is committed to improving the quality and relevance of career education. We have a long history of supporting rural communities - especially in West Virginia - and Chevron’s commitment to these areas makes us natural partners. We believe our combined efforts are making an important contribution to small towns and rural communities in the tri-state region by offering unique assistance to educators regarding the real-world demands of the workplace."

— James V. Denova, Vice President, Claude Worthington Benedum Foundation
Figure 12. API Largest Collective Investments

“While Chevron’s commitment to the Appalachia Partnership Initiative represents one of the company’s largest social investments, our contribution goes beyond funding alone. We also dedicate time, expertise, and volunteers to support programs that we hope will help residents of our operating region thrive for generations.” — Stacey Olson, President, Chevron Appalachia, LLC.
3. CURRENT INVESTMENT

3.1. Upstream and Midstream – Drilling and Fractionation

In Pennsylvania alone, 10,000 unconventional wells have been drilled in past 10 years with a proposed investment of $12B in pipeline transmission.

Ohio has nearly $7 billion in proposed shale gas projects with a capacity of 3.3 million metric tons. This shale gas investment could generate $4.9 billion in additional chemistry industry output and support more than 17,000 jobs, shares Jenn Klein, President, Ohio Chemistry Technology Council in an interview with Petrochemical Update (PCU).

The Appalachian region has already invested tens of billions of dollars in capacity to separate dry natural gas from impurities and NGLs and in capacity to separate (also called “fractionate”) mixed NGLs into purity products, such as ethane. The region is home to a robust and growing interstate natural gas transmission pipeline network; 10 natural gas processing plants and five fractionators; and four major NGL interstate pipelines built or under development.

3.2. Chemical Sector – A Firm Foundation

Ranking as the 10th largest producer of chemicals in the U.S., PA already has roughly 41,000 direct jobs in the chemical industry, notes Jeff Logan, President, Pennsylvania Chemical Industry Council.

In IIR’s tracking of the installed base capacity for 12 industry sectors, PA ranked # 4 among the 50 states. IIR data shows an increase from 28 to 35 million manhours from 2016 to 2017, with the growth targeted in power generation, natural gas pipelines, and chemical processing.

Ranking as the 6th largest producer of chemicals in the U.S., Ohio has over 43,500 direct jobs in the chemical industry; another 59,000 related jobs; and 56,000 jobs in plastic and rubber products.

Ohio is currently the #1 plastics producer in the U.S. with a dense concentration of plastic and rubber processors, who are in turn supported by molded toolmakers, machinery manufacturers, resin compounders and distributors that ship over $6.5 billion/year in products globally. End customer markets are automotive, aerospace and aviation, food processing, advanced manufacturing, pharmaceuticals, logistics and distribution.

Chemical and polymer manufacturing in West Virginia is home to nearly 140 companies that employ 12,800 workers. The state is ranked 6th in the share of overall gross domestic product that comes from chemicals and polymers. Nearly 25 percent of the state’s $4.8 billion in international exports are chemicals and polymers.

3.3. Other Chemicals

Solvay plans to double production capacity of high molecular weight hindered amine light stabilizers (HALS) at its Willow Island, WV, site to support its polymers line. Expansion work is expected to be operational by mid-2019. Solvay also plans to build a second, fully independent high molecular weight HALS manufacturing unit at the site, the company said in a statement.
4. ETHANE CRACKER PROJECTS UPDATE

In the Northeast, three crackers dominate the spotlight.

Table 2. Northeast U.S. Ethane Crackers

<table>
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<tr>
<th>Company /Location</th>
<th>Ethylene Capacity, kta</th>
<th>Derivative Units</th>
<th>FID</th>
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<td>polyethylene</td>
<td>Taken</td>
<td>2022</td>
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<td>PTT Global Chemicals Belmont County, OH</td>
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<td>Polyethylene Monoethylene glycol</td>
<td>Evaluating</td>
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<tr>
<td>Braskem Wood County, WV</td>
<td>1050</td>
<td>polyethylene</td>
<td>On hold</td>
<td>-</td>
</tr>
</tbody>
</table>

4.1. Shell – Strike the Original Match

The Shell petrochemical complex in Pennsylvania will be the first major U.S. project of its type to be built outside the Gulf Coast in 20 years.

Houston-based Shell Chemical Appalachia, LLC became the first company to approve a major petrochemical complex in the region in June 2016, when it announced it would begin construction of its 1500 kta ethylene cracker by the fourth quarter of 2017 in Potter Township, Beaver County, about 30 miles north-west of Pittsburgh.

“As a result of its proximity to gas feedstock, the complex, and its customers, will benefit from shorter and more dependable supply chains, compared to supply from the Gulf Coast,” Shell said. “The location is also ideal because more than 70% of North American polyethylene customers are within a 700-mile radius of Pittsburgh.

“Shell bought the 300-acre facility for $13.5 billion in June 2015 and later acquired an additional 700 acres nearby. Infrastructure changes have already been completed including moving Route 18 closer to the facility and building an onto the interstate to keep construction traffic away from county traffic. In addition, CSX Rail moved its main rail line closer to the facility, Ruppersberger explained.

The project is expected to bring growth and jobs to the region, with up to 6,000 construction workers involved in building the facility and an expected 600 permanent employees when completed.

The complex includes processing facilities for 1000 kta of high-density polyethylene and 550 kta of linear low-density polyethylene; as well as infrastructure comprised of a cogeneration unit, water treatment plant, water detention pond, dock, rail, and truck loading.
Allegheny County Executive Rich Fitzgerald said the agreement by Shell was achieved through a collaborative effort by the “building trades and the United Steelworkers, the bipartisan support from the Pennsylvania house and senate, and the efforts of the Allegheny Conference and the Marcellus Shale Coalition.

Shell is pouring foundations as this report is penned. Civil works has begun and start-up is scheduled for 2022, which will be converted to more than.

Figure 13. Shell Site

“Shell’s investment is clearly an affirming decision with regards to their independent validation of the resource availability in the Appalachian Basin,” Hedrick said. “Major construction efforts increase the density of resources available for that heavy construction, such as civil engineers, process engineers and the construction trades. Once deployed into the geography, those resources may be redeployed rapidly with the region to new, adjacent construction sites.”

4.2. PTT – Cautious Optimism

PPT Global Chemicals officials have publicly cited that a decision will be made its $6 billion investment before year end.

Roughly four years from its first public announcement, PTT Global Chemical America bought a 168-acre parcel overlooking the Ohio River in Dillies Bottom, an unincorporated area in Belmont County, Ohio across the Ohio River from Wheeling, West Virginia. The land was purchased from FirstEnergy Corp for $13.8 million. FirstEnergy demolished its old coal-and-oil-fired R.E. Burger power plant and cleaned up the site in the fall of 2016.

According to an article in The Plain Dealer, the company took a $14 million loan from JobsOhio, a private, non-profit corporation, to do the demolition and cleanup work. Under the terms of the loan, JobsOhio forgave the loan when FirstEnergy could show proof that it had the work done properly and had paid for it, something PTT Global also needed to know. That occurred in June, said FirstEnergy spokeswoman Jennifer Young.

Site preparation for the planned cracker in Belmont County, is nearly complete, with no evidence of the former R.E. Burger power plant.

In early October this year, Mr. Toasaporn Boonyapipat, President and Chief Executive Officer of PTTGC America,
and Mr. John Minor, President and Chief Investment Officer of JobsOhio, an investment promotion agency of the State of Ohio, signed a memorandum of understanding (MOU) stating agreement by the two parties to jointly establish a community infrastructure development plan to enhance the well-being and quality of life for the communities in the area surrounding PTTGC America’s planned petrochemical complex in Belmont County, Ohio, after the Final Investment Decision.

PTTGC America, a subsidiary company of Thailand’s PTT Global Chemical Public Company Limited, has conducted the front-end engineering design for the complex over the past two years to help determine the project’s feasibility. At this stage, an economic evaluation and further engineering work are underway.

The project cleared a significant hurdle in the first week of January when the Ohio Environmental Protection Agency agreed to let the company discharge wastewater into the Ohio River. The Ohio EPA is still reviewing the air permit for the project, according to an agency spokesperson.

Optimism regarding the project holds firm, says Belmont County Port Authority Director Larry Merry and Mike Jacoby, who serves as vice president of business development for Appalachian Partnership for Economic Growth.

Optimism regarding the project holds firm, says Belmont County Port Authority Director Larry Merry and Mike Jacoby, who serves as vice president of business development for Appalachian Partnership for Economic Growth.

4.3. Odebrecht Suspended

Odebrecht and Braskem first announced intentions to build an ethane cracker near Parkersburg in 2013: Appalachian Shale Cracker Enterprise. West Virginia Department of Commerce General Counsel Josh Jarrell confirmed that although Odebrecht is no longer participating in the project, Braskem retains an interest in the land. “It’s not dead,” Jarrell said of the possible Wood County ethane cracker. “We’re anxiously waiting for them to take another step with us.”

Braskem has been planning a 1.1 mtpa cracker in Parkersburg, W. Va., although multiple sources have confirmed to Petrochemical Update that these plans are on hold due to the legal troubles of Brazilian parent company Odebrecht.
5. REGIONAL CHALLENGES TO REALIZING THE SHALE GAS OPPORTUNITY

5.1. Site Selection

According to Dennis Yabolonsky, CEO, Allegheny Conference on Community Development, a significant challenge is finding another site in tri-state area, even across state borders, with the 800 to 1000 acres required to support a petrochemical complex.

Everything that attracted Shell to build in PA is there: abundant, affordable ethane; proximity to customers; navigable waterways; Class 1 rail service (Wheeling & Lake Erie; Norfolk Southern (NS); CSX and Genesee & Wyoming); interstate highway connections; and state incentives.

In fact, Yabolonsky notes the momentum in progress because of Shell’s cracker has created a strong foundation for continued partnerships with federal, state and local government authorities; environmental permitting; workforce development to build and operate the facility; union relations; and community relations.

Patty Horvatich, PRA Vice President Business Investment, says that in contrast to the Gulf Coast, where the flat topography makes it easier to secure suitable land for large plants, in the tri-state area it is difficult to find even 200 hundred acres of flat land, and there is a need for “more ready-to-go sites.”

The challenge to find a relatively flat, large, and logistically-favored sites to support a petrochemical complex is the business of the Ohio River Corridor Team established in 2016 by Bryce Custer, SIOR, CCIM as a Petrochemical and Energy Site Selection and Commercial Real Estate Services Company under NAI Spring Commercial Realty. Custer is advocating a “Hi-Low” or “Tiered” approach, where processing, utilities, warehousing, and administration facilities may be co-located on the same site, but different elevations.

Custer has coined the phrase “from Rust Belt to Plastic Belt” when referring to the cusp of an economic revolution in the Ohio River Corridor. An ethane cracker requires a large footprint not only the process / production units but also storage, construction laydown and staging, and infrastructure such as power generation and logistics. And a cracker requires proximity to a water source for process cooling water, as well as logistic access to rail, navigable waterways, and interstates.

At the 2017 Ohio Oil and Gas Association Technical Conference, Custer identified two locations that meet cracker site selection criteria as discussed above. These are as follows:

- Newell, West Virginia (1,000+ acres) – Hancock County, Weirton–Steubenville Metropolitan Statistical Area
- Weirton, West Virginia (1,000+ acres 250-acre Brown’s Island Ohio River)

Other sites that have potential for manufacturing are Mingo Junction, Ohio (~100 acres); Moundsville, West Virginia (58 acres); and Marietta, Ohio (various facilities).
5.2. Regulatory Hurdles

The fate of seizing the opportunity of the chemical manufacturing “big bang” hangs in the balance as key policies that determine if natural gas and NGL supplies remain robust and affordable are determined. According to ACC, these include the following:

- access to oil and natural gas reserves on federal, state, and private lands;
- continued state-based regulation of unconventional oil and gas production;
- timely, transparent, and efficient regulatory permitting process for manufacturing projects and investments, such as new plants and expansions;
- expedited the building of infrastructure, such as pipelines, that links energy production to chemical facilities;
- accelerated depreciation schedules for chemical industry investments in new plants/equipment; and
- expanded access to foreign markets for U.S. goods.

Opposition to creating such infrastructure is led by PennFuture, the Clean Air Council, the Delaware Povertykeeper (a/k/a Riverkeeper), Statel ImpactPA and others primarily financed by the Heinz Endowments and William Penn Foundation.
Co-founders and Principals of Silent Majority Strategies (SMS), an energy sector consulting firm focused on messaging, communications, regulatory and permitting strategy, told PCU, “The opposition is committed to nothing short of destruction of the hydrocarbons business from the well-pad to the chemical plant to the consumer. Thus far, industry has underestimated this political risk and that is proving to be costly.”

SMS identified 3 ways in which the politics of infrastructure has changed: (1) construction in areas that have not seen buildout in many decades; (2) mass ideological and political organizations against the hydrocarbons industries; and (3) critical links in the supply chain (i.e., pipelines). SMS advocates that “political risk can only be addressed and mitigated by direct action.” The public narrative needs to be personal, diversified, and compelling; answering “what’s in it for me?”

Politics is emotional and irrational; changing abruptly and unpredictably. Regulatory messaging must maintain logical consistency and address all germane arguments. Agencies fear losing in Court and fear loss of funding and power from legislative or executive action.

5.3. Work Force Development

Finding skilled craft workers to build America’s new petrochemical projects is an acute challenge for the Northeast, and true even on the Gulf Coast. An aging workforce with its loss of expertise, expectations of tech-savvy millennials, skill gaps and leadership development are all pressing challenges.

Sam Lyon, Global Workforce Services Manager at Bechtel, the engineering, procurement, and construction contractor for the Shell cracker, has estimated that 10,000-15,000 craft-labor jobs will be needed in the tri-state area in the next five to six years.

![Figure 17. Shell Cracker Projected Craft Requirements](source)

<table>
<thead>
<tr>
<th>Projects</th>
<th>Investment, $ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marcellus/Utica Midstream MarkWest</td>
<td>275</td>
</tr>
<tr>
<td>Marcellus/Utica Midstream EQT</td>
<td>85</td>
</tr>
<tr>
<td>St Clair Hospital</td>
<td>80</td>
</tr>
<tr>
<td>AGH Hospital Expansion</td>
<td>50</td>
</tr>
<tr>
<td>Almono, Lumiere, The Junction, Several School Districts, Carnegie Science Center, CMU Gateway, 911th Airlift, Lower Hill 28 acres, others</td>
<td>340</td>
</tr>
</tbody>
</table>

![Figure 18. Regional Construction excl. crackers](source)

All the trade unions in the region are focused on making sure there are as many construction workers from the region as possible, but “you just don’t snap you fingers and come up with trained union construction people,” Schliebs said.
5.3.1. Industry Partners with Academia

This increasing demand for labor paired with reduced labor availability is causing companies to rethink their strategies for attracting, keeping and maximizing the contributions of skilled workers. Owners are looking at options to train the new workers. There is an emphasis on bringing in trained professionals from community colleges, such as the one in Beaver County and in neighboring Allegheny County (where Pittsburgh is based).

An impressive, proactive and aggressive approach is being taken by partnerships between industry and academia. The Community College Beaver County (CCBC) is a catalyst in this process with its eye on a goal larger than a sustainable workforce for Shell. It has a K-16 approach that affords flexibility to students to pursue a 2-year degree with all credits transferable to a 4-year degree. CCBC has researched best practices in Houston’s community colleges.

"It’s a pretty simple model. You have an industry-driven curriculum, you have a common training curriculum and tools that are used by the community colleges, and then you have companies at the backend that are willing to hire people who come out of the training with those certifications," says Yablonsky.

Apprenticeship Readiness Program prepares an individual to enter unions with family sustaining wages; 45 of 60 credits can later be applied to a 2-year associate degree. Incentive to pursue degree if so choose.

Beaver County Career and Technology Center works closely with CCBC and local universities. Student awareness and education of manufacturing job options in middle school is a big part of the effort. Career fairs create excitement. Since 2011, Chevron has been active in creating pathways for adult learners, says Mary Murrin, Social Investment Team Lead for Chevron.

In the 2016 report Inflection Point, commissioned by the Allegheny Conference on Community Development, data on regional skills gaps found that energy and advanced manufacturing employers will need to fill 5,000 job openings annually due to an aging workforce. The report highlighted the seven fastest-growing industry-related occupations in the region through 2025: industrial machinery mechanics; computer-controlled machine tool operators; machinists; mechanical engineers; petroleum engineers; heavy- and tractor-trailer truck drivers; and installation, maintenance, and repair workers.

5.3.2. States Without Borders

Shell’s site is a border location that will draw its workforce from 3 states. A multi-state labor shed approach brings together education and training providers across geopolitical boundaries, to meet the same standards of workforce preparation.

Speaking at the Conference, Tony Salemme said supply is near its maximum and that the timeline to develop additional workforce may be insufficient to match the rise in demand. Salemme predicts Pittsburg is competing for travelers by craft by year: wages and per diems. Cleveland, Columbus, Philadelphia.

For a major Bechtel project in Illinois, conducted for a different industry, employees came from most states in the Lower 48," said Lyon. Likewise, according to Schliebs, when BP constructed a refinery in Indiana a few years ago, they had to bring in construction workers from at least a 500-mile radius – many of them from Pittsburgh.

There is a recognition in the region that experienced personnel will need to be brought in from the Gulf Coast and abroad to lead and run these facilities at the beginning. Schliebs explained, "Shell understands that they’re not just trying to build a workforce for Shell. There needs to be a workforce for the entire, broader industry here, because that will benefit everyone. And the more enlightened companies, like Shell, have a focus on that."
5.3.3. Clear and Present Danger

Princeton Economist Alan Krueger released a study in September this year partially attributing a 20 percent drop in the labor force participation rate for prime age men between 1999 and 2015 to the opioid epidemic driven in part by opioid availability. Krantz concurs in his article in Business Insider, October 31, 2017, that while underlying causes of the crisis are many, high rates of overdose deaths are driven by prescription/over prescription of legal opioids that act as a gateway to addiction. Many states where prescription rates are high, like the four states in the Cleveland Fed study, also have high levels of opioid abuse.

In the article “Opioid Epidemic and the Labor Market” published in Economic Commentary, September 29, 2017, authors Dionissi Aliprantis and Anne Chen share that while a high rate of overdose deaths is spread across the U.S., areas in the west and across the northeast are hardest-hit.

The rates of death from opioid overdoses in West Virginia, Ohio, Kentucky, and Pennsylvania are all above the national average, according to a study by the Federal Reserve Bank of Cleveland. The study focuses on the impact of the opioid crisis on the labor market in the fourth Federal Reserve district, which includes parts of all four states.

In Ohio, the hardest hit counties are in the southwest and northeast. Eastern Kentucky, western West Virginia, and western Pennsylvania all have high rates of overdose deaths. The time trends in overdose deaths in Ohio match those in the United States. Heroin deaths have increased continuously in Ohio since 2010, and fentanyl deaths have increased dramatically since 2013. Total overdose deaths from any opioid are occurring at a much higher rate in Fourth District states than the US rate (figure 13).

Figure 19. Opioid Overdose Deaths in Fourth District States

Source: Ohio Department of Health via the Federal Reserve Bank of Cleveland

Health experts like the Stanford professor Keith Humphreys told Business Insider that tackling the broad opioid issue will require responding to socioeconomic problems like poverty, a lack of economic opportunity, and a lack of health insurance make people more likely to fall into addictive behavior. Thus, the chicken and the egg metaphor apply. Economic development of the quad-state region provides jobs; however, to qualify for these jobs, workers must pass strict drug tests and remain subject to random drug testing.
6. INFRASTRUCTURE REQUIREMENTS

6.1. Appalachian Natural Gas Liquids Storage Hub

A Hub is a location at which large quantities of products are bought and sold, relative to other points within a geographic region. A hub creates a common point for commercial trading contracts to settle, with or without physical delivery; provides price signals for geographical regions by aggregating a group of participants; and reduces transaction risk related to a single buyer or seller.

“The Appalachian Storage Hub is necessary to maximize the potential of the raw materials present in the Marcellus, Utica and Rogersville Shales,” MATRIC Chief Executive Steve Hedrick said. MATRIC is the Mid-Atlantic Technology, Research & Innovation Center in South Charleston, West Virginia that has been nationally vocal on the infrastructure improvements required for the Appalachian Storage Hub. “Further, infrastructure beyond the storage facility itself will include significant pipeline infrastructure to support the distribution of key raw materials and intermediates, including but not limited to methane, ethane, ethylene, propane, propylene and chlorine. All are building blocks for further manufacturing opportunities that may be realized in the Ohio River and Kanawha River Valleys.”

![Appalachian Storage Hub](image)

Figure 20. Appalachian Storage Hub

The Hub would handle some 100 million barrels of natural gas liquids (NGLs) and liquid chemicals, and include about 3,000 miles of underground pipelines to move the chemicals to industries along a 454-mile corridor in the four states.

The cost of the Hub would be around $10 billion according to TopLine Analytics.
6.1.1. Legislation

ACC says that while private industry can develop the Hub, Congress and the Administration are needed to reduce uncertainty around financing by affirming that the Hub is eligible for existing private-public financing programs; make infrastructure modernization legislation a priority; and ensure a timely and efficient regulatory permitting process.

U.S. Senators Shelley Moore Capito (R-W.Va.), Rob Portman (R-Ohio), and Joe Manchin (D-W.Va.) have introduced bipartisan legislation to assess the feasibility and potential benefits of establishing an ethane storage and distribution hub in central Appalachia. The Appalachian Ethane Storage Hub Study Act of 2017 (S. 1075) will help inform efforts to maximize America’s domestic energy and manufacturing potential. In the House, Rep. David McKinley (R-W.Va.) introduced a companion bill that is co-sponsored by Reps. Evan Jenkins (R-W.Va.), Alex Mooney (R-W.Va.), Tim Murphy (R-Pa.), and Bill Johnson (R-Ohio).

Other key legislation recently introduced includes:

- **Capitalizing American Storage Potential (CASP) Act (S. 1337)** sponsored by Senators Capito and Manchin to make a regional storage hub eligible for the U.S. Department of Energy’s successful Title XVII loan guarantee program.
- **Appalachian Energy and Manufacturing Infrastructure Revitalization Act (S. 1340)** sponsored by Senator Capito to streamline the federal permitting process for an Appalachian energy hub, designating it as a “critical energy infrastructure” project eligible for expedited federal permitting.

6.1.2. The NGL Storage Hub Project

Energy Storage Ventures LLC (ESV) is in early project development for creation of bulk NGL storage in new caverns to be developed in the Salina bedded salt formation. The Salina formation has been used for liquids storage in other parts of the country (e.g., Bath and Seneca New York, Maryville, MI). The area is area is a fairly homogenous, relatively thin layer of salt located ~ 6300’ to 6700 feet below the surface.

Brine disposal presents the greatest challenge to new NGL storage cavern development in the northeast and mid-Atlantic regions. Powhatan Salt Company, a wholly owned subsidiary of ESV, is responsible for developing, constructing and operating solution mining facilities; including drilling well; fresh water intake and injection equipment; and the withdrawal and transport of brine via a 10” pipeline as feedstock for a regional chemical plant.

Mountaineer NGL Storage, LLC, a wholly owned subsidiary of ESV recently acquired a 200-acre site with all mineral rights in Monroe County, Ohio. Mountaineer will construct a multi-cycle NGL storage system including a saltwater impoundment structure and a NGL load-in and load-out delivery system.

Mountaineer’s Phase I design is to develop four 500,000-barrel NGL storage caverns. NGLs, including butane, propane, and ethane will be stored in each of the solution-mined caverns created by Powhatan Salt in the Salina salt formation.

In 2016 ESV completed two phases to appropriately de-risk construction and operational concerns: a “Control Phase” and a “Technical and Commercial Validation Phase.” With preliminary design and engineering on most of the project completed, ESV has filed all state & local permits for both operation companies.
6.2. Natural Gas Pipelines

Five pipeline projects in the U.S. Northeast gained approval by the Federal Energy Regulatory Commission (FERC) in October, pushing the potential the Appalachian region holds for the plastics industry closer to reality.

Designed to increase the delivery capacity from the Northeast’s Utica and Marcellus shales, they are as follows:

1. Mountain Valley Pipeline: 2 billion cubic feet per day (Bcf/d), 303-mile pipeline from West Virginia to Virginia
2. Equitrans Expansion Project: about 8 miles in pipeline expansions, providing 0.6 Bcf/d from Pennsylvania to West Virginia
3. Supply Header Pipeline: a 1.5 Bcf/d, 38-mile pipeline from West Virginia to Pennsylvania
4. Atlantic Coast Pipeline: a 1.5 Bcf/d, 600-mile pipeline from West Virginia to North Carolina
5. Eastern Shore 2017 Expansion Project: 40 miles in pipeline expansions, providing 0.061 Bcf/d from Pennsylvania to Delaware

Figure 21. Selected natural gas Pipeline Projects Undergoing FERC Review  
Source: EIA

6.3. New NGL Pipelines

Earlier this year the Pennsylvania Department of Environmental Protection permitted Sunoco Logistics to construct a new underground 20-inch diameter, 350-mile Mariner East 2 Pipeline with an initial capacity of 275,000 b/d with the ability to expand to approximately 450,000 b/d to carry natural gas liquids such as propane, ethane and butane east from Ohio and West Virginia into Pennsylvania. Sunoco Logistics CEO Michael Hennigan confirms that a second 16-inch pipe will be built in the right of way. Construction of both lines is underway.

Markwest Energy Partners (MPLX), EQT and Williams are the largest NGL and natural gas midstream service providers in the northeast region, with gathering, processing and fractionation capacity.
6.4. Ethane Pipelines

As depicted in figures 15 and 16, new ethane pipelines are required to provide take-away capacity within and from the region.

Based on current utilization, MPLX can support the production of an additional ~60 MBPD of purity ethane with existing assets. The company sees an opportunity to invest $500 MM to $1 B to support Northeast ethane recovery over the next five years.
6.4.1. Shell Falcon Ethane Pipeline

Shell Pipeline will build, own and operate the Falcon Ethane Pipeline, the 97-mile, common carrier purity liquid ethane supply line that will feed its Pennsylvania Chemical Plant. Connections to three ethane supply points (Pennsylvania and Ohio) in the Marcellus and Utica Shale reservoirs.

Speaking at the Northeast U.S. Petrochemical Construction conference in Pittsburgh, Doug Scott, project manager for the Shell Pipeline, said that 455 landowners across Pennsylvania have been approached for land easements and rights of way. “We’ve had very good support from landowners,” he said. Because the pipeline is a private project being undertaken by Shell, the company could not utilize eminent domain to secure the necessary land.

Hiring about 1,000 workers across the region when construction starts in 2019. Shell plans to complete 100,000 b/d, two-leg pipeline, as depicted in figure 4 by 2020, about two years before the cracker comes online. Once complete, Scott said the Falcon Ethane Pipeline will be monitored 24 hours a day, seven days a week from a remote “state of the art” facility in Houston for leaks and for security purposes.

Shell maintains an unwavering focus on safety and community Relations throughout route selection process; pipe design; selection of safe construction contractors; road transport safety and intelligent integrity technology.
7. CRAFT PRODUCTIVITY DATA

Labor construction productivity values are used in resource planning, project control activity, and benchmarking with similar construction projects. The approach of evaluating "process/refinery/manufacturing" construction productivity is to compare various locations around the US to a known basis or benchmark of 1.00 or 100 for the Gulf Coast. Numerous final labor man-hour completion reports related to projects have been compiled over years to form the historical basis of U.S. Gulf Coast Productivity.

Open Shop / Non-Union labor is for the most part carried out in the U.S. south east region and other rural areas outside of major cities. Union work is performed primarily in major cities such as New York, Chicago, Philadelphia, Los Angeles and Pittsburgh, etc.

Union labor is typically 20% to 30% more expensive than Open Shop / Non-Union labor as it typically requires labor support, such as helpers and requires compliance with strict site procedures.

John G. McConville CCP, Operations Director at Compass International, cites a number of factors that impact productivity, such as: weather (extreme temperatures hot or cold; continuous rain or snow conditions); inadequate worker skill or lack of experience; unsuitable, inappropriate, or incorrectly sized construction equipment; lack of trained equipment operators; inadequate crew supervision; limited access to work areas caused by congested work areas, stairs, numerous floor levels and inadequate access roads; frequent work stoppages and re-starts as the result of contractual disputes between the contracting parties; and extended work week more than 40-50 hours.

Traveller are individuals / craftsman (typically the pipefitters, welders, electricians, and instrumentation installers) that live more than 50 miles from the construction site. They are paid a per diem to offset their daily living expenses; currently this per diem rate is between $80 and $140 ($10 to $17.50 per hour worked) for each day worked. Typically, between 25% and 50% of the skilled craftsmen i.e. pipefitters, welders, electricians, and instrumentation installers can be considered travellers and are paid this per diem.

The wage data in table 4 is sourced by McConnville.

Table 4 Average Union Wage Rates (Pennsylvania) 3rd Q 2017

<table>
<thead>
<tr>
<th>Abbreviations</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB/H = Fringe Benefits - Holidays</td>
</tr>
<tr>
<td>WCI = Workers Compensation Insurance Average</td>
</tr>
<tr>
<td>F&amp;S / FICA = Federal &amp; State Unemployment / FICA</td>
</tr>
<tr>
<td>ST&amp;C = Small Tools &amp; Consumables</td>
</tr>
<tr>
<td>SS = Safety Supplies</td>
</tr>
<tr>
<td>ST = Sub Total</td>
</tr>
<tr>
<td>HO &amp; S &amp; P = Home Office Support &amp; Profit</td>
</tr>
<tr>
<td>THR (W/O per Diem) * = Total Hourly Rate without per diem per Diem</td>
</tr>
</tbody>
</table>
# Trade / Skill  | Base Hourly Rate  | FB/HWP Average 4.25%  | WCI Average 16.50%  | F&S / FICA Average 15%  | ST&C $4.35  | SS 2.5%  | ST  | HOS & P 15%  | THR (W/O)** per diem |
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
1 Carpenter (Journeyman)  | 35.30  | 1.50  | 5.83  | 5.30  | 4.35  | 0.88  | 53.16  | 7.97  | 61.13 |
2 Mason / Bricklayer (Journeyman)  | 35.15  | 1.49  | 5.80  | 5.27  | 4.35  | 0.88  | 52.94  | 7.94  | 60.88 |
3 Concrete Finisher  | 26.83  | 1.14  | 4.43  | 4.02  | 4.35  | 0.67  | 41.44  | 6.22  | 47.65 |
4 Equipment Operator (Heavy Crawlers / Cranes)  | 35.76  | 1.52  | 5.90  | 5.36  | 4.35  | 0.89  | 53.79  | 8.07  | 61.85 |
5 Electrician (Journeyman)  | 39.35  | 1.67  | 6.49  | 5.90  | 4.35  | 0.98  | 58.75  | 8.81  | 67.56 |
6 Instrumentation Installer (Journeyman)  | 39.35  | 1.67  | 6.49  | 5.90  | 4.35  | 0.98  | 58.75  | 8.81  | 67.56 |
7 Insulator (Journeyman)  | 33.45  | 1.42  | 5.52  | 5.02  | 4.35  | 0.84  | 50.60  | 7.59  | 58.19 |
8 Ironworker (Journeyman)  | 35.80  | 1.52  | 5.91  | 5.37  | 4.35  | 0.89  | 53.84  | 8.08  | 61.91 |
9 Laborer  | 23.99  | 1.02  | 3.96  | 3.60  | 4.35  | 0.60  | 37.52  | 5.63  | 43.15 |
10 Millwright (Journeyman)  | 38.44  | 1.63  | 6.34  | 5.77  | 4.35  | 0.96  | 57.49  | 8.62  | 66.12 |
11 Oiler / Mechanic (Journeyman)  | 36.06  | 1.53  | 5.95  | 5.41  | 4.35  | 0.90  | 54.20  | 8.13  | 62.33 |
12 Pipefitter (Journeyman)  | 38.43  | 1.63  | 6.34  | 5.76  | 4.35  | 0.96  | 57.48  | 8.62  | 66.10 |
13 Painter  | 29.85  | 1.27  | 4.93  | 4.48  | 4.35  | 0.75  | 45.62  | 6.84  | 52.47 |
14 Refractory (Journeyman)  | 35.40  | 1.50  | 5.84  | 5.31  | 4.35  | 0.89  | 53.29  | 7.99  | 61.29 |
15 Rebar Installer  | 34.95  | 1.49  | 5.77  | 5.24  | 4.35  | 0.87  | 52.67  | 7.90  | 60.57 |
16 Scaffolder  | 29.48  | 1.25  | 4.86  | 4.42  | 4.35  | 0.74  | 45.10  | 6.77  | 51.87 |
17 Truck Driver / JLG Lift  | 26.94  | 1.15  | 4.45  | 4.04  | 4.35  | 0.67  | 41.60  | 6.24  | 47.84 |
18 Welder (Journeyman)  | 38.47  | 1.63  | 6.35  | 5.77  | 4.35  | 0.96  | 57.53  | 8.63  | 66.16 |
8. TO BE OR NOT TO BE

Perhaps Keith Burdette, West Virginia Secretary of Commerce, captured it best in his comments at the PCU June Conference this year: “We’re not trying to build a facility anymore. We’re trying to build an industry. And building an industry is a lot more complicated.”

The contributions of a fully developed Appalachian chemical and plastics products industry could be significant not only to the region, but also to the nation, extending well beyond its direct economic footprint.

While the region with its ample and reliable supply of ethane is primed for the emergence as a second major petrochemical manufacturing hub in the United States, it faces the challenges of rapidly developing a workforce, as well as storage and pipeline infrastructure to fuel such development.

Following the path of least resistance by relying on existing routes to export NGLs and ethane out region to the Gulf Coast and Canada would be “hearing the knock” and failing to open the door.

If opportunity doesn't knock, build a door.

Milton Berle