

IHS

Marcus Hook Industrial Complex Reuse Study: Update 2015, a Regional Analysis

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Consulting Study

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Executive Summary: Marcus Hook Industrial Complex Reuse Study: Update 2015, a Regional Analysis

Introduction and Context

The Marcus Hook Industrial Complex (MHIC) and abutting assets have emerged as symbols of economic promise and industrial revitalization made possible by the US energy renaissance. When IHS undertook its analysis of possible MHIC reuse options in 2012, the Borough of Marcus Hook, and the economy of Delaware County (the County), was facing a crisis as Sunoco had recently announced its intentions to close its Marcus Hook refinery, which would eliminate 500 well-paying jobs at the refinery, and many more related positions in the County. A little over three years later, MHIC has attracted hundreds of millions of dollars in new capital investment as options for reuse are becoming a reality. In response to the development interest at the MHIC, Sunoco Logistics (SXL) is making major enhancements to existing infrastructure at the site, which in turn is creating new opportunities for industrial development in the area. The ongoing investment and development in the MHIC and adjacent sections of the County's Delaware River shoreline today are fueling the revival of Greater Philadelphia as a dynamic energy hub.

How much has changed since the original MHIC reuse assessment in 2012? Fundamentally, the significant increase in natural gas liquids (NGLs) coming from the Marcellus and Utica shale regions – transported by Sunoco Logistics Mariner East pipeline – is rapidly expanding downstream opportunities, including improved viability for ethane cracking and derivatives operations. The low-cost, shale-gas feedstocks available to the US chemical industry has shifted global competitiveness, providing the US a competitive edge in chemical derivative markets that use natural gas and/or natural gas liquids (NGLs) as a feedstock. Furthermore, ongoing site improvements are enabling more efficient land-use at MHIC which increase the scale of reuse options that were limited (in capacity) in 2012 by the amount of usable space at the site.

While many of the MHIC reuse options remain the same as 2012 (see below), decision-making around these opportunities carries a greater degree of complexity than previously existed. Simply put, in 2012 MHIC faced a binary future for the site – survival or closure. In 2015, an influx of new infrastructure investment, increasingly supported by the rapidly growing flow of NGLs, means new development is a step closer to reality but requires deeper investigation of the options to

Changes since 2012 affecting future reuse of the MHIC include:

Energy

- Significant increase in the supplies of natural gas and NGLs being produced in the Marcellus and Utica Shale and higher future potential. The increase in future supplies of NGLs is substantially higher than IHS forecast in 2012.
- The large drop in the price of crude oil since the summer of 2014.
- The first phase of SXL's Mariner East pipeline project began operating in late 2014, delivering ethane and propane.

Logistic

- SXL started implementing its Mariner East pipeline projects that will significantly increase the supply of NGLs at the MHIC.
- The Eddystone Rail transfer facility began receiving Bakken crude oil by unit train in May 2014; the oil is transferred to barges and sent to Monroe Energy.
- The existence of a 4-hour window between midnight and 4 AM as the only time when rail service, including unit trains, can use the Conrail line that serves the Delaware County waterfront.
- The deepening of the Delaware River to 45'. The section offshore from the MHIC, including the turning basin, will be completed in 2017 enabling larger vessels, including lightered very large crude oil carriers (VLCCs) to call on the MHIC.
- The opening of a new marine terminal at the former BP oil refinery in Paulsboro NJ.

Site

- More land area, and enhanced site planning flexibility to accommodate new development at MHIC as old structures have been demolished.
- SXL has begun work on propane dehydrogenation (PDH) plant at the MHIC to supply propylene to the adjacent Braskem plant.
- Monroe Energy now operates the former ConocoPhillips Trainer refinery immediately north of MHIC, producing jet fuel for Delta.
- Increase in the capacity of the substation and electric distribution line serving the MHIC by PECO this will be able to meet the power demands of proposed development.
- The former Evraz Steel site, located adjacent to the MHIC's western boundary in Delaware, is being redeveloped; it is potentially a site for compatible industrial and waterfront development.
- Philadelphia Energy Solutions' (PES) refinery on the Schuylkill River began receiving unit trains carrying crude oil from the Bakken.
- The potential development of the Southport site at the east end of the Philadelphia Naval Yard. One possible concept is a mixed use plan with both a container port and energy uses.

evaluate the potential return on capital to investors and to maximize the future economic development benefits to the County and region.

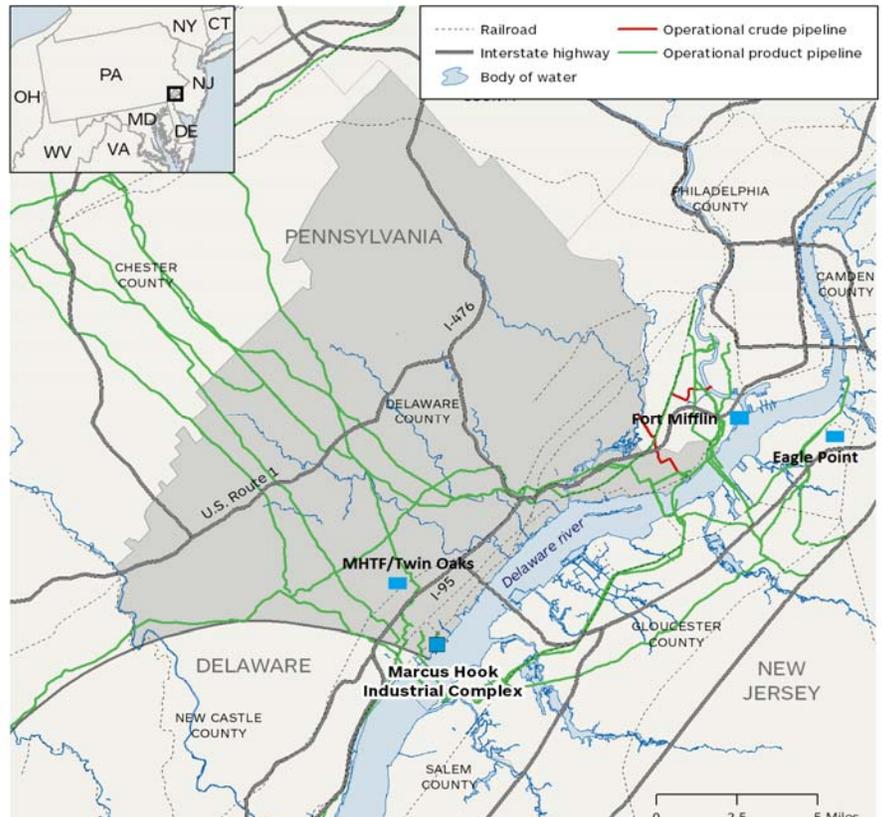
Building on the approach employed in the 2012 analysis, IHS has updated the study to re-assess the viability and requirements of re-use options. The analysis integrates evolving economic, energy and chemical market dynamics that shape the viability of each option. IHS employed experts from its Economics, Energy, Chemical and Transportation teams to update and characterize the re-use potential of various options as well as the advantages and challenges of the MHIC site and surrounding assets and attributes.

The Marcus Hook Industrial Complex

The MHIC is located in the southeastern corner of the Delaware County in the Borough of Marcus Hook and Lower Chichester Township on the Delaware River, as shown in the accompanying regional map. The 780-acre MHIC site is located about 20 miles southwest of center city Philadelphia and about 90 miles up the Delaware River from the Atlantic Ocean. The core of the site, located south of Market Street (US Route 13) is 550 acres, with the remaining 230 acres located north of Market Street. The MHIC has excellent transportation accessibility as it is on the river, is served by rail, located only a few miles from an interchange on I-95, and is close to operating oil and natural gas pipelines. The natural gas pipeline system is capable of moving condensates. The main channel of the Delaware River in front of the MHIC, including the vessel turning basin, will be deepened to 45' by 2017.

SXL operates several other facilities in the region that would support future reuses at the MHIC and elsewhere along the Delaware River:

- **The Marcus Hook Tank Farm (MHTF)** or #2 tank farm that is located several miles north of the MHIC on US Route 322 and is connected to it by a refined products pipeline. The MHTF has the capacity to store about 1 million barrels of refined products. Adjacent to the MHTF is the Twin Oaks truck terminal where outbound truck shipments of refined product originate.
- **Eagle Point**, a former refinery located in Gloucester County NJ across from the Philadelphia International Airport (PHL). It occupies more than 300 acres and has 5 million barrels of storage capacity, three deep water docks, truck racks, and rail for crude unit trains. Eagle Point is not currently connected to the MHIC by pipeline, but it is connected to Philadelphia Energy Solution's (PES) Schuylkill Refinery via pipeline. Eagle Point is indirectly connected to the MHIC and Monroe Energy via the Harbor pipeline which delivers refined products to users located throughout New Jersey as far north as New York Harbor.
- **Fort Mifflin storage terminal** located on the west shore of Delaware River just south of the mouth of the Schuylkill River and immediately adjacent to Philadelphia International Airport (PHL). It is located in Tinicum Township with a portion of the storage in Darby Township. The Fort Mifflin complex includes the immediately adjacent Hog Island Wharf that fronts on the Schuylkill River, the Darby Creek Tank Farm, and connecting pipelines. The Fort Mifflin



facility has 300,000 barrels of storage capacity and has two deep water berths capable of handling very large crude carriers (VLCC's) vessels that have been lightered to 40'. Fort Mifflin is the primary way that PES's Schuylkill refinery receives crude oil by water. The Darby Creek Tank Farm is a primary crude oil storage terminal for the PES refinery which operates it under a joint venture with SXL. This facility has a total storage capacity of approximately 3 million barrels. Darby Creek receives crude oil from the Fort Mifflin Terminal and Hog Island Wharf via pipeline.

The proximity of the MHIC to related facilities such as Braskem, Philadelphia Energy Solution's (PES) Schuylkill River Refinery, Monroe Energy, the Eddystone Rail barge transfer facility, and the two PBF refineries as shown in the accompanying map, and the connections between them, must be considered when evaluating reuses at the MHIC. The adjacent facilities would be able to support activities located within MHIC, potentially decreasing the amount land required at the MHIC.

2012 Reuse Recommendations

In 2012, IHS identified the potential reuses for the MHIC described in the table below by market viability; the accompanying text is from the 2012 report. At that time, we assigned the potentially feasible uses to one of three levels of market viability: high, medium, and low. As will be explained in our recommendations, two of the 2012 reuses with high market viability – a propane dehydrogenation (PDH) plant and natural gas liquids (NGLs) processing - are currently being developed at the MHIC.

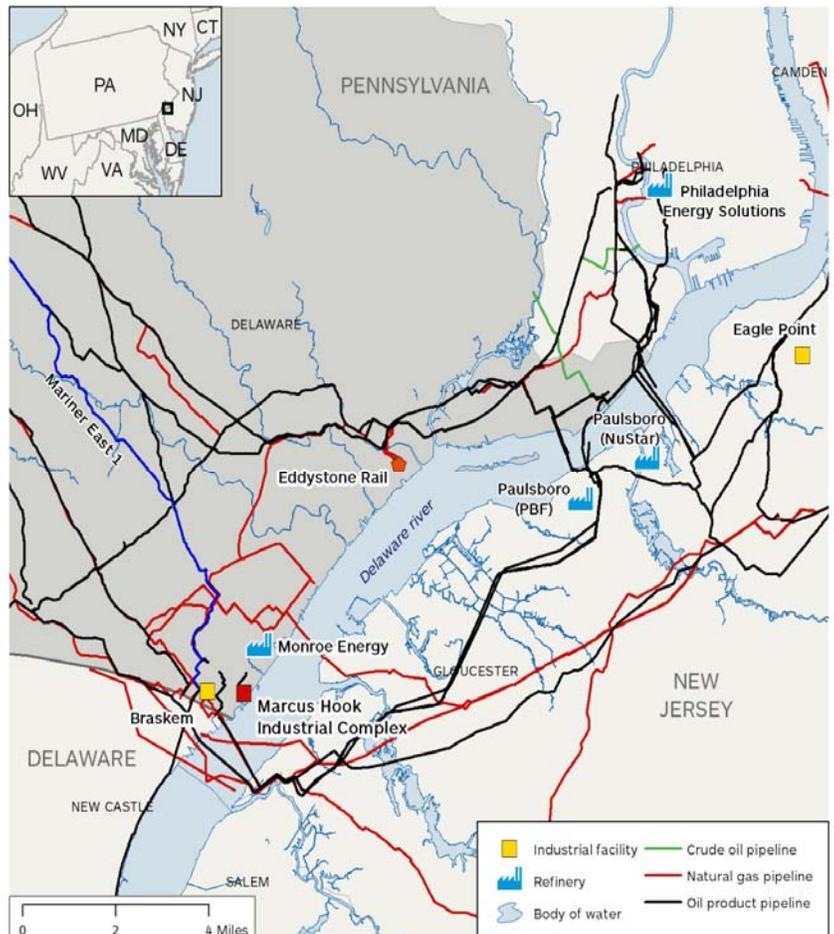
We continue to recommend an ethane cracker, assigned a medium market viability in 2012. The probable scale of these three uses is considerably larger than we envisioned in 2012 due to higher than anticipated growth in the volume of NGLs being produced in the Marcellus shale formation. The large increase in the volume of NGLs that will flow to MHIC via the Mariner East pipeline projects also increases the potential for exports of natural gas liquids.

Advantages and Disadvantages of the MHIC Site – Revised for 2015

The current advantages and disadvantages of the MHIC site are presented below; they have been revised as appropriate from our 2012 study.

Advantages

- High capacity of on-site infrastructure can accommodate most re-use options. Sufficient capacity of public utilities (e.g., water, wastewater, electric power) to accommodate increases in demand from reuses.
- Increase in the amount of developable acreage within the MHIC as old structures have been demolished.
- Multiple berthing locations in the dock. Once the Delaware River and the turning basin off the MHIC are deepened to 45 feet by 2017, the MHIC will be able to accommodate Very Large Crude Carriers (VLCCs) that have been lightered to 45' and Very Large Gas Carriers (VLGCs).



2012 Reuse Recommendations

High Market Viability



- **Natural Gas Liquids (NGLs) Processing Facility** – Rapidly expanding production of wet natural gas and associated liquefied petroleum gases will require significant infrastructure investment in the future to bring this production to market. From a review of current East Coast NGLs export terminals, Marcus Hook is already advantaged – it has more natural storage capacity than many current East Coast NGLs export terminals. The construction of an NGL fractionation facility combined with existing marine infrastructure at Marcus Hook positions the facility to export NGLs, or pure components, and alleviate a projected regional market surplus of ethane, butane, and natural gasoline.
- **Propane Dehydrogenation** – This reuse option is especially attractive since there is currently a shortfall in local propylene supply due to the shut-down of refinery operations at Marcus Hook. In addition, the propylene produced by this reuse already has demand from Braskem’s existing polypropylene operations at the complex.
- **Refined Petroleum Products Terminal** – There is an expected long-term imbalance in market supply and demand for petroleum products in the Philadelphia/Southern NJ/Inland PA regions. Marcus Hook has sufficient base infrastructure, large LPG storage capacity, and existing logistical connections to keep these markets well supplied with petroleum products.

Medium Market Viability



- **Natural Gas Power Generation** – The Marcus Hook complex is located in the mid-Atlantic region whose power demand is expected to grow approximately 1.7% annually. While this market is not projected to require additional generating capacity until 2016, the facility could transition to a power generating facility to be used for local consumption or possibly for export. One mitigating factor is the rate at which current coal-burning plants, which currently constitute 41% of power supply in the region, will phase out due to environmental considerations.
- **Ethane Cracker and Derivatives** – An ethane cracker at Marcus Hook has high market potential due to expected increased market demand for polyethylene resins. Moreover, the location provides logistical advantages compared to other facilities primarily located on Gulf Coast. However, these advantages are offset by high capital costs for start-up and the amount of available space at the facility . More research into space availability for such a reuse needs to be conducted to adequately assess the market potential of this reuse option.

Low Market Viability



- **Liquefied Natural Gas (LNG) Export Terminal** – Worldwide demand for LNG is expected to grow and natural gas local supply will increase from emerging shale gas plays, making the development of LNG liquefaction facility in Marcus Hook very promising. However, there are still a number of factors which may limit viability of this reuse option, including the current number of projects in planning, high capital cost requirements, access to sufficient gas reserves, and Delaware River deepwater port access.
- **Gas to Liquids Production and Storage** – While the GTL market continues to grow, a gas-to-liquids processing plant at Marcus Hook was one of the least viable reuse options because of technological risks and this option’s high natural gas demand requirement which may not be supportable with existing regional production forecasts.

- The completion of Mariner East 1 pipeline has the capacity to deliver 70,000 barrels per day of ethane and propane from the Marcellus; the next phases involving two new pipelines will increase the supply of NGLs available at MHIC to a total of 750,000 bpd.

- Large onsite storage capacity with good logistics connections to the existing SXL distribution network.
- The MHIC is significantly closer to European, South American, and Southern and East Asian markets for NGLs than are the major exports terminals located along the US Gulf Coast (combined pipeline and marine distances).
- Can accommodate a wide variety of logistics options for loading/unloading.
- Two natural gas-fired electric generating plants, operated by NextEra, are located at the MHIC. The larger 750-megawatt combined cycle plant is an intermediate load facility that can provide up to 1 million pounds of steam per hour to MHIC. The smaller 50-megawatt combustion turbine sends all its steam to the MHIC.
- Properly zoned, no rezoning or variances required for reuses.

Disadvantages

- No access, other than by rail, to discounted midcontinent crude oil.
- The 4-hour window that limits when unit trains can deliver commodities to industrial facilities along the County's Delaware River waterfront; the capacity of the nearby Stony Creek rail yard is maxed out.
- Residential uses are located immediately adjacent to the eastern and the northeaster boundaries of the site. By contrast, compatible industrial land uses are located immediately adjacent to the northwest and the entire southwest boundaries.
- Environmental exposure consistent with an oil processing facility of similar age and condition.
- Competing pipelines could reduce Marcellus/Utica NGLs flows to Delaware County by moving products to the US gulf coast to make higher value petrochemical products for exports.

Local Economy, Land Use, and Transportation Findings

Advantages

- A healthy, diverse local economy with a total 225,400 jobs in 2015. Delaware County's economy fared better than the Greater Philadelphia Region during the Great Recession, and it grew at a slightly higher pace from 2007 to 2014. In June 2015 Delaware County's unemployment rate of 4.7% was lower than in the Philadelphia MSA, PA, NJ and the US.
- An evolving economic structure from goods production to service provision. Highest annual employment growth rates in County from 2000 and 2015 were in: Management of Companies – 3.6%; Transportation & Warehousing - 2.6%; Arts, Entertainment & Recreation – 1.8%; and Finance & Insurance – also 1.8%.
- Similar industrial facilities are present along most of the County's Delaware River shoreline. Eddystone Rail Corporation completed a transshipment facility in May 2015 that currently sends Bakken crude oil to the Monroe Energy refinery in Trainer. The adjacent industrial facilities could potentially support and/or benefit the reuses at the MHIC.
- The proximity of the MHIC to the other energy, chemical, and industrial facilities along the Delaware River from Trenton south to lower Delaware Bay such Philadelphia Energy Solution's Philadelphia Refinery, Braskem's polypropylene facility, Honeywell's Frankford chemical facility, the PBF refineries in Paulsboro (NJ) and Delaware City (DE); and potential future energy uses at the Southport complex located at the eastern end of the Philadelphia Navy Yard.
- MHIC is uniquely position to take advantage of shale-based natural gas and natural gas liquids from the Marcellus and Utica plays. . As one of the few facilities of its type in northeastern United States, MHIC is positioned to process and

distribute hydrocarbons and chemical derivatives competitively to the underserved northeastern market and global markets.

- Mariner East 1 and 2 pipelines: Provides capacity for NGLs from Marcellus and Utica Shales. Mariner East 1 began operating in December 2014, with current capacity of 70,000 barrels per day of ethane and propane. Mariner 2 will increase the capacity to move Marcellus/Utica NGLs by as much as 680,000 barrels per day.
- Once the Delaware River and the turning basin off the MHIC are deepened to 45 feet by 2017, the MHIC will be able to accommodate larger vessels, shipping to and from global points, which enhances export options for chemical derivatives in the short term, and oil & gas in the longer term.

Challenges and Uncertainties

- Nationally, the manufacturing section struggled during the Great Recession, and Delaware County's experience was no different. However, since the trough of the recession and the closing of two refineries, it has begun to recovery some of the lost manufacturing jobs.
- Ensuring a sufficient supply of resident workers with the skills, training and education to support reuse activities at the MHIC could present a challenge.
- Rail access with capacity limitations: a four hour window currently exists for during which unit trains can travel to and from industrial customers located along the County's Delaware River shoreline such as Eddystone Rail, Braskem, etc. This window, coupled with local build-out constraints for additional rail lines, and the current capacity at the Stony Brook rail storage facility near the MHIC, limits the amount of crude oil and feedstocks which can be delivered via unit trains. These constraints, if they remain, could limit petrochemical development that is dependent on rail. All other types of trains can service the MHIC, Braskem, and Honeywell at any time.
- I-95 corridor: This major interstate connector has the capacity to accommodate additional truck traffic and deliver new freight to markets, but congestion and road maintenance require route management.

Delaware County's total and private sector employment rose by 4.1% and 5.3% between 2007 and 2015, both the highest increases among the five counties of Southeast Pennsylvania.

Energy and Chemicals Findings

Advantages

- Since 2012, SXL added the Mariner East pipeline system which provides more than sufficient natural gas liquids capacity for the currently planned large-scale reuse options.
- The reuse for MHIC will only be limited by the available space at the site and the inbound supply capacity. If all of the proposed Mariner 2 capacity is built, supply will not be a physical limitation for MHIC development.
- If the proposed Mariner additions are built as planned, the raw materials could be available for substantial petrochemical production and NGLs export developments. The increase in NGLs supply in western Pennsylvania, along with the proposed pipelines to deliver some of the production to the MHIC, are two key ingredients for creating and integrated refinery petrochemical operations in the Philadelphia market, the center of which would be the MHIC.
- A potential regional benefit of reuses at MHIC is refinery integration. The major benefits of the chemicals complex there to the refiners would be: 1) creating a market for refinery-produced petrochemical feedstocks, such as aromatics; and 2) a source of hydrogen from propane dehydrogenation and ethane cracking, which can be used to produce cleaner transportation fuels.

- MHIC is an excellent site for using ethane and propane from shale gas for downstream products such as ethylene, polyethylene, and possibly propylene, as well as producing refined products for the domestic and export markets. The use of Marcellus shale natural gas at the MHIC could enable the creation of a regional petrochemical complex.
- A propane dehydrogenation (PDH) plant at the MHIC will enable the continued operation of Braskem's polypropylene plant by ensuring adequate supply of propylene.
- The proposed purchase by Energy Transfer Corporation, SXL's parent, of Williams, a large natural gas pipeline company. The purchase would include the Transco natural gas pipeline system assets which deliver large volumes of natural gas to the Middle Atlantic and Northeastern States. A major Transco interstate natural gas transmission line passes through southeast Pennsylvania, and southern New Jersey along the I-95 corridor.

Challenges and Uncertainties

- The outlook for natural gas and refined products options remain unchanged or are less attractive today than in the 2012 study.
- The ability of SXL to obtain the required permits in a timely manner so that the future phases of the Mariner East pipeline and MHIC projects could represent a potential challenge.
- LNG exports from MHIC will depend on the supply of competitively priced natural gas. However, since land availability at MHIC could be limited and the NGLs pipeline capacity is being expanded, which will support the development of petrochemicals and liquids fractionation, an LNG export terminal may not be the highest value use for the available land.
- The sharp decline in world oil prices in late 2014 and early 2015 narrowed the price difference between oil and natural gas so that current prices are too low to cover the cost of converting natural gas into petroleum products. A gas to liquids (GTL) facility at MHIC would have to compete with other local uses for natural gas, both current and potential. Since the Philadelphia refiners are already exporters of distillate fuels to the international market, the demand for increased diesel supply from a GTL will be minimal.
- The Mariner system is competing with planned pipelines to move Marcellus/Utica NGLs to the petrochemical complexes in the US gulf coast market.

Proposed 2015 Reuse Options at the MHIC

IHS revised recommendations for the most economically viable and technically feasible reuses at the MHIC are summarized below. The recommendations consist of chemical development based on ethane and propane feedstocks to be supplied by the Marcellus Shale. Our proposed reuses are presented based on their current 2015 market viabilities.

Propane Dehydrogenation Plant

IHS' first recommendation is for the construction of a propane dehydrogenation (PDH) plant to make propylene for Braskem's existing polypropylene plant at the Marcus Hook site, using shale-based propane from Marcellus shale. Propylene supply limitations have constrained regional demand growth, driving propylene prices up. IHS forecasts that polypropylene demand growth is expected to average 4.9% over the next 5 years. The current market viability of a PDH at the MHIC is high, the same as in 2012 study. IHS estimates that a proposed PDH plant could have an annual capacity of up to 400,000 metric tonnes if most of its output is sent to the adjacent Braskem polypropylene plant. If SXL is able to find other customers for the propylene, the capacity of the PDH facility could be substantially higher. The existing space and facilities at the MHIC would be able to accommodate a larger PDH plant. The PDH reuse option is compact and would occupy a relatively small area, but is also a highly feasible and potentially profitable one which will have the benefits of:

- Facilitating the continued operation of Braskem's polypropylene plant by ensuring an adequate propylene feedstock..

- Possible integration into the existing propylene processing operations currently being done at MHIC involving processing refinery-grade materials being supplied by other regional refineries to serve the existing propylene splitters operated by Braskem.
- Provides 75,000 metric tonnes of propylene to also produce cumene, which in turn is used by the Honeywell plant in Philadelphia to make phenol. Cumene is in short supply in the Philadelphia region. Due to the smaller scale of this project, compared to an ethane cracker, IHS concludes that it can be implemented, along with other energy reuse options in a mixed-use option strategy.

Large Scale Ethane Cracker

IHS second recommendation is for the construction of a world-scale ethane steam cracker to produce ethylene, with associated downstream use of the ethylene in polyethylene production. The recommended plant would have the capacity to produce 1 million metric tons of ethylene annually for use at a world-scale polyethylene facility. Since an ethylene project needs to have downstream uses located in close proximity, preferably accessible by pipeline, the potential downstream PE derivative plants that could be supported by the existence of a cracker are:

- Low-density polyethylene (LDPE),
- High-density polyethylene, and
- Linear low-density polyethylene (LLDPE).

Ethylene can also be used for a number of different downstream PE variations depending on specific market requirements.

Our recommendation is based on:

- A strong market fundamentals outlook for the polyethylene products
- Advantaged ethane feedstock, and
- Advantaged market access to Northeast US plastics converters.

The ethane steam cracker and polyethylene production option represents a significant investment and requires a significant portion of the available site plot plan. Typically polyethylene plants require a large area for a rail siding to handle the large number of grades of polyethylene products and associated logistics for inventory management. This reuse option may limit a mixed-use reuse strategy at the MHIC because of the large amount of land it would require. An ethane cracker could also create opportunities for refineries in the area to buy and sell intermediate products into the petrochemical operations.

Lower natural gas prices relative to crude oil have improved the relative cash cost position of most ethylene producers in North America using NGLs as feedstocks. Competitors to the North American ethylene markets use naphtha (crude-oil derived) as feedstock, while North American natural gas feedstocks are significantly more cost-competitive. Shale gas-based ethane will stay significantly cost-advantaged versus other feedstocks. A polyethylene producer in the North East US would have a freight advantage to highly concentrated markets by being very competitive on a delivered cost basis into US markets, especially those in the North East US.

Comparison of the Current and 2012 Reuses

The accompanying table presents a comparison between the reuses presented in the current study and in our 2012 study. The market viabilities of several of the uses presented in 2012 with high market viability have remained the same, or have increased due to changes in the global and national energy and chemical markets that have occurred since then. This is especially true because of the decline in the global crude oil price and the rising levels of natural gas production and NGLs coming from the Marcellus and Utica formations.

The proposed PDH plant’s capital costs are estimated at \$1 to \$2 billion, while its level of permanent employment, including contract workers, would range between 80 and 125 workers. A major benefit of a PDH plant at the MHIC is that some of the supply of propylene would go to the adjacent Braskem plant to produce polypropylene, providing a significant logistical advantage to both parties. By contrast, the world-scale ethane cracker would have an estimated capital cost of \$4 to \$7 billion, which would generate substantial temporary increases in economic activity in Delaware County and the Greater Philadelphia during its construction. An ethane cracker’s direct employment, once it begins full operations, would be between 250 and 350 workers, about three times greater than for the PDH plant. The ethane cracker’s operation would generate substantial increases in economic activity through the indirect economic multiplier effect. More important, as noted above and in our full report, the presence of operating ethane cracker would be a necessary component to the long-term development of an integrated petrochemical production complex along the Delaware River, both within and outside of Delaware County.

The current market viability of a Natural Gas Liquids fractionation plant is high. The scope and characteristics of the NLG processing activities, and the required equipment, will depend on the volume and composition of the NGLs received, and the value of individual NGLs products in the local and export markets. IHS recommends that an NGL fractionation facility be constructed at the MHIC to maximize the economic development benefits of the Mariner East project. This use was determined in our 2012 study to have high market viability - if sufficient infrastructure would be constructed to bring NGLs to MHIC was developed. With the Mariner East pipelines providing the needed infrastructure, IHS continues to support this option, which was further confirmed by Energy Transfer Partners’ (ETP) announcement in June 2015 that is plans to build an NGLs fractionation facility at the MHIC.

MHIC Reuse Options Comparisons						
Reuse Options	Market Viability		Employment Ranges		Capital Investment	Comment
	2015	2012	FTE	Contract Workers		
Propane Dehydrogenation (PDH)	High	High	50-75	30-50	\$1 billion to \$2 billion	Uses propane from Marcellus shale shipped to MHIC via the Mariner East pipelines. Provides reliability to and enables expansion of Braskem's polypropylene plant.
Natural Gas Liquids (NGL) Processing Facility	High	High	75-100	75-100	\$300 million to \$400 million	An NGL facility would support potential development of three types of polyethylene derivative plants, and increase exports of NGLs. Energy Transfer Partners (ETP) has recently (summer 2015) announced plans to build a NGLs fractionation plant at the MHIC that would go into operation by 2017q2.
NGLs Terminal	High	High	75-125	250-300	\$400 million to \$800 million	Marcellus NGLs exported from MHIC is closer to the European, Southern Atlantic and SE Asian than the USGC. SXL has completed building a NGLs terminal at the MHIC.
Ethane Cracker and Derivatives	Medium	Medium	150-200	100-150	\$4 billion to \$7 billion	The cracker would produce 1 million metric tonnes of ethylene annually, which supports development of 3 types of world-scale polyethylene plants -LDPE, HDPE, or LLDPE. Potentially competing facilities are being considered in PA and adjacent states.
Natural Gas Power Generation	Medium	Medium	45-55	25-50	\$650 million to \$750 million	Electric power is produced at the MHIC by NextEra's two natural-gas fired power plants that also cogenerate steam used at the site.
Refined Petroleum Products Terminal	Low	High	75-125	250-300	\$100 million to \$200 million	Can be integrated with ethane cracker and PDH plant, but would have several competitors in the area
Liquefied Natural Gas (LNG) Export Terminal	Low	Low	150-200	150-200	\$2 billion to \$2.5 billion	Other sites are ahead of MHIC in planning and seeking permits for such facilities
Gas to Liquids Production and Storage	Low	Low	290-340	250-300	\$4 billion to \$6 billion	Similar in size and workforce to the former Marcus Hook Petroleum refinery.

The current viability of NGLs export related facilities is also high and is synergistic with some of the existing assets at MHIC. Marcellus/Utica NGLs exports via MHIC are geographically closer to Europe, the Southern Atlantic and SE Asian markets than the US gulf coast export facilities.

Total employment figures for the recommended reuses include both FTE operating personnel and contract workers. The sum of reuse employment and current levels of employment at the MHIC could result in total employment at the site that will approach the level that existed when the refinery was operating at full capacity. The fully-developed MHIC will have employment that is distributed across different types of activities, improving resiliency to changes in market conditions compared to when refining was the dominant activity there. Finally, MHIC's likely role as the central component in a world-class petrochemical complex along the Delaware River, including potential marine and rail transport activities, will enable the creation of a large number of additional direct jobs throughout the Greater Philadelphia Region, with the bulk of the direct jobs likely located in or close to Delaware County.

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