Health Impact Assessment of the Shell Chemical Appalachia Petrochemical Complex

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Glossary and Acronyms

Glossary terms have been bolded the first time they appear in the document

Acid Gas Removal – A process that removes hydrogen sulfide, carbon dioxide, and organic sulfur compounds in order to sweeten (reduce the sulfur content of) a gas.

Attainment Area – A geographic area where the measured concentrations of the criteria pollutants are within the National Ambient Air Quality Standards (NAAQS).

Best Available Control Technology (BACT) – An emission limitation which is based on the maximum degree of control that can be achieved. It is a case-by-case decision that considers energy, environment, and economic impact. BACT can be add-on control equipment or modification of the production processes or methods.

Carbon Monoxide (CO) – A poisonous, odorless gas that reduces oxygen in the body. CO is released due to incomplete combustion.

Cardiovascular Disease (CVD) – Also known as heart disease, refers to any disease that affects the heart and blood vessels, blood vessels of the brain and kidney, or obstruction of vessels in the periphery.

Cogeneration – Also known as combined heat and power (CHP) is the use of recovered excess heat from a power generation process that can be used to heat surrounding areas or power other processes.

Continuous Emissions Monitoring System (CEMS) – Equipment which continuously measures the emission rates or concentration of pollutants.

Cardio Obstructive Pulmonary Disease (COPD) – One of the most common lung diseases that makes it difficult to breathe. This is a general term used to describe progressive lung diseases including emphysema, and chronic bronchitis.

Cracker – A series of pipes, furnaces, air compressors, tanks, and towers used to split up fossil fuels into various components meeting different industrial needs. Cracking refers specifically to the breakdown of more complex, longer chain, hydrocarbons into less complex, smaller chain, hydrocarbons.

Cryogenic Separation – A process that cools a mixture of gases in order to remove an undesired gas with a higher liquefaction point or freezing point from the mixture.

Cumulative Risk – The health and environmental risk due to the combined effects and interactions of pollution exposures from multiple sources.

Decoking – A cleaning process involving air and steam to remove unwanted by-products (e.g. tar) from the inside of metal tubes.

Differential Absorption Light Detection and Ranging (DIAL) – A laser based method of gas sensing. DIAL measures light backscattered from laser pulses that bounce off of gas plumes. It is used to remotely measure, locate, map, and quantify fugitive emissions from a facility's operation.

Downstream – The use or additional processing of the raw materials produced by the cracker.

Emission Reduction Credits (ERCs) – A surplus emission reduction which can be used to offset emission increases.

Ethane (C_2H_6) – A component of natural gas. Ethan will be fed into the Shell cracker to form ethylene and polyethylene.

Ethylene (C_2H_4) – The major gaseous product of the ethane cracker which is used to produce plastics after processing into polyethylene at the polyethylene.

Equivalent Carbon Dioxide (CO_2e) – The amount of carbon dioxide that would produce a similar greenhouse gas effect as a different amount of a different chemical.

Excess Emissions – Any emissions in excess of what is permitted other than fugitive emissions. Typically occurs during startup, shutdown, or when process or pollution control equipment malfunctions or breaks down.

Feedstock – The source of raw materials used to manufacture other products.

Flaring – The burning of gas and chemical by-products in order to prevent disruptions in operations, relieve pressure within the system, and adjust product quality. Elevated flares are located above the facility and are designed burn larger volumes of gas than ground flares. Ground flares are located at ground level and can either be enclosed or open. Flares can operate and high or low pressure, depending on the pressure of the gas in the system that is being released to the flaring system and burned.

Fracking – The process of injecting large amounts of water, chemicals, and sand under high pressure into a gas well to release trapped gas. It is also known as hydraulic fracturing or hydrofracking.

Fractionation – The process of separating of one material or chemical from another using a property of that chemical or material. Usually in the petroleum and natural gas industry liquids and gases are separated by boiling point (a process known as fractional distillation).

Fugitive Emissions – Air pollution emissions due to process equipment leaks that can not reasonably pass through a stack, chimney, or vent.

Hazardous Air Pollutants (HAPs) – Also called air toxics are those pollutants known or suspected of causing cancer, other serious health problems, or adverse environmental effects.

Health Impact Assessment (HIA) – A tool and process to assess the social, environmental, and human health impacts of proposed projects or policies.

Heat Recovery Steam Generator (HRSG) – A machine or process which recovers waste heat for cogeneration.

High Density Polyethylene (HDPE) – A type of polyethylene used to make harder plastics, which can be used to manufacture harder plastic materials such as fuel tanks, hard hats, or piping.

Hydrocarbons – An organic compound made of only hydrogen and carbon.

Hydrogenation – The addition of hydrogen atoms to a compound, usually an organic compound.

Infrared Monitoring – A method of detecting leaks and emissions not normally visible to the human eye using infrared cameras to detect the thermal radiation of emissions and visually represent it. Gases from plant operations will emit a different heat signature than ambient air. Cameras can be tuned to this heat signature, allowing for leaks to stand out on camera.

Low Linear Density Polyethylene (LLDPE) – A type of polyethylene used for softer plastics, which can be used to manufacture thinner plastic materials such as bags and stretch wrapping

Low NO_X Burners (LNB) – A form of emissions control. Low NO_X burners provide combustion that is stable and multi-zoned (different stable flame sections that serve different purposes), allowing for more complete combustion of fuel and lower NO_X emissions.

Lowest Achievable Emission Rates (LAER) – The most stringent emission limitation achieved in practice by a given source category.

Marcellus Shale – An underground rock-bed formation containing large amounts of natural gas beneath West Virginia, Pennsylvania, Ohio, and New York.

Methane (CH_4) – An invisible, combustible gas which is the main component of natural gas. Methane is a potent greenhouse gas.

Metropolitan Planning Organization (MPO) – A federally mandated planning organization in an urban area with more than 50,000 people that is designated by the state to plan for the transportation needs of that area. The MPO develops long-range transportation plans and short-term transportation improvement programs.

Metropolitan Statistical Areas (MSAs) – A geographical area with one or more adjacent counties that have at least one urban core area of at least 50,000 population, and adjacent areas that has a high degree of social and economic integration with the core as measured by commuting ties.

Modeling – Air modeling is a way to mathematically simulate atmospheric conditions and behavior. It is usually performed using computer programs. For example, air pollution modeling can help estimate how much of a specific air pollutant will be present at different distances from the source.

National Ambient Air Quality Standards (NAAQS) – EPA established national standards for air pollutants considered harmful to public health and the environment. There are six pollutants for which the EPA has established NAAQS: carbon monoxide, lead, nitrogen dioxide, ozone, particle pollution, and sulfur dioxide.

Natural Gas – Naturally occurring, non-renewable combustible liquids and gases primarily composed of methane, ethane, propylene, and other hydrocarbons; it can be burned as a fuel and energy source. Natural gas was formed many years ago by breakdown of organic matter such as plants and animals.

Nitrogen Oxides (NO_X) – Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as "oxides of nitrogen," or "nitrogen oxides (NO_X). NO_X can react with ammonia, water vapor, or other compounds to form particulate matter. In the presence of VOCs, heat and sunlight, NO_X can react to form ozone.

Nonattainment Area – A geographic area where the measured concentrations of any of the six criteria pollutants exceed the National Ambient Air Quality Standards.

Nonattainment New Source Review (NNSR) – Permit program that applies to new major sources and major sources that make modifications in a nonattainment area.

Outside Battery Limit (OSBL) – Supporting elements outside of the facility that are not stated as inside battery limits (ISBL). Usually items that do not take place in direct production, such as outside infrastructure, secondary process units, pipelines, warehouses, and waste stream disposal equipment.

Ozone (O_3) – A reactive form of oxygen and a powerful oxidant. It is formed by reaction with NO_X and VOCs. Ground-level ozone is the main ingredient of smog and is a respiratory hazard.

Particulate Matter (PM) – Solid matter and liquid droplets found in the air. The smaller the particles, the more likely they are to enter the body and contribute to health problems

Pennsylvania Department of Environmental Protection (PA DEP) – Pennsylvania state government agency that administers environmental laws and regulations

Pennsylvania New Jersey Maryland Interconnection LLC (PJM) – A Mid-Atlantic region power pool that manages the electrical grid and power distribution.

Pennsylvania Economy League of Greater Pittsburgh (PELGP) – A public policy research organization based in southwestern Pennsylvania. Performs economic impact analyses of activities in the greater Pittsburgh region.

Polyethylene – A polymer manufactured from ethylene, used as a material to make plastic products.

Potential to Emit (PTE) – The maximum capacity a source can emit based on its physical and operational design.

Prevention of Significant Deterioration (PSD) – Permit program that applies to new major sources or major sources that make modifications in an attainment area.

Selective Catalytic Reduction (SCR) – An emissions control process used to reduce NO_X emissions downstream from combustion units.

Southwestern Pennsylvania Commission (SPC) – The designated MPO for the 10-county area in southwestern Pennsylvania.

Stakeholder – People or organizations that have an interest in, or who will be impacted by, a proposal or project.

Startup – When cracker furnaces, compressors, and other equipment are turned on. Different levels and types of air pollution may be released during startup in comparison to normal, everyday operations.

State Implementation Plan (SIP) – The plan that a state is required to develop under the Clean Air Act to attain and maintain the NAAQS.

Shutdown – When cracker furnaces, compressors, and other equipment are turned off. Different levels and types of air pollution may be released during shutdown in comparison to normal, everyday operations.

Sulfur Oxides (SO_X) – Chemical compounds that contribute to the formation of air-borne particulate pollution and contribute to the formation of acid precipitation.

Tail Gas – Residual gas from the ethane cracking process, primarily composed of hydrogen gas and methane, can be treated and burned for process heat or energy.

Transportation Conformity Determination – Under the Clean Air Act, a determination that a transportation plan developed by a designated MPO facilitates attainment with the NAAQS and does not (1) cause or contribute to new violations; (2) increase the frequency and severity of existing violations; or (3) delay timely attainment of the NAAQS.

Transportation Improvement Program (TIP) – A short-term plan developed by a designated MPO that identifies projects to be carried out over the next three years.

Quenching – Rapid cooling of a material or chemical. In an ethane cracking facility cracked gases are quenched with water to cool gas and reduce its volume before compression. Quenching also can absorb some acidic components of the cracked gases.

Upstream – The collection or processing of natural gas that occurs before it arrives at the facility.

Volatile Organic Compounds (VOCs) – Various carbon-based compounds, excluding carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, that participate in photochemical reactions. Usually emitted during leaks or formed by incomplete combustion of fuel. Chemical reactions between NO_X and VOCs lead to the formation of ground level ozone.

Introduction and Executive Summary

Executive Summary

Proposed Petrochemical Facility in Beaver County, Pennsylvania

Currently, natural gas is paving the way as an alternative source of cheap energy over coal in the United States. This is especially true in Pennsylvania, where the **Marcellus Shale** is estimated to contain trillions of cubic feet of natural gas reserves that have yet to be tapped. Due to this abundance, Pennsylvania leadership has invited extractive industries to build gas infrastructure that they hope will grow Pennsylvania's economy. A majority of natural gas is **methane**. However, a portion of the natural gas in southwestern Pennsylvania contains **ethane** and other **hydrocarbons**. This ethane-rich gas is called "wet gas." This wet gas is preferable to dry gas (gas without ethane and other non-methane hydrocarbons), because ethane can be used to produce plastic products.

In June 2011, Shell Chemical Appalachia LLC (Shell) announced plans to assess the building of a world-scale petrochemical complex, or ethane cracker, in Monaca, PA, within Potter and Center townships located in southwestern Pennsylvania. This facility would take locally-produced ethane from shale gas production and use it as a feedstock to produce **polyethylene** (plastic) pellets. These pellets would be later processed to manufacture plastic bags, automotive components, and other polyethylene-based products. The proposed facility would produce an average of one and a half million metric tons of **ethylene** per year (SHELL, 1-2).

Health Impact Assessment

This report serves as a public, written documentation of the process, partners, measures, and outcomes of Clean Air Council's 2013-2014 **Health Impact Assessment (HIA)** of Shell's proposal to build a large-scale petrochemical plant in Monaca, Beaver County, Pennsylvania. Shell's Air Quality Plan Approval Application is subject to change and revision over time. Due to this, the Council could not account for on going and future revisions in this HIA. In this HIA, the Council referred to Shell's Air Quality Plan Approval Application from May 2014.

Pennsylvania's Clean Air Council (the Council) conducted this HIA in collaboration with professionals and researchers in chemistry, atmospheric sciences, environmental engineering, public health, economics, and law, as well as representatives from Shell. The construction and operation of a large ethane processing facility, capable of processing millions of tons of gases and liquids, will result in a variety of foreseen and unforeseen consequences, both positive and negative, for the community and the region. The goal of this health impact assessment is to explore some of these consequences and start a public dialogue.

Audience

This Health Impact Assessment is intended for the general public, community residents, community-based organizations, Shell, decision-makers, as well as other interested stakeholders. The Council recommends that this HIA be used to promote a discussion about Shell's ethane cracking facility in Beaver County, PA.

Findings

The Council examined potential health impacts of the proposed facility and found that there needs to be adequate measures and steps taken to ensure that the community is educated and protected from the possible health and quality of life impacts that may occur. Although the facility may have a positive economic impact for Monaca, PA and the southwestern Pennsylvania region, a broader discussion needs to take place on how to protect public health and the environment. This HIA provides recommendations on how to to address potential health impacts for air quality, noise and light pollution, increased construction-related traffic, economic impacts, quality of life impacts, and emergency management practices. The recommendations include such suggestions as fence-line monitoring, dust control plans, and educational investments into the community. A full summary list of recommendations can be found towards the end of this document in *Summary of Recommendations* section.

Introduction

This report serves as public, written documentation of the partners, measures, process, and outcomes of Clean Air Council's 2013-2014 Health Impact Assessment of Shell's proposal to build a world-class-scale petrochemical facility in Monaca, Pennsylvania, Beaver County. The proposed facility would take **natural gas** components, in this case ethane **feedstock**, from the area via pipeline and convert them into polyethylene plastic pellets with varying grades and degrees of malleability. These pellets will be used **downstream** to make plastic bags, automotive components, plastic moldings, and other plastic and resin products (SHELL, 3-1). The Council hopes the HIA will stimulate a broad discussion about Shell's proposed plant.

This HIA was conducted by an interdisciplinary group of field experts, researchers, and community advocates in an effort to identify potential impacts from the proposed facility. It is important to note that an HIA is an unbiased look at a proposed policy, project, or decision. This HIA will not take a position for or against the building and operating of a proposed facility. It merely allows specific health, social, and economic concerns to be identified, raised, and addressed.[1]

As part of the HIA, Clean Air Council reached out to and invited input by local residents and community leaders in Beaver County, as well as the surrounding boroughs. This was done through two surveys: (1) a community-based online survey along with post-survey follow-up of those surveyed who agreed to be contacted for more detailed interviews, and (2) a targeted phone survey of registered voters in Beaver County. The questions and results from these surveys can be found in *Appendices A, B, and C.*

Health Impact Assessment Defined

Individual and population health are determined in part by surrounding environmental, social, and economic conditions. A **health impact assessment (HIA)** is a process by which health protection and promotion practices are integrated into the policies, planning, and development of building projects that have potential to impact the environment and public health.[2] HIAs can be a powerful tool for community members, **stakeholders**, businesses, government, and health professionals to join together to maximize the benefits from any given project, and reduce undesired environmental, economic, or health consequences.[2] HIAs are becoming more popular, as the process has often resulted in positive outcomes for both the group proposing the project or decision and the surrounding community.

What is a Health Impact Assessment?

A tool to help understand the social, environmental, and human health impacts of building projects or policies. Understanding these impacts can help ensure that a project has a positive influence on a community and region.

The steps to an HIA are: (1) screening: decide whether conducting an HIA makes sense and on what scale, (2) scoping: select the time frame, geographic area, and types of impacts, (3) conducting the HIA, (4) engaging the public, (5) appraising and review of HIA report, (6) establishing a framework for collaboration between those proposing the project and other stakeholders, (7) providing recommendations that protect health, and (8) monitoring compliance and population-level health.[2] The Council's HIA will follow this basic approach.

However, this particular assessment is not a traditional HIA in that there is no official decision being made at this time by Shell on whether to go forward with the proposed project, since Shell is still prospecting and developing the project. The Council felt given the size of the proposed facility, public discussion should start as early as possible. There are also many issues that will not be covered as part of this HIA that warrant further scrutiny and better understanding by political leaders and community; some of those issues include the construction of pipelines to transport ethane, water use and discharge issues, and public health/quality of life issues from noise and light pollution, traffic and potential impacts on land values of nearby communities, all of which might merit their own HIA. In order to make this HIA manageable, the Council had to choose which issues to focus on determined by community surveys.

Instead, this HIA will serve as a resource for the public and highlights potential air quality impacts. Many community members have questions about the potential environmental, economic, and social impacts of the proposed facility. This HIA will attempt to address those questions and concerns, and will encourage opportunities for communities to be involved in the greater discussion and decision-making process. Moreover, the level of community awareness and knowledge of the project and the nature of the concerns held by community members helped guide the HIA.

Screening: Determining the Need for a Health Impact Assessment

Screening determines whether an HIA is likely to succeed and add value in terms of health and social benefits that might not be available without it. In addition, screening calls for an examination of the specific proposed project, program, or policy decision that the HIA will address. For example, if the HIA will address a proposal for a natural gas-fired power plant, the screening process may ask the following questions:

- What specific decision-making process (e.g. air quality permit) will the HIA examine?
- How important to public health is the decision?

- Will the HIA provide new and important insight on previously unrecognized public health issues?
- And finally, will it be feasible in terms of available resources?

HIAs can be used to inform decisions about projects, policies, or plans on a local, regional, state, or national level.[2] To be most effective HIAs should be done before a project is completed or a policy is implemented. Action should be taken by the organization proposing the project, and the community, to address any concerns regarding the proposal before it is completed. Once a facility or project has been proposed, designed, and approved, it is much more difficult to adjust the project and make changes to protect the public.

The proposed petrochemical facility is still in the relatively early stages of planning, and Shell has not fully committed to building the facility. According to Shell, a chemical and gas complex of this nature will require:

What This HIA Will Cover:

- Proposed project background
- What daily operations will look like
- Community concerns
- Sources, types, and amounts of pollution
- Air quality permit evaluation
- Construction impacts
- General economic impacts
- Recommendations for reducing environmental impact

> "A long and intricate planning process typically lasting five years or more to build, from planning to **startup**. There are many hurdles that Shell would like to clear before making an investment decision. We need to confirm the suitability of the site, secure ethane feedstock (raw material) supply, complete engineering and design work, confirm the support of customers for our products, receive all necessary permits and determine whether the project is economically sound and competitive with alternative investment opportunity.[3] "

Shell has not yet made a final decision, and may not for months or years. Though Shell has not fully committed to building the facility, Shell has extended an agreement with Horsehead Corporation (the previous land owner) that was made in 2012, and they have exercised their option on this agreement. Shell sought bids from ethane suppliers in 2013. Shell has already secured supply commitments from CNX Gas Company LLC, a subsidiary of CONSOL Energy Inc, Hilcorp Energy Company, Noble Energy Inc., and Seneca Resources Corporation.[3] These feedstock suppliers are critical for the plant since they will be providing Shell with the needed ethane for cracking. In addition, Shell submitted a plan approval application in May 2014, with the **Pennsylvania Department Environmental Protection (PA DEP)**. This plan approval application was acquired by Clean Air Council and used as a reference in this HIA.

If the proposed facility is eventually constructed, it will have significant environmental, social, and economic impacts. However, the full extent of these impacts is not clear at this time. Similar existing facilities in the southern United States (e.g. Williams' facility in Geismar, LA) have been shown to produce air pollution, noise pollution, light pollution, and extensive traffic infrastructure impacts. Ethane crackers also conduct **flaring**, during which by-products are burned and emitted in order to relieve pressure within the system, adjust product quality, and prevent disruptions in operations. Economists and various news media sources also suggest that the facility will promote economic growth through potential job creation and business development, though the basis for the job creation and economic figures being used in the media and by elected officials were not made available to the Council. Collectively, the potential economic, environmental, and public health impacts support the need for an HIA, and substantial public education about the project beyond the often quoted but hard to substantiate economic impacts.

Scope: Geographic, Environmental, Economic

This HIA primarily focuses on examining potential air quality impacts because survey results indicated air pollution was a leading concern of the community. A limited analysis of potential impacts from light, noise, soil, and other factors that may affect the surrounding area will also be considered. The HIA includes information about expected emissions and health impacts of various types of air pollution including **particulate matter ($PM_{2.5}$)**, **nitrogen oxides (NO_X)**, **volatile organic compounds (VOCs)**, **sulfur oxides (SO_X)**, and **hazardous air pollutants (HAPs)** such as benzene, formaldehyde, toluene, and hexane. All of these air pollutants are listed in Shell's plan approval application to the PA DEP as pollutants that may be emitted from the proposed facility.

This HIA also includes an analysis of potential economic impacts of the proposed facility. These impacts include job creation during the facility construction and operation phases, changes in economic activity in adjacent industries, and changes in local housing prices. Statements about job creation are available, however the Council was not able to obtain the data and assumptions that were the basis of the job creation numbers cited by elected leaders and Shell regarding the economic benefits of the plant. Facilities such as the proposed ethane cracker have historically resulted in spin-off facilities and related industrial activity.[4] These spin-off facilities would bring additional environmental and economic impacts, but these impacts are outside the scope of this HIA.

What This HIA Will *Not* Cover:

- Impact on water
- Impact of natural gas pipelines being built and connected to the facility
- Detailed economic impacts
- Downstream plastics manufacturing
- Full impact of noise and light pollution
- Full impact of traffic
- Impact on community land values
- Impact of potential "spin-off" facilities
- Impact of this facility's power plant and effluent facilities

The proposed facility would take an estimated 3-4 years to complete and has the potential to be operational for decades. Shell's timeline estimates construction will start in late 2015, with full operation of the plant beginning in 2018. Locating a plant that handles and processes high volumes of materials for a wide range of industries may spark further industrial development and additional associated impacts. This HIA will focus on the potential air impacts occurring during construction and operation. However, it is possible that this facility would be part of more profound changes to the local area over the long-term, as other industries may chose to locate nearby in order to take advantage of the new infrastructure, available waste materials produced by the plant, and the newly available polyethylene.

The Council will discuss briefly the **upstream** ethane feedstock sourcing and downstream processing of polyethylene products from the facility. However this HIA will not examine the impacts from infrastructure that is upstream or downstream from the facility as the primary focus is on the cracker facility itself. Other impacts that will not be examined in this HIA include the impacts of pipeline infrastructure that would be needed to transport the ethane feedstock to the facility and the natural gas pipeline that would extend into the facility to power it. Operations surrounding the harvest of natural gas feedstocks and the processing of polyethylene pellets into finished plastic products have their own economic, environmental, and public health impacts that will not be addressed in this HIA.

Background and Facility Profile

Proposed Shell Petrochemical Project Background

Project's Place in Pennsylvania's Natural Gas History

The **Marcellus Shale** is a 350 million year old rock formation that lies in the Appalachian Basin over most of Pennsylvania and parts of New York, Ohio, West Virginia, Maryland and Virginia.[5] The rock is composed of fine, dense sediment that developed from the compression of mud and decomposition of organic material.[6] Within the shale formation, natural gas is trapped within pores. This gas that is trapped within the shale is called "unconventional gas", whereas "conventional gas" is gas that has permiated through rock and is trapped in a more easily accessible, free-flowing gas reservoir. It is estimated that the Marcellus Shale could contain approximately 141 trillion cubic feet of this natural gas, enough to provide the United States with enough energy for seventeen years.[7] A map of the Marcellus Shale can be seen in Figure 1.

What is "Natural Gas"?

Naturally occurring, non-renewable combustible *liquids and gases* burned as a fuel and energy source. Natural gas was formed many years ago by breakdown of organic matter such as plants and animals. Natural gas is mostly composed of methane.

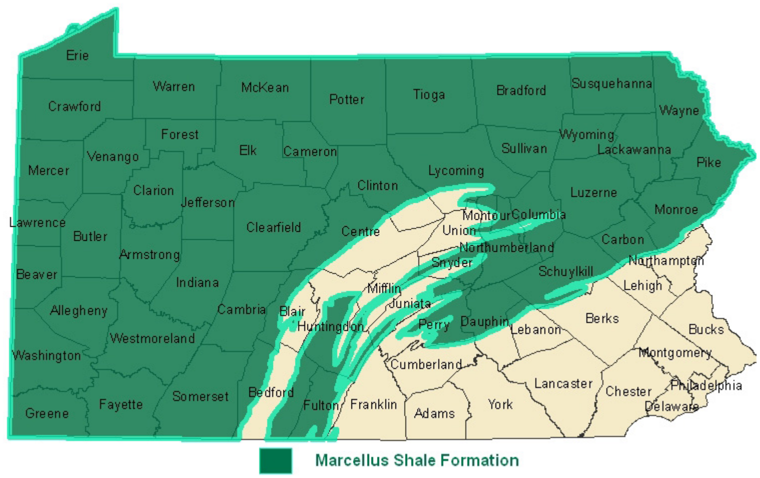


Figure 1. Detailed Map of Marcellus Shale Region

Source: PA DEP

The actual employment impact of the Marcellus Shale is highly disputed, with estimates ranging from 5,669 (according to the Pennsylvania Department of Labor and Industry) to 48,000 (according to industry reports) jobs between fiscal years 2007-2010.[9] Pennsylvania is not new to fossil fuel drilling and extraction. It was the location of the first commercial oil well, drilled in 1859 in northwest Pennsylvania.[10] Since then, it has hosted the oil and coal industries for 150 years. Pennsylvania was the location of the first oil boom in the United States, fueled the railroad industry with coal and produced half of the world's oil until 1901.[5] While the application of hydraulic fracturing and horizontal drilling for shale gas did not begin in Pennsylvania until 2003, comparatively simple vertical drilling for shallower natural gas reserves began in Pennsylvania in the late 1800s. The large amount of shallow natural gas deposits and a lack of regulation led to a rapid proliferation of natural gas wells. However, Pennsylvania did not pass a law requiring operators to report oil and gas well locations until 1956 according to the PA DEP. An image of permitted gas wells in Pennsylvania may be seen in Figure 2. Many of these wells leak methane, contributing to climate change and putting nearby properties at risk, especially when new unconventional natural gas wells cross paths with unmapped abandoned natural gas wells.

What is "Ethane"?

A component of natural gas that will be fed into the Shell ethane cracker. However, sometimes ethane is left in natural gas and is burned.

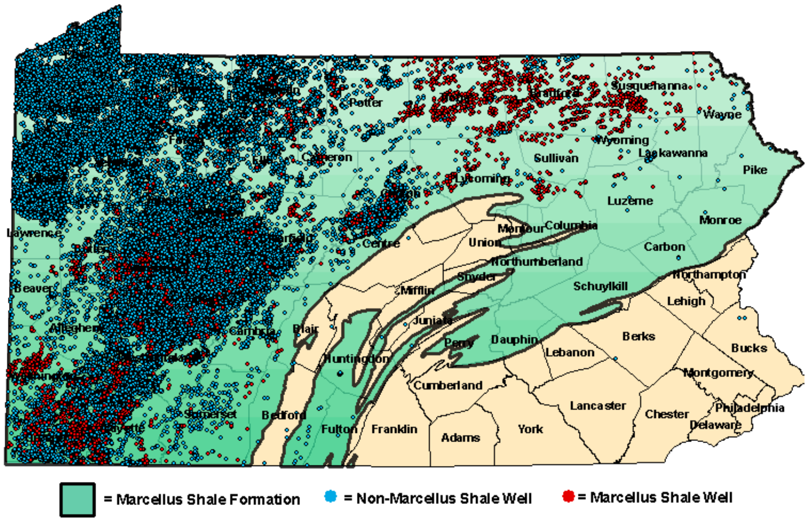


Figure 2. Image of Permitted Gas Wells in Pennsylvania

Source: PA DEP

The sudden boom in the shale gas industry's presence in Pennsylvania, however, is new. Scientists have known about the Marcellus Shale formation and hypothesized about the natural gas deposits it contains for centuries, but up until the last 5 years it was not considered a technologically feasible or economically viable source of natural gas. Due to the depth of the gas, roughly 5,000 to 9,000 feet below the surface, it requires much more time, effort, and resources to extract than conventionally drilled natural gas.[11,12] It was not until 2003 that a method for extracting this deeper, harder to extract gas, was devised.

In 2003, Range Resources, an oil and gas company based out of Texas, began to experiment with a technique known as hydraulic fracturing (also hydrofracking or **fracking**).[13] Fracking involves the collection of oil and gas compressed into rock and sediment thousands of feet below the Earth's surface. In hydraulic fracturing gas, is collected, after drilling the well, by the injection of water, proppant (usually sand or other small rigid particles), and other chemicals into the wellhead. The pressure from the introduced water creates micro-fissures in the porous rock, the proppant props open micro-fissures in the rock, allowing for hydrocarbons and associated chemicals to be released from the rock.[12] This technique had existed for nearly a century, but had lacked the proper technology to fully implement drilling in the Marcellus Shale. Range Resources, after experimentation and technology development, attempted to use the technique to capture Marcellus gas in Washington County, Pennsylvania.[13]

Traditionally, fracking had been done vertically, making the costly process of well pad selection and construction uneconomical compared to the amount of gas that was collected. In 2006, however, Range Resources began extending vertical drills horizontally, essentially creating subsurface drilling networks.[13] They then combined this horizontal drilling technique with high pressure hydraulic fracturing and a new mix of chemicals. Through this process, Range Resources struck an incredibly rich supply of gas. This began a rush to assess the true wealth of the Marcellus Shale, knowledge of which has led to the current regional gas boom.[13]

Development, Context, and Timeline

In June 2011, Shell announced plans to consider construction of a world-scale petrochemical complex — including an ethane cracker — in the U.S. Appalachian region. This complex would be built on the site of the former Horsehead Corporation Monaca Zinc Smelter. The petrochemical complex would upgrade locally produced ethane from shale gas production into commercially viable polyethylene (plastic) pellets (SHELL, 3-1). On March 15, 2012, Shell entered into an agreement to evaluate a site to build the potential petrochemical complex in Beaver County near Monaca, PA. This agreement has been extended at least three times since 2012. However according to Shell, a final decision on whether to build the facility has not been made, and the decision may not be made until late 2014 or 2015. The proposed facility will be the first major project of this type built in the US outside of the Gulf Coast region in 20 years (SHELL, 1-1).

In choosing a site for the proposed facility, Shell examined the following factors: good access to liquids-rich natural gas resources and water, road and rail transportation infrastructure, access to the electrical grid, sufficient land for the petrochemical complex and potential future expansions, and other economic concerns (SHELL, Appendix E 2.1). In addition, Shell has also secured tax breaks from the Commonwealth of Pennsylvania estimated to be around $2.10 in tax credits for each gallon purchased from Pennsylvania-based natural gas drillers.[14] If the ethane proposed facility is approved, construction is set to start in 2015, with operations starting in 2018. A more detailed estimated timeline of events leading up to and potentially occurring during construction of the facility can be seen in Figure 3. The ethane cracker is projected to produce 1.5 million tons of ethylene per year. Currently, similar facilities in the United States can be found mostly in the Southern states such as Texas and Louisiana. Shell expects the plant, when operational, to employ 400 workers (SHELL, Appendix E 2.1). In a meeting with the Council, Shell stated that it hopes to hire from the local community but is aware that a wider net may need to be cast in order to find workers with the right skills. However, despite Shell meeting all its internal benchmarks to proceed with the project, it must also meet a number of legal and environmental permitting requirements intended to ensure the safety of the workers, nearby natural resources, and the public's health.

What is an "Ethane Cracker"?

An industrial facility made up of a series of pipes, furnaces, air compressors, tanks, and towers used to split up fossil fuels into various components meeting different industrial and consumer needs. Crackers split up larger hydrocarbon molecules to produce smaller ones, in this case ethylene. This ethylene will be used to create polyethylene plastic pellets.

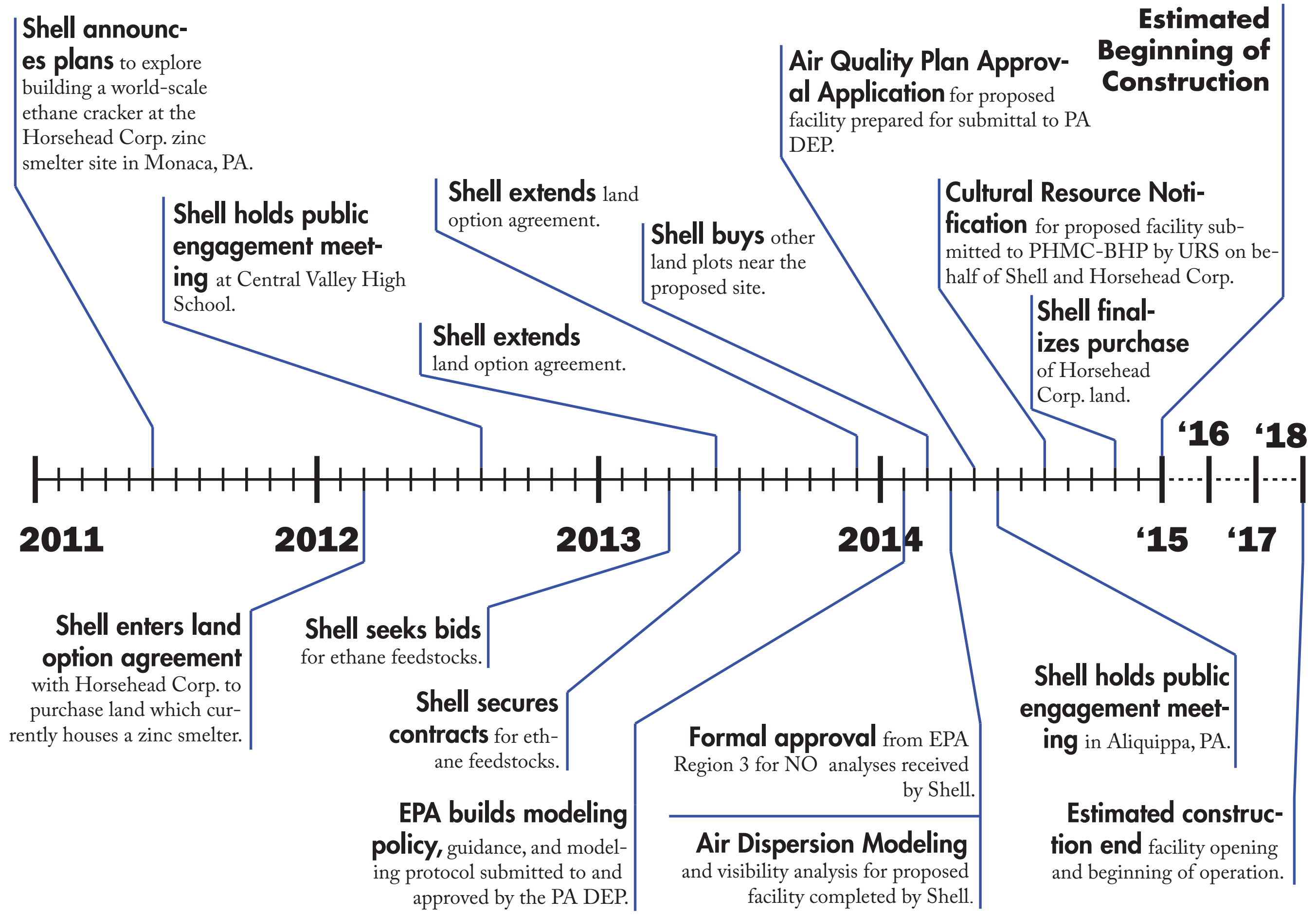


Figure 3. Estimated Timeline for the Petrochemical Facility

Sources: Shell Chemical Appalachia, LLC, Air Quality Plan Approval Application, Petrochemicals Complex, Beaver County, May 2014

When Will the Facility be Built?

Though Shell has not fully committed to building the facility, they have purchased the plots of land where they would build this facility, and additional local plots. Shell has made agreements with suppliers of raw material feedstocks. Shell has stated that this land purchase does not indicate that the facility will definitely be built but, "is a necessary step for Shell to advance the permitting process and allows us to proceed with some preliminary site development work." *

* http://triblive.com/business/headlines/7111318-74/shell-decision-purchase

Community and Stakeholder Engagement

Community and stakeholder engagement is an important part of an effective HIA. Throughout the process of this HIA, the Council has been engaged with different types of stakeholders including community residents, environmental groups in southwestern Pennsylvania, local officials and business owners, as well as representatives from Shell. The Council attended community meetings that were held at the Central Valley High School in Monaca, PA, which was hosted by the Pittsburgh Regional Alliance and Shell. The Beaver County Corporation for Economic Development, the Beaver County Commissioners, Central Valley School District, Center Township, Potter Township, Pennsylvania Governor's Action Team, and Greater Pittsburgh Chamber of Commerce were all in attendance.

The Council also invited various decision-makers and township supervisors in Beaver County to be a part of a community advisory panel that provides insights, concerns, and recommendations that can be incorporated in the direction of the HIA. However, only one township supervisor responded and declined our invitation, stating that the Council's presence might be a threat to the development of the facility, despite the Council being very clear that the HIA will be unbiased. The supervisor's primary concern was for the potential economic development for the region provided by the building and operation of the proposed facility. Civic leaders, and community members alike have simultaneously expressed genuine interest in the outcomes and recommendations of the HIA. The technical and community advisory panels the Council formed consisted of experts from chemical and environmental engineering, economics, environmental toxicology, environmental organizations, and healthcare professionals.

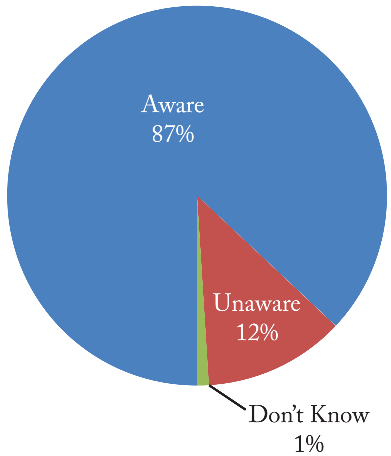
To solicit further community input and guide the HIA process, the Council used several types of outreach tools to determine community thoughts about the proposed plant. First, Council staff conducted interviews with persons in the Beaver County region who expressed interest in the HIA project and were willing to elaborate on their perspectives. Further measurement of attitudes and concerns were collected from a random-digit dialing survey of voters in Beaver County. The same questions were also available as an anonymous online survey.

In addition to engaging community members and community stakeholders, the Council was also able to establish a good working relationship with Shell. During public meetings, the Council was able to connect with Shell's community liaison, who facilitated communications with Shell's project managers. In April 2014, the Council attended a public meeting and a one-on-one meeting organized by Shell in Beaver County. Subsequent face-to-face meetings with Shell's environmental advisor and community liaison provided insights into the possible nature of the proposed facility and its related supporting operations, and the proposed plan approval application. Although Shell representatives declined to be directly involved in the Council's HIA, they offered to provide important environmental data and permitting information, and act as a resource to help ensure the accuracy of the HIA. The Council has remained in contact with Shell throughout the HIA project. The Council has also submitted a draft of the HIA to Shell for their review.

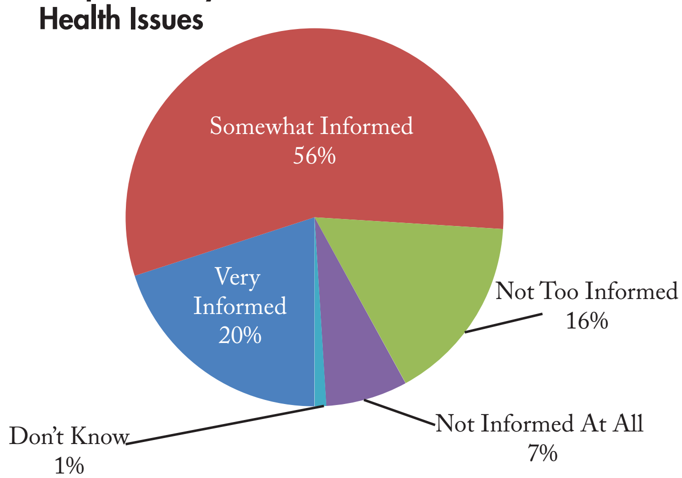
Survey Highlights

To better understand the concerns and awareness of residents in the area about the proposed facility, the Council conducted two surveys, an anonymous online survey, and a phone survey of registered voters. Both surveys were designed to gather information about the public's awareness, attitudes, and concerns related to the facility, and to prioritize areas of concerns and perceptions of benefits. The Council also conducted follow-up interviews with residents who wanted to learn more about the ethane cracker. Community residents were most concerned about impacts to water and air, and most interested in economic benefits such as jobs. *Please refer to Appendices A, B, and C at the end of this document for survey details.*

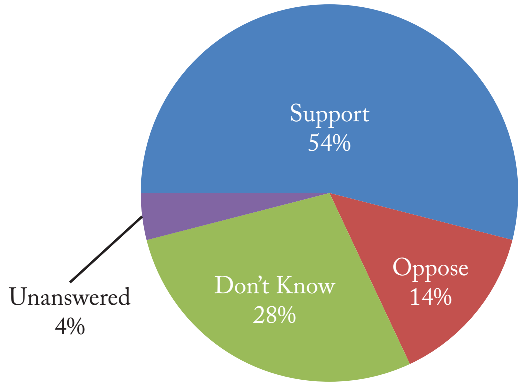
People Surveyed Aware of the Proposed Facility



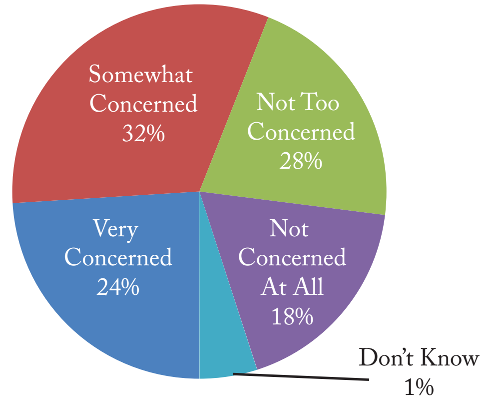
People Surveyed Informed about Environmental Health Issues



Percentage of People Surveyed Who Support or Oppose the Proposed Facility



People Surveyed Concerned About Environmental Impacts



Benefits of the Proposed Facility People Surveyed Would Most Like to See

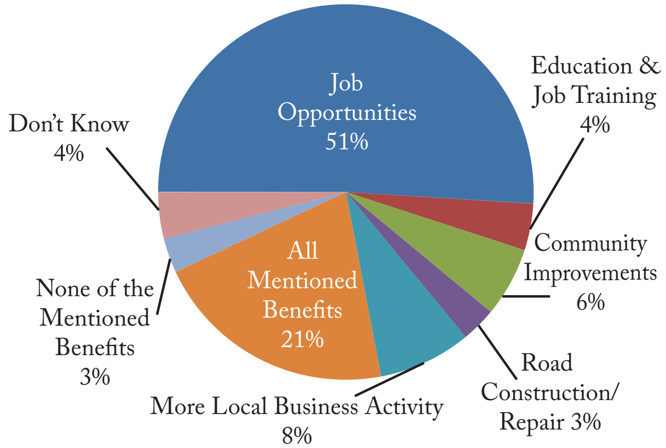


Figure 4. Pie Charts of Phone Survey Results

Demographic and Health Profile of Beaver County

In order to understand how any large project or facility can impact the community, it is important to know the community's present circumstances in terms of geography, environment, health status, economic well being, and employment. Due to the mixed availability of data, this HIA uses various data sets at local and county levels, including data from the United States Census Tract, Pennsylvania Department of Labor and Industry, and Pennsylvania Department of Health. Pennsylvania State Health Status Indicators and National Air Toxics Assessments were also used to identify any risk factors in the distribution of chronic diseases, and the associated health care use.[15,16]

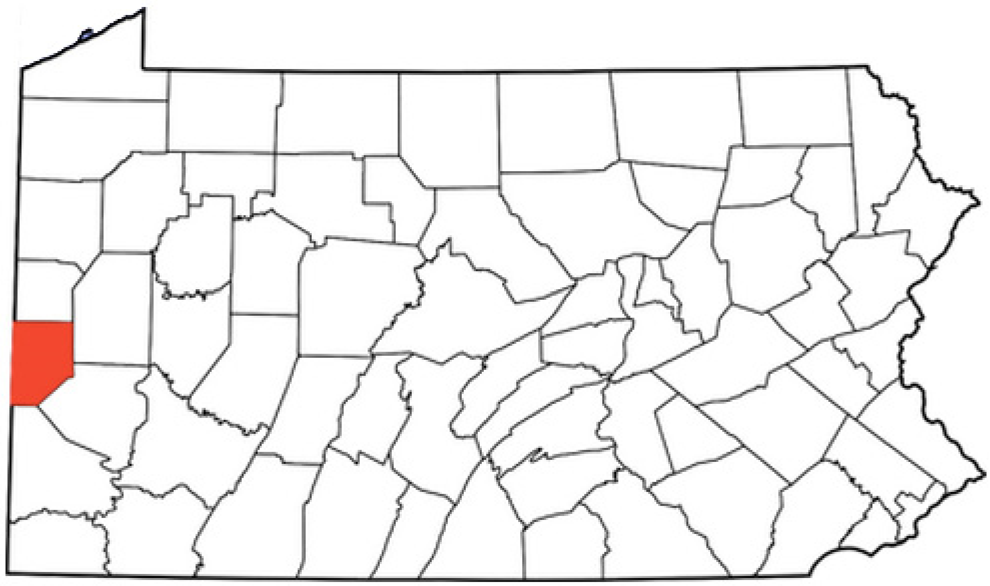


Figure 5. Location of Beaver County Within Pennsylvania
Source: David Benbennick, "Map of Pennsylvania highlighting Beaver County" February 12, 2006 via Wikipedia, Creative Commons Attribution

Geography and Population

Beaver County (Figure 5) is in southwestern Pennsylvania along the Ohio River, just northwest of Pittsburgh. The proposed facility will be sited near two bridges and a railroad bridge that crosses the Ohio River into Monaca. Monaca consists of Potter and Center Townships, where there are hundreds of homes within 2-3 miles of the proposed petrochemical facility. Todd Lane Elementary, Center Valley Middle School and Center Valley High School are also in the vicinity. The closest residential neighborhood in Monaca is about a half mile from the proposed site. A map of the healthcare facilities and schools in the vicinity of the proposed facility can be seen in Figure 6. A map depicting the residential areas in the vicinity of the facility can be seen in Figure 7. There are about 6,000 people in Monaca borough, and approximately 68,000 people living within a 5-mile radius of Monaca.[17] Approximately 170,000 total people live in Beaver County.[18]

Online Survey Participants:

- 27.4% live within 10 miles of Monaca, PA
- 46.2% live 11 to 30 miles away
- 22.2% live 30 to 100 miles away

Table 1. Baseline Demographics

	Monaca	Beaver County*	Pennsylvania
Population	5,737	170,115	12,702,379
Age			
Under 5 years of age	6.4%	5.1%	5.7%
Under 18 years of age	19.7%	19.8%	22.0%
Over 65 years of age	20.0%	19.3%	15.4%
Race / Ethnicity			
White / Caucasian	95.4%	91.2%	81.3%
Black / African-American	2.1%	6.3%	10.8%
Hispanic / Latino	1.2%	1.4%	5.7%
American Indian / Alaskan Native	0.1%	0.1%	0.2%
Asian	0.4%	0.5%	2.7%
Other	1.9%	1.8%	1.9%
Gender			
Female	53.0%	51.50%	51.30%
Male	47.0%	48.50%	48.70%
Median Income	$45,610	$48,311	$52,267
Education			
High School Graduate (25+ yrs old)	88.5%	90.4%	88.3%
Bachelor's Degree or Higher (25+ yrs old)	16.3%	20.9%	27.0%
Unemployment	7.6%	5.10%	5.30%
Poverty Rate	17%	12.40%	13.10%
Source: * 2013 and 2010 United States Census Tract Quick Facts; Pennsylvania Dept. of Labor and Industry			

In Beaver County, home to the proposed facility, 51.5% are female, with 48.5% male. 91% are White, 5% Black or African-American, and very few are Hispanic or Latino, American Indian, Asian, more than one race, or other. The median age is 44.4 in Beaver County, in comparison to 40.4 across the state.[18] Higher proportion of older adults in Monaca warrant special attention because of environmental health vulnerabilities associated with aging, and chronic diseases (e.g. heart disease).

90.4% of the adult population have at least a high school diploma, and 20.9% have a bachelor's degree or higher. 12.4% live below the poverty line in Beaver County, slightly less than the statewide percentage (13.1%). 6.4% are unemployed.

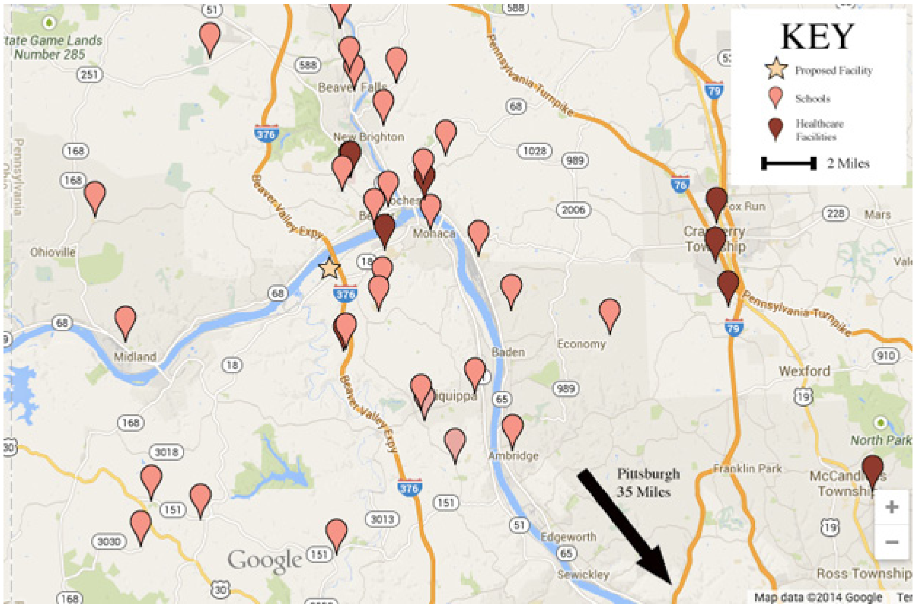


Figure 6. Map of Schools and Healthcare Facilities Surrounding Proposed Facility
Source: Google Maps

Figure 7. Map of Facility Location in Relation to the Ohio River and Nearest Resident
Source: Google Maps

Figure 8. Former Horsehead Smelter Site
Source: Google Earth

The area is comprised mostly of moderate-low density, single home lots, with some countryside and farmland. 70% or more of the residences in Beaver County are owned by the residents, and 89.9% of those have lived in the same house for more than one year.

Nearby Communities:

- Vanport, PA – 1 mi, W
- Beaver, PA – 2.29 mi, ENE
- Rochester, PA – 3.5 mi, ENE
- Fallston, PA – 3.96 mi, NE
- Industry, PA – 4.46 mi, WSW
- Beaver Falls, PA – 5.7 mi, NNE

Current Health Profile

The current health status of the population living near industrial development and activity is important for understanding the potential health impacts of a new facility. Understanding the characteristics of a population will help ensure that the needs of the people in that region are met. Current health profiles also act as a baseline, or starting point, from which public health officials can monitor any changes in health. Surveys of the health of a population help guide policy towards meeting the needs of people, including those most vulnerable to environmental exposures. For example, pregnant women, older adults, and those with chronic disease are more susceptible to exposures from air pollution and toxics, which means that they may experience a greater health burden from exposure to pollution.

Who is Most Susceptible to the Negative Health Effects of Air Pollution?

Everyone can be harmed by air pollution. However, some people, such as children, the elderly, those with pre-existing health conditions (e.g., asthma, heart disease) may experience greater health risks.

Age — When exposed to environmental toxins, a child's biological defenses are forced to deal with higher amounts of the chemical in proportion to their body weight; children, depending on their developmental stage, may be more at risk for health complications associated with exposures to air pollution and toxics.

Older adults and immune system compromised individuals are also more likely to be negatively impacted by environmental exposures. Most notably, Beaver County has a higher median age (45.5 year) in comparison to the state average (40.1 years).[18] 19.3% of the population is above the age of 65.[18] Older adults are more likely to have heart disease, cancers, lung disorders, and many other health conditions. Likewise, older adults experience more acute health events, such as heart attacks and strokes.

Lung Health — Asthma is a leading cause of school absenteeism and loss of employment days in Pennsylvania. From 1997 to 2009, asthma among school students in Pennsylvania increased from 6.6% to 11.3%.[19] Furthermore, more people are hospitalized for asthma in Beaver County in comparison to most other counties in Pennsylvania.[19] **Chronic Obstructive Pulmonary Disease (COPD)** rates are also higher in Pennsylvania in comparison to other parts of the country; lung cancer rates are also higher here when compared to other parts of the country. 56.2 per 100,000 deaths are caused by lung cancer in Beaver County.[19] This proportion is similar to the Pennsylvania state average (53 per 100,000). Both Beaver County and Pennsylvania state averages exceed the national average of 50.5 per 100,000 deaths caused by lung cancer.[19]

Cardiovascular Health — Heart disease or **cardiovascular disease (CVD)** is one of the leading causes of death in the United States. A 2009 survey found that CVD is more commonly linked to death in Beaver County than in the rest of the state.[19] 293 per 100,000 deaths are caused by CVD in Beaver County, compared to the national average of 249 per 100,000. Given that Beaver County is home to a higher proportion of older adults, who also exhibit more CVD, the impact from additional air pollutants could be significant. Beaver County and the Pittsburgh area, and much of the Southwest Pennsylvania region, suffer from elevated levels of air pollution above those allowed by national standards.[20]

All employment and income statistics were drawn from Pennsylvania's Department of Labor and Industry, Center for Workforce Information and Analysis unless otherwise documented.[21]

The current civilian labor force in Beaver County is about 90,100. The seasonally adjusted unemployment rate is at 6.4%, with a 19.4% increase in the number of online job postings from July 2013 to July 2014. Per Capita Personal Income was calculated to be around $40,428, and Median Household Income and Median Family Income were estimated to be about $48,311 and $60,947, respectively. Table 2 compares various economic indicators for Monaca, PA, Beaver County, PA, Pennsylvania, and the national economy. In general, the population of Monaca has lower income, is more impoverished, is more likely to be unemployed, has a lower cost of living, and has less educational attainment in comparison to the rest of Beaver County, Pennsylvania, and the U.S. overall.

Table 2. Economic Indicators

	Monaca, PA	Beaver County	Pennsylvania	National
Population	5,749	170,115	12,773,801	317,297,938
Number Employed	2,836	85,400	5,976,200	147,800,000
Poverty Rate	17%	12.40%	13.10%	14.90%
Median Income	$45,610	$48,311	$52,267	$53,046
Unemployment Rate	7.6%	5.2%	5.3%	6.0%
Cost of Living Index	81	90	102	100
Source: Pennsylvania Dept. of Labor and Industry, Center for Workforce Information and Analysis				

Table 3 compares the the top 5 largest industry sectors in Monaca, Beaver County, Pennsylvania, and the national economy. Some major employers near the proposed facility include Valley Medical Facilities Inc., FirstEnergy Nuclear Operating Co., Beaver County, and TMK IPSCO Koppel Tubulars Corporation.

Table 3. Top 5 Industries for Employment

Monaca, PA	Beaver County	Pennsylvania	National
Retail	Health Care and Social Assistance	Health Care and Social Assistance	Retail Trade
Manufacturing	Manufacturing	Retail Trade	Accomodation and Food Services
Health Care and Social Assistance	Retail Trade	Manufacturing	Professional and Technical Trade
Educational Services	Accomodation and Food Services	Educational Services	Administration and Waste Services
Transportation and Warehousing	Professional and Technical Services	Construction	Educational Services
Source: Pennsylvania Dept. of Labor and Industry, Center for Workforce Information and Analysis			

According to Shell the chosen site offers strategic advantages such as good access to marine, rail and road transportation, and pipeline proximity to a supply of ethane, and also is close to markets for the end product which will be polyethylene pellets (SHELL 1-1). The plant will employ an estimated 400 workers (SHELL, Appendix E 2.1). Horsehead Corporation previously employed approximately 600 workers at the site (SHELL, 7-2).

Facility Overview

The proposed facility will be used to process natural gas liquids into ethylene. Three polyethylene manufacturing units, three **cogeneration** units and various other equipment will support the operations, along with three natural gas-fired combustion turbines, **heat recovery steam generators (HRSGs)**, four diesel generators, two cooling towers, storage tanks, and pressure vessels (SHELL, 1-6). The ethylene manufacturing process will consist of seven cracking furnaces that will be capable of producing up to 1,500,000 metric tons of ethylene per year (SHELL, 1-6). The polyethylene manufacturing process will consist of two gas phase polyethylene manufacturing units and one slurry-based technology unit. The gas phase units will produce 550,000 metric tons of linear, low density polyethylene pellets (LLDPE) per year each and the slurry unit will produce 500,000 metric tons of **high density** polyethylene pellets (HDPE) per year (SHELL, 1-6).

The proposed facility will contain multiple flares that will take emissions from the cracking furnaces and polyethylene units (SHELL, 3-22). Low pressure flaring will take place at the facility, primarily during **startup, shutdown**, and during maintenance. High pressure elevated flaring will take place only during an emergency, as a secondary pressure relief system (SHELL, 3-23). The proposed facility currently consists of five flares: two high pressure ground flares, a high pressure elevated flare (emergency flare), a low pressure ground flare, and an elevated refrigeration system flare.

Manufacturing and Production

Ethane is a natural gas liquid that can be found in natural gas deposits. Natural gas liquids are separated from natural gas during processing and are shipped by pipeline for use as fuels or as feedstocks (SHELL, 1-5). Ethane's primary use is to create ethylene, which in turn, is used to produce different types of polyethylene, including LLDPE and HDPE (SHELL, 1-6). LLDPE pellets can be used to manufacture items such as plastic bags, stretch wraps, cable insulation, and flexible tubing (SHELL, 1-6). HDPE can be used to manufacture items such as bottle caps, coaxial cable insulation, food storage containers, hard hats, and folding chairs and tables (SHELL, 1-6).

During the ethylene manufacturing process, ethane feedstock will be thermally cracked into ethylene, propylene, methane, hydrogen, and other by-products in cracking furnaces at temperatures up to 1560° Fahrenheit at a maximum rate of 1,500,000 metric tons per year (SHELL, 1-6, 3-2). A basic flow diagram of this process can be seen in Figure 9. The gases are cooled and **quenched** to reduce the volume of gas that must be compressed prior to separation and purification of the ethylene product (SHELL, 3-4). Compression takes place in a five-stage centrifugal compressor. The cracked gas is also scrubbed with caustic soda to remove carbon dioxide and hydrogen sulfide (SHELL, 3-5). Next, the cracked gas passes through cooling and drying sections, and is then separated into two hydrocarbon ($C_2/CH_4/H_2$ and C_3+) streams (SHELL, 3-5). The $C_2/CH_4/H_2$ stream is further separated into ethylene, unconverted ethane, and **tail gas** (hydrogen and methane) (SHELL, 3-5). The unconverted ethane is recycled back to the cracking furnaces as feedstock.

What are the Causes of Air Pollution from the Ethane Cracker?

- Furnaces
- Steam turbines
- Diesel engines
- Fugitive emissions (uncaptured leaks in pipes, valves, etc.)
- Excess emissions (startup, shutdown, equipment failures, etc.)

The steam and electricity for the plant will be supplied by a natural gas-fired combined cycle cogeneration unit. Excess electricity will be sold for use within the **Pennsylvania New Jersey Maryland Intercon-**

nection LLC (PJM). The plant will also have four emergency diesel generators. The plant will be contained with its own effluent treatment, storage, logistics, cooling water facilities, emergency flares, building and warehouses (SHELL,1-2).

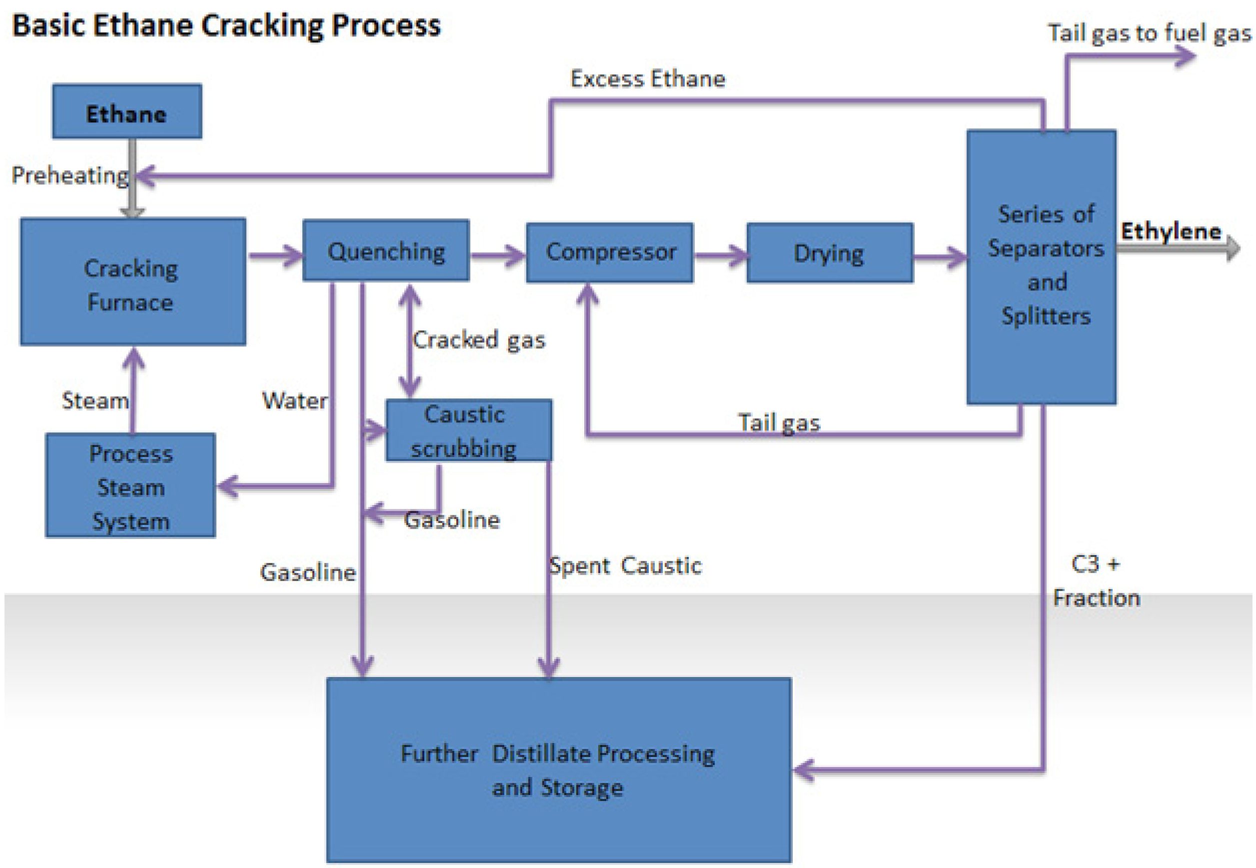


Figure 9. A Simplified Flow Diagram of the Ethane Cracking Process

Source: Shell Plan Approval Application, http://www.dep.wv.gov/daq/permitting/documents/appendix_c_ascent_pfds_final_may2014.pdf, http://www.slideshare.net/davidpassmore/cracking-the-ethane-cracker-14001281 (slide 26)

Potential Technical Requirements for Facility Due to Nonattainment

EPA sets **National Ambient Air Quality Standards (NAAQS)** for certain pollutants that are determined to be harmful to human health and public welfare, including animals, crops, and vegetation. NAAQS are identified by the year they were adopted and how the standards are measured over a given time period. Counties or a group of counties, such as **Metropolitan Statistical Areas (MSAs)**, are designated **attainment** or **nonattainment** of NAAQS depending on whether measurable ambient concentrations of a given pollutant are within the standard. Being in non-

What is Attainment and Nonattainment?

Attainment areas meet the concentration of criteria pollutants allowed by the National Ambient Air Quality Standards under the Clean Air Act. Nonattainment areas exceed the concentration of criteria pollutants allowed by the National Ambient Air Quality Standards. An area can be in attainment for one pollutant and nonattainment for another.

Areas Not Determined as Attainment or Nonattainment

Areas that have not been determined attainment or nonattainment are called unclassifiable and are treated as attainment areas.

attainment for primary NAAQS means that the area does not meet the health-based standards. Further, areas that have not been designated are deemed unclassifiable by EPA and treated as **attainment areas**.

To assist with compliance with the NAAQS, EPA has implemented the New Source Review (NSR) preconstruction permitting program. The NSR program sets out specific requirements for the owner-operators of new or modified major stationary sources to follow, including emission limits, operating guidelines and control technologies. There are separate requirements for attainment and **nonattainment areas**. Sources in attainment areas must comply with **prevention of significant deterioration (PSD)** permit requirements, including the use of **best available control technology (BACT)**, and sources in nonattainment areas must comply with **nonattainment new source review (NNSR)** permit requirements, including the use of emission offsets and **lowest achievable emission rates (LAER)**. The PSD permitting program is intended to assist states in maintaining good air quality in areas that meet the NAAQS, whereas the NNSR program is used to ensure emissions from new or modified major sources do not add to pollution in areas that do not meet the NAAQS, and thereby, protect the integrity of the **state implementation plan (SIP)**.

The proposed facility will be located in an area that is designated as nonattainment for **ozone**, lead (partial county designation), the 1-hour **sulfur dioxide (SO_2)** NAAQS (partial designation), and the annual **$PM_{2.5}$** NAAQS. Based on Shell's estimate of the proposed facility's annual **potential to emit (PTE)** pollutants, the proposed facility will be a major source of **NO_X** and **VOCs, $PM_{2.5}$, carbon monoxide (CO)**, and **equivalent carbon dioxide (CO_2e).** Thus, the proposed facility will be subject to NNSR requirements for these pollutants.[22]

Under the applicable state and federal NNSR regulations, Shell must obtain offsets for its flue and **fugitive emissions** of NO_X, VOCs, and $PM_{2.5}$, at ratios of 1.15, 1.15, and 1.1 respectively (*25 Pa. Code §§ 127.205(3), (4), 127.210; 40 CFR 51, Appendix S*). Based on Shell's PTE estimate for each pollutant (NO_X = 327 tons per year; VOC = 484 tons per year; $PM_{2.5}$ = 164 tons per year), Shell must secure the following amounts of **emission reduction credits (ERCs)**: NO_X = 376 tons; VOC = 557 tons; $PM_{2.5}$ = 176 tons (SHELL 1-5).[23, 24]

Each component, or emission unit, of the proposed facility will have specific control technologies and compliance methods for the pollutants emitted. Since Beaver County is designated as nonattainment for ozone and the proposed facility is a major source of NO_X and VOCs, Shell is proposing to apply the following controls and compliance methods at the listed emission units for NO_X and VOCs to satisfy NNSR/LAER requirements:

1. Cracking Furnaces: **low NO_X burners (LNB), selective catalytic reduction (SCR)**, and **continuous emissions monitoring system (CEMS)** for NO_X control and compliance; good combustion practices and 5 year performance tests in concurrence with *EPA Reference Methods 18 and 25* for VOC control and compliance;
2. Combustion Turbines/Duct Burners: dry LNBs, SCR, CEMS, and additional monitoring requirements under *25*

What do the Permits Require and What is Shell Doing to Prevent Air Pollution?

Since the proposed facility will be located in a nonattainment area for several pollutants, and because the facility has the potential to emit significant amounts of these pollutants, Shell must satisfy stricter permitting requirements. Shell must also secure emission offsets for these pollutants.

Pa. Code §§ 145.70, 145.213[25, 26] for NO_X control and compliance; CO oxidation catalyst, good combustion practices and 5 year performance tests in concurrence with *EPA Reference Methods 18 and 25* for VOC control and compliance;

3. Diesel Engines (emergency generators and firewater pumps): combustion control techniques and engine certifications for NO_X and VOC control and compliance;
4. Equipment Leaks: enhanced leak detection and repair (LDAR) for VOC control and compliance;
5. Polyethylene Manufacturing Process Vents, Storage, and Handling: VOC-containing vents will be directed to a VOC control system that will achieve a 99.5% VOC destruction removal efficiency and VOC content of polyethylene will be checked weekly for VOC control and compliance;
6. Tanks and Vessels: design, vents, and LP thermal incinerator for VOC control and compliance;
7. Cooling Tower: determination of VOC concentration in cooling water in concurrence with *40 CFR 136* for VOC compliance; and
8. Loading Operations (liquid loading): design and work practices for VOC control (SHELL 5-9 to 5-20).

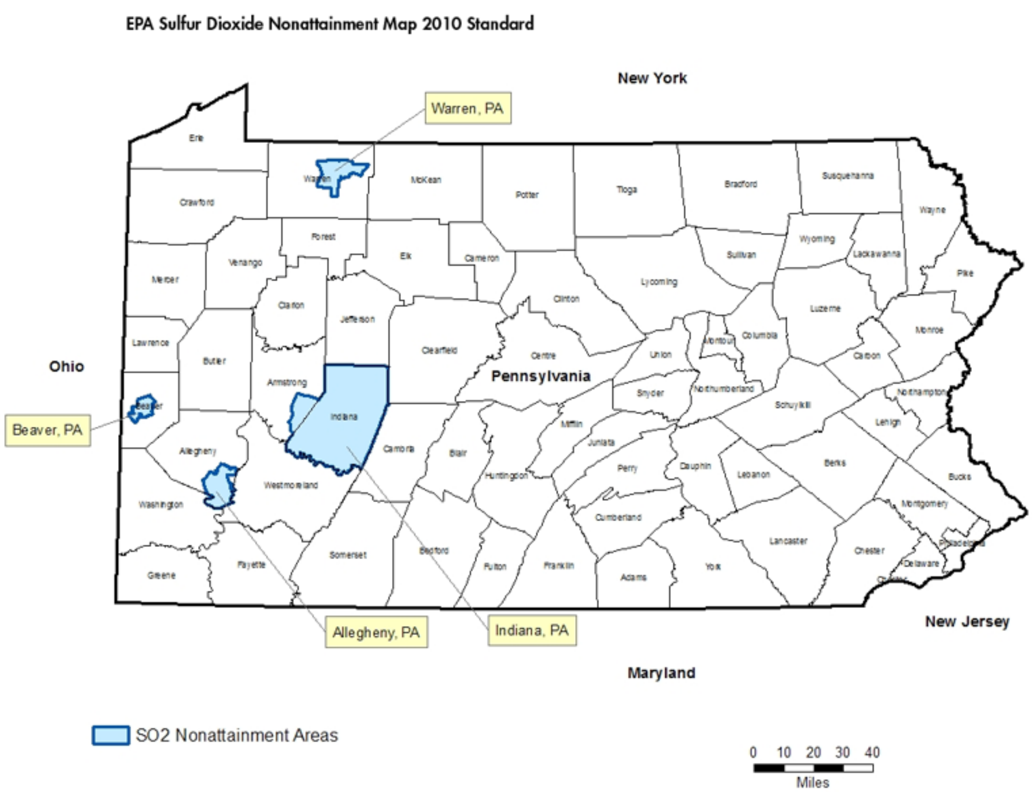
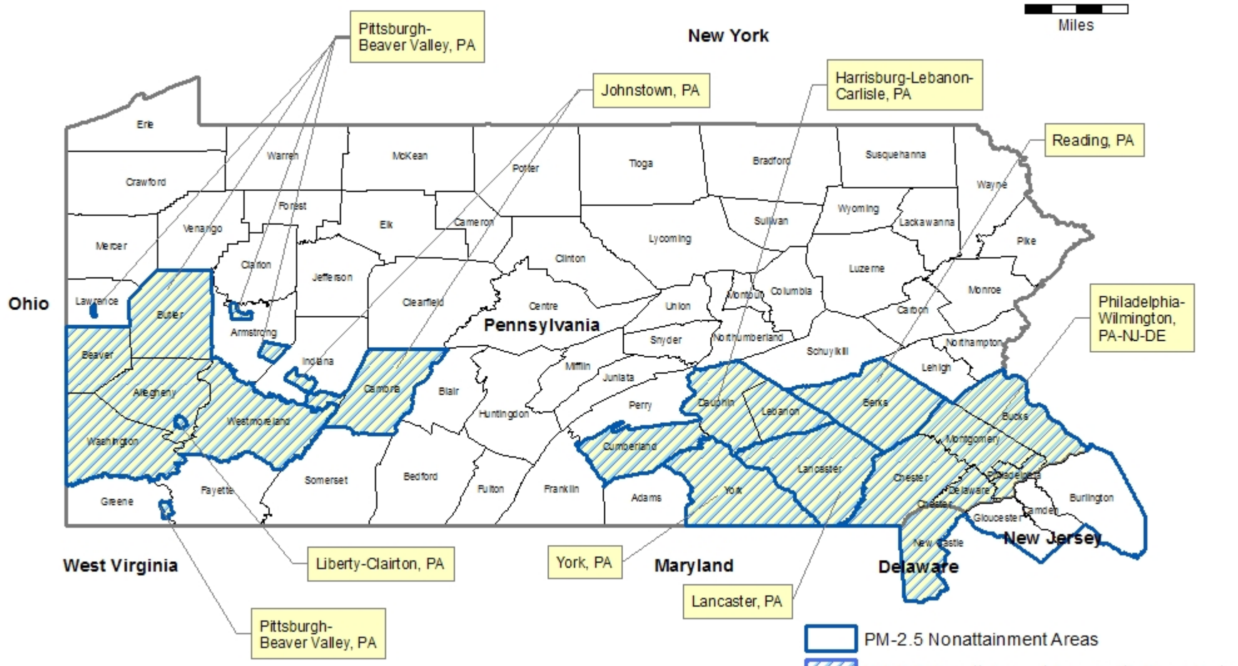


Figure 10. Pennsylvania Nonattainment Maps of Criteria Pollutants

Source: EPA Green Book

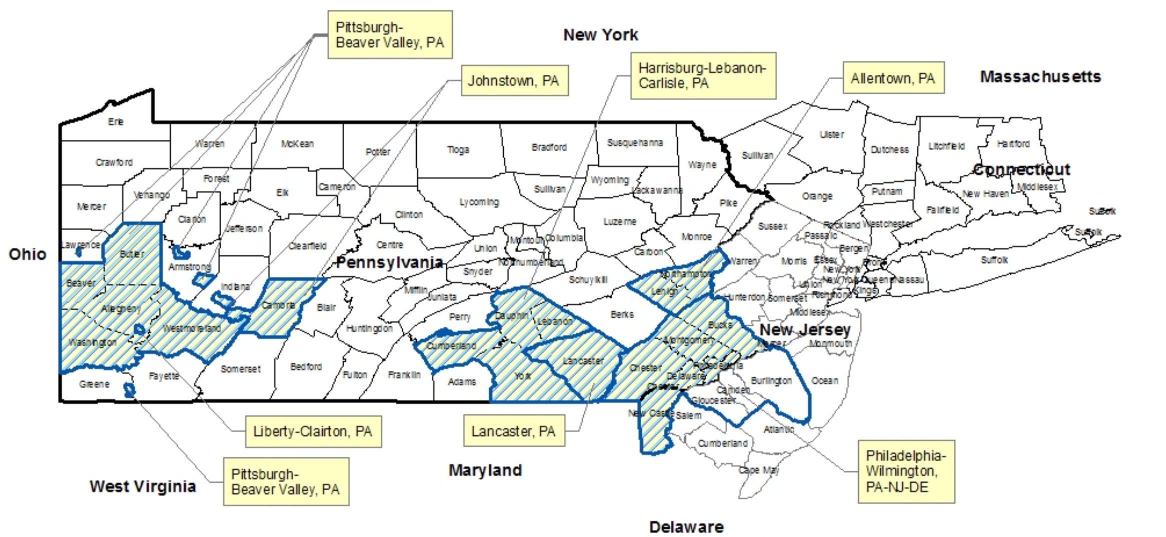
Continued on pages 24–26

EPA PM 2.5 Nonattainment Map 1997 Standard



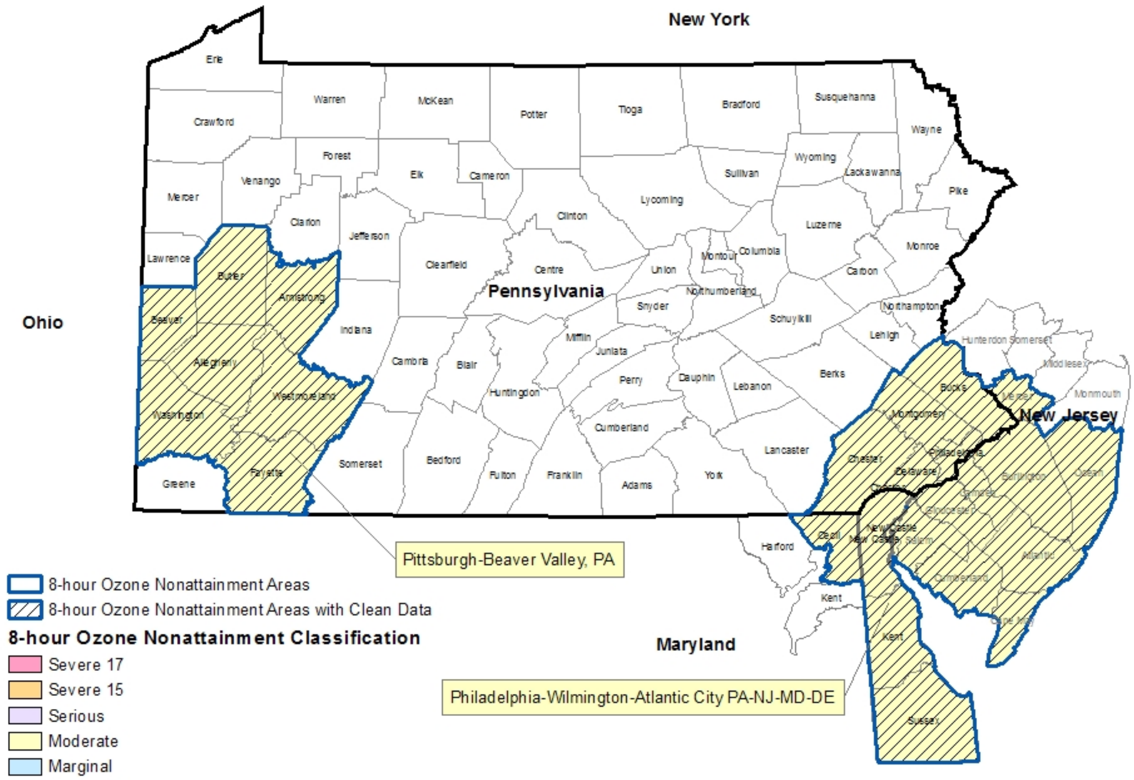
The New Jersey portion of the Philadelphia-Wilmington, PA-NJ-DE PM-2.5 (1997 Standard) nonattainment area was redesignated on September 4, 2013, while the Pennsylvania and Delaware portions have not. The entire area is not considered in maintenance until all states in a multi-state area are redesignated.

EPA PM 2.5 Nonattainment Map 2006 Standard

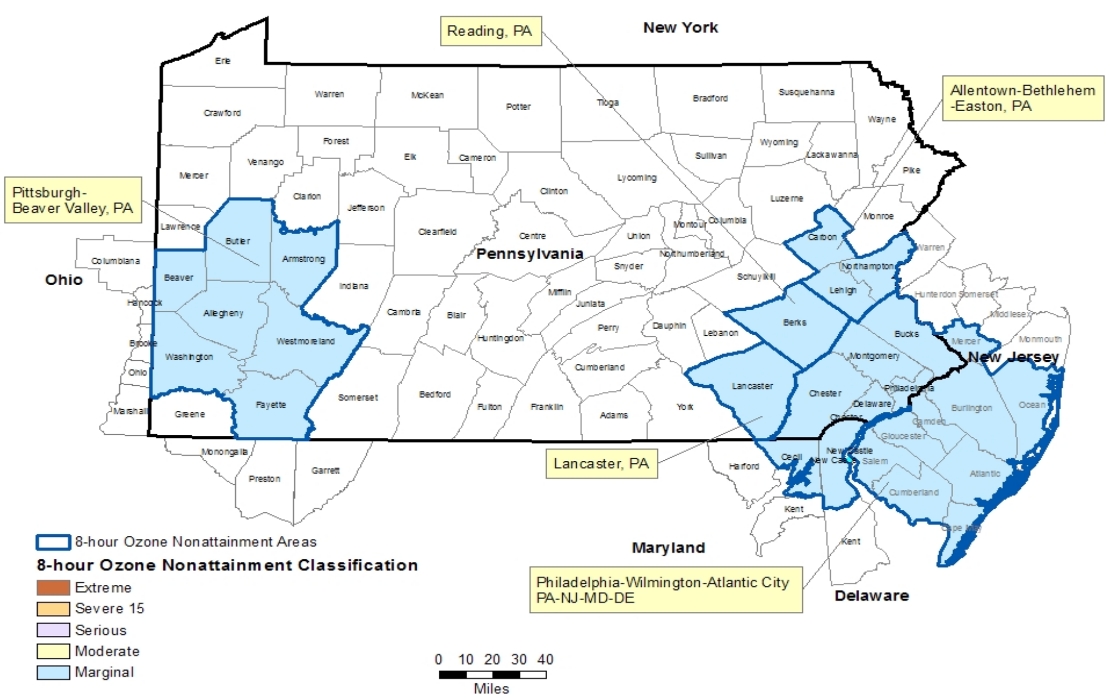


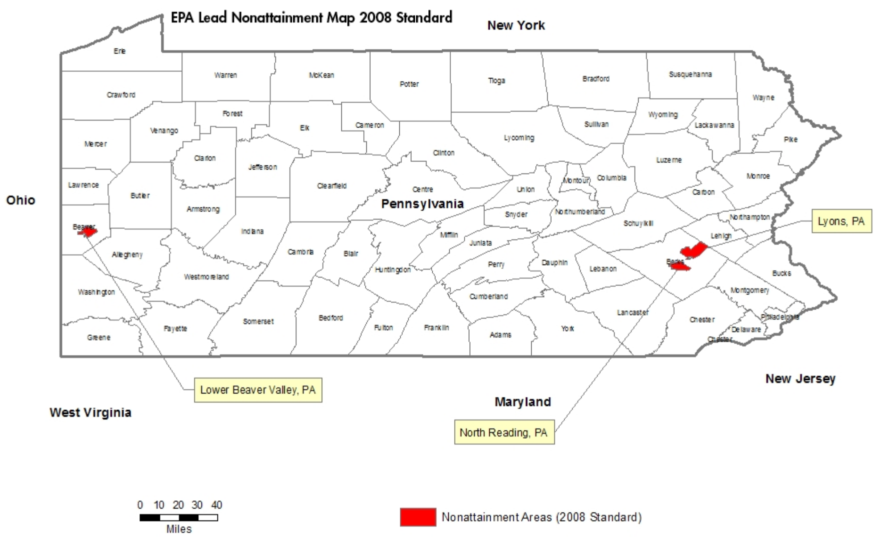
The New Jersey portion of the Philadelphia-Wilmington, PA-NJ-DE PM-2.5 (2006 Standard) nonattainment area was redesignated on September 4, 2013, while the Pennsylvania and Delaware portions have not. The entire area is not considered in maintenance until all states in a multi-state area are redesignated.

EPA 8 Hour Ozone Nonattainment Map 1997 Standard



EPA 8 Hour Ozone Nonattainment Map 2008 Standard





Comparable Facilities

Several comparable facilities currently exist or are being constructed in the U.S., primarily in the Gulf Coast. Some of these include: BASF FINA Industrial Organic Chemicals Facility in Port Arthur, TX; Chevron Phillips Chemical Cedar Bayou Plant in Baytown, TX; Dow Chemical in Freeport, TX; Exxon Mobil Baytown Olefins Plant in Baytown, TX; and Formosa Plastics Corporation in Point Comfort, TX. A comparison of these facilities can be seen in Table 4.

The feedstocks of these facilities vary, though primarily ethane and naphtha are used for ethylene production. The ethane feedstock is derived from natural gas, while the naphtha feedstock is usually derived from crude oil. Changes in feedstocks can lead to different process steps, plant sizes, and end product streams and amounts. For example, plants that use naphtha as a feedstock will have more plant infrastructure, and will produce more propylene or C_4 than an ethylene plant. Due to this extra processing, these plants may require larger facilities than the proposed Shell ethane cracker, along with different pollution controls, and other considerations.[27]

Cracking is the most energy intensive process in the chemical industry. Using ethane as a feedstock, as opposed to naphtha or a heavier feedstock, will cut down on energy usage. Since the proposed Shell facility will use ethane as a feedstock, it will likely use less energy than other existing plants, and, as a result, emit less CO_2 during its operation. The tail gas that will be fired in the proposed facility will be rich in hydrogen, as opposed to the methane-rich fuel burned in liquid naphtha processes. This hydrogen has the advantage of reducing greenhouse gas emissions from process furnaces (primarily CO_2), however, it carries the disadvantage of increasing nitrogen oxide emissions by 60% compared to methane furnaces (SHELL 5-29). Though the new construction of any plant will result in more emissions overall, according to Shell, the proposed ethane cracker will most likely emit less CO_2 than other comparable natural gas-fired plants that have already been constructed (SHELL 5-146).[27]

There are also various new comparable facilities planned for future construction. However, there is concern that due to seven new ethane cracking facilities currently proposed for construction in the U.S., ethane supplies might reach a shortage around 2017 and no longer be as economically viable.[4] It may be prudent to further examine the potential of shortage due to the over-building of facilities. This issue was also raised by concerned residents in the more intensive survey.

Table 4. A Comparison of Similar Ethane Cracking Facilities

	Proposed Shell Petrochemicals Complex*	BASF FINA Industrial Organic Chemicals Facility†	Chevron Phillips Chemical Cedar Bayou Plant‡	Dow Chemical§	Exxon Mobil Baytown Olefins Plant‖	Formosa Plastics Corporation¶
Location	Monaca, PA	Port Arthur, TX	Baytown, TX	Freeport, TX	Baytown, TX	Point Comfort, TX
Production Capacity (metric tons/ yr)	1.5 million	1 to 1.3 million	1.5 million	About 1.9 million	2 million	1 million
Feedstock	Ethane	Naphtha and Ethane (50/50)	Ethane (primary) and other feedstocks	Ethane and Propane	Ethane	Ethane
Size (acres)	400	60	650 (developed), 1,200 (whole)	5,000 (complex)	320	Not Listed
Cracking Furnace Heat Input (MMBtu/hr/ furnace)	620	487.5	500	598	575	250
Furnaces	7	10	8	8	8	9
Permitted Fuel Types	Tail gas and Natural gas Supplement	Natural gas or Tail gas	Natural gas or Natural gas / Tail gas blend	Natural gas, Tail gas, or blend	Plant fuel gas, Ethane, or Natural gas	Natural gas, Hydrogen-rich Tail gas
Flares	High pressure ground flares, Refrigerated tank flares, and Elevated flares	Shielded flare and Backup Ground flare	Low-Profile flare	Pressure assisted and Low pressure flares	Elevated flare and Ground flare	Two Low pressure flares, Elevated flare
Cogeneration	Yes	Yes	Not Listed	Yes	Yes	Yes

* *Source: Shell Petrochemicals Complex Air Quality Plan Approval Application (SHELL). May 2014.*

† *Source: BASF FINA Industrial Organic Facility Texas Council of Environmental Quality (TCEQ) Air Quality Permit No. 36644*

‡ *Source: Chevron Phillips Chemical Cedar Bayou Plant TCEQ Air Quality Permit No. 1504A*

§ *Source: Dow Chemical Company – Dow Texas Operations Freeport PSD Greenhouse Gas Permit Application – Light Hydrocarbon 9 (November 2012)*

‖ *Source: Exxon Mobil Baytown Olefins Plant TCEQ Air Quality Permit No. 102982*

¶ *Source: Formosa Plastics Corporation PSD Greenhouse Gas Permit Application - 2012 Olefins Expansion Project (November 2012)*

Impact Assessments

Air Quality and Health

The proposed facility will be located in Potter and Center Townships near the Ohio River in Beaver County. Beaver County is part of the Pittsburgh-Beaver Valley MSA. In addition to Beaver County, the MSA also includes the counties of Allegheny, Armstrong, Butler, Fayette, Greene, Lawrence, Washington, and Westmoreland. Pittsburgh, the seat of Allegheny County and largest city in the area, is about thirty-five miles southeast of the proposed facility location. Parts or all of the Pittsburgh-Beaver Valley MSA is currently designated as nonattainment for the following NAAQS: (1) 1997 8-hour ozone; (2) 2008 8-hour ozone; (3) 1997 annual $PM_{2.5}$; and (4) 2006 24-hour $PM_{2.5}$.[20] Allegheny and Beaver counties are currently designated as nonattainment for the 2010 1-hour SO_2 standard.[20] Beaver County is partially designated, including the area around the proposed facility site, as nonattainment for the 2008 lead standard.[20] The MSA which houses Beaver County is also downwind from Jefferson County in Ohio, and Hancock and Brooke counties in West Virginia, identified together as the Steubenville-Weirton area. The Steubenville-Weirton area is designated as nonattainment for the following NAAQS: (1) 1997 annual $PM_{2.5}$; (2) 2006 24-hour $PM_{2.5}$; and (3) 2010 1-hour SO_2 (partial designation).[20] This area is also designated as a maintenance area for the 1997 8-hour ozone standard.[20] Any additional pollution from new sources such as the proposed facility has the potential to exacerbate air pollution, so pre-construction and operation permits for the facility require compliance with the Clean Air Act's rules and associated regulation for NNSR.

What Types of Air Pollutants will be Released?

- Particulate Matter (10 and 2.5)
- Nitrogen Oxides
- Sulfur Dioxide
- Carbon Monoxide
- Carbon Dioxide Equivalents
- Volatile Organic Compounds
- Hazardous Air Pollutants

Due to the expected levels of emissions, the proposed facility will be regulated as a major source of air pollution. According to Shell, the facility is expected to emit significant amounts of air pollution including **NO_X**, **SO_2**, **$PM_{2.5}$**, **VOCs**, and **HAPs**. Table 5 includes health impacts of these pollutants, and the estimates for how much of each pollutant will be produced by the proposed facility. Human exposure to NO_X, SO_2, $PM_{2.5}$, and ozone, has been linked to increased risk of respiratory and cardiovascular symptoms, and with increased mortality rates.[28-30]

People exposed to nitrogen oxides are more likely to report respiratory issues such as coughing, shortness of breath or difficulty breathing, wheezing, and increased emergency room visits for asthma and other respiratory complications such as COPD.[31-37] Health impacts of NO_X on children are more serious when compared to those of adults because of children's smaller body sizes and higher breathing rates. In addition, some studies have indicated that there was an increase in respiratory related mortality among people exposed to NO_X.[35-39]

Similar effects have been revealed in studies on exposures to SO_2 which is another pollutant that will be emitted from Shell's ethane cracker. Short-term exposures to SO_2 can lead to a 20% increase in emergency room visits and admissions for respiratory complications.[40-47] Other studies have found that odds of suffering from cardiopulmonary disease are 30% higher in those who are exposed to SO_2.[48,49]

Of Residents Surveyed by Phone:

- 56% felt they were informed about air quality and environmental issues
- 87% were aware of the proposed facility
- 32% felt they were somewhat concerned about environmental and health impacts

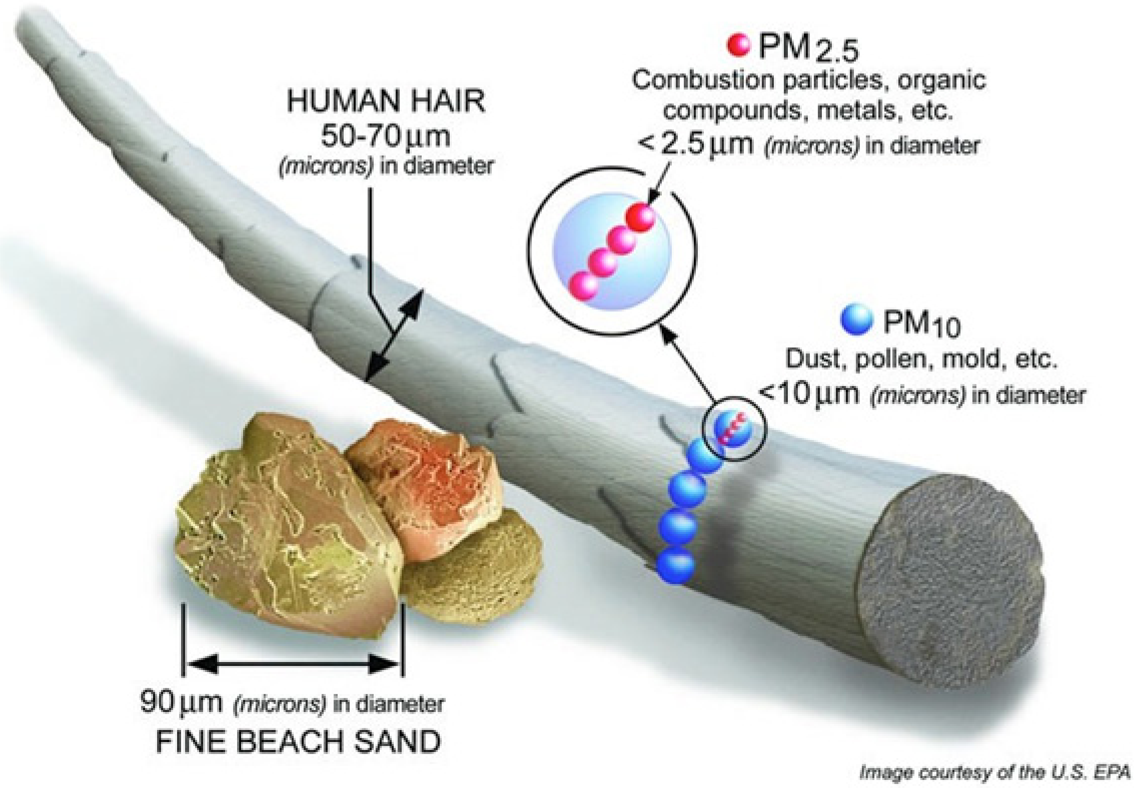


Figure 11. Particulate Size Comparison

Source: http://www.epa.gov/pm/graphics/pm2_5_graphic_lg.jpg

Long-term exposures to SO_2 have greater health implications even at lower concentrations, such as respiratory arrest, increased cancer risk and death,[50-52] and adverse prenatal and neonatal outcomes.[53,54] SO_2 emissions also impact the environment directly, leading to the formation of acid rain and reacting with other compounds to form particulates.

The proposed facility will also emit particulate matter (PM). Health risks associated with PM largely depend on the size of particles. Figure 11 shows particulate size compared to a strand of human hair. PM_{10} are particles that are between 2.5-10 micrometers in diameter and often called "coarse particles". $PM_{2.5}$ are smaller than 2.5 micrometers in diameter and are often referred as "fine particles". Both PM_{10} and $PM_{2.5}$ can be carried by the wind over long distances, resulting in the acidification of streams and lakes and nutrient depletion in the soil over a large area far from of the original source. Current research shows that long-term exposure to PM_{10}, even at lower concentrations, is associated with increases in cardiovascular mortality.[55,56] However, exposure to $PM_{2.5}$ may be of greater concern due to the smaller particles' ability to diffuse into smaller airways in the lungs and enter the bloodstream. Exposures to $PM_{2.5}$ has been shown to be associated with increased visits to the ER and hospitalizations, and missed work and school days due to exacerbated asthma or related respiratory complications.[53-58] $PM_{2.5}$ exposure has also been shown to increase risks for COPD, heart disease, stroke, and cardiopulmonary mortality.[59-72]

Ozone is formed through photochemical reactions between NO_X and VOCs. Ground-level ozone is the primary component of smog. Smog and ozone are known to cause respiratory health problems, and reduce lung capacity. Children are particularly vulnerable to outdoor ozone exposures due to higher amount of time spent outdoors, especially during the summer season. In a study in the greater Seattle, WA, area there was an observed positive association between ozone and emergency room visits for asthma-related cases, which suggests that ozone exacerbates asthma in people, especially in children.[75] In addition, ozone at peak concentration has been found to be associated with nearly 10-20 percent of all respiratory hospital visits and emergency room admission in the US.[76] It was also shown that children who were exposed to higher ozone levels were more likely to have current asthma and/or recent asthma attacks than children exposed to lower levels of ozone.[77] Ozone also has negative effects on vegetation and sensitive ecosystems, including parks and wildlife refuges, and has been linked to decrease in agricultural crop yield.[78]

Toxic air pollutants, also known as hazardous air pollutants (HAPs) are pollutants that are known or suspected to cause cancer and other serious health effects, such as reproductive or birth defects and adverse environmental effects.[79] Under the Clean Air Act the EPA is required to regulate 187 HAPs. This HIA will only examine a short list of HAPs that are of particular concern to the ethane cracker and their health impacts, which can be found in Tables 6 and 9. Exposures to HAPs at sufficient concentrations and duration may increase an individual's chance of getting cancer or experiencing other serious health effects such as damage to the immune system, neurological damage, reproductive and developmental impacts, and respiratory issues.[79] Howver, HAPs are not equally toxic at similar concentrations. Some HAPs have high risk even at very low exposure concentrations. Most HAPs are from human activity, such as driving cars, trucks, and buses, and stationary sources like factories, refineries, and power plants.[79] People are exposed to HAPs via many pathways, such as: breathing contaminated air, eating or drinking contaminated food and water, and through direct skin contact.[79]

94.3% of online survey participants were concerned about air pollution and 56% of phone survey participants were very concerned or somewhat concerned about air pollution.

Table 5. Health Impacts from Expected Emissions of Air Pollutants

Pollutant	NSR Threshold	Potential to emit	Environmental and Public Health Impacts
Particulate Matter 10 (PM_{10})	15 tons per year	164 tons per year	Particulate pollution — especially fine particles ($PM_{2.5}$) — can get deep into the lungs and cause serious health problems such as premature death in people with heart or lung disease, heart attacks, irregular heartbeat, aggravated asthma, irritation of the airways, coughing or difficulty breathing.
Particulate Matter 2.5 ($PM_{2.5}$)	100 tons per year	160 tons per year	
Nitrogen Oxides (NO_X)	100 tons per year	327 tons per year	Short-term exposure (30 mins to 24 hrs) is connected with respiratory inflammation in healthy individuals and increased respiratory symptoms in individuals with asthma. Elevated short-term exposure is connected with ER visits for respiratory issues. NO_X contributes to ozone formation.
Sulfur Dioxides (SO_2)	100 tons per year	22 tons per year	Short-term exposures ranging from 5 minutes to 24 hours, with an array of adverse respiratory effects including bronchoconstriction and increased asthma symptoms. These effects are particularly important for asthmatics at elevated ventilation rates (e.g., while exercising or playing).
Carbon Monoxide (CO)	100 tons per year	991 tons per year	Impaired oxygen delivery to vital tissues and organs affecting the cardiopulmonary and nervous systems. Immediate symptoms include dizziness, headaches, vomiting, nausea, fatigue, memory and visual impairment, and decreased muscular control.
Carbon Dioxide Equivalent (CO_2e)	100,000 tons per year	2,259,466 tons per year	At low concentrations carbon dioxide is not harmful to human health. At higher concentrations in a closed and confined space it can displace the oxygen in the air which can lead to asphyxiation. The biggest concern is carbon dioxide and similar greenhouse gases' contribution to climate change.
Volatile Organic Compounds (VOCs)	50 tons per year	484 tons per year	Some VOCs can cause cancer in animals; some are suspected or known to cause cancer in humans. Eye and respiratory tract irritation, headaches, nausea, dizziness, visual disorders, and memory impairment are among the immediate symptoms. VOCs contribute to ozone formation.
Hazardous Air Pollutants (HAPs)	N/A	41.9 tons per year	Cancer, reproductive effects or birth defects, adverse environmental and ecological impacts. May impact human health at low concentrations.

Source: U.S. Environmental Protection Agency; Shell Chemical Appalachia, LLC, Air Quality Plan Approval Application, Petrochemicals Complex, Beaver County, May 2014

Potentially variable emissions from the ethylene manufacturing process are expected to occur during: (1) normal operation, (2) startup, (3) shutdown, (4) **decoking**, and (5) hot standby of the cracking furnaces (SHELL 3-6). Emissions of methane and VOCs are also expected to result from equipment leaks: (1) cracking furnace fuel and process equipment; (2) quench water system; (3) cracked gas compression, **acid gas removal** and drying process area; (4) **cryogenic separation** area; (5) C_2 **fractionation**; (6) C_2 **hydrogenation** unit; and (7) spent caustic oxidation unit (SHELL, 3-6).

Table 6. Health Effects and Impacts from Hazardous Air Pollutants

Pollutant	Environmental and Health Effects
Benzene	Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin, and respiratory tract irritation, and, at high levels, unconsciousness. Chronic (long-term) inhalation exposure has caused various disorders in the blood, including reduced numbers of red blood cells and aplastic anemia, in occupational settings.
Ethylbenzene	Acute (short-term) exposure to ethylbenzene in humans results in respiratory effects, such as throat irritation and chest constriction, irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure to ethylbenzene by inhalation in humans has shown conflicting results regarding its effects on the blood.
Hexane	Acute (short-term) inhalation exposure of humans to high levels of hexane causes mild central nervous system (CNS) effects, including dizziness, giddiness, slight nausea, and headache. Chronic (long-term) exposure to hexane in air is associated with polyneuropathy in humans, with numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue observed.
Toluene	Acute (short-term) exposure to elevated airborne levels of toluene cause CNS dysfunction and narcosis symptoms such as fatigue, sleepiness, headaches, and nausea. Chronic inhalation exposure of humans to toluene also causes irritation of the upper respiratory tract and eyes, sore throat, dizziness, headache, and CNS depression.
Xylene	Acute (short-term) inhalation exposure to mixed xylenes in humans results in irritation of the eyes, nose, and throat, gastrointestinal effects, eye irritation, and neurological effects. Chronic (long-term) inhalation exposure of humans to mixed xylenes results primarily in CNS effects, such as headache, dizziness, fatigue, tremors, and incoordination; respiratory, cardiovascular, and kidney effects have also been reported.
Source: U.S. EPA; Agency for Toxic Substances and Disease Registry (ATSDR)	

Four types of emissions can be expected from the polyethylene manufacturing process: VOCs and particulate emissions from process vents, emissions from the sand pit, fugitive emissions from leaks, and **excess emissions** from startup, shutdown, maintenance or emergencies (SHELL, 3-16). The specific points of these emissions are considered confidential trade secrets by Shell and were redacted from the approval application (SHELL, Appendix D).

Flaring and Health

One of the major concerns of the community was the health and environmental impacts of flaring on the surrounding area. During flaring, by-products are burned and emitted in order to relieve pressure within the system, adjust product quality, and prevent disruptions in operations. According to the Council's online survey, 90% of respondents were concerned about flaring. Shell's estimated emissions for flares and incinerators indicate that annually flares and incinerators will be the largest emitters of **VOCs** in the facility (SHELL, 1-4). This amounts to an estimated 219 tons of VOCs emitted annually or 45% of the facility's total estimated VOC emissions (SHELL, 1-4). One purpose of flaring is to destroy VOCs, however, some VOCs are emitted from flaring due to incomplete combustion. Flaring will also emit carbon monoxide, nitrogen oxides, PM_{10} and $PM_{2.5}$, sulfur dioxide, sulfuric acid mist, HAPs, and carbon dioxide, quantifications of these estimated emissions can be found in Table 7. Flaring will also be a source of noise and light pollution within the area.

Flaring at the facility will consist of five flares: two high pressure ground flares, a high pressure elevated flare (emergency flare), a low pressure ground flare, and an elevated refrigeration system flare. High pressure ground flares will primarily be used for startup, shutdown, and maintenance of the ethane cracking unit and will take similar emissions from the polyethylene units (SHELL, 3-22). The high pressure elevated flare will only be used as a secondary system for pressure relief due to an emergency (SHELL, 3-23). The low pressure flare will be used to handle continuous and intermittent vents at the polyethylene facilities and tank emission control systems. The low pressure flare will only operate if the thermal incinerator's capacity is exceeded (SHELL, 3-23). According to Shell, normal operations of the proposed facility (startup, daily operation and production, facility shutdown) will not include elevated flares, although 20 minute flares might occur every 5-10 years.[80]

What is "Flaing"?

The burning and emitting of gas and chemical byproducts in order to prevent disruptions, relieve pressure within the system, and adjust product quality.

The emission of flaring pollutants could potentially bring associated health impacts, especially if the emission is from the elevated flare, where emissions may spread to the surrounding area. A more detailed study on the potential impact of these emissions on the surrounding area is recommended.

90.2% of online survey participants were concerned about flaring and burning of chemical waste.

Table 7. Shell Estimated Emissions for Flares and Incinerators

Pollutant	Flare and Incinerator Emissions (tons/yr)	Total Facility Emissions (tons/yr)	Percentage of Flaring and Incinerator Emissions vs. Total Facility Emissions
Carbon Monoxide	277	991	28
Nitrogen Oxides	74.8	327	23
Particulate Matter	4.6	79	6
PM_{10}	8.2	164	5
$PM_{2.5}$	8.2	164	5
Sulfur Dioxide	5	22	23
VOCs	219	484	45
CO_2e	147,708	2,259,446	7
Sulfuric Acid Mist	0.2	0.9	22
Total HAP	3.4	41.9	8
Source: Shell Chemical Appalachia LLC, Air Quality Plan Approval Application, Petrochemicals Complex, Beaver County, May 2014.			

Fugitive and Excess Emissions

Fugitive emissions are emissions that occur regularly during chemical transfer or during processes and cannot reasonably pass through a stack or vent and thereby be captured for destruction by a control device. Fugitive emissions will result from leaks in joints, valves, seals, pumps, flanges, and imperfections or cracks in transfer or containment infrastructure when capture is not possible.

Shell estimates the major sources of fugitive emissions will be from leaks in equipment, tanks, cooling towers, and pressure safety valves (SHELL, Appendix A Section B). These emissions will occur in the proposed ethylene and polyethylene manufacturing plants, associated tanks, cogeneration units, auxiliary engines, and waste water treatment plants.

What is Fugitive vs. Excess Emissions?

Fugitive emissions usually result from leaks in equipment (like joints or seals) when recapture is not possible; they are not stack emissions and happen during regular plant operation.

Excess emissions occur during maintenance, startup and shutdown of facilities or happen when equipment breaks down, and exceeds emission limitations.

Potential fugitive emissions include methane, **VOCs**, and **HAPs**. Leaks may occur during ethylene transmission, tail gas transmission, and ethane transmission, resulting in ethylene, hydrogen, and ethane leaks. The total yearly estimated emissions from the cracking furnaces, polyethylene manufacturing plants, and **outside battery limit (OSBL)** non-process emissions can be seen in Table 8 (SHELL, B-24 to B-26).

Levels of fugitive emissions depend greatly on how well the plant is being monitored for such emissions, good work practices and proper maintenance. The more complex the facility, the greater the possibility for fugitive emissions. A good maintenance and Leak Detection and Repair (LDAR) program should limit fugitive emissions.

Table 8. Shell Total Estimated Fugitive Emissions

	Emissions (Tons per Year)		
	Methane	VOCs	HAPs
Cracking Furnaces	4.1	17.4	3.6
Polyethylene Units 1-3	-	24.3	1.2
OSBL	1.4	5.7	0.6

Source: SHELL Appendix B 24-26

Unlike fugitive emissions, excess emissions do not happen during regular plant operation when equipment is functioning properly. Excess emissions occur during maintenance, startup and shutdown of facilities or happen when process or pollution control equipment breaks down. Any emissions that result from faulty pollution control devices, equipment, valves, seals, and joints are treated as excess emissions. Permits will have to contain conditions to prevent excess emissions and facilities are required to report these emissions to PA DEP since they would exceed applicable emission limitations.

Potential Cumulative Health Impacts

Assessing the **cumulative risks** and impacts of pollutants is important for understanding the potential public health effects from long-term exposure to a combination of different pollutants at the same time. Cumulative risk assessments are a useful tool to assess the risks of a proposed facility and potential new sources of pollution that facility may produce.[81]

The proposed facility will be sited near several other industrial sites, and major sources of air pollution along the Ohio River, including the AES Beaver Valley coal-fired power plant, a BASF manufacturing complex, and the NOVA Chemicals Beaver Valley facility. AES Beaver Valley and the BASF and NOVA Chemicals facilities are all directly adjacent to and within one mile of the proposed facility site. The FirstEnergy Bruce Mansfield coal-fired power plant and the FirstEnergy Beaver Valley nuclear power plant are located approximately 4 miles southwest of the proposed facility site, in Shippingsport, PA. A detailed quantification of air pollution emissions from these local facilities can be found in *Appendix D*.

Portions of the NOVA Chemicals site, presently owned by the Lyondell Environmental Custodial Trust, required remedial measures between 1999 and 2001 due to soil and groundwater contamination.[82] The primary pollutants included benzene, toluene, ethylbenzene, xylene, and styrene. EPA has determined that human exposure to contaminants is unlikely, but acknowledges groundwater monitoring data is insufficient to determine contamination migration and that further remedial investigations will be required.[82]

Collectively, these large sources of air and water pollution present potential combined impacts to human and environmental health. In most cases, evaluating cumula-

What are Cumulative Impacts?

Cumulative Impacts are the total combined effects on human and environmental health from environmental stressors, pollutants, hazards, and risks over a prolonged period of time.

tive health risk from long-term exposure to environmental hazards takes several years of study and data collection, combining results from human and animal exposure to pollutants at various distances from the pollutant source.[83] However, air **modeling** can be used to estimate potential risks from exposure to air pollutants. The amount of exposure and response of the body following exposure to the pollutant are analyzed along with the maximum lifetime exposure to generate a maximum individual lifetime risk. The estimated lifetime risk for exposure to various individual hazardous pollutants potentially emitted from the proposed facility can be seen in Table 9.

This individual risk does not take into account cumulative and interaction impacts between other stressors and multiple chemicals. An individual in the community is not just exposed to air pollution from industrial facilities; he or she is exposed to industrial air pollution, as well as regional air pollution, and may also be experiencing occupational (work-related) exposures, second-hand smoke exposures, along with any other household or individual factors (e.g. high stress living situations, poor diet, alcohol consumption, indoor air pollution) that increase risk for health complication. It is difficult to understand the extent to which individuals will be exposed to various chemicals, and the extent to which those specific exposures will combine to contribute to health problems. However, being exposed to more air pollution and more types of pollution increases the chance for these pollutants to impact human health.

Historical data for the greater Pittsburgh area does take into account various pollutants, computer modeled ambient concentrations of those pollutants, and specific population exposures to the population. From these factors, a relative lifetime (estimated at 70 years) cancer risk of the population can be obtained.[84] Currently, the EPA's target cancer risk increase is one in one million people having an increased risk of cancer as a result of air pollutants. According to the National-Scale Air Toxics Assessments (NATA) map seen in Figure 12, based on the 2005 EPA NATA report, the total lifetime cancer risk for Monaca is between 79 to 98 people in one million, over the EPA target.

Table 9. Risks from Inhalation Exposure to HAPs

Hazardous Air Pollutant	Cancer Classification Category	Cancer Risk Level	Concentration for cancer risk for lifetime exposure (μg/m³)	Reference Concentration for Chronic Inhalation Exposure (RfC) (μg/m³)*	Critical Effect for RfC
Benzene	A — Known Human Carcinogen	1 in 1,000,000	0.13 to 0.45	30	Decreased white blood cell count
Ethylbenzene	Inadequate information to assess carcinogenic potential	N/A	N/A	1,000	Development toxicity
Formaldehyde	B1 — Probable Human Carcinogen	1 in 1,000,000	0.08	N/A	N/A
Hexane	Inadequate information to assess carcinogenic potential	N/A	N/A	700	Damage to nerves in periphery or in the extremities.
Toluene	Inadequate information to assess carcinogenic potential	N/A	N/A	5,000	Neurological effects in occupationally-exposed workers
Xylene	Inadequate information to assess carcinogenic potential	N/A	N/A	100	Impaired motor coordination
Zinc	Inadequate information to assess carcinogenic potential	N/A	N/A	N/A	Information reviewed, but value not estimated. Has a reference dose for chronic oral exposure of 0.3 mg/kg/day
Source: U.S. EPA IRIS Database, *updated on 12/18/14*					

* *The inhalation Reference Concentration (RfC) is analogous to the oral RfD and is likewise based on the assumption that thresholds exist for certain toxic effects such as cellular necrosis. The inhalation RfC considers toxic effects for both the respiratory system (portal-of-entry) and for effects peripheral to the respiratory system (extra-respiratory effects). It is generally expressed in units of mg/m³. In general, the RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Inhalation RfCs were derived according to Methods for Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry (U.S. EPA, 1994). RfCs can also be derived for the noncarcinogenic health effects of substances that are carcinogens.*

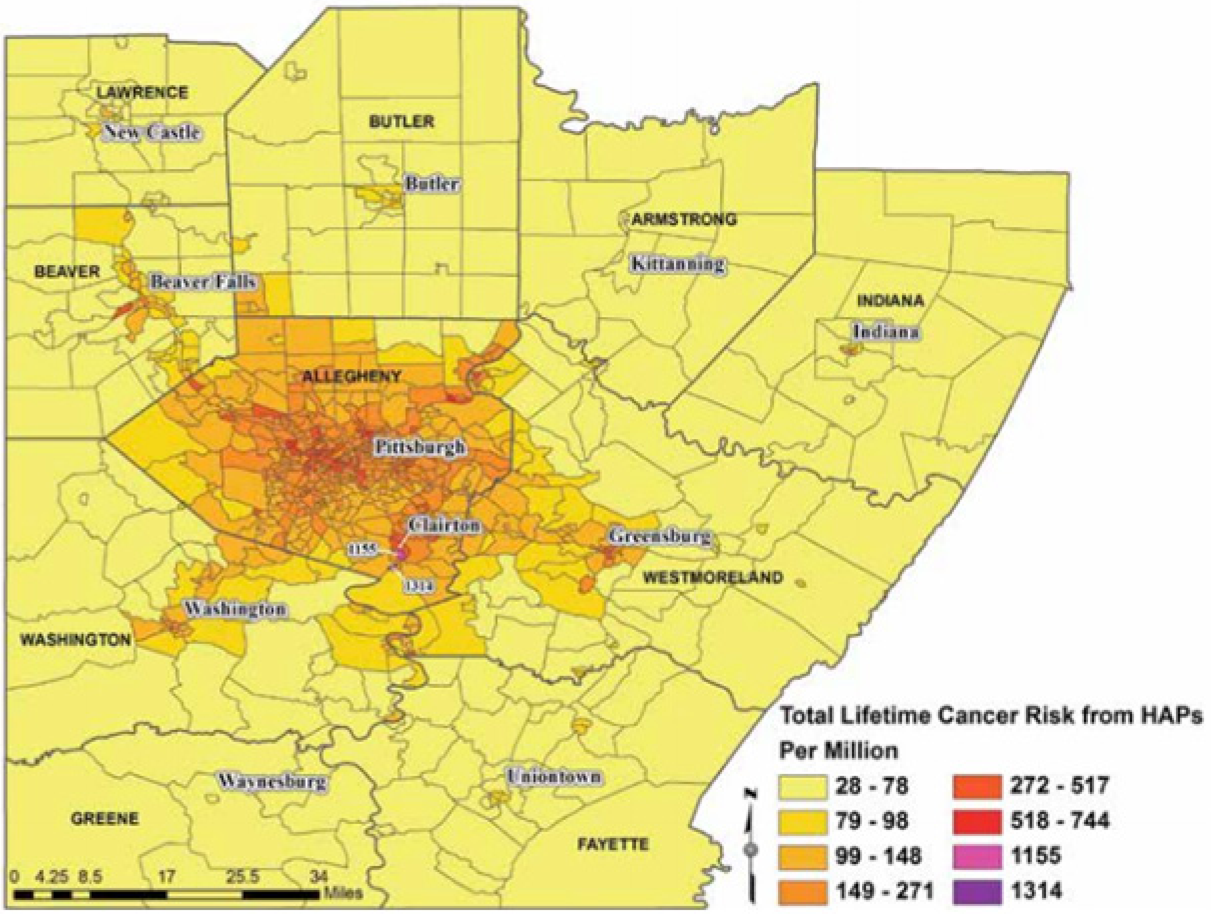


Figure 12. Region Map of Total Lifetime Cancer Risk Increase from Hazardous Air Pollutants[84]

Source: The Center for Healthy Environments and Communities (CHEC), *PRETA Air: Hazardous Air Pollutants*

It is important to note that the construction of a new ethane cracker will change the air chemistry in its vicinity. In 2002, the Horsehead zinc smelter, formerly located on the same site as the proposed facility was ranked among the largest sources of pollution in the country.[84] The zinc smelter will no longer be emitting roughly 5 tons of lead into the air per year, and the proposed facility will most likely emit trace amounts of lead.[84] However, this does not imply that all emissions will decrease when compared to the smelter. Facilities comparable to the proposed Shell ethane cracker have been known to emit significantly more VOCs than the former the Horsehead zinc smelter.[84] The estimated emissions in the Shell permit application (484 tons of VOCs per year) are much greater than that of the past emissions of the Horsehead zinc smelter (66 tons of VOCs per year) (SHELL Appendix B 24-26).

In addition to the cumulative impacts from existing industries, there could also be effects from other infrastructures and goods movement, such as ship traffic on the adjacent Ohio River and the air pollution from the rail yard. These impacts will not be discussed in this HIA, but should be examined further in a separate HIA.

Recommendations for Environment and Air Quality Impacts

Implementing the following recommendations for air quality could reduce potential negative health impacts from the proposed facility and improve community outcomes.

It is recommended that:

- ERCs be purchased from the same nonattainment area or an adjacent one, where the reduced emission offsets would benefit the local airshed.
- A dedicated and properly staffed phone number be established to address residents' concerns, complaints, and comments.
- A clear communications plan be established with community residents about facility emissions, making this data be open and easy to access through an emissions profile.
- Conditions of current local air quality in the community be readily accessible via internet, mobile devices, and through email or text-based alerts.
- Prior monitoring of air quality and study of estimated cumulative cancer risk take place before the proposed facility is constructed, and continue throughout its operating lifetime.
- Shell implement an active, fence-line monitoring system. This system would complement PA DEP monitors in Beaver Valley, Brighton Township, and Beaver Falls. Shell should use current technology to give nearby residents access to real-time, continuous air quality data.
- All environmental permits and enforcement actions be openly and easily accessible for the community without the need for a formal file review with PA DEP.

Both **excess** and **fugitive emission** monitoring and leak repair is important for maintaining good ambient air quality in the plant and surrounding areas. Shell does not state specific monitoring methods but does suggest there will be a method of enhanced leak detection and repair for its equipment leaks (SHELL, 5-12).

It is recommended that:

- A series of infrared (IR) cameras be placed throughout the facility and monitored by employees in order to detect and repair leaks in real time. This method of leak detection will not provide specific chemical concentrations but should prove effective in simple leak detection and facilitate quick repair.[85]
- **Differential absorption light detection and ranging (DIAL)** be used along with wind speed data to monitor the mass fluxes of specific gases leaving the site. DIAL can be done by an outside independent company periodically. Data can be made available to the public and will be useful for improved leak detection and combustion efficiency measurements for plant operation.[85]

The following recommendations are regarding Shell's Plan Approval Application — Appendix B: Emissions Estimates:

- Shell provide emergency flaring emission estimates. These are not included in Section 1.14 or Table B-27.
- Shell provide speciated (i.e., list individual pollutants) **fugitive** HAP emission estimates in Table B-2.
- Shell provide further explanation for the fact that valve leakage and other fugitive estimates account for LDAR at a high degree of control efficiency. This assumes that the facility will need to maintain strict preventive maintenance procedures to prevent fugitives from increasing. Shell bases its LAER control efficiency rates on TCEQ LAER LDAR program control effectiveness. Shell should verify and explain how these rates are applicable to Pennsylvania.
- Shell provide estimates for emissions of ethane and ethylene due to fugitive and stack emissions and provide discussion and/or dispersion modeling of these chemicals as ozone precursors and as greenhouse gases.

- Shell provide a visibility screening analysis in order to measure haze for nearby sensitive receptors, such as schools, residences, and senior centers.

The following recommendations are regarding Shell's Plan Approval Application — Appendix C: Air Dispersion Modeling and Class II Visibility Analysis:

- Shell conduct dispersion modeling of the criteria and hazardous air pollutant emissions for flares used during malfunction (emergency flaring).
- Shell consider conducting its own background ambient monitoring, instead of using older (2 to 4 years old) CO data from Pittsburgh (40 km away), and older (2 to 4 years old) NO_2 and PM_{10} data from Beaver Falls 9 km away. If on-site ambient monitoring for background levels is ruled out, Shell should provide a detailed explanation of that decision and request a waiver of that requirement. The *EPA Monitoring Guidelines* suggest that air quality monitoring data used to meet PSD data requirements should be "collected in the 3-year period preceding the permit application."
- Shell use recent meteorological data from 2009-2013. Bear Valley Nuclear Generating Station collects surface wind data continuously and that data should be included in Shell's analysis. *EPA Modeling Guidelines* encourage the use of data from the "most recent, readily available 5-year period."
- Shell model or provide an explanation of why no modeling was included for VOC as ozone precursor, even though the maximum potential VOC emissions for the site are 484 tons per year.
- Shell should conduct an air dispersion modeling analysis for benzene, formaldehyde, and other HAPs. These HAPs have a maximum emission potential of 42 tons per year. A significant portion of these emissions are **fugitive** (approx. 10%) and potentially at ground level.

The following recommendations are regarding Shell's Plan Approval Application — Appendix D:

- Shell provide a copy of Appendix D, which has been redacted from the Plan Approval application. Appendix D contains a Table D-4 showing which vents from the polyethylene process go to the control devices and, possibly, which are vented to atmosphere. Table D-5 has particulate controls.

Impacts from Construction Traffic and Development

What is a Transportation Conformity Determination?

Under the Clean Air Act, a determination that a transportation plan developed by a designated MPO facilitates attainment with the NAAQS, and does not cause or contribute to new violations, increase the frequency and severity of existing violations, or delay timely attainment of the NAAQS.

The main air pollutants that are relevant to this project during the development and construction phase of the proposed facility are particulate matter and emissions from construction equipment and traffic. Road dust from construction equipment can contain many different dangerous substances such as polycyclic aromatic hydrocarbons, particulate matter, and allergens.[86, 87] Vehicle emissions from construction activity cause air quality impacts. The air pollutants emitted or caused indirectly by vehicles are regulated by the EPA as criteria pollutants — O_3 (indirect), PM, CO, NO_X, and SO_2. Diesel exhaust is a toxic air pollutant due to its carcinogenicity, and its potential to cause premature death and health impacts. These health impacts disproportionately affect different segments of the population. Elderly, children, people with respiratory illnesses and heart disease, and people who have compromised immune systems are more severely impacted and more susceptible to air quality risks.[88, 89] In addition, low-income communities are often more likely to live closer to traffic hubs and areas of high industrial activity such as manufacturing and chemical processing.

In a study conducted in Fresno, CA, it has been shown that there are exacerbations in asthma symptoms with exposures to traffic-related pollution and particulate matter, where wheezing was significantly associated with exposures to ozone, nitrogen dioxide, $PM_{2.5}$, PM_{10}, and diesel exhaust.[73] It has also been observed that children who lived in areas of high volumes of vehicle traffic tended to have higher rates of asthma prevalence and reported cases of hospitalization for asthma-related emergencies, giving strong indication that traffic-related pollution exposures in children are associated to the development of asthma.[74] Further asthma symptoms were shown to have dose-response relationship with proximity to the source of air pollution, where it was shown that children who lived closer to the interstate highway or areas of high-volume traffic had higher prevalence of asthma symptoms and attacks compared to children who lived farther away.[73,74]

62.2% of online survey participants were concerned about excess traffic.

Traffic safety is another area of public health concern. The increased number of construction-related vehicles, increased traffic congestion, vehicle types, limits of existing road infrastructures — both current and newly constructed traffic patterns — and population density will have impacts to public health. Increased traffic during construction will lead to increased risk of injury and death due to vehicle-to-vehicle accidents and vehicle-to-pedestrian injury and death.[90-93] Driver behaviors such as fast driving, drowsy driving or fatigue, driving at night, and consumption of alcohol or other drugs are also a concern especially if there are increases in traffic in urban and suburban areas.[94,95] The impact on the region's transportation improvement program (TIP) will have to be assessed by the **Southwestern Pennsylvania Commission (SPC)** through a **transportation conformity determination**.

Impacts from Site Remediation

In 1996, PA DEP established the Land Recycling Program, more commonly referred to as Act 2. This package of acts promotes voluntary cleanup and reuse of contaminated commercial and industrial sites. According to PA

DEP, the purpose of the act is to "encourage public sector cleanup of contaminated, vacant or otherwise under-utilized properties and return them to productive use." *The Land Recycling Program* was designed to address four redevelopment hurdles including uniform cleanup standards, liability relief, standardized reviews and time limits, and financial assistance. The standards regarding the administration of the land recycling program are presented in *Chapter 250 of the Pennsylvania Code.*

The proposed facility will be located on a property that was a former zinc smelter. The soil at the site may be contaminated with zinc and other heavy metals. Due to this, soil remediation will most likely be required to meet the Act 2 Land Recycling standards prior to use. The latest Regional Screening Levels (RSL) for zinc and zinc compounds are 35,000 mg/kg for both the ingestion screening level and the noncarcinogenic screening level.

A detailed site characterization will be needed to determine the extent and types of the potential remediation. The site characterization reports will be useful to the public for understanding the potential next steps for preparing the existing site for use for the ethane cracker.

Recommendations for Construction Traffic and Development Impacts

Implementing the following recommendations for construction and development impacts could reduce negative health effects and improve community outcomes.

It is recommended that:

- Before construction begins and throughout the operation of the facility, signage is improved for all roadways near the facility to warn vehicles, cyclists, and pedestrians of new traffic patterns, increased truck traffic, on going construction, and industrial activities.
- Location of known school bus routes and schools should be considered when designating routes for construction vehicles, delivery vehicles, or operations going to the facility (i.e. pipelines).
- Before construction begins and through the lifetime of facility operations, roadways, sidewalks, and street lighting is maintained around facility and nearby residential areas.
- Vehicle dust, noise, and combustion emissions are controlled by spraying roadways, covering trucks when carrying materials that can be volatilized, reducing vehicle speed, and installing emissions control devices on all vehicles and equipment (e.g. diesel particulate filters and diesel oxidation catalysts).
- All heavy duty on-road vehicles should go through undercarriage wash stations for dust control.
- All diesel-powered equipment should use ultra-low sulfur fuel.
- All vehicles of Shell and its contractors should create, implement, and monitor an anti-idling plan for heavy duty vehicles and other diesel equipment. All truck drivers and equipment operators should be educated on anti-idling protocol. This protocol should be enforced by Shell through a global positioning system (GPS) and onboard diagnostics.

Any site remediation should be designed to protect the environment and public health during the process. Potential mechanisms and mitigation measures for environmental and health impacts during an extensive soil and groundwater remediation should include the following examples:

- Control for fugitive dust from the soil excavation and heavy metals emissions by water spray, chemical suppression, and speed limit restrictions for vehicles.

- Control for volatilization of solvents and other chemicals during remediation by ventilation capture followed by controls including afterburners, carbon adsorption, scrubbing, or condensation.
- Control for cross-media transfer of contaminants during cleanup activities by best management practices for soils treatment technologies, soil washing, thermal treatment, vapor extraction, bioremediation, incineration treatment, and other physical chemical treatment options.

The Council anticipates that the remediation measures to be proposed by Shell for the site will be based on a process that includes:

- A thorough assessment of the human health risks posed by contaminants at the site based on current best practices, including an EPA Superfund-type assessment.[96] As stated on the EPA website: "The baseline risk assessment is an analysis of the potential adverse health effects (current or future) caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). The baseline risk assessment contributes to the site characterization and subsequent development, evaluation, and selection of appropriate response alternatives."
- Adherence to all *Pennsylvania Land Recycling Program* requirements.[97] The four cornerstones for the land recycling program are: (1) uniform cleanup standards, (2) liability relief, (3) standardized use in time limits, and (4) financial assistance. The goals of the *Land Recycling Program* are to encourage public sector cleanup of contaminated, vacant or otherwise underutilized properties and return them to productive use.
- State-of-the-art remediation for soils and groundwater should be utilized as needed, based on the detailed site characterization.[98] Some of the general remediation approaches that have been successfully applied to the remediation of soils and groundwater include: isolation through capping or subsurface barriers, immobilization through solidification/stabilization or vitrification, toxicity or mobility reduction through chemical or biological treatment, and extraction through soil washing, pyrometallurgical extraction or electrokinetic treatment.
- Review of any nearby remediation activities for their potential impact on the subject facility should be performed.[99]

Quality of Life Related Health Impacts

Noise and Health

65.3% of online survey participants were concerned about noise pollution. 0% of phone survey participants had noise pollution as their major concern.

Noise is considered both an air pollution issue that impacts public health and a quality of life issue. Varying levels of noise and vibration can be expected for the construction phase and during plant operation (likely to be 24 hours a day, 365 days a year). There have been numerous studies centered around the potential health impacts of environmental noise from both natural ambient city noise and noise from construction projects. Noise pollution has been linked to stress, cardiovascular disease, sleep interference and hearing loss.[100] Noise pollution at night is particularly of concern for health as disturbed sleep can lead to mental health disorders or decrease a person's ability to cope with stress.[100, 101] Low-level chronic noise pollution has also been shown to stress children and increase blood pressures, heart rates, and stress hormone levels.[102] Noise pollution is also associated with decreased quality of life. Despite these adverse health effects, many air pollution enforcement agencies do not make addressing noise pollution a priority. Noise will continually be produced by the proposed facility and its surrounding operations starting from construction, and continuing throughout its operation.

Light and Health

57% of online survey participants were concerned about light pollution. Phone survey participants were not surveyed about light pollution.

Light pollution is ubiquitous in many areas, and is a threat to public health and residential quality of life. Many large industrial facilities have lights that can be visible for tens of miles, which are needed to allow for safe night time operation. Many environmental health scientists consider light pollution to be the fastest growing form of environmental pollution. Scientific research increasingly links light pollution with lasting adverse health effects on humans and wildlife.[103] The circadian clock or circadian rhythm, is the body's natural internal timekeeper that coordinates its biology and behavior with daily and seasonal changes in the day-night cycle. These processes include brain wave patterns, hormone production, cell regulation, and other activities like sleeping. Light pollution can disrupt or reset the circadian clock which has been linked to several medical disorders in humans, including depression, insomnia, cardiovascular disease, and cancer.[103] Light pollution could impact the community during construction and during normal operation of the proposed facility.

Community Livability

Of Residents Surveyed by Phone:

- 54% support the proposed facility
- 28% were unsure
- 14% were opposed

Of Residents Surveyed Online:

- 72.1% strongly oppose the proposed facility
- 69.4% were concerned about negative impacts on social wellbeing

As the plans for the plant continues to be unveiled and the community becomes more involved, there may be concern about the plant's impact on community livability. Home ownership is most families biggest financial investment. Air pollution, noise pollution, light pollution, impact on transportation infrastructure, increased truck traffic through neighborhoods all could impact community livability. Nearby industrial activity, especially if new industrial plants are built to capitalize on the opportunities created by the proposed facility, can impact property values, taxes, and the ability of schools and the local health system to accommodate a growing need.

Finally the siting and expansion of industrial facilities may also damage a neighborhood's social cohesion if some of the residents are strongly in favor of siting new plants and others are strongly opposed. This can be somewhat mitigated by Shell and local elected officials' willingness to do extensive outreach to nearby communities and genuinely listen and respond to community concerns.

Population Influx

As discussed, this project may result in a large spike in employment of non-local and local workers, especially during the construction phase. Previous impact assessments of similar facilities, and local reports indicate some adverse impacts attributable to increases in population, such as increased communicable and infectious disease such as hepatitis, colds, influenza, HIV/AIDS and other STDs, as well as increased crime, and drunk driving incidents. In addition to potential strains to the social fabric, population spikes also represent possible strain on local healthcare facilities and schools. Such concerns were raised in more in-depth interviews conducted by the Council.

Recommendations for Quality of Life Related Heath Impacts

Implementing the following recommendations for quality of life impacts could reduce negative health effects and improve community outcomes.

It is recommended that:

- Frequent town hall meetings take place between Shell plant managers and community to discuss on going concerns of residents and updates regarding the proposed facility such as violations, inspections, or changes.
- Sound walls or barriers be built to reduce noise pollution from construction and operations.
- Develop a dedicated phone number and communication plan between the facility manager and community to ensure any noise complaints are addressed promptly.
- To reduce light pollution, high intensity lighting should be used at a minimum during night hours and should only light up areas that are absolutely needed for safety and security.
- Lighting should always be pointing downwards and should be equipped with shields so that illumination does not spill over horizontally in surrounding areas.
- Shell implements a road dust control program during construction as well as during operation. This should include spraying roadways and sweeping roads in areas surrounding the facility and nearby residential areas.
- The power plant and effluent treatment facilities should be examined in separate additional HIAs in order to prevent possible environmental and health impacts unique to those facilities. Though the proposed power plant and effluent treatment facilities that may be constructed in addition to the ethane cracker will have an impact on the surrounding area, the effects of their construction and operation are outside of the scope of this HIA.
- Local officials should look to make an assessment of the adequacy of the pool of emergency responders and hospital resources to meet the needs of a rapid influx in population for numerous years.
- A "Community Health Center" be established by Shell that can be utilized by community residents.
- A "Community Health Fund" be created by Shell to provide free yearly health screenings for community residents and fund public health education. Such benefits for the community being asked to host and assume the risks associated with the siting of such industrial facilities are not uncommon.

Of Residents Surveyed Online:

- 72.1% strongly oppose the proposed facility
- 28% were unsure
- 14% were opposed

What is IMPLAN and I-O Analysis?

Input-output (I-O) analysis measures the economic impacts of cooperatives and other enterprises, usually over a one year period. I-O models offer a "snapshot" of the economy, detailing the sales and purchases of goods and services between all sectors of the economy.

The IMPLAN modeling system is one type of I-O (input-output) modeling method that combines the U.S. Bureau of Economic Analysis' Input-Output Benchmarks with other data to construct quantitative models of trade flow relationships between businesses and final consumers. From this data, one can examine the effects of a change in one or several economic activities to predict its effect on specific state, regional, or local economies (impact analysis). The IMPLAN input-output accounts are based on industry survey data collected periodically by the U.S. Bureau of Economic Analysis and follow a balanced account format recommended by the United Nations.

In September of 2012, the **Pennsylvania Economy League of Greater Pittsburgh (PELGP)** performed an economic impact analysis of the proposed facility in Beaver County. In addition to the 2012 PELGP report, Shell has commissioned the Robert Morris University in Moon, PA to conduct an additional economic impact study. At the time of this HIA, the Robert Morris Study has not been completed, but the results will be made available to the public in the future. PELGP estimates that during construction the project will create 10,000 direct construction jobs as well as another 8,000 indirect or induced jobs. Indirect jobs are jobs created in businesses that supply goods and services to the cracker facility, while induced jobs are jobs created when people who have gotten the direct and indirect jobs spend their money in the community. Once in operation, this study estimates that the plant will employ 400 people (SHELL, Appendix E 2.1). There will also be additional 2,000 to 8,000 indirect and induced jobs.

The PELGP study used IMPLAN methodology to estimate these job results. This is a methodology which is commonly used by academics and researchers to estimate the economic effects of a new policy. The direct job numbers from this study seem reasonable. A proposed Chevron cracking plant in Baytown, TX is estimated to create 400 permanent jobs at the plant and 10,000 temporary construction jobs.

However, the indirect and induced job estimates are on less solid ground. This issue with these job estimates is that they critically depend on assumptions made by the authors of the study and they are inherently speculative:

- Percentage of jobs going to workers in the community vs. the workers being brought in from other states.
- Percentage of income workers spend vs. the percentage they save.
- Percentage of income workers spend in the community vs. the percentage they send out of the community.

Of Residents Surveyed:

- 50.2% of online participants would like to see job opportunities arise from the proposed facility
- 51% of those surveyed by phone would like to see job opportunities arise
- 72.4% of online participants would like to see community improvements

The Council contacted PELGP and Shell to determine what assumptions were used in their economic impact study. PELGP was unable to provide comment. However, Shell was able connect the Council with their economist and addressed the Council's questions.

The Council asked Shell how indirect and induced job numbers were calculated. Shell responded that they used commonly used methodologies, IMPLAN and RIMS. The Council then asked Shell why there was such a large margin for predicted indirect/induced jobs. Shell responded that this was due to the use of two different models with different levels of specificity.

Several outstanding issues remain regarding Shell's economic projections. First, it is not not clear what percentages of employees Shell expects to employ locally, as opposed to what percentage will be brought in from outside the community. Shell anticipates that the project will draw from the Pittsburgh area, Ohio, and West Virginia. Further, Shell's analysis does not address how much economic growth is expected from the influx of new hires. It is also unclear whether any jobs would be transferable from the former Horsehead zinc smelter.

The Council also examined other studies done by PELGP in recent years. Though the industries differ, the analysis should be somewhat similar. For a 2011 study on the steel industry, PELGP found that 4.55 indirect jobs were created for every direct job.[104] A 2010 study by PELGP on the coal industry found that 3.77 indirect jobs were created for every direct job.[105] In a 2008 study for the oil and gas industry, PELGP found that 1.52 indirect jobs were created for every direct job.[106] In the 2012 study on the ethane cracker, PELGP found that 5-20 indirect jobs would be created for every direct permanent job.[107]

A final issue is the idea of efficiency of job creation. While some jobs will be created, the $1.7 billion tax credit given to Shell by the Commonwealth of Pennsylvania may not be the best use of those dollars. For instance, if Pennsylvania eliminates that tax credit and instead uses that money to reduce tax rates for businesses across Pennsylvania, then those businesses may be able to create jobs as well. This tax credit has been the single largest tax break in the Commonwealth's history and would also provide tax amnesty for fifteen years, meaning Shell would not have to pay state or local taxes during that period.

Employment and Health

A large amount of research has shown that employment with stable income plays a large role in an individual's health. Having stable income is key to increasing access to medical care, promoting healthier lifestyles such as safe places for work and play, as well as enabling people to better manage stress.[108,109] On a personal level, employment and income are one of the core determinants of health.[109] Research shows that health status and outcomes and perceptions of health are different across the spectrum of socioeconomic status. In most cases those who are at a lower socioeconomic status and education level are at increased risk for adverse health outcomes.[109,110] Unemployment or low income has been associated with increases in stress, depression, and mental disorders, chronic disease such as heart disease, and some cancers. Full employment and increased income in families or individuals has been shown to improve health outcomes, improve access to better health care, reduce mental health impacts, reduce stress, and increase overall quality of life.[79]

PELGP Job Creation Estimates:

- 400 permanent jobs at the facility
- 10,000 temporary jobs
- 2,000-8,000 indirect jobs

Recommendations for Economics and Employment

Due to the lack of economic data that was available to the Council, the following recommendation for economics and employment are limited, however implementing the following recommendations for economics and employment could reduce negative health impacts and improve community outcomes.

It is recommended that:

- Shell prioritize hiring local contractors and skilled laborers for both construction and operation of the facility.
- Shell make educational training investments for local high school, junior/community college, and technical schools; ensuring that there is a future pool of local skilled laborers to select from to employ at the facility.
- Shell develop and provide an internship or apprenticeship program for the local population. This program should provide hands-on onsite training within the petrochemical facility, as well as a retraining program for former zinc smelter employees to develop skills necessary to work at the proposed facility.
- Shell share how it arrived at the figure for the number of jobs this plant may create so that the calculations can be independently reviewed.

An industrial processing facility of this type will come with certain risks in terms of unintended consequences associated with startup and shutdown operations. The following section describes the nature of these events, as well as their likelihood, based on information received from Shell engineers. Shell is required by law to have risk management plans that meet certain criteria, seen in the Risk Management Plan Requirements section below.

Flaring and Explosions

Historically, one of the more visible aspects of cracker operation is flaring. Flaring involves the burning and release of high pressure gas and chemical storages. Emergency flaring can release large amounts of NO_X, VOCs, and air toxics. Older facilities may have to flare more regularly and for longer periods of time than newer facilities such as the one proposed. According to Shell, startup, operation, and shutdown, with contemporary technology, can be handled without elevated flare. Additional processing, and "recycled loops" of gases and chemicals into individual storage vessel columns are all maintained to specifications required by permit, which reduce the need for flaring.

While flaring may be less likely in this facility in comparison to older ones, it will still occur (e.g. due to power grid failure). According to Shell, normal operations of the proposed facility (startup, daily operation and production, facility shutdown) will not include elevated flares, although 20 minute flares might occur every 5-10 years.[80] Aside from flaring events, the site will continually house large quantities of flammable substances that require accident prevention strategies.

Even with good operating practice and pressure controls through flaring, historically explosions at ethane and ethylene processing plants have been an issue. In 1989 an explosion and fire killed 23 workers at the Phillips 66 polyethylene plant in Pasadena, TX.[112] In 1997 a check valve failed at a Shell olefins plant in Deer Park, TX, causing a large explosion heard and from up to ten miles away.[113] As recently as June 2013, an explosion at Williams Olefins in Geismar, LA killed two people and injured 80 after a failure to find and correct safety violations.[114] It is recommended that extensive safety training, regular independent plant inspection, and regular maintenance be performed in order to avoid any equipment failure or violations that may result in similar incidents at the Shell facility.

Accident and Risk Management Plan Requirements

Based on information provided by Shell, the facility is expected to exceed the threshold quantity for accidental release prevention for flammable substances as defined in *Table 3 to § 68.130 — List Of Regulated Flammable Substances and Threshold Quantities For Accidental Release Prevention*. Exceeding the threshold quantity means that the facility will have greater than 10,000 pounds of a flammable substance (flammable gas or a volatile flammable liquid) on-site at any one time. The flammable substances that will be present at the facility that may exceed the threshold quantity include ethylene, methane, ethane, propane and propylene.

Shell will be required to comply with the *EPA Risk Management Plan (RMP) Rule* that implements Section 112(r) of the Clean Air Act which applies to facilities that use extremely hazardous substances. Their written RMP plan must be submitted to U.S. EPA and must address the following three primary areas:

- Hazard assessment of accidental releases describing the potential effects of an accidental release and evaluating worst-case accidental releases.
- Prevention program equivalent to that outlined in the *OSHA Process Safety Management of Highly Hazard-*

ous Chemicals standard (29 CFR 1910.119) and including safety precautions and maintenance, monitoring, and employee training measures.

- Detailed emergency response program that could be implemented should an accident occur that involves one of the chemicals that exceeds the threshold quantity.

Recommendations for Emergencies and Management Practices

Implementing the following recommendations for emergencies and management practices could reduce negative health impacts and improve community outcomes.

It is recommended that:

- Shell establish open communication among EPA, PA DEP, and the community regarding inspections, flaring, and violations.
- There are on going first responder training to prepare for any events that may occur at the proposed facility.
- Shell establish a warning system that will alert the community of any emergency that occurs.
- Shell conduct extensive safety training, regular independent plant safety inspections, and regular maintenance to prevent any equipment failures or violations at the proposed facility.

Summary of Recommendations

The Council recommends that:

- ERCs be purchased from the same nonattainment area or an adjacent one, where the reduced emission offsets would benefit the local airshed.
- A dedicated and properly staffed phone number be established to address residents' concerns, complaints, and comments.
- A clear communications plan be established with community residents about facility emissions, making this data be open and easy to access through an emissions profile.
- Conditions of current local air quality in the community be readily accessible via internet, mobile devices, and through email or text-based alerts.
- Prior monitoring of air quality and study of estimated cumulative cancer risk take place before the proposed facility is constructed, and continue throughout its operating lifetime.
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- Shell use recent meteorological data from 2009-2013. Bear Valley Nuclear Generating Station collects

surface wind data continuously and that data should be included in Shell's analysis. *EPA Modeling Guidelines* encourage the use of data from the "most recent, readily available 5-year period."

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Construction and Development

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- Control for volatilization of solvents and other chemicals during remediation by ventilation capture followed by controls including afterburners, carbon adsorption, scrubbing, or condensation.
- Control for cross-media transfer of contaminants during cleanup activities by best management practices for soils treatment technologies, soil washing, thermal treatment, vapor extraction, bioremediation, incineration treatment, and other physical chemical treatment options.
- A thorough assessment of the human health risks posed by contaminants at the site based on current best practices, including an EPA Superfund-type assessment.[96] As stated on the EPA website: "The baseline risk assessment is an analysis of the potential adverse health effects (current or future) caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). The baseline risk assessment contributes to the site characterization and subsequent development, evaluation, and selection of appropriate response alternatives."
- Adherence to all *Pennsylvania Land Recycling Program* requirements.[97] The four cornerstones for the land recycling program are: (1) uniform cleanup standards, (2) liability relief, (3) standardized use in time limits, and (4) financial assistance. The goals of the *Land Recycling Program* are to encourage public sector cleanup of contaminated, vacant or otherwise underutilized properties and return them to productive use.
- State-of-the-art remediation for soils and groundwater should be utilized as needed, based on the detailed site characterization.[98] Some of the general remediation approaches that have been successfully applied to the remediation of soils and groundwater include: isolation through capping or subsurface barriers, immobilization through solidification/stabilization or vitrification, toxicity or mobility reduction through

chemical or biological treatment, and extraction through soil washing, pyrometallurgical extraction or electrokinetic treatment.

- Review of any nearby remediation activities for their potential impact on the subject facility should be performed.[99]

Quality of Life

The Council recommends:

- Frequent town hall meetings take place between Shell plant managers and community to discuss on going concerns of residents and updates regarding the proposed facility such as violations, inspections, or changes.
- Sound walls or barriers be built to reduce noise pollution from construction and operations.
- Develop a dedicated phone number and communication plan between the facility manager and community to ensure any noise complaints are addressed promptly.
- To reduce light pollution, high intensity lighting should be used at a minimum during night hours and should only light up areas that are absolutely needed for safety and security.
- Lighting should always be pointing downwards and should be equipped with shields so that illumination does not spill over horizontally in surrounding areas.
- Shell implements a road dust control program during construction as well as during operation. This should include spraying roadways and sweeping roads in areas surrounding the facility and nearby residential areas.
- The power plant and effluent treatment facilities should be examined in separate additional HIAs in order to prevent possible environmental and health impacts unique to those facilities. Though the proposed power plant and effluent treatment facilities that may be constructed in addition to the ethane cracker will have an impact on the surrounding area, the effects of their construction and operation are outside of the scope of this HIA.
- Local officials should look to make an assessment of the adequacy of the pool of emergency responders and hospital resources to meet the needs of a rapid influx in population for numerous years.
- A "Community Health Center" be established by Shell that can be utilized by community residents.
- A "Community Health Fund" be created by Shell to provide free yearly health screenings for community residents and fund public health education. Such benefits for the community being asked to host and assume the risks associated with the siting of such industrial facilities are not uncommon.

Economic

The Council recommends:

- Shell prioritize hiring local contractors and skilled laborers for both construction and operation of the facility.
- Shell make educational training investments for local high school, junior/community college, and technical schools; ensuring that there is a future pool of local skilled laborers to select from to employ at the facility.
- Shell develop and provide an internship or apprenticeship program for the local population. This program should provide hands-on onsite training within the petrochemical facility, as well as a retraining program for former zinc smelter employees to develop skills necessary to work at the proposed facility. Shell prioritize hiring local contractors and skilled laborers for both construction and operation of the facility.
- Shell share how it arrived at the figure for the number of jobs this plant may create so that the calculations can be independently reviewed.

Emergency and Management

The Council recommends:

- Shell establish open communication among EPA, PA DEP, and the community regarding inspections, flaring, and violations.
- There are on going first responder training to prepare for any events that may occur at the proposed facility.
- Shell establish a warning system that will alert the community of any emergency that occurs.
- Shell conduct extensive safety training, regular independent plant safety inspections, and regular maintenance to prevent any equipment failures or violations at the proposed facility.

Summary of Findings

Shell's proposed facility will have an impact on local ambient air quality. The degree of this impact is currently estimated but not fully understood. Due to this, air quality data should be collected during facility construction and operation and estimated before construction takes place. It is recommended that there be transparency throughout planning, construction, and operation of the facility. The community should be informed and notified about air quality. It is also recommended that Shell work within the community, keeping jobs local, and developing local health and education programs. It is important that Shell and the community maintain an open dialogue about the proposed facility before, during, and after construction.

Shell's Plan Approval documents are cited a significant amount in this HIA. They will be denoted within the HIA with special citation as (SHELL page#). All other references will conform to IEEE standard formatting for endnotes.

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Appendices

Appendix A: Public Awareness Survey Findings

Survey Background

In an effort to engage the public and gather information, the Council conducted two surveys, an anonymous online survey and a phone survey of 400 randomly chosen registered voters. These surveys were designed to gauge public awareness and opinion regarding the proposed facility and its associated impacts. The data from these surveys was used to inform the Council and guide the content of this HIA.

Survey Conclusions

Phone survey data suggests that a majority of Beaver County voters feel somewhat informed about environmental health issues. The Council recommends that some environmental education be provided when communicating with the community regarding the proposed facility. This education can serve as a supplement to the community's existing knowledge base and help educate the minority of less informed Beaver County citizens. Phone survey data also indicated that 12% of citizens were not aware of the proposed facility and 28% don't know whether they support or oppose the proposed facility. The Council recommends that an outreach effort take place in order to inform the Beaver County community about the proposed facility.

Both online and phone survey data indicated that a majority of citizens were somewhat concerned to very concerned about the environmental and health impacts of the proposed facility. The Council conducted this HIA in an attempt address these concerns and further educate the community. The Council suggests that further study be conducted to ensure that all community concerns are addressed.

Online and phone survey data also suggested that citizens wish to see various benefits arise from the construction of the proposed facility. A majority of respondents wanted to see potential job opportunities arise; respondents also wanted to see increased local business activity and community and infrastructure improvements as a result of the construction of the proposed facility. The Council has outlined some of these benefits in this HIA and has suggested measures to help meet community expectations.

The random voter phone survey and online survey have been useful tools for community engagement and for crafting a more community-based and informed HIA. They have assisted in the accurate assessment of community concerns and expectations, and in collecting community ideas and contact information for use in further community engagement. Any questions regarding survey design and execution should be addressed to John Lee, MPH (jlee@cleanair.org) or Joseph Minott, Esq. (joe_minott@cleanair.org).

Questions and Results (400 Voters)

Percentages represent the percent of 400 respondents who chose each response option:

1. How informed are you when it comes to environmental health issues such as air quality?
   a) Very informed (20%)
   b) Somewhat informed (56%)
   c) Not too informed (16%)
   d) Not informed at all (7%)
   e) Don't know (1%)

2. Are you aware that Shell Chemical is considering building a large-scale natural gas and chemical processing "ethane cracker" plant in Beaver County?
   a) Yes (87%)
   b) No (12%)
   c) Don't know (1%)

3. As I mentioned, Shell Chemical is considering building an "ethane cracker" plant in Beaver County. From what you know about it, do you support or oppose the "ethane cracker" plant being built in Beaver County.
   a) Support (54%)
   b) Oppose (14%)
   c) Don't Know (28%)
   d) Unanswered (4%)

4. How concerned are you about the environmental and health impacts from the proposed "ethane cracker" plant?
   a) Very concerned (24%)
   b) Somewhat concerned (32%)
   c) Not too concerned (21%)
   d) Not concerned at all (18%)
   e) Don't know (5%)

5. Which of the following is your biggest concern about the proposed "ethane cracker" plant?
   a) Air pollution (18%)
   b) Water pollution (28%)
   c) Noise pollution (0%)
   d) Excess traffic (7%)
   e) Construction (1%)

f) Explosion/other safety issue (9%)
g) All (15%)
h) None (17%)
i) Don't know (5%)

6. Which of the following benefits would you most like to see emerge from the building of the "ethane cracker" plant?
   a) Job opportunities (51%)
   b) Education and job training (4%)
   c) Community improvements (6%)
   d) Road construction/repair (3%)
   e) More local business activity (8%)
   f) All (21%)
   g) None (3%)
   h) Don't know (4%)

Online Survey

The online survey was completed as a preliminary survey (before the phone survey), in lieu of contacting residents directly through canvassing. The intention of the online survey was to reach the people closest to the site of the proposed facility; however, anyone was able to complete the survey as the online survey was circulated via email and social media. Follow up calls and interviews were conducted with some respondents after completion of the online survey. These follow up calls were separate from the phone survey and considered part of the online survey. To request a copy of the survey contact John Lee, MPH (jlee@cleanair.org).

Advantages and Disadvantages to Online Survey

Online surveys are useful tools for conducting preliminary research on a population, gauging initial opinions and attitudes, and establishing initial contact with residents. An online survey allows for more flexibility than phone surveys or canvassing; open ended questions can be asked, the survey may be taken at any time, and the survey can be distributed by residents to neighbors, local organizations, and community leaders.

However, this flexibility also results in data that must be looked at with careful scrutiny. The Council's online survey could not limit multiple submissions, so it is conceivable the survey may have been taken multiple times by the same person. Volunteer online surveys do not take truly random samples of the population, resulting in potential sampling and selection bias. Data collection occurred through email blasts, social media posts, and word of mouth; all of these methods may contribute to sampling and selection bias. Response bias, the influence of a respondent's answers based on the phrasing of the questions, was also a concern. The Council aimed to limit response bias by working with a professional third-party survey design firm in order to craft questions in a way that would not skew results.

This survey and the follow-up interviews with residents helped the Council gain a better understanding of public opinion and awareness of the proposed facility. The survey also served as an effective starting point and guide for the subsequent phone survey.

Results from Cracker HIA Online Community Survey (n = 198 as of October 17th 2014)

1. How far do you live from Monaca, PA (Beaver County)?
   a) 0-10 Miles (27.4%)
   b) 11-30 Miles (46.2%)
   c) 31-100 Miles (22.2%)
   d) 101+ (4.1%)

2. Before hearing about this survey were you aware that Shell Oil is considering building a large-scale natural gas and chemical processing "ethane cracker" facility in Beaver County, PA?
   a) Yes (82.1%)
   b) No (17.9%)

3. In your opinion how likely is it that the proposed cracker will be built in Beaver County, PA?

a) Very Likely (27.4%)
b) Somewhat Likely (30.5%)
c) 50/50 (20.8%)
d) Somewhat Unlikely (7.6%)
e) Very Unlikely (4.1%)
f) Unsure (9.6%)

4. Are you in favor of the facility being built in Beaver County?
    a) Strong in favor (9.1%)
    b) In favor (4.1%)
    c) Neutral (4.6%)
    d) Somewhat against (7.1%)
    e) Strongly Against (72.1%)
    f) Unsure (3.0%)
5. What benefits would you most like to see emerge from industrial activities in your area? (please select all that apply)
    a) Job opportunities (59.2%)
    b) Education/training opportunities (36.2%)
    c) Community Improvements (e.g. bike paths, tree planting) (72.4%)
    d) Road and Bridge construction (44.1%)
    e) Enhanced local business activity (61.2%)
6. Are you worried about environmental and health impacts from the facility?
    a) Very worried (77.7%)
    b) Worried (10.2%)
    c) Just a little worried (6.0%)
    d) Not at all worried (5.1%)
    e) Indifferent (1.0%)
7. Do you have any concerns about the facility (Please select all that apply)
    a) Air pollution (94.3%)
    b) Water pollution (92.7%)
    c) Noise pollution (65.3%)
    d) Light pollution (57%)
    e) Excess traffic (62.2%)

f) Flaring and burning of chemical waste (90.2%)
g) Change in housing availability (35.8%)
h) Negative impact on social well-being (69.4%)
i) (OTHER – PLEASE SPECIFY)?

[*Editor's note: Responses to open-ended questions have not been edited or altered.*]

- Who will pay for medical treatment when the local population becomes ill?
- Home values going down
- Perpetuates the climate change status quo
- An epidemic of mistrust among residents who formerly trusted each and worked for the "common" good
- Cancer rates
- Detrimental socio-economics for local inhabitants
- I'm concerned about citizens accepting the lies made by the fossil fuel extraction cartel and its PR machine that dulls our imagination for a better world with its messages of domination and inevitability. There is a deliberate attempt to not study the effects of drilling on our overall wellbeing on not only human health, but on other species within complex, but fragile ecoysystems. There is no concern for the externalities being borne by average small town and rurual Pennsylvanian. They and their property are sacrificial lambs.
- Climate imbalance and melting ice that will cause tectonic and methane disruption in the arctic and antarctic
- The gas drilling industry is temporary. What happens when all the resources run dry in 10-15 years?
- Increase in crime, prostitution, etc. associated with gas industry
- Corruption of politicians, total disregard of the health of Beaver Countians
- Global warming
- The cracker plant will bring in other industries that will be equally polluting such as tires, fertilizers, chemicals other plastics plus far more drilling for natural gas, pipelines, compressor stations
- Will create chronic health issues
- Plant Safety
- Unacceptable threat the public health and safety
- Out of state workers bring drugs, sex, crime, and diseases
- Real Estate devaluation
- Chemical spills – see West Virgina. Birth defects and medical issues for residents.
- Illness as a result of the pollution, ground pollution
- Decrease in property valuables
- Devaluation of property values
- Light and vibration pollution
- None, It is being built by a world class organization

- No concerns. Shell is a fine company.
- Smell
- Increased health risks
- All, I'm uninformed about this issue
- Death
- Industrial accidents
- Corruption and lying by Shell
- Long-term medical effects
- Explosions
- Taxes will go up
- Health impacts, where the money will come from to study these impacts
- Cancer risks
- Clean up once it's abandoned
- Economic impact because people won't move here
- Economic burden on surrounding communities, e.g., need to train first responders about chemical hazards, situations.
- No viable clean water
- Increased production of petroleum based chemicals
- Boom/Bust of the gas business. Excavation of and remediation of the current site. Misrepresentation of benefits to the public at large.

8. Do you have any other comments, suggestions, or questions? (Open-ended question)

[*Editor's note: Responses to open-ended questions have not been edited or altered.*]

- More concerned about negative effects of eventual fracking
- It is increasingly obvious that the regulations do not exist that would keep this plant from causing irreparable damage to residents and the environment. Accidents happen everyday that contaminate air and water, sometimes for generations of people before it's ever found out. This happened to me: http://en.wikipedia.org/wiki/Perfluorooctanoic_acid
- Ban fracking now
- the huge tax break is not warranted.
- Bring in solar, geothermal, wind, biofuel...clean and sustainable.
- Natural gas fracking is only profitable because the real costs to our residents and environment are being swept under the rug. That and the subsidies paid by the state or feds in exchange for campaign support. If the companies had to pay restitution for the fresh water lost, the medical conditions, the pollution cleanup... there is no way we would consider this a viable energy solution.
- This is already going threw this servey is a little late the gas company's do whatever they want

- We need to increase renewable energy sources. We do not need bridge fuels. We have other technologies which do not pollute as do fossil fuels.
- We are preparing to move out of the area if built.
- I moved to Beaver County for the benefits of living on a farm in a healthy rural area. I drive 40 miles one way to work everyday in order to live my dream. I don't want fracking and the use of that gas in a pollution filled plant to ruin my environment.
- Also concerned about the danger of explosions. (I am a member of the Beaver County Marcellus Awareness Committee and we are currently working on protecting our drinking water fracking at the Ambridge Reservoir, Service Creek watershed.)
- More importantly than distance from cracker plant is whether your down wind. Most of the time wind comes from the west around here. I'm very concerned with amount of air pollution from the cracker plant and all other industries that come along. We already have very bad air quality around here. I don't believe our politicians have the know how or ability to make sure the plant is built with all restrictions and regulatory components to make sure it will be built to cleanest standards
- Do not build the plant in Beaver County.
- I want Shell to do landscape-level land conservation in the Raccoon Creek Valley corridor. This is necessary to preserve the area green space. Thank you.
- Shell has the opportunity to do landscape-level land conservation in the Raccoon Creek valley and should do so.
- be the first GREEN cracker plant ever built. Keep the local forest and greenspace intact and enhance wildlife and the ecology for childrens sake.
- Light pollution can be minimized but will Shell do it without being forced to? There will be no nighttime in Beaver, Vanport, parts of Industry, Center and Potter. Living things need darkness to remain healthy and sane. This may be the hardest battle because light pollution is not on people's radar screens around here. Shell has the opportunity to do landscape-level land conservation and greenway establishment in the Raccoon Creek valley by acquiring and conserving Horsehead's forested acreage. If Shell doesn't conserve the Raccoon Creek valley it will get ruined with self-storage units, parking lots, trailer parks and cracker box houses. The Ohio River Slopes are a Biological Diversity Area of global significance. A lot is at stake here.
- Shale gas has become one of the main drivers of our regional economy. We desperately need the cracker to continue the job growth and economic growth related to that industry.
- Build it, we need it!
- The ancient zinc plant at the site recently shuttered was a huge polluter. The Shell facility should conform to newer pollution standards than the zinc plant, so that is a plus. But, the question remains that what type of new pollution will we see versus a zinc smelter. I live downwind from the plant, as the bird flies, 4 or so miles away on the mountaintop overlooking the Ohio River. The 15061 zip code and surrounding ones will see a medium term economic boost, no doubt. How much that will cost the current members of the community is to be determined.
- I understand that the environmental concerns , but I think the benefit of the jobs that this project will bring outweighs the environmental concerns.

- I'm at a crossroads with this because the area is direly in need of an economic boost, but at the same time the cracking and processing will undoubtedly lead to additional pollution. For an area that has just recently recovered from the industrial revolution, and one which now contends with high amounts of h20 pollution from the nuclear plant in midland, it seems that we have some thinking to do about how much this will generate positives vs. negatives.
- Don't build it!!!!!!!!!
- It is absurd that Shell is being offered massive tax subsidies when it is one of the most grossly profitable multi-nationals and shows absolutely no concern for the environment.
- Do the right thing
- beaver county is already screwed thanks to the nuke plants, but no reason to worsen an existing environmental nightmare.
- I am not in favor of exporting fossil fuels or their derivatives.
- How can I become more involved?
- Stop the ethane cracker plant! Ban fracking!
- More heavy industry might look like a solution to the socio-economic doldrums in Beaver County, but in the long run, they are just more of the same old problems, especially when dealing with an industry as irresponsible as "the frackers" have proven to be.
- From one toxic dump to another is not an improvement. No matter how much money. No one cleans up the toxic mess.
- This region already has some of the worst air quality in the US, we don't need anymore chemicals in our air. Our region suffers from elevated levels of respiratory problems (asthma, emphysema, bronchitis, COPD, etc.), cancers, circulatory and cardiovascular diseases primarily due to our polluted air.
- we should be making methane from bio-sources, not from fossil sources! this way we divert what's polluting our water (sewage and ag runoff) and eliminate the need to drill/frack.
- We don't need this dangerous type of industry -
- There are no economic benefits to a facility that taxpayers will be footing the bill for at least 30 years, by then the natural gas boom will be gone and we'll be left with the negative environmental and social impacts that will harm our communities today and tomorrow.
- We can't overlook environmental risks for the sake of money. You can't drink Money ...or breathe it either.
- We don't need this. What we need is leadership that can see the wisdom in geothermal approaches to energy -- solar and wind resources.
- Natural gas is not a healthy path for Pennsylvania. We should be developing renewable energy sources and providing union jobs that are good for communities and good for the planet.
- Green technology and energy is our only hope. This carbon filth industry must stop!!
- Stop selling out our state our water and the health of the public
- Require green chemistry production processes for all new chemical plants; discourage expansion of production processes with toxic products or by-products such as ethane

- The facility in question will be all right if all environmental factors are taking into account. Not to forget the impacts from the controversial unconventional natural gas drilling. Natural gas for this facility should be provided from only responsible sources of natural gas, companies who have not had an infraction pertaining to their drilling procedure.
- Although I am staunchly opposed to this facility, I mainly look forward to having the real facts presented to the public and to the local politicians.

Appendix D: EPA ECHO Nearby Facility Data

	BASF Monaca PLT		Lyondell Chemical (NovaChem)		FirstEnergy Generation		Beaver Valley	
	Emissions (lbs)		Emissions (lbs)		Emissions (lbs)		Emissions (lbs)	
	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack	Fugitive	Stack
1,3-Butadiene	3,919	145	—	—	—	—	—	—
Acrylamide	60	—	—	—	—	—	—	—
Acrylic Acid	58	37	—	—	—	—	—	—
Acrylonitrile	180	79	—	—	—	—	—	—
Ammonia	1,593	79	—	—	50,390	35.2	—	—
Arsenic Compounds	—	—	—	—	32.7	1,113	—	—
Barium Compounds	—	—	—	—	322.6	3,719	—	93
Benzo (G, H, I) Perylene	—	—	—	—	—	0.246	—	—
Beryllium Compounds	—	—	—	—	4.8	64.7	—	—
Butyl Acrylate	169	280	920	4.39	—	—	—	—
Chromium Compounds	—	—	—	—	59.5	1,398	—	—
Cobalt Compounds	—	—	—	—	17.3	415.5	—	—
Copper Compounds	—	—	—	—	38.6	1,079	—	—
Dioxin, Dioxin Like Compounds	—	—	—	—	—	0.0075	—	—
Ethyl Acrylate	55	6	—	—	—	—	—	—
Hydrochloric Acid	—	—	—	—	—	368,800	—	—
Hydrogen Fluoride	—	—	—	—	—	59,530	—	—
Lead Compounds	—	—	—	—	27.5	1,100	—	10
Manganese Compounds	—	—	—	—	96.5	1,858	—	—
Mercury Compounds	—	—	—	—	0.06	505	—	—
Methyl Acrylate	45	2	—	—	—	—	—	—
Methyl Methacrylate	203	—	—	—	—	—	—	—
Naphthalene	—	—	—	—	—	106	—	—
Nickel Compounds	—	—	—	—	32.7	1,326	—	—
Polycyclic Aromatic Compounds	—	—	—	—	—	6	—	—
Selenium Compounds	—	—	—	—	3.8	4,560	—	—
Styrene	2,887	403	4,700	9,400	—	—	—	—
Sulfuric Acid	—	—	—	—	—	1,811	—	11,014
Tert-Butyl Alcohol	284	60	—	—	—	—	—	—
Vanadium Compounds	—	—	—	—	89.8	1,688	—	—
Vinyl Acetate	609	7	—	—	—	—	—	—
Zinc Compounds	—	—	—	—	49.4	3,887	1	2,295
Total Emissions	**10,062**	**1,098**	**5,620**	**9,404**	**51,165**	**453,002**	**1**	**13,412**
Source: echo.epa.gov								