

The Opportunity for Plastics Manufacturers in the Appalachian Region
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Introduction

The economical extraction of shale gas and liquids from the Appalachian region has significantly changed the landscape for petrochemical industries in the United States. The availability of shale gas has led to a reduction in the price of natural gas, and its use as a feedstock to produce valuable chemicals has been encouraged in addition to its use as an energy source. Furthermore, the natural gas liquids (NGLs), such as ethane and propane, which are associated with shale gas are available in large quantities and this has led to the development of light hydrocarbon crackers. Royal Dutch Shell is in the process of commissioning a \$6+ billion ethane cracker in Beaver County this year. This is the first plant in the Marcellus region to utilize ethane to produce high-density polyethylene (HDPE) and linear low-density polyethylene (LLDPE) pellets, which serve as the raw material to make a variety of plastic products.

Overall Economic Analysis

An economic analysis of plastic manufacturing indicates that the availability of shale gas locally has made manufacturing cheaper in the US. While labor costs are cheaper outside the US (e.g. 50% of US wages in China), plastic products that utilize HDPE and LLDPE are highly automated plants and these are becoming cheaper to operate in the US. Resin is cheaper to obtain in the US compared to China and electricity is 60% the cost of China. Furthermore, the overall carbon emissions of this manufacturing enterprise are significantly smaller in the United States as compared to Asia. Large companies such as Amazon, Walmart, and Proctor & Gamble see plastics products as low hanging fruit to reduce costs and reduce carbon emissions. Currently plastic products worth over \$45 billion are imported from overseas (40% from China) and there is a significant potential to move this market to the Appalachian region. The availability of HDPE and LLDPE in the region, with significantly reduced transportation costs, provides the exciting possibility for plastics manufacturers (e.g. those with the NAICS codes 325211 and 326111-326199) to produce polymer products locally in the Appalachian region instead of importing these bulk commodity chemicals from the Gulf Coast region or from countries such as China.

Polyethylene products market is \$23 billion with a potential profit of \$1.86 billion in the United States. Polyethylene is estimated to generate a greater share of revenue in 2021 as the consumption of consumer goods becomes increasingly important for industry operators amid high levels of online shopping during global quarantine measures. As a result, industry revenue is expected to rebound in 2021, increasing by 7.9% according to IBISWorld, Report 32521, January 2022. As we come out of the pandemic, greater consumer spending is increasing demand for goods that use plastic. Input prices have dropped, forcing industry operators to lower prices to reflect the low input costs. Manufacturing activity has risen and supported higher demand for related plastics. Exports have been a source of consistent demand for plastic and resin manufacturers. In addition, emerging economies, such as Mexico and China, have demanded more plastic and resin materials to serve an expanding middle class. A strengthening US dollar has decreased the relative purchasing power of foreign buyers, while China's growth is slowing, leading the country to purchase fewer domestically manufactured goods. As such, exports are anticipated to increase at an annualized rate of 4.5%. The importance of plastic and resin products in construction and manufacturing markets is expected to help the plastic and resin manufacturing industry rebound in revenue over the five years to 2026. The industry's two largest

buyers, downstream manufacturers, and the construction sector, are set to experience growth in demand and revenue over the next five years as they rebound from the coronavirus outbreak and subsequent recession. Demand for plastic-based construction materials is also anticipated to expand. The value of residential construction is expected to increase at an annualized rate of 0.9% over the five years to 2026. As construction projects advance, demand for pipes, flooring and other plastic-based construction materials will increase, stimulating demand for plastic and resin inputs.

Downstream Markets

Over the five years to 2026, growing downstream markets are expected to support industry demand, while improving input prices are expected to support industry revenue. This growth experienced during the period is expected to happen during the first few years, stemming from a global economic recovery following coronavirus. The increase in prices comes from the industry's main key input, natural gas. As such, over the five years to 2026, IBISWorld expects revenue to expand at an annualized rate of 1.0%. The manufacturing and construction sectors account for nearly half of industry revenue. Key manufacturing industries include automobile manufacturing, which use plastic and resin as inputs for automotive parts and interior components, and packaging material production, which use industry products to manufacture plastic bags, films, sheets, and bottles. In the construction sector, several materials are produced with plastic and resin inputs, including piping, wallpaper, flooring, and windows.

Price is the key basis for competition in the plastic and resin manufacturing industry. However, given the fact that plastic materials, resin, and synthetic rubber are global commodities, prices are largely determined by those of global chemicals like ethylene, which is a key input for polyethylene and other thermoplastics. Product performance attributes, such as strength-to-weight ratios, waterproof ability, malleability, safety, installation costs and the ability to be recycled are also major factors for competition. The plastic and resin manufacturing industry has a high level of global exposure, which is evident by the industry's reliance on trade. In 2021, imports are anticipated to account for 30.3% of

domestic demand after increasing at an annualized rate of 6.3% to \$22.4 billion over the five years to 2021. This relatively high level of imports is primarily due to a strengthening US dollar over the past five years, making foreign goods relatively less expensive than their domestic counterparts.

The mid-Atlantic region has 15% of the US population but only 10% of the plastics industry (out of a total of about 1,113 companies). Since the raw material cost and transportation are the two major cost drivers, plastics manufacturing plants tend to be near refineries or ports. West Virginia is poorly represented in this as shown in

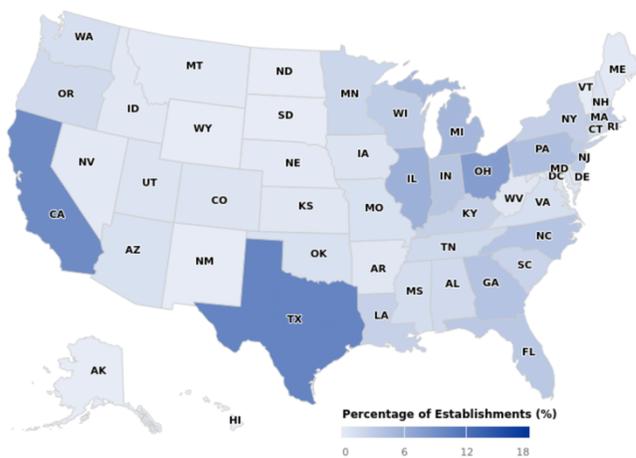


Figure 1: Plastics Industries by Region

Figure 1. There is a significant opportunity to change this due to the proximity of the Shell ethane cracker in the vicinity.

Downstream Market Opportunities for Polyethylene Compounds

In this study, we explore the opportunities for small and medium-scale manufacturers to utilize HDPE and LLDPE pellets to make polyethylene compounds that are used in the manufacture of pipes, films, sheets, fittings, and bottles, which are used in the following industries: Building and Construction, Automotive, Packaging, Agriculture, and Mining. Polyethylene (PE) compounds are PE-based materials produced using a mixture of PE resins (HDPE or LLDPE) and various additives to impact specific properties. Manufacturing steps involved in this process include blending, extrusion, testing, and packaging. PE compounds can be classified as follows based on the property that is modified via additives:

PE Compounds Used for Modifying Color: Color masterbatches are used to produce colored resin like black, orange, and blue from HDPE resin. These are used for pipe applications. The required amount of colored HDPE resin is used in extruders to manufacture pipes.

PE Compounds Used for Modifying Surface Properties: Masterbatches are used for producing slip–anti block LLDPE/HDPE resins. The additives are homogeneously dispersed in carrier resin results in outstanding slip and antiblock properties with excellent optics in the final film, produced with the LLDPE/HDPE resin. The required quantity (as per slip–anti block requirement of the film) of this masterbatch can be added through dry-blending or automated dosing system to the polyethylene resin during film manufacturing. The film extrusion can be done using a normal polyethylene film extrusion screw.

PE Compounds Used for Modifying Transport Properties: Manufacture of masterbatches for film production in which calcium carbonate, TiO₂ and functional fillers are important components. These modify the transport properties of the resulting film. For example, calcium carbonate masterbatches can be made for demanding applications such as breathable hygiene film (e.g. for baby diapers).

Manufacturing Opportunities in West Virginia

Even though Figure 1 shows that West Virginia is not heavily represented among current plastics manufacturers, there is significant opportunity for profitable growth of polyethylene compounds as

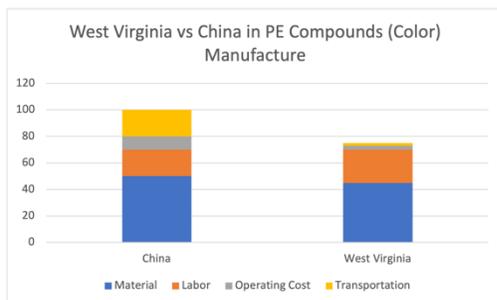


Figure 2: Comparison of Manufacturing Cost

described in this section. Figure 2 shows the comparison between cost of manufacturing a colored PE compound masterbatch for pipe applications in West Virginia versus China. It is observed that there is a significant manufacturing advantage in West Virginia due to the proximity of location for the supply of raw material (HDPE), energy source (natural gas) and customers (within a 500-mile radius) as compared to China. The ability to tailor polymer properties to specific applications allows manufacturers to add a premium to the selling price.

Research and development (R&D) is the basis for improving product performance and establishing a higher degree of differentiation between competitors; therefore, plastic and resin manufacturers, especially smaller companies, require ready access to R&D facilities. The availability of a world-class research facility for plastics research for tailoring polymer properties to customer specifications at West Virginia University provides a competitive edge to manufacturers in this region. Another advantage that West Virginia provides is the availability of a workforce that can be readily trained in the manufacturing steps involved in polyethylene compound production, include blending, extrusion, testing, and packaging. The existing infrastructure of transportation and industrial zones that were previously used in the mining industry can be repurposed for plastics manufacture. West Virginia is ripe for reinvestment and there is plenty of untapped potential to create jobs as an off-ramp for current and former coal workers.

Equipment Needed for Polyethylene Compounds Manufacture

The major equipment needed for the manufacture of polyethylene compounds is a screw extruder. Measured amounts of additives are added to the HDPE or LLDPE pellets to form polyethylene



compounds of the desired properties. Furthermore, access to an analytical testing facility is needed to characterize and certify the thermal, mechanical and dynamic properties of the manufactured compound and resolve material-related issues. All testing must be performed according to the specified ASTM, ISO or other standard test method. Frequently, the materials testing is done off-site (e.g. at a university research facility) until there is sufficient volume business to justify the purchase of the testing equipment on-site.

Figure 3: Screw Extruder