Global Economic Factors Align

Favoring U.S. Based Plastic Product Manufacturing over China Operations

DECEMBER 2022 - A REPORT BY SHALE CRESCENT USA

Long Term Fundamental Shifts Have Changed the Playing Field

ShaleCrescent USA
THE OHIO VALLEY ENERGY ADVANTAGE

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1. SHALE CRESCENT USA

Shale Crescent USA (SCUSA) is a tax exempt 501(c) 4 organization with leadership that includes a network of senior level management and experts in the energy industry, manufacturing industry, economic development, academia, and private investment. **SCUSA was established in 2016 to promote the region of Ohio, Pennsylvania, and West Virginia that sits atop two of the most prolific natural gas fields (the Marcellus & Utica) in the United States.** SCUSA is devoted to promoting the region's abundant natural resources in an effort to attract the investment of global companies and related supply chain operations that can support and sustain high-wage jobs in Ohio, West Virginia, and Pennsylvania.

The organization identifies and conducts industry specific research that informs: (1) investment in the existing domestic energy intensive industries ranging from the production of commodity petrochemicals to the manufacturing of plastic based finished consumer goods, **(2)** onshoring and reshoring of global supply chain operations and, **(3)** expansion of existing stateside energy intensive manufacturing that advances regional prosperity while addressing global climate effects and strengthening national security.

Since 2016, SCUSA has designed and commissioned industry research that examines key indicators for potential investment in the energy and manufacturing supply chain. **This investigation – that examines factors related to supply & demand, manufacturing operations, international imports, logistics, labor, and climate change - has produced data that show Shale Crescent USA is one of the most profitable and resilient locations to build a petrochemical plant and other downstream manufacturing, substantially exceeding the advantages of the U.S. Gulf Coast.** Unlike the U.S. Gulf Coast or other global supply chain regions, the SCUSA region has both robust supply of feedstock and high customer demand for chemical and plastics-based products. This creates a significant logistics, economics, and environmental advantage over other regions of the world. SCUSA has developed validated reports, materials, and presentations derived from this data to educate the petrochemical and associated industries through peer engagement.

SCUSA has recently expanded its research and prospect development to include downstream plastics manufacturing. By attracting manufacturers and ancillary environmental support companies to the region, SCUSA in effect brings operation of the entire supply chain to the center of the country's largest end market. **Shared proximity to raw materials and market has the potential to make Shale Crescent USA one of the most economic and sustainable petrochemical and manufacturing hubs in the world.** Eliminating global transportation and significantly decreasing national transportation will result in reduced emissions, energy efficiency, reduced costs, inventory advantages, and opportunities to develop and expand based on the unique advantage of possessing both world class supply and demand within the same region, Shale Crescent USA.

1.1 SHALE CRESCENT USA PROPRIETARY RESEARCH

COMPREHENSIVE ANALYSIS OF QUALITY DATA TO DRIVE PROFITABILITY AND GROWTH:

Shale Crescent USA has invested over one million dollars in market research to provide quality data to C-level executives in the energy industry[1]. SCUSA understands that C-level executives tasked with meeting growth and profitability goals must consider a myriad of variables supported by quality data. SCUSA subject

[1] Shale Crescent USA: https://shalecrescentusa.com/resources/market-resources/

matter experts are able to translate data, analyze influential variables, and develop qualified projections. As veteran practitioners, these experts have intimate knowledge of the energy industry ensuring an analysis that considers complex systems, volatile markets, and transnational operations.

- **(2016)** The Natural Gas Resource Advantage of the Shale Crescent USA
- **(2017)** Understanding U.S. Chemical Industry Investments
- **(2018)** Benefits, Risks, & Estimated Cash Flows: Ethylene Project in the SCUSA vs the U.S. Gulf
- **(2019)** Estimated Logistics Benefits of the SCUSA vs U.S. Gulf for Natural Gas, Propane, & Butane
- **(2020)** Natural Gas Savings to U.S. End-Users: Industrial, Commercial, Electric, Residential
- **(2020)** U.S. Manufacturing Jobs: Directly tied to Oil and Gas Production in the Shale Crescent USA
- **(2021)** Extreme Weather Impacts on the Industrial U.S. Gulf Coast. SCUSA Advantaged
- **(2022)** Global Economic Factors Favor U.S. Plastic-Product Manufacturing over China- Based Operations
- ***(2023)** Proposed: ESG Enhancer: Emissions Savings Created by Eliminating Long-haul Transportation*

1.2 CONTRIBUTORS

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Nathan is the President of Shale Crescent USA. In this role, he works closely with the organization's board of directors to develop strategic industry research and deliver qualified data to guide the investment decisions of energy intensive industries. He oversees all operations, strategy, marketing, and fund development for the organization. Nathan is a fierce advocate for the long-term benefits of energy and manufacturing investment in the Ohio River Valley including economic development, high-wage jobs, and improved quality of life for generations to come. He earned his Bachelor of Science in Finance from Marietta College and an MBA from Liberty University.

TOM GELLRICH: CEO AND FOUNDER TOPLINE ANALYTICS

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Tom Gellrich is an energy industry expert who specializes in the investigation of downstream opportunities related to the Shale Gas revolution on chemicals, plastics, and manufacturing. His presentations and white papers have been extensively quoted and continue to receive international attention. As a Chemical Engineer with Exxon Mobile, Tom designed ethylene and propylene compressors. Later, he held a variety of positions in Strategic Planning, Business Management, and Business Consulting with Total-Arkema. He was instrumental in the founding of Elemica, a B2B service for the chemical industry, where he served as Managing Director of European operations in the late 2000s. In 2012, Tom launched his consulting company, Topline Analytics where he works today.

JOE EDDY: FORMER CEO & OWNER EAGLE MANUFACTURING, SCUSA DIRECTOR

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Joe Eddy recently retired as President/CEO of Eagle Manufacturing Company in Wellsburg, WV and Executive VP of Justrite Safety Group in Chicago, IL, after 23 years of service. He currently owns and manages an energy development company, Enhanced Technologies LLC, and a real estate development trust, Heritage Holdings LLC. He is the past Chairman of West Virginia Manufacturers Association and the WVMA Education Foundation. He has served on the Federal Reserve Bank of Richmond-Industry Advisory Board, National Association of Manufacturers Board, National Institute of Standards & Technology-MEP Advisory, West Virginia Economic Development Authority Board, and WVU's Global Supply Chain Advisory Committee. Joe is an Executive Committee Member & Strategic Advisor to Shale Crescent USA. In 2012, with Joe as CEO, Eagle ranked #5 nationally in Chief Executive's-Best Private Companies for Leaders. In 2015, Eagle won the National Association of Manufacturers-Sandy Trowbridge Award for Excellence in Community Service, and in 2016 the President's E-Award for Excellence in Export Growth, and the "Top Manufacturing Brand" in West Virginia (one of Top 50 Brands in the U.S.), and in 2018 The Governor's Award for Smart Advanced Manufacturing. Joe earned his Bachelor of Science in Petroleum Engineering from Marietta College and has completed advanced studies at the University of Wyoming and University of Chicago.

WALLY KANDEL: SENIOR VP, SOLVAY & CO-FOUNDER, SHALE CRESCENT USA

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Wally Kandel is a Senior Vice President at Solvay and serves as the North American Director of Group Engineering and Construction. Wally earned his Bachelor of Science in Petroleum Engineering from Marietta College. Wally's career began at Chevron / Chevron Phillips where he worked for 20 years before joining Solvay in 2007. He has been in leadership roles in both the upstream oil and gas industry as well as the downstream petrochemical industry. He has worked in these industries for over 30 years including work on 4 continents. He is a co-founder, volunteer Director, and Strategic Advisor for Shale Crescent USA.

GREG KOZERA: SALES & MARKETING DIRECTOR, SHALE CRESCENT USA

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Greg Kozera is the Director of Sales and Marketing for Shale Crescent USA. In this role, he promotes the organization's research efforts across the globe through media channels, conferences, appearances, and executive level meetings. Greg works directly with manufacturers who want to capitalize on the region's advantages. He is a professional engineer and an environmentalist with more than 40 years of experience in the natural gas and oil industry. Greg is a leadership expert, professional speaker, and a writer with numerous published articles. Kozera is the author of the books *Just the Fracks Ma'am* and *Learned Leadership*.

JERRY JAMES: PRESIDENT, ARTEX OIL & CO-FOUNDER, SHALE CRESCENT USA

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Jerry James has served as President of Artex Oil Company since 1995. Prior to assuming his current role, he held positions with various major oil companies in Texas, Louisiana, and Wyoming. Jerry has served as President of the Ohio Oil and Gas Association (OOGA) and previously served as chairman of the Ohio Oil and Gas Energy Education Program (OOGEEP). Jerry earned his Bachelor of Science in Petroleum Engineering from Marietta College in 1980 where he graduated Magna Cum Laude. He is a Registered Professional Engineer in Ohio, Kentucky, West Virginia, and Pennsylvania. Jerry is a member of the Society of Petroleum Engineers as well as the Society of Petroleum Evaluation Engineers. He is co-founder, volunteer board member, and strategic advisor for Shale Crescent USA.

REPORT OBJECTIVE: 2

2. REPORT OBJECTIVE

This report presents an analysis of key issues and underlying trends that are changing the balance of global manufacturing. **What was a long-held belief – *it is cheaper and better to import manufactured goods* - is no longer true.** The following research and collection of data provide a compelling case for onshoring and reshoring plastics-based manufacturing operations. This document is designed to be used by related Ohio company executives and their teams to initiate strategic and tactical planning for expanded operations.

Using real-time data aligned to regional resources and global manufacturing cost factors, **Shale Crescent USA has identified opportunities for industry expansion that support business growth, create high paying jobs, enhance national security, and foster long-term, sustainable economic development.**

The study was conducted to validate the advantages related to stateside manufacturing expansions and new investment opportunities, particularly in the state of Ohio and the greater Ohio River Valley. Potential benefits of associated growth include **recapturing some of the $53 billion market in plastic-based products imported to the U.S. each year[2].** This market represents a small fraction of manufactured plastic products as it does not include plastic parts that are integrated into other products. Each year the U.S. imports roughly $500 billion of goods from China alone[3].

The Shale Crescent USA region (Ohio, West Virginia, and Pennsylvania) possesses a collection of characteristics that combine to create ground zero for onshoring and reshoring opportunities. The abundant, world-class supply of natural gas and natural gas liquids in the region has dramatically reduced energy costs and increased the supply of plastic resin. The region has a long history and well-established plastics processing industry and is located within a day's truck drive of over 50% of the U.S. consumer market. Based on fundamental economic factors and existing manufacturing operations, **plastic-based imports have been identified as the 'low-hanging fruit' for onshoring and reshoring operations** that can create high wage manufacturing jobs in Ohio. Today, many of the imported energy intensive products can be competitively manufactured in and around the state of Ohio. **Existing Ohio manufacturers are best positioned to quickly take advantage of this new onshoring opportunity.**

> ***…plastic-based imports have been identified as the 'low-hanging fruit' for onshoring…Existing Ohio manufacturers are best positioned to quickly take advantage…***

The quality data and analysis presented in this report will support and leverage existing Ohio assets including, successful manufacturing operations, a competitive workforce, and stable supply chains, to advance the interest of the region and quality of life for generations.

2.1 SCOPE OF STUDY

A number of significant topics have been covered in this report to highlight reshoring and onshoring opportunities for U.S. plastics-based manufacturing operations and investors. This report highlights investigation into the following topics:

OHIO PLASTICS-BASED MANUFACTURING OPERATIONS

An inventory and analysis of nearly all Ohio plastics-based manufacturing operations was conducted. Operations were examined to better understand which types of imported plastic-based products could most easily qualify as candidates for local manufacturing. In this assessment of Ohio plastics-based manufacturing operations, three (3) key categories were reviewed: feedstock used, processing type, and market segment. This information was cataloged along with general company information.

- **Analysis of Ohio plastics-based manufacturing operations:**

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[2] U.S. Census Bureau: https://usatrade.census.gov/

[3] U.S. Census Bureau: https://www.census.gov/foreign-trade/balance/c5700.html

- **1)** Feedstock Used
- **2)** Processing Type
- **3)** Market Segment
- **4)** Additional Data
  - Manufacturer Location
  - Size of Company by Revenue
  - Size of Company by Employee Count
  - Contact Information

In addition, the top U.S. plastics-based manufacturing operations were reviewed and compared with Ohio operations. The goal was to identify and highlight any strengths, weaknesses, and/or differences that may exist between Ohio plastics-based manufacturers and the rest of the country.

U.S. PLASTICS IMPORTS

A deep dive into U.S. imports of plastic-based products was performed. This analysis examined macro trends of imported plastic products as well as specific representative products. The data was collected from the *U.S. Census Bureau* and utilized both the *North American Industrial Classification System (NAICS)* and the *Harmonized Tariff Schedule of the United States (HTS).* NAICS data was used for the macro level review and to identify import trends over the past 20 years. HTS data was used to identify specific product categories and the associated import value. Combined these databases provide the ability to highlight which plastic-based products present the most accessible and competitive onshoring and/or reshoring opportunities for Ohio manufacturers.

- **Analysis of U.S. imported plastic products from China:**
  - Macro level review and trends
  - A deep dive cost analysis and comparison of 8 representative plastic-based products

REDUCED GLOBAL EMISSIONS

The manufacturing and importing of goods to the U.S. relies on a complex system of logistics and transportation that emits significant levels of air pollutants and greenhouse gases. This report includes a base case study, that analyzes the C02 emissions from inland transport of a product. Inland transport only represents one part of the entire transportation process. The analysis estimates and compares C02 emissions and the sustainability impact that can result from onshoring manufacturing to the U.S. as opposed to importing finished goods.

REGIONAL RESIN PRODUCTION

New resin supply within the Shale Crescent USA region will create new opportunities for plastics-based manufacturing operations. This study highlights and defines the reduced transit time, the reduced transportation costs, and the reduced working capital that plastics-based manufacturing operations in the greater Ohio region can experience.

RETAILER BENEFITS FROM REGIONALLY PRODUCED CONSUMER GOODS

This report highlights and defines the reduced transit time and reduced working capital that U.S. retailers can enjoy as the manufacturing of plastics-based consumers goods are onshored. Reduced emissions are also shown as one of the advantages for retailers.

In addition, the report features a review of Walmart's new initiative focused on onshoring the manufacturing of consumer goods in the U.S.

MANUFACTURING COST DRIVER MODEL

The report presents an economic model comparing two hypothetical and identical manufacturing facilities in separate locations. For analysis and economic projections, the facilities are set to each consume 20 million pounds of polyethylene a year. The function of the model is to identify which manufacturer can produce an identical plastics-based product more economically. Manufacturing facility 1 is staged in Cambridge, Ohio, and Manufacturing facility 2 is staged in Zhejiang, China. Inputs for the model are the major cost drivers of a plastics-based manufacturing operation. An analysis of each of the cost drivers listed below has been conducted and the results are highlighted in this report.

- **The economic rationale for onshoring manufacturing of imported plastic products by reviewing major static costs associated with production in the U.S. and China:**
    - Labor
    - Utilities (Electricity)
    - Transportation
    - Site Costs
    - Resin costs (Polyethylene)

The cost of production for 8 plastic-based products has been conducted. The 8 products are intentionally varied. These products provide a range of product sizes, processing techniques, resin types, and end market segments. The individual cost components of each product that are required for the manufacturing of the product are highlighted in actual dollar amount and percent cost of production.

In addition, the report has run and compared the macro-economics of the two identical manufacturing plants by selecting a variety of the 8 analyzed products to be combined and manufactured at an amount equal to 20 million pounds of annual resin consumption.

NEXT STEPS – THE PROCESS

This study includes a step-by-step process to identify currently imported products and how to onshore manufacturing. **The guide is from the perspective of two former executives in the plastics processing business.** The report and guide have been designed to be used by Ohio company executives and their teams to initiate strategic and tactical planning for expanded operations. In addition, the report can be used as an effective tool for out of the region manufacturers and/or investors who recognize the growing opportunity to capture imported market share and as a result are considering locating in the region.

PLANS FOR FURTHER INVESTIGATION

Manufacturing, imports, and commodities are part of a complex economic ecosystem that affects and is affected by a wide array of important topics. While this report presents foundational research for competitive advantage, it does not cover each one of these topics in detail. This study will inform direction for additional in-depth research to include: cost of capital, import/export taxes, tariffs on imported/exported goods, comprehensive economic impact, manufacturing jobs created, indirect and induced jobs created, and a detailed study on the global effects of reduced emissions.

EXECUTIVE SUMMARY:

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3. EXECUTIVE SUMMARY

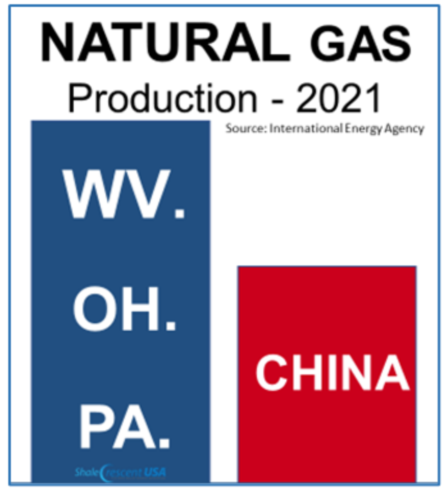
INTRODUCTION

China has lost its manufacturing competitive advantage and the annual $25 billion of exported plastic-based goods from China represent a vulnerable and accessible market share opportunity for U.S. operations. **What has been a long-held belief – *it is cheaper to import plastic based manufactured goods* – is no longer true.** The forces and trends that led to offshoring U.S. manufacturing operations have reversed course and are now favoring domestic production.

Feedstock/resin and transportation are the largest cost drivers of globally produced plastic-based goods. The Shale Crescent USA report finds that close proximity to low-cost raw materials coupled with direct access to consumer markets provide U.S. manufacturers with significant cost advantages over China-based competitors who must import raw materials and export finished goods. **The elimination of trans-continental supply chains results in cost savings that magnify a U.S. competitive advantage.** This paradigm shift favoring U.S. operations has accelerated over the past decade. **These changes are fundamental, long term, and will continue for the foreseeable future.**

WHAT HAS CHANGED? SOURCE OF ENERGY, FEEDSTOCK, AND MATERIALS

The U.S. Shale Gas revolution resulted in low-cost natural gas and natural gas liquids, which are used to produce plastic resin. Ohio, West Virginia, and Pennsylvania combined (Shale Crescent USA) now produce over one third of U.S. natural gas supply and over one and a half times more natural gas than the entire country of China. **China is energy deficient and is reliant on global supply chains to either import plastic resin or produce resin from much costlier oil-based Naphtha.**



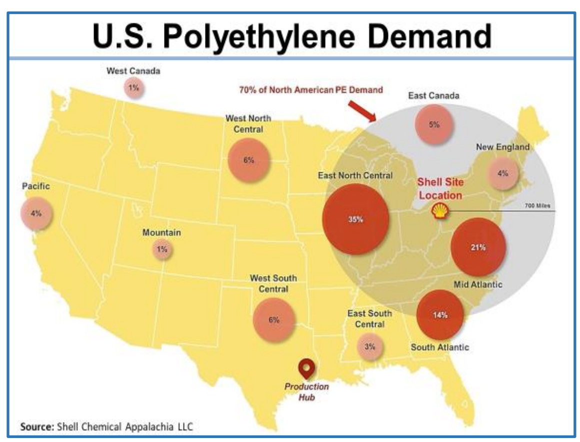
Just northwest of Pittsburgh, PA Shell Chemicals has completed a world scale ethylene cracker plant with a production capacity of 3.5 billion pounds of polyethylene resin. **Local plastics manufacturing operations will enjoy the benefit of regionally sourced resin eliminating long and costly logistics.** The outcomes of this regional supply are shorter transit times, decreased working capital, greater feedstock flexibility, and other cost saving factors.

WHY OHIO? UNIQUE LOCATION - WORLD CLASS ASSETS

Ohio is one of the top producers of plastic products in the United States with over 600 operational plastic-based manufacturers. The state's manufacturing operations use a wide range of resin and processing types and service a variety of market segments. As detailed in the Shale Crescent USA study, Ohio manufacturers are well positioned to onshore production of plastic-based goods with strong supporting factors that include diversity of plastic resins, alignment of processing types, and access to consumer markets. **Their location, anchored in the state of Ohio, is the foundation of their competitive advantage.**

Within a one-day drive, Ohio boasts:

- Over one-third of U.S. natural gas production
- A well-established industry that contains 70% polyethylene (PE) and 77% polypropylene (PP) U.S. consumption
- New regional PE supply (Shell facility in Monaca, PA - 2022)
- Over 50% of U.S. population and 30% of Canadian population
- The ability to eliminate long-haul transportation and associated costs for both incoming resin supply and outgoing finished consumer products
- Environmental advantages by eliminating global supply chains resulting in calculable reduced emissions

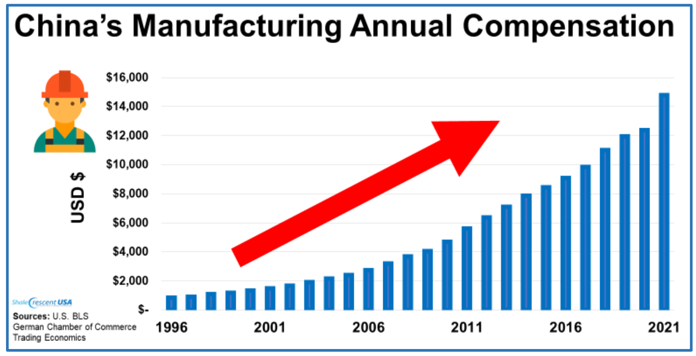


WHY NOW? SHALE CRESCENT USA COST ADVANTAGES VS. CHINA

A myriad of economic and societal forces have aligned to support the onshoring of U.S. manufacturing. Increased automation, technological advancements, the accessibility of U.S. Shale gas, and the volatility of global supply chains are all long term and fundamental shifts. As a result, the prime cost drivers in the manufacturing of plastic-based goods: **Feedstock/Resin, labor, electricity, lease rates, and transportation are pointing in favor of U.S. operations.**

Feedstock/Resin: **Currently, U.S. and China commodity resin prices are comparable, but the forces of supply and demand are positioned to positively impact U.S. resin prices.** The U.S. is a net exporter of polyethylene and China is a net importer. In addition, the U.S. uses low-cost natural gas to produce resin while China uses more expensive oil-based naphtha. Since more than 80% of PE production costs are dependent on the type of feedstock and energy used, **U.S. resin producers experience greater margins and higher overall profits compared to overseas producers.**

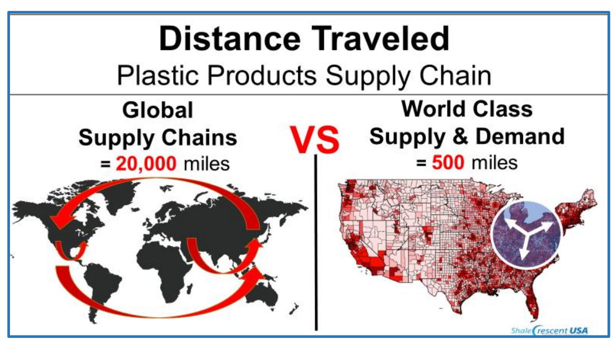
Labor Rates: **Over the past 25 years, China's manufacturing wages have increased more than ten-fold and continue to rise.** China's manufacturing industry averages annual compounded wage rate increases of more than 10 percent. Furthermore, in terms of productivity output, U.S. Gross Domestic Product in 2021 was $141,200 per person, versus China's average at just $27,600 per person. **Increased use of automation and productivity enhancements have decreased the labor cost input of manufacturing and increasing wages in China have eroded** China's historical labor cost advantage.



Electricity: U.S. electric prices have shown relatively stable or downward trending rates over the last eleven years. This can be attributed in part to a newly abundant and accessible fuel source, natural gas, used for power generation. Between 2010 and 2021, industrial consumers in the state of Ohio have experienced nationally competitive rates around 6.50¢ per kilowatt-hour (kWh). **In China, industrial electric rates averaged 10.00¢ (kWh) over the same period and have shown volatility and intermittent outages.** Projections show that electric prices will continue to trend in favor of the U.S.

Manufacturing Lease Rates: China has experienced exponential growth in its manufacturing sector since the turn of the century and the decreased availability of industrial space has driven demand resulting in increased lease rates. Lease rates in the industrial provinces of **China range from $6 – $7 per sq./ft. compared to Ohio's average of $4-$5 per sq./ft.**

Transportation: **Ohio based operations have both resin supply and consumer demand for finished products inside a geographic radius that can be reached in a one-day drive.** The elimination of complex supply chains creates an enormous transportation advantage.



China operations are required to import raw materials and export finished products. **The transport of feedstock/resin to China based manufacturers coupled with the transport of finished products to the U.S. is an estimated 20,000 miles.**

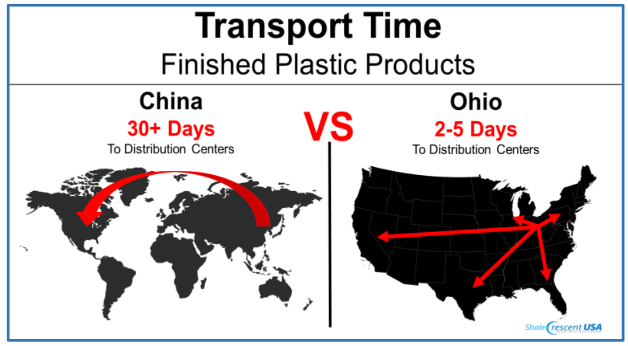
The cost to ship finished plastic based goods is a significant factor in the overall supply chain. A standard 40' cargo container traveling from China to the U.S. west coast has historically averaged from $2,500 to $3,500. **In 2021, container rates rose to over $20,000, an expense that is eliminated for U.S. based manufacturing and sales.**

WHY NOW? SIGNIFICANT ESG ADVANTAGES OVER CHINA

ESG (Environment, Social, and Governance) performance has become an integral part of business operations and investment decisions. The Shale Crescent USA report highlights why **Ohio-based manufacturers have a tremendous ESG advantage founded on location that supports reduced environmental impact.** Manufacturing in Ohio eliminates significant transportation emissions that burden China-based manufacturers who must import raw materials and export finished goods via transcontinental supply chains. China-based manufacturers cannot avoid global transportation. **Ohio plastic product manufacturers are already natural leaders in ESG without changing core business practices.** Manufacturers in Ohio have a timely opportunity to capitalize on this existing advantage through education and promotion of environmental benefits to their partners and consumer base.

WHY NOW? CUSTOMER ADVANTAGES

In the 1990's and 2000's large-scale distributors and retailers such as Walmart led the offshoring manufacturing movement to capitalize on low-cost China labor. At the peak of offshored U.S. manufacturing, it is estimated that 70-80 percent of Walmart's merchandise was sourced from China.



The Covid supply chain crisis has challenged the use of distant and slow to respond supply lines. Wallstreet has evaluated long supply chains in light of unreliable product supply as a significant risk and cost. **Shorter supply chains are being recognized as financially beneficial.**

Products manufactured in the U.S. versus China conservatively eliminate 30 days in the supply chain process. For retailers, this means greater inventory flexibility and working capital savings. In early 2021, Walmart announced plans to spend $**350 billion over the next decade on items made, grown, or assembled in the U.S. Plastic products are specifically identified as a priority in their plan.** The company has cited **reduced global emissions tied to the elimination of transcontinental transportation as a motivating factor.**

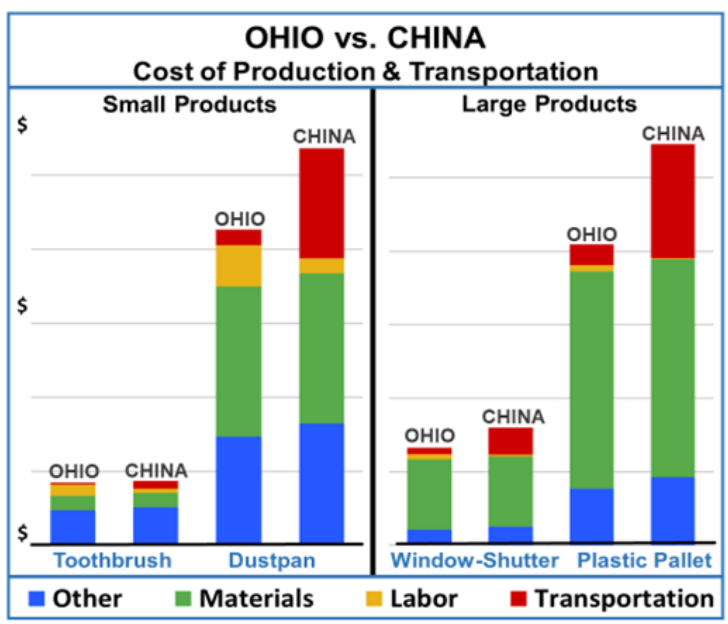
WHAT ARE THE ECONOMICS? OHIO: LOWER COST MANUFACTURER VS. CHINA

Utilizing the findings on manufacturing cost drivers, the Shale Crescent USA report includes a production cash flow cost model that compares the cost of manufacturing plastic-based products in Ohio versus China. The model leverages findings associated with each of the locations prime cost drivers and analyzes large volume import products, that vary in size, resin type, processing type, and end market. **Milacron, a leading global manufacturer of plastic processing equipment, assisted in developing the model.** Milacron's expertise and real-world experience were critical in ensuring a realistic and reliable cost model.

The specially designed cost model is available to processors. Processors can **tailor the model to their operation specifications** including products, equipment, resins, and other factors allowing for a deep understanding of cost comparisons specific to a processor's unique situation.

Primary conclusions of cost drivers in the 'OHIO vs. CHINA Manufacturing Model' can be summarized as follows:

- Transportation is a major cost driver in the overall per unit cost for overseas production
- Resin prices are a significant cost factor
- Energy, maintenance, and lease rates are important but relatively minor
- With an increase in automation, labor costs become less of a contributing factor
- Capital equipment costs are important but have trade-offs in terms of productivity and require a case-by-case basis evaluation
- Part size has a major impact on operational costs. As part size increases, the following changes occur:
    - Relative labor costs decrease
    - Transportation costs & resin costs increase
    - Capital equipment costs increase



In comparing manufacturing in Ohio versus China, transportation emerges as the major differentiator, with growing significance as part size increases. The upward trends of labor, energy, and transportation costs associated with China defines a long-term shift. **The trend of individual cost drivers can be considered long term, fundamental, and protected from volatility for a timeframe measured in decades.** While this report is focused on China, it can be deduced there is U.S. competitiveness versus other regions of the world. **Ohio's unique location advantage cannot be overlooked.** Ohio manufacturing operations are well positioned to capture a significant share of the annual $25 Billion of imported plastic products.

OFFSHORED MANUFACTURING:

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4. OFF-SHORED MANUFACTURING

OFFSHORING AND THE INCREASE OF U.S. IMPORTS FROM CHINA

For the past three decades, U.S. manufacturers have migrated overseas to capitalize on favorable market conditions, largely concentrated in China. Low-cost foreign labor and a decreasing U.S. energy supply created an advantage for minimal investment, increased production, and wide sales margins. During this time, imports from China drastically increased from nearly non-existent to roughly $500 Billion per year[4]. **Since 1985, the U.S. has imported a total of over $8.0 Trillion in consumer goods from China,** with the majority of imports occurring in just the past 10 years.

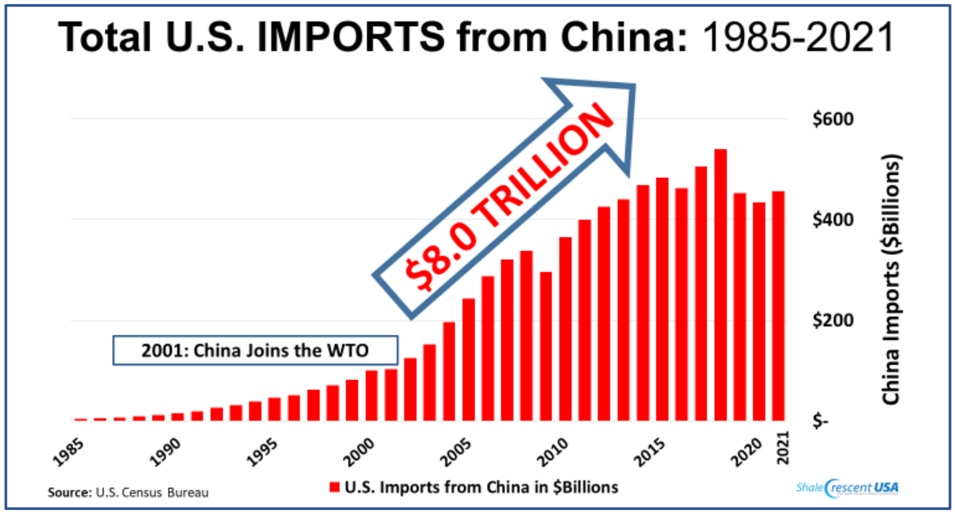

Figure 1: Total U.S. Imports from China: 1985-2020

The meteoric rise of China's exports to the U.S, has led to significant negative implications for the U.S. manufacturing industry for decades. As a result, manufacturing jobs have suffered. **There is a direct correlation between the increase in imports from China and the decrease in U.S. manufacturing jobs.** Data shows that U.S. jobs lost related to manufacturing can be measured in the millions. Competitive advantage in favor of offshoring production created a devastating turn of events for U.S. manufacturers. Manufacturers of all types were having to close their doors by the thousands and manufacturing related job loss reached a peak of nearly 6 million[5]. As a result, the offshoring movement has had widespread regional and national economic and societal implications on the United States.

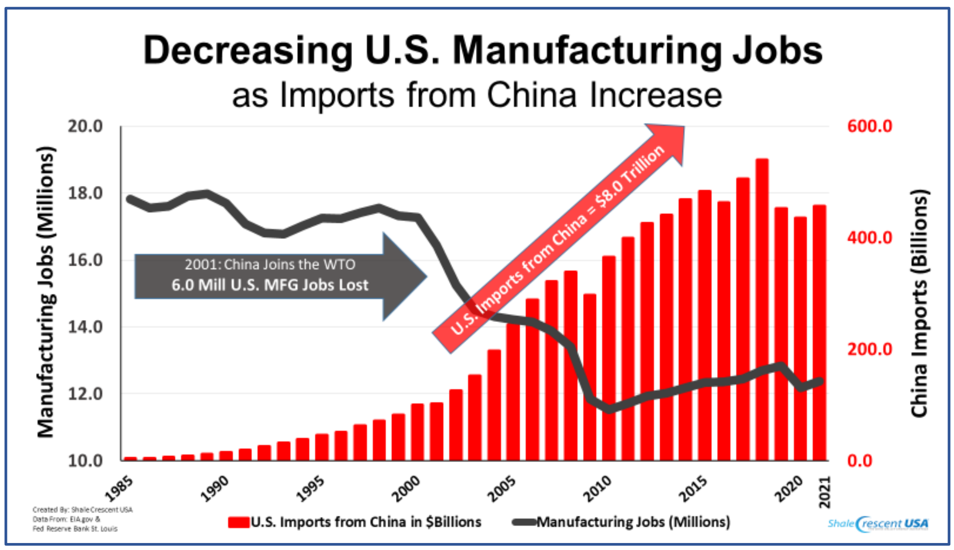

Figure 2: U.S. Manufacturing & U.S. Imports from China

THE START OF OFFSHORING: ENERGY DECLINE

Many factors have contributed to the offshoring crisis, but none of them more significant than the decline of U.S. oil and gas production. **From the 1970's (the start of the energy crisis) to the early 2000's, the United States faced a serious energy decline.** As shortages drove up domestic oil and gas prices, the U.S. began to lose its energy advantage. Energy intensive manufacturing operations buckled in the wake of the energy crisis and production left for more affordable operations overseas.

[4] U.S. Census Bureau: https://www.census.gov/foreign-trade/balance/c5700.html

[5] Federal Reserve Bank of St. Louis - https://fred.stlouisfed.org/series/MANEMP

This widespread industrial decline became painfully visible as the *Rust Belt* grew in America's heartland. Abandoned factories spurred ancillary effects related to economic decline, population loss, unemployment, and poverty.

ENERGY AND MANUFACTURING ARE DIRECTLY CORRELATED:

Manufacturing job growth shows direct correlation to the stability and growth of U.S. oil and gas production. Oil and gas are the primary feedstock and fuel supply for many manufacturing operations. **Without oil and gas, modern manufacturing cannot exist.** This makes the cost and availability of energy a significant component in the economics of manufacturing. *The following chart illustrates the direct correlation of U.S. Oil and Gas Production to U.S. Manufacturing jobs.*

> ***Without oil and gas, modern manufacturing cannot exist.***

As oil and gas production rose from the 1940s through the late 1960s, so did the ability to competitively manufacture within the United States. Similarly, as U.S. oil and gas production declined, from the 1970's through the early 2000's, nearly 3 million manufacturing jobs were lost. U.S. manufacturing jobs took another steep fall in 2001 when China joined the World Trade Organization, with an estimated loss of nearly 6 million additional jobs. It must also be recognized that total jobs lost is much more significant than only manufacturing jobs. For every one (1) manufacturing job created, there are five (5) supporting jobs generated[6].

As a result of shale development in the U.S. beginning around 2008, domestic oil and gas production reversed course and the U.S. quickly became the number one oil and gas producing country in the world. The trends associated with manufacturing jobs followed suit and began to rebound. **Since 2010, there have been 1.4 million manufacturing jobs created in the U.S.** supported by shale gas development[7].

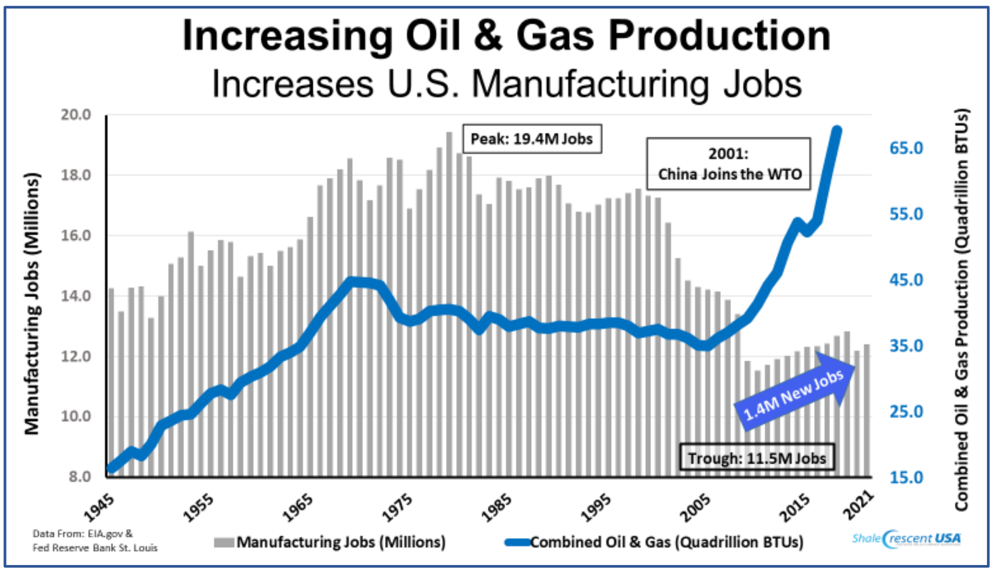

Figure 3: Increased Energy - Increased Manufacturing Jobs

ENERGY GROWTH IS THE SOLUTION:

The new U.S. energy supply has disrupted global manufacturing advantages. The majority of U.S. energy and feedstocks supply, in addition to the greatest concentration of U.S. consumer demand for manufactured products can now be found together in the greater Shale Crescent USA region *(explained later in the report)*. This formula has created a once in a lifetime opportunity to retain, create and attract manufacturing to the region. **Plastics-based manufacturing operations in Ohio are well positioned to expand production and capitalize on market share that is currently being captured by overseas importing companies.** By identifying plastics-based goods that can be competitively manufactured in the U.S. and aligning those products to existing manufacturing operations in Ohio, industry executives can lead a domestic revolution in reshoring that is anchored in Ohio.

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[6] National Association of Manufacturers: https://www.nam.org/facts-about-manufacturing/

[7] Federal Reserve Bank of St. Louis: https://fred.stlouisfed.org/series/MANEMP

THE ONSHORING OPPORTUNITY: PLASTICS

5

5. THE ONSHORING OPPORTUNITY: PLASTICS

The economics surrounding global manufacturing has experienced a significant shift in the last decade**. Abundant energy supply and industrial feedstocks in the U.S. have become available, accessible, and affordable.** Labor rates in China have increased dramatically due to decades of double-digit annual wage increases driven by declining birth rates and consistent improvements to productivity through automation. **Many of the forces that drove the offshoring of U.S. manufacturing operations to China have reversed course in favor of America.** The opportunity to onshore manufacturing to the U.S. based on competitive economic advantage is the strongest it has been in decades.

> ***Many of the forces that drove the offshoring of U.S. manufacturing operations to China have reversed course in favor of America.***

The energy intensive nature of plastics-based manufacturing coupled with a growing domestic energy advantage creates a timely opportunity for U.S. operations. While great opportunity exists for new domestic operations, existing manufacturers can use the anchor and agility of current operations to expedite action.

5.1 U.S. NATURAL GAS ADVANTAGE

Natural Gas and Natural Gas Liquids (NGLs) are feedstocks and represent the main ingredient for petrochemicals that are commonly used to create plastic resin such as Polyethylene, Polypropylene and Polyvinyl Chloride. **For countries to produce these resins, they must have an accessible and ample supply of either oil or natural gas.** Undersupplied countries must import their feedstocks. **Resin manufacturers in the U.S. have an abundant oil and gas supply** and are not required to import hydrocarbons. This is a significant economic and logistics advantage over other manufacturing economies.

Natural Gas Liquids → **Petrochemicals** → **Plastic Resins**

The Shale Gas Revolution has transformed the U.S. from a net importer of Oil and Gas to a net exporter[8]. This new U.S. energy advantage has created a significant opportunity to onshore manufacturing. **Within the nation, the greatest economic opportunity for manufacturing is in the Shale Crescent USA region.** Both the majority of U.S. energy feedstock supply and the majority of U.S. demand for manufactured products are concentrated in the greater Shale Crescent USA region. This creates an unprecedented economic and environmental advantage for plastics based manufacturing operations.

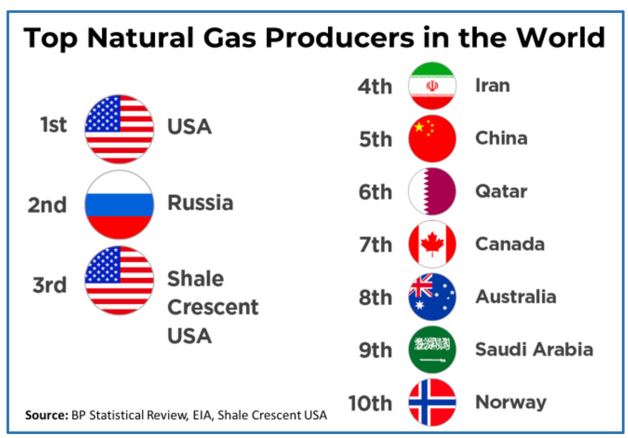

Figure 4: Global Marketed Natural Gas Production (Country Rank)

Historically, the U.S. has been a major energy producer, with significant contribution to the global Oil and Gas supply. The first commercial wells in the world were drilled in the Ohio, West Virginia, and Pennsylvania region and today there is an abundant supply of Oil and Gas. But from the 1970s to the late 2000s, U.S. oil and gas production took a back seat to foreign imports. The Arab Oil Embargo of the 1970s and the energy crisis of the 1990s & early 2000s contributed to America's reliance on imported energy from the middle east OPEC (Organization of the Petroleum Exporting Countries) members.

[8] EIA: https://www.eia.gov/naturalgas/data.php#imports

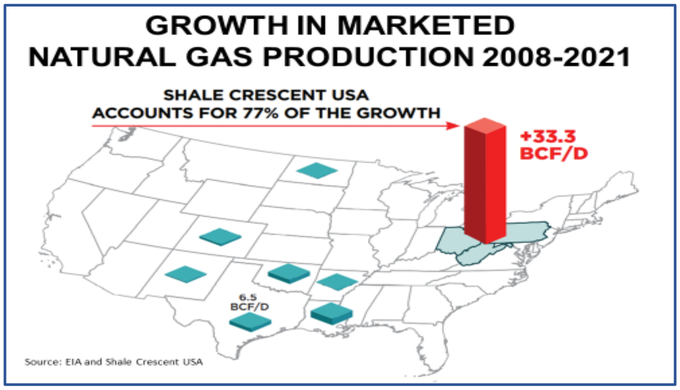

Figure 5: Shale Crescent USA Marketed Natural Gas Production

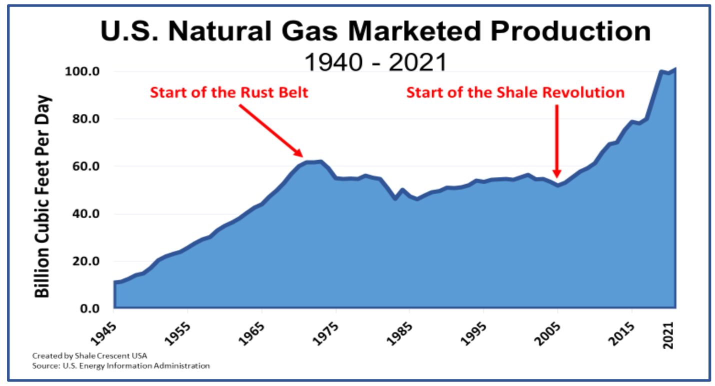

Figure 6: U.S. Marketed Natural Gas Production

A dramatic shift in natural gas production occurred in the late 2000s from a technology advancement, horizontal drilling. The new ability to drill within and along the underground formations unlocked trapped oil and gas resources. **Today, the U.S. produces oil and gas in abundance and has become a net exporter.**

The states of Ohio, West Virginia and Pennsylvania are global leaders in energy production. Combined, these three U.S. states are the 3rd greatest natural gas producing region in the world. The three states currently comprise about 35% of U.S. natural gas production. In 2010, they produced only 3%. To put this in perspective, the well-known energy state of Texas has twice the land mass of OH, WV, and PA combined, but produces far less natural gas at roughly 25% of U.S. production[9]. Furthermore, **the three Shale Crescent USA states produce well over one & a half times (1.5x) as much natural gas as the entire country of China, despite a land mass that is thirty times (30x) smaller**[10]. China is a net importer of natural gas and must acquire their feedstock from other regions of the world such as the U.S. or the Middle East.

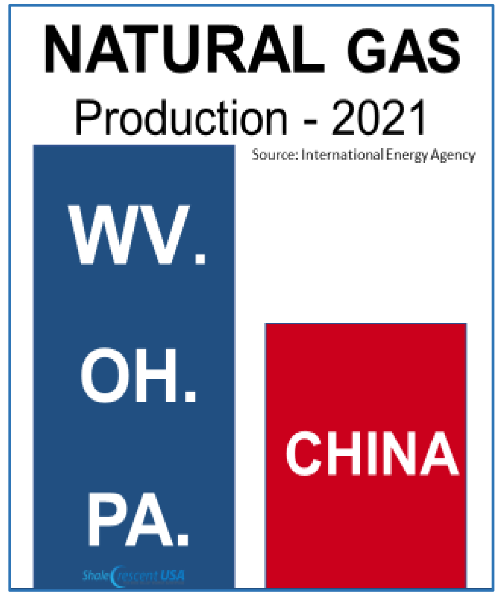

Figure 7: Shale Crescent USA vs. China Natural Gas Production

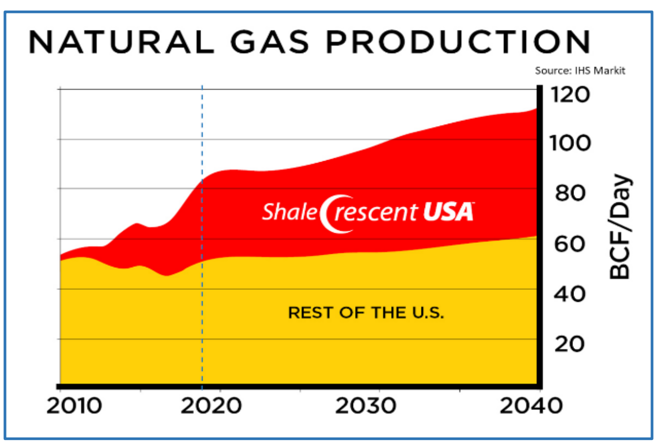

Figure 8: Projected Natural Gas Production

The Shale Crescent USA region currently comprises over a third of U.S. natural gas production and can produce enough ethane to support at least five (5) world scale cracker plants. IHS Markit forecasts the Shale Crescent USA region will supply **45% of the nation's natural gas and will double in natural gas liquids (NGLs) production by 2040**[11]**.** This energy shift has occurred in just the past few years**. It is critical for regional companies to be aware of the global manufacturing shift occurring as a result of this energy evolution.** The magnitude and pace of this shift will require swift planning and action on the part of U.S. manufacturers to leverage favorable conditions for significant economic gains.

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9 EIA: https://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_VGM_mmcf_m.htm

10 BP Statistical Review: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

11 IHS Markit: https://shalecrescentusa.com/wp-content/uploads/2019/12/Public-Executive-Summary-Shale-Crescent-3-19-19.pdf

THE IMPACT AND DOLLAR SAVINGS

Energy is a master resource and any change in its supply or cost will have a level of impact on all ancillary industries. The Shale Revolution has occurred so fast and to such a significant degree that it has had global implications and is creating disruption in the downstream industries that consume oil and gas as a feedstock. **The new abundant supply of U.S. natural gas, 77% of which is from the Shale Crescent USA, has dramatically decreased U.S. natural gas prices and given the U.S. an energy supply and cost advantage over the rest of the world.** Natural gas prices, according to the Henry Hub market, have declined by 65% over the past decade.

In a recent study, it was found that **U.S. end-users have conservatively realized $1.1 Trillion in energy savings over the past decade as a result of increased natural gas production primarily from the Shale Crescent USA region**[12]. This includes savings in residential, commercial, industrial, and electric generation categories. U.S. Industrial users such as **manufacturers saved $333 Billion as a result of lower natural gas prices** during this period. Industrial users in the Shale Crescent USA region (Ohio, Pennsylvania, West Virginia) alone experienced savings of just under $25 Billion. **Ohio 'Industrial' comprised $14 Billion of this amount.**

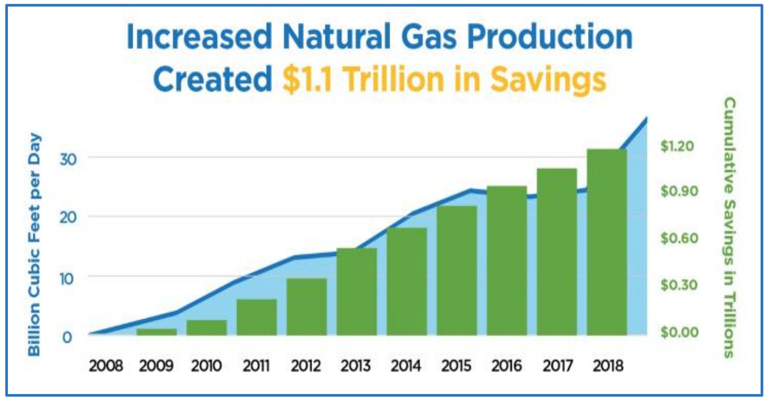

Figure 9: Dollar Savings from Increased Natural Gas Production

> ***...new supply...has dramatically decreased U.S. natural gas prices and given the U.S. an energy supply and cost advantage over the rest of the world.***

5.2 U.S. LOCATION ADVANTAGE

ELIMINATION OF TRANSPORTATION

The current Asia centered manufacturing model depends on energy based raw materials from the U.S or Middle East being shipped to Asia. These raw materials are used to manufacture goods, and those finished goods are then shipped to the U.S. for distribution and sale to consumer end-markets. Current conditions prove that this model has become inefficient, cost prohibitive, and environmentally flawed. **Manufacturers in the U.S. and more specifically the Shale Crescent USA region possess both world class supply of feedstock and the highest concentrated U.S. demand for finished products**. Manufacturers in this region are able to source, produce, and consume all related plastics-based manufactured goods in the same region. **Conversely, China's industrial operations must import molecules and export finished products along an extensive global logistics system.** Further analysis included in this report will investigate the elimination of transcontinental transportation and related economic and environmental benefits.

[12] SCUSA: https://shalecrescentusa.com/wp-content/uploads/2019/12/Kleinhenz-Associates_Natural_Gas_Savings_to_End_Users_2008-2018.pdf

SHALE CRESCENT USA PROXIMITY TO SUPPLY AND MARKET

The greater Shale Crescent USA region is a historic manufacturing center. The very first oil producing wells in the world were in Pennsylvania, Ohio, and West Virginia. During the second half of the 1800s, this region was the world supplier and main market for oil. As a result, downstream petrochemical industry operations were developed and located near the abundant source of feedstock supply. **Today, plastics manufacturing is clustered in the greater Shale Crescent USA where over three-quarters of resin consumption and a majority of U.S. petrochemical demand is located[13].**

Today, plastics manufacturing is clustered in the greater Shale Crescent USA where over three-quarters of resin consumption and a majority of U.S. petrochemical demand is located.

In addition to being a historic oil and gas producing region and now a global oil and gas leader, the greater Shale Crescent USA is also one of the largest economies in the world. Fifty percent of U.S. and Canadian population is within a day's drive[14]. **Many of the nation's largest cities and markets are inside a 600-mile radius from the center of the region.**

LOCATION ADVANTAGE BENEFITS: COST SAVINGS AND EMISSIONS SAVINGS

World class supply and demand are in the same location. This global logistics advantage creates two primary benefits.

Utilizing Shale Crescent USA energy supply to manufacture in the region is both more cost competitive and sustainable.

1) Elimination of cost associated with extensive transcontinental shipping. These costs are incurred as energy/molecules move overseas, and finished products are returned to the U.S.

2) Elimination of emissions produced from ocean vessels and related land-based infrastructure required for transcontinental shipping. Again, produced and released throughout the process of moving energy overseas and returning product to U.S. Consumer markets.

Utilizing Shale Crescent USA energy supply to manufacture in the region is both more cost competitive and sustainable.

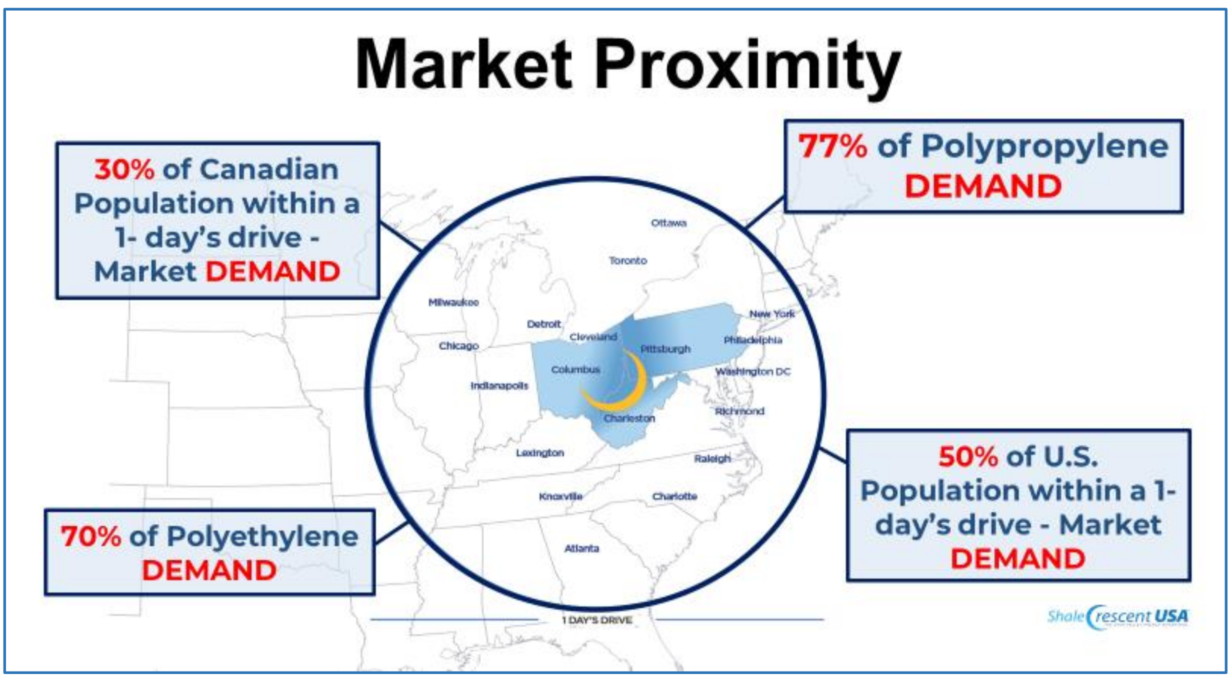

Figure 10: Petrochemical Market Proximity

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[13] IHS Markit: https://shalecrescentusa.com/wp-content/uploads/2019/12/ShaleCrescent-ExecutiveSummary-12March20181.pdf

[14] Polymer Alliance Zone: https://pazwv.org/why-the-polymer-alliance-zone/#proximity

5.3 U.S. MANUFACTURING COMPETITIVENESS:

Assumptions that manufacturing in China is more economical than manufacturing in the U.S. have carried over from a time when competitive factors were very different. **Annual double digit increases in China's labor costs, abundant low-cost U.S. energy supply, and a myriad of other factors have combined to create an equalizer for manufacturing operations in China and the U.S.** *The Boston Consulting Group* annually analyzes and compares general manufacturing cost competitiveness between the U.S. and other countries. Their index tracks relative factory wages, productivity growth, currency exchange rates, and energy costs[15].

The Boston Consulting Group's 2018 and 2019 reports indicate that **China's manufacturing cost advantage over the U.S. has vastly eroded, and the United States now has advantages in manufacturing that it has not had for decades**[16]. Though the data is several years old, trends indicate the gap between the U.S. and China is narrowing and not widening.

China's manufacturing cost advantage over the U.S. has vastly eroded, and the United States now has advantages in manufacturing that it has not had for decades.

Further analysis identifies Shale Crescent USA as having the strongest economics among U.S. regions for competitive manufacturing operations. Recent studies highlight the significant reduction of transportation as a key component that supports favorability over other parts of the country. *More on the regional manufacturing economic advantages and the manufacturing prime cost drivers will be covered later in this report.*

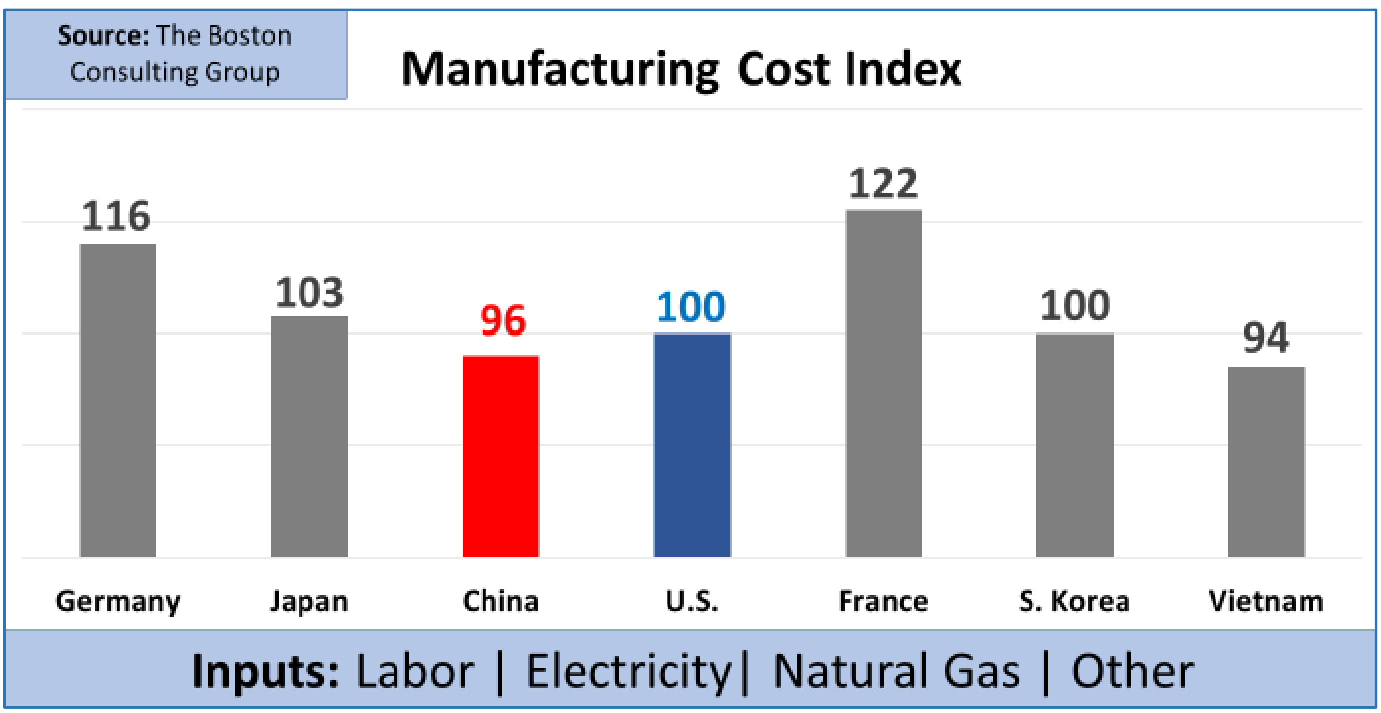

Figure 11: Manufacturing Cost Index

[15] The Boston Consulting Group: https://www.bcg.com/en-us/publications/2020/manufacturing-strategy-built-trade-instability

[16] See Appendix A – Manufacturing Cost Index

OHIO:
PLASTICS MANUFACTURING

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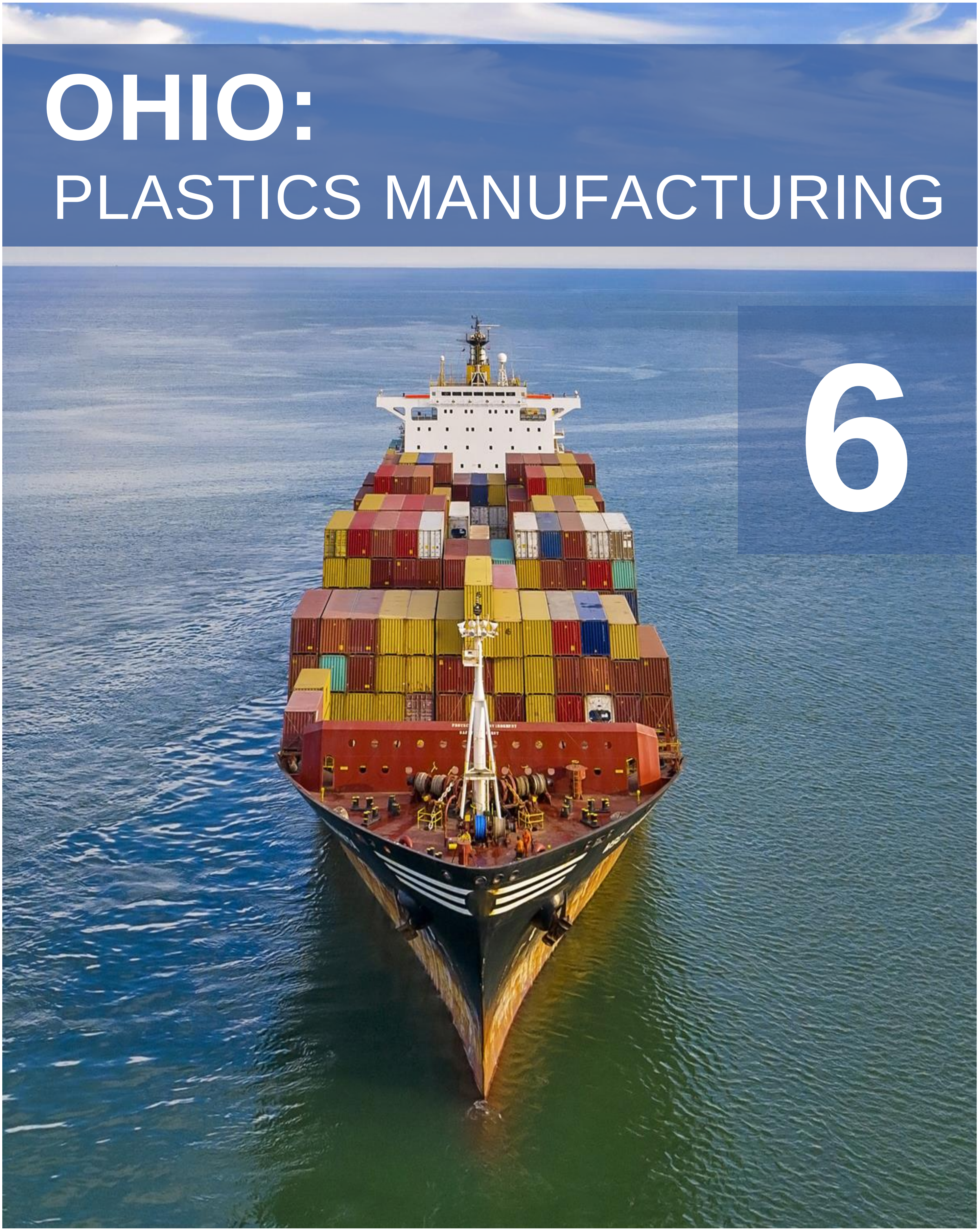

6. OHIO: PLASTICS MANUFACTURING

The plastics industry is robust and well established in the state of Ohio. This can be attributed in part to manufacturing operations that were established in the late 1800's following initial discovery of oil and gas deposits. This abundant energy supply supported the development of energy intensive industries such as petrochemicals and plastics that have grown to include industry clusters throughout the region.

Ohio is one of the top producers of plastic products in the United States. **The state is tied for 1st with Texas in industry employment at an estimated 70,500 people.** When considering ancillary industry support, Ohio's employment numbers are estimated at an impressive 1.8 million jobs[17]

Ohio's established plastics industry produces an incredible amount of product. In 2019, Ohio's Gross Domestic Product by the polymer industry was over $50 Billion[18] making Ohio one of the top producing states in the nation. The state also houses some of the nation's largest plastics equipment manufacturers and other support services further adding to the industry stronghold of the plastics producing state. Furthermore, 70% of all U.S. polyethylene demand and 77% of all U.S. polypropylene demand is within a day's drive of the greater Ohio region. *For more detailed information on the size and output of the plastics industry in Ohio, as well as leading industry data and market intelligence, visit the Plastics Industry Association website.*

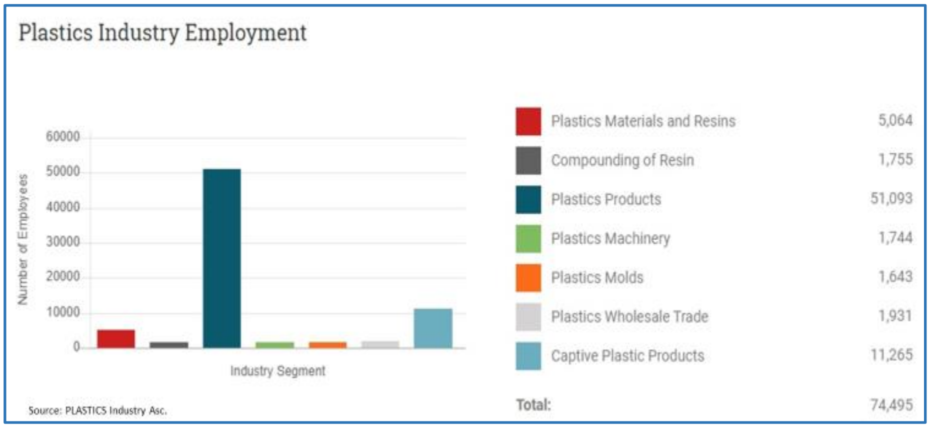

Figure 12: Plastics Industry Employment – Source: PLASTICS Industry Association

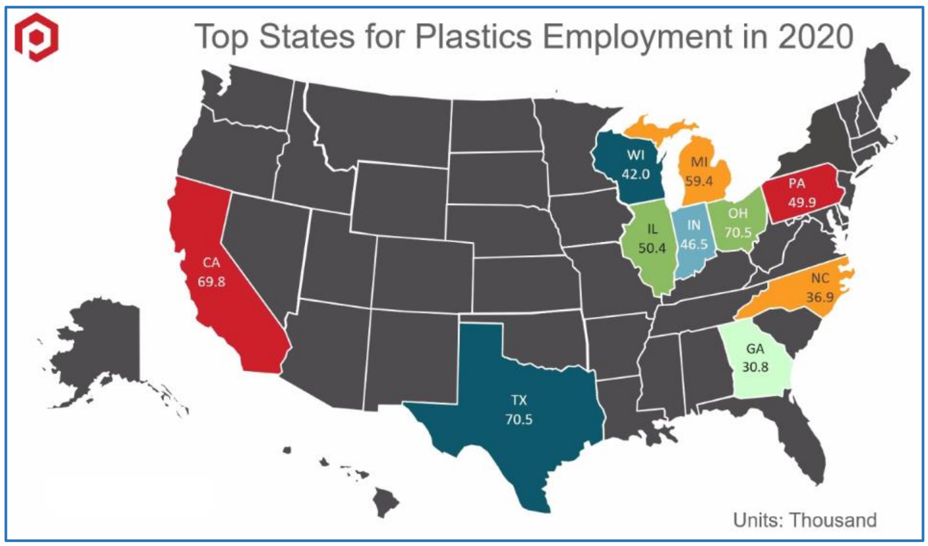

Figure 13: U.S. Plastics Employment 2020 – Source: Plastics Industry Association

6.1 OHIO PLASTICS PRODUCTION: RESINS, TYPES, AND MARKETS

An analysis of nearly all Ohio plastics-based manufacturing operations was conducted to identify specifically how many and what type of manufacturers are positioned to capture some of the market production currently being made overseas and imported to the U.S. *(See Appendices B,C,D,E for more information).* The inventory and analysis was used to identify which types of imported plastic-based products are best candidates for local production by existing manufacturers. The analysis revealed similar capabilities and commonalities of those companies that are positioned well for growth.

[17] The Plastics Industry Association: https://www.plasticsindustry.org/factsheet/ohio

[18] Polymer Ohio

The three criteria below were used as a baseline for identification of existing operations that are best suited to be globally competitive in the domestic production of imported plastics-based consumer goods:

- **Feedstock Plastic-Resin Used** – technical familiarity and existing supply chain
- **Processing Type** – equipment required for production of products
- **Market Segment** – knowledge of market, connection to consumer base

The inventory also included location, company contact information, annual revenue, and number of employees. Plastics processors were identified by their North American Industry Classification System (NAICS) code. NAICS code 326199 "All Other Plastics Product Manufacturing" is the most pertinent classification for the purpose of this study. **The research identified and reviewed just over 600 manufacturers in the state of Ohio.**

OHIO: FEEDSTOCK - PLASTIC RESIN USED

The Ohio polymer industry consumes a variety of plastic resins ranging from commodities to composites, to engineered polymers. **The commodity pellets of Polyethylene and Polypropylene are among the largest sources for most Ohio based manufacturing operations**. Over one-third of plastics manufacturers use multiple types of plastic resins. This allows manufacturers the flexibility to produce a wide range of products geared to specific client needs.[19]

Overall, Ohio is representative of the U.S. related to type of plastic resins in use by manufacturers. Polyethylene Terephthalate (PET), which is primarily used in plastic bottle production, is used slightly less in Ohio than in other states. To minimize transportation costs, PET bottles are produced in or near large population centers often within line of sight of bottling plants. *For more detailed information on feedstock types in Ohio see Appendix C – Ohio Manufacturing Feedstocks.*

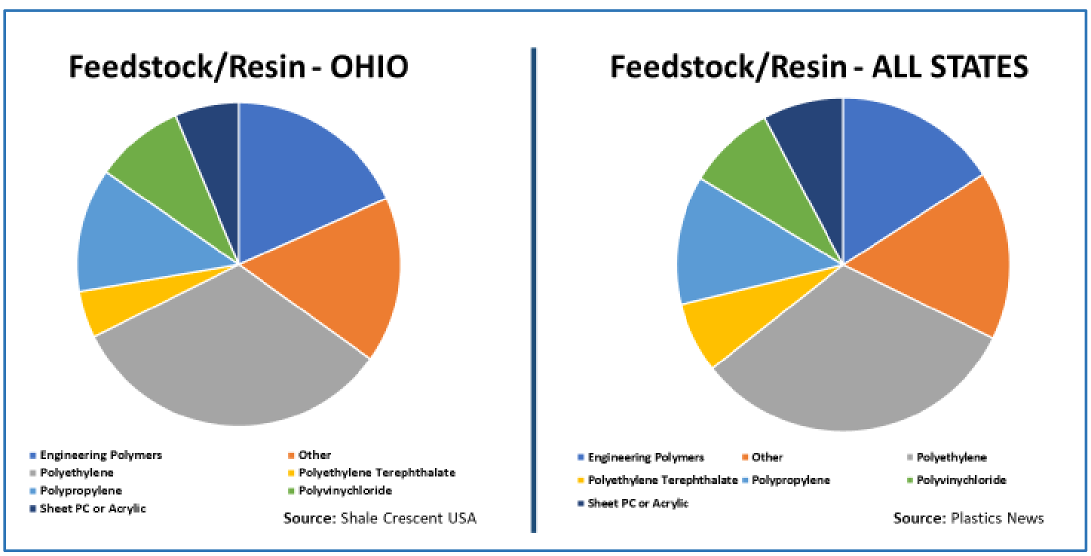

Figure 14: Ohio/U.S. Feedstock/Resin Used

[19] See Appendix C – Ohio Plastics Processors: Feedstock/Resin Used

OHIO: PROCESSING TYPE

Ohio is also representative of the U.S. in type of processing. **Injection molding accounted for nearly half of all processing types in Ohio, compared to over half country wide**. Ohio has measurably less thermoforming than in all of the U.S. Thermoforming is used in the manufacturing of disposable cups, containers, lids, trays, clamshells, and other products for food, medical, and general retail industries. Like plastic bottles, these are produced close to large population centers to minimize transportation costs. Almost all the manufacturers analyzed utilized multiple processing types to meet customer needs.

Due to size of product and cost of transportation it is likely that blow, pipe and rotational molded products experienced less offshoring. *For more detailed information on processing types conducted in Ohio see Appendix D: Ohio Plastics Processors: Processing Types.*

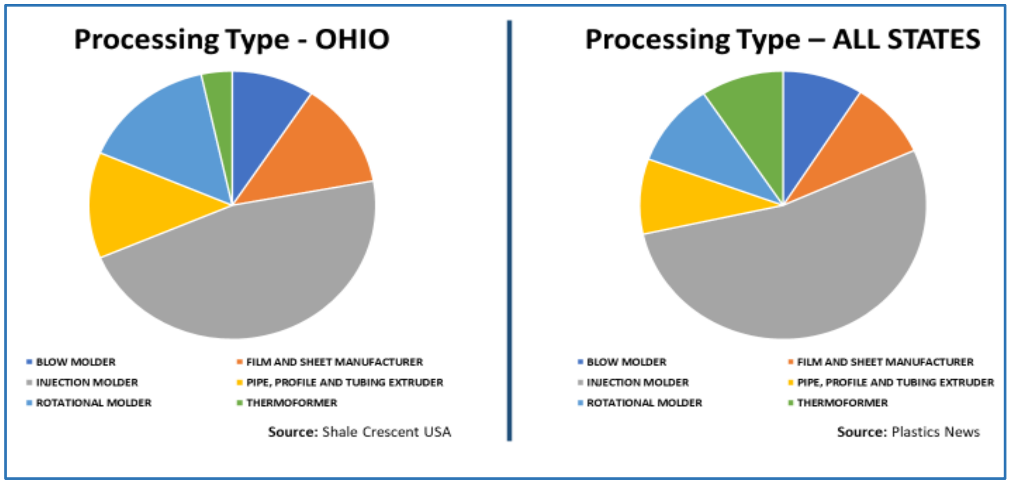

Figure 15: Ohio/U.S. Processing Type Used

OHIO: MARKET SEGMENT

The purpose of this research is to identify products that can be onshored for production. **Manufacturers who are already producing in market segments similar to those with a currently high volume of imported products begin with several advantages including consumer connection.**

Ohio producers manufacture many products ranging from industrial and consumer goods to automotive parts and medical devices. This distribution of production types is representative of market segment production across the country.

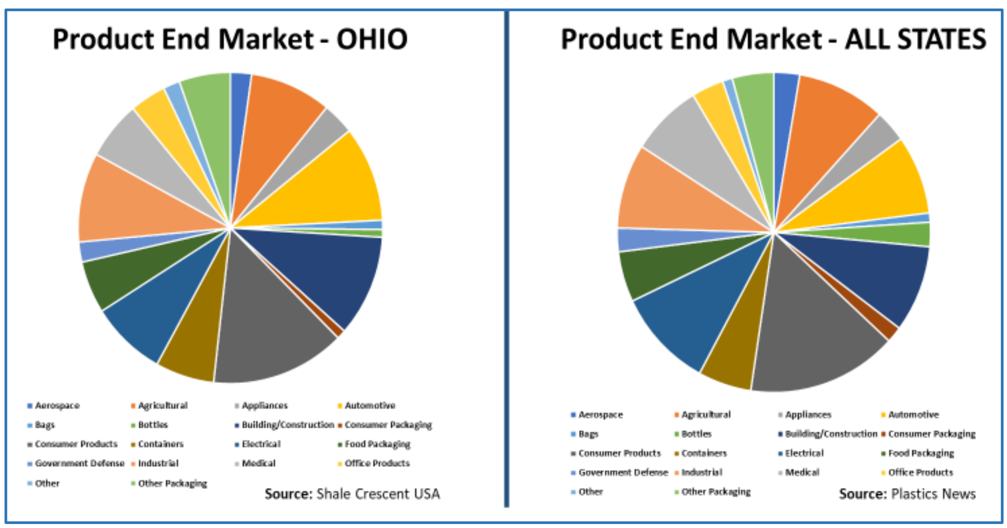

Figure 16: Ohio/U.S. Product End Markets

> ***Manufacturers who are already producing in market segments similar to those that represent imported products begin with several advantages including consumer connection.***

Displayed another way using general product categories it is clear that consumer products are the largest market category for Ohio manufacturers. A vast majority of imported products from China are consumer products. The second and third highest production by category are Building Construction and automotive, both of which are in high demand in the state and the surrounding region. *See Appendix E – Ohio Plastics Processors: Product End Markets*

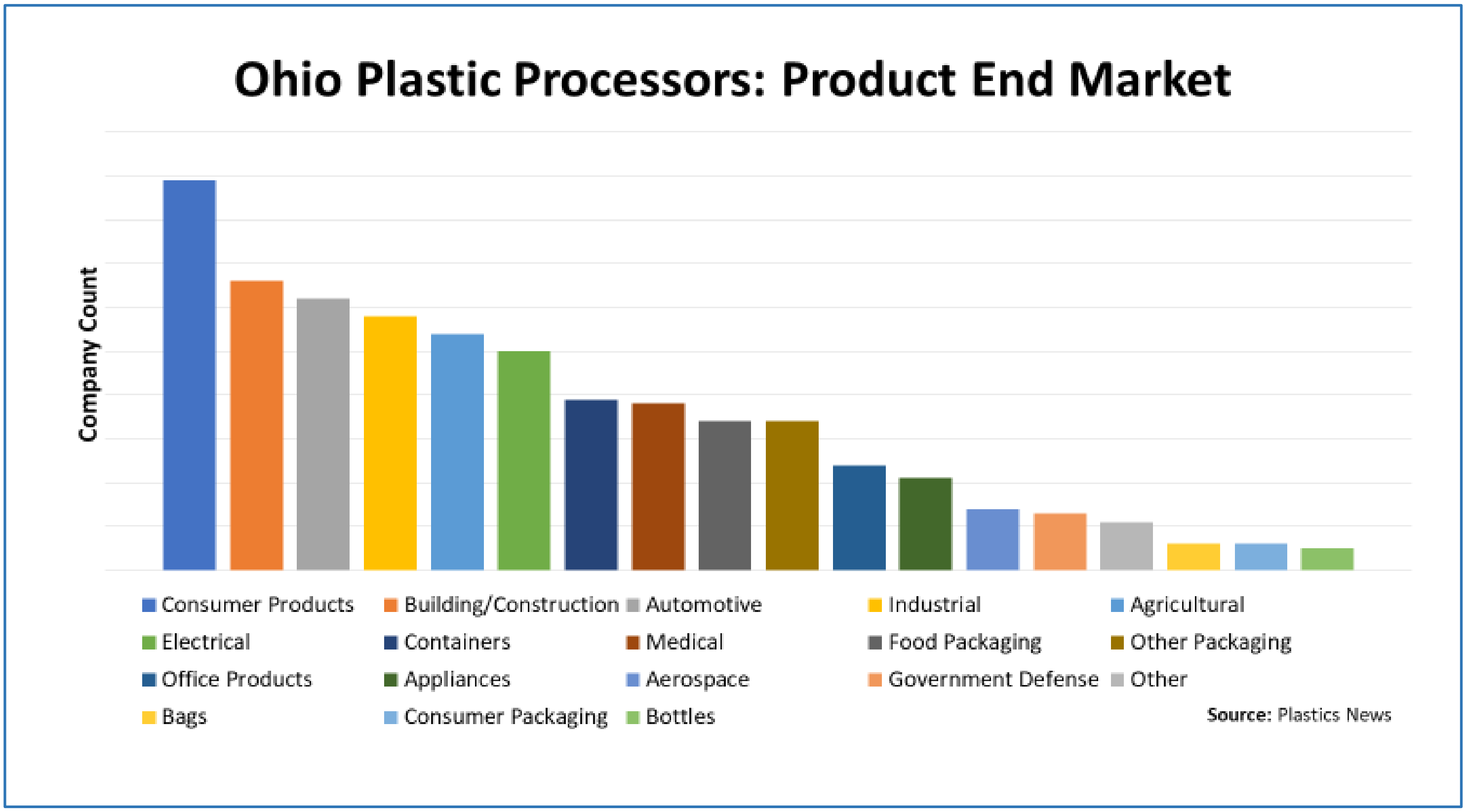

Figure 17: Ohio End Market - Bar Chart

OHIO PLASTICS PROCESS RESEARCH: SUMMARY

Ohio is well positioned to onshore plastics-based manufacturing operations with strong supporting factors that include diversity of plastic resins, alignment of processing types, and access to consumer markets. Existing plastics facilities in the state of Ohio have current active operations that consume a wide variety of feedstocks, utilize multiple processing techniques, and have well-established relationships with consumer markets. Chinese imported items that can be produced competitively in the state have been identified with special attention to these baseline criteria and will be reviewed later in this study. **Manufacturers that align will be best suited to capture a portion of the currently imported market share.**

Manufacturers that align will be best suited to capture a portion of the currently imported market share.

OHIO VS. ZHEJIANG:

DRIVERS FOR ONSHORING MANUFACTURING

7

7. OHIO VS. ZHEJIANG: DRIVERS FOR ONSHIORING MANUFACTURING

A primary goal of this study is to identify if currently imported plastics products from China can be produced competitively in the U.S. and more specifically, in Ohio.

While these countries are worlds apart, both geographically and politically, a simple model that considers key manufacturing cost drivers will allow for a sound economic comparison of production for two hypothetical and identical plastics-based manufacturing facilities on opposite sides of the globe. **The prime cost drivers that have been identified for the purpose of this study include labor, electric, transportation, general site expenses, plastic resins.** Over the past two decades, each one of these drivers has experienced significant change and can be measured as a long-term trajectory. **The driving forces that led to offshoring U.S. manufacturing to China have reversed course and are now favoring domestic production.** The opportunity to onshore manufacturing to the U.S. based on competitive economic factors is the strongest it has been in decades**.**

The driving forces that led to offshoring U.S. manufacturing to China have reversed course and are now favoring domestic production.

DEMOGRAPHICS COMPARISON

The Zhejiang Province of China has been identified as a region that is reasonably comparable to U.S. operations in the state of Ohio**. Like Ohio, Zhejiang is a manufacturing region with a robust economy built on manufacturing.** Zhejiang is the leading province in China for the manufacturing of plastics-based consumer goods, both in value and volume. It has the longest coastline of any province and is an ideal location for exports. Zhejiang's GDP is just under $1.0 Trillion per year and is the fourth ranked province in China in terms of GDP[20]. Ohio's GDP is roughly $0.7Trillion annually and ranks 7th in the U.S.[21] in terms of GDP. Ohio's population is far smaller at roughly 11.5 million compared to Zhejiang's roughly 60 million people. At 39,000 sq. miles Zhejiang is slightly smaller than Ohio at 45,000 sq. miles and has 8 times the population density as Ohio. In terms of per capita GDP, Ohio is nearly four times greater than Zhejiang.

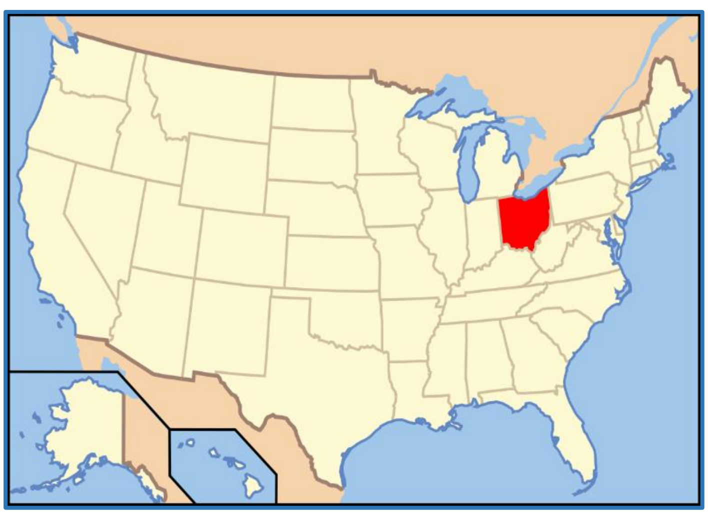

Figure 18: Map of Ohio, USA

Figure 19: Map of Zhejiang, China

[20] Statista: https://www.statista.com/statistics/1092992/china-gross-domestic-product-of-zhejiang-province/

[21] U.S. Bureau of Economic Analysis: https://www.bea.gov/sites/default/files/2021-06/qgdpstate0621.pdf

FOR FURTHER INVESTIGATION

The focus of the cost analysis in this study is not inclusive of transcontinental tax, tariff, and cost of capital. The complexity of these applications is largely influenced by a number of dynamic factors including, but not limited to classifications, volume, business characteristics, and local and national government control. Although not included in this report, it is an important part of the global competitive equation and can be generally considered a factor that in part favors the case for onshoring and/or reshoring U.S manufacturing operations.

7.1 WAGE AND LABOR COSTS

Wages are a significant cost driver for manufacturing operations and must be considered when investigating competitive advantage. There are many factors that impact the cost of labor such as: equipment used, processing type, end-product, contracts, volumes, geography, and more. A labor cost range will likely fall somewhere between 5% to 40% of the total cost of manufacturing the product. The variance in the percent of labor cost is also determined by the overall cost of the product and the cost of other inputs such as resin, electricity, overhead, etc. **An analysis of the annual manufacturing wages was conducted for both Ohio and Zhejiang to compare the labor costs in the modeled manufacturing facilities.**

Total Cost per Employee (TCE) was used as a standard to compare workforce investment in the hypothetical study areas. TCE includes both wages and benefits and represents the total compensation of the employee. Three representative employment levels including entry-level, mid-level, and senior level occupations were selected to represent the varying degrees of employee wage costs[22].

1. **Entry Level - Manufacturing Operator:** Special but limited skills. Equipment operation with some work experience.
2. **Mid-Level – Manufacturing Supervisor:** Responsible for managing parts of assembly, scheduling workforce, training new employees, performing limited quality control, overviewing safety regulations.
3. **Senior Level – Manufacturing Plant Manager:** Managing production, planning new production methods, product and equipment investment decisions, and oversight of significant maintenance.

OHIO LABOR COSTS

Ohio wage rates were compiled from both the *Bureau of Labor Statistics (BLS)* and the *Manufacturers Association of Plastics Processors (MAPP).* **The following figures are inclusive of 2021 wages and benefits and represent the TCE.** Benefits were calculated by using the manufacturing industry standard of 33.6% of total compensation, an industry number provided by the *BLS.*[23]Entry level positions including manufacturing operators, earned a median annual wage of $46,987.[24] Mid-level positions including manufacturing supervisors median wage is $78,939 per year. Senior level, manufacturing plant managers are reported at a median annual income of $134,698 annually.

Ohio vs. China: Total Compensation

	U.S. Plastics Industry (2021)	China Plastics Industry (2021)
Plant Manager	$134,500	$69,000
Shift Supervisor	$79,000	$33,000
Operator	$47,000	$15,000

Source: U.S. BLS, German Chamber of Commerce

ShaleCrescent USA

Figure 20: Ohio vs. China Total Compensation

[22] See Appendix F: China Manufacturing Positions, Wage Rates and Compensation

[23] The Bureau of Labor Statistics: https://www.bls.gov/news.release/pdf/ecec.pdf

[24] See Appendix G: Ohio Manufacturing Positions, Wage Rates and Compensation

CHINA LABOR COSTS

China wage rates have been acquired and cross referenced from several sources. The key data points used for this study came from the German Chamber of Commerce in China. This organization works on behalf of the Federal Republic of Germany and is the primary organization for promotion of German foreign business development in China[25] by both industry & region. The following reported figures include both 2021 salary and benefits and represent the TCE. Entry level positions including manufacturing operators, annual earnings were reported at a median of $14,966[26]. Mid-level positions including manufacturing supervisors were reported at a median of $33,475 per year. And senior level positions including manufacturing plant managers were reported at a median of $69,323 annually.

CHINA WAGE RATES ON THE RISE

China's wage rate advantage has seen consistent decline for more than two decades because of exponential annual increases in labor costs. **During the past 25 years China's manufacturing wages have increased more than 10-fold and continue to rise[27]**. Annual rate increases of 10 to 13 percent in China's manufacturing industry have been consistent over the last 25 years. **This trend in China's manufacturing wages equates to a doubling of rates every six to seven years. From 2020 to 2021, China's wage rates took a significant jump and increased by 20%.**

The exponential increase in China's manufacturing wage rates has been driven in part by a growing demand for qualified manufacturing workers. For the past five decades, manufacturing in China has grown at a drastic rate. Annual exports from China to the U.S. have risen from nearly non-existent in 1985 to an estimated $500 Billion in market value today[28]. China's exports to the rest of the world by market value are much larger at (5) times the amount of the U.S.[29]

Contrary to popular belief, China's population has seen a significant deceleration in growth compared to the end of the 20th century, which contributes to a declining available workforce[30]. "China's family planning policy is claimed to have averted the increase in population of some hundreds of millions of people, and at the same time has eliminated hundreds of millions of potential laborers"[31].The effects of this trend can be seen in the current workforce. There are regions within China that show signs of a developing "rust belt", similar to regions of the Midwest U.S. A 2020 study by *The British Medical Journal* predicts the population in China will fall from 1.41 billion to 0.73 billion by the end of the century. Together, the increasing demand for manufacturers and the decreasing supply of workers is **driving up labor rates at an annual average pace of more than 10%.**

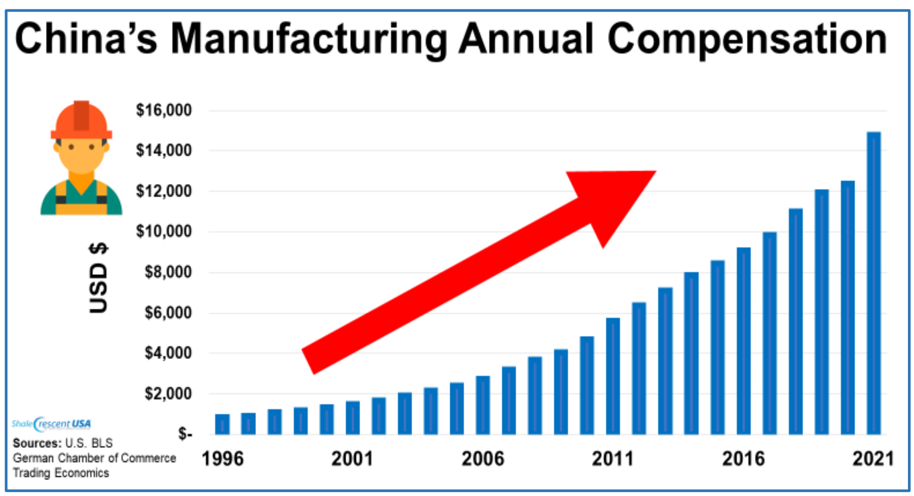

Figure 21: Chinese Manufacturing Annual Earnings

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[25] AHK: https://china.ahk.de/market-info

[26] See Appendix F: China Manufacturing Positions, Wage Rates and Compensation

[27] Trading Economics: https://tradingeconomics.com/china/wages-in-manufacturing

[28] U.S. Census Bureau: https://www.census.gov/foreign-trade/balance/c5700.html

[29] Trading Economics: https://tradingeconomics.com/china/exports-by-country

[30] See Appendix H: Slowing Chinese Population Growth

[31] U.S. National Library of Medicine: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4657744/

WAGE AND LABOR COSTS: FINDINGS

Based on the reports analyzed as part of this study, annual compensation for entry-, mid-, and senior-level manufacturing employees in China averages two to three times less than comparable U.S. manufacturing compensation, which represents the most comparable range recorded in recent history. **For decades, China has had a nearly insurmountable labor cost advantage over the U.S. and other leading industrial economies, but annual double digit wage rate increases have slashed China's cost advantage**. Furthermore, in terms of productivity output, U.S. Gross Domestic Product in 2021 was $141,200 per person, versus China's average at just $27,600 per person[32]. As China continues to deal with a decreasing labor supply, associated labor costs will likely experience a correlated upward trend. Meanwhile, the gap between the U.S. and China manufacturing workforce is expected to continue as a shrinking trend.

> ***...annual double digit wage rate increases have slashed China's cost advantage.***

7.2 ELECTRICITY RATES

Manufacturing in general is energy intensive. For the plastics processing industry, the electricity consumed directly by equipment for product manufacturing must be accounted. In the U.S. Midwest the cost of electricity used for production will range anywhere from 2% to 7% of the total cost of a manufactured product. The variance of the percent cost of electricity is primarily based on the manufacturer's electric rates, type of machinery, and product type. The other cost factors of manufacturing will also play a role in the allocated percent cost of electricity. An analysis and comparison of electricity costs was conducted for both the state of Ohio and the Zhejiang province. To perform this analysis, a general assumption has been made that plastic-based manufacturing operations are able to contract for electrical service at industrial rates.

OHIO ELECTRIC RATES

U.S. electric prices have shown relatively stable or downward trending rates over the last ten years. **This can be attributed in part to a new abundant and accessible fuel source, natural gas, used for power generation.** Between 2010 and 2021, industrial consumers in the state of Ohio have experienced nationally competitive rates ranging from 6.10¢ to 7.00¢ per kilowatt-hour (kWh)[33]. It should be noted that prices vary greatly among U.S. states. During the same period (2010-2021), California industrial rates rose from 9.80¢ to 15.04¢per (kWh)[34].

THE IMPACT OF NATURAL GAS ON U.S. ELECTRIC RATES

The abundant supply of U.S. natural gas, which now accounts for 40% of the feedstock for electrical power generation, has contributed to downward pressure on U.S. industrial electric costs[35]. Within the past decade, the U.S. has repositioned itself from a net importer of energy to a net exporter of energy and is now the number one natural gas producing country in the world[36]. Over 75% of this new supply of natural gas has been produced in the Shale Crescent USA region, that includes the total area of Ohio, West Virginia, and Pennsylvania. **Lower natural gas prices have led to substantial savings of natural gas consumption, in addition to significant electric cost savings.** Since the Shale Revolution, electric cost savings

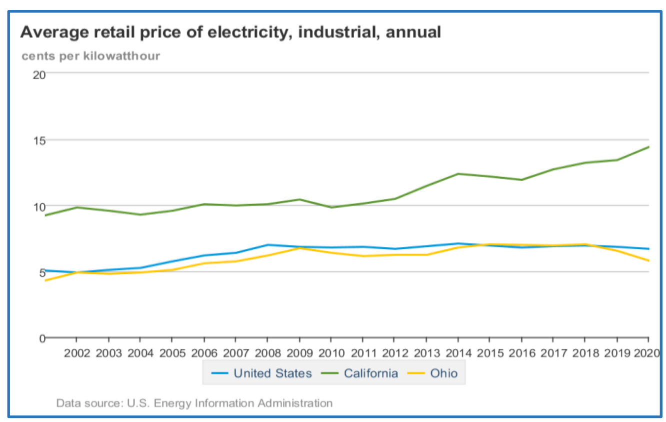

Figure 22: Industrial Electric Price U.S., California, Ohio

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[32] International Labour Organization: https://ilostat.ilo.org/topics/labour-productivity/

[33] Energy Information Administration: Ohio Industrial Electric Rates

[34] See Appendix I: U.S. and State Industrial Electric Rates

[35] EIA: https://www.eia.gov/electricity/data.php#consumption

[36] BP Statistical Review: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf

for U.S. consumers equates to roughly $400 billion[37]. **Ohio consumers have saved nearly $9 billion on electric costs during this same time[38].**

CHINA ELECTRIC RATES

Over the past decade, industrial electric rates in China have shown considerable variance. In 2010, industrial electric rates in the Zhejiang province were 13.25¢ per kWh[39][40]. Rates peaked in 2014 at 14.52¢ per kWh and have since declined to a price of 10.08¢ per kWh reported in 2021. This drop in prices can be partly attributed to a decrease in the price of coal over the last half of the decade[41]. However, **relying on imported energy brings great volatility.** In 2021 and 2022 coal prices significantly increased.

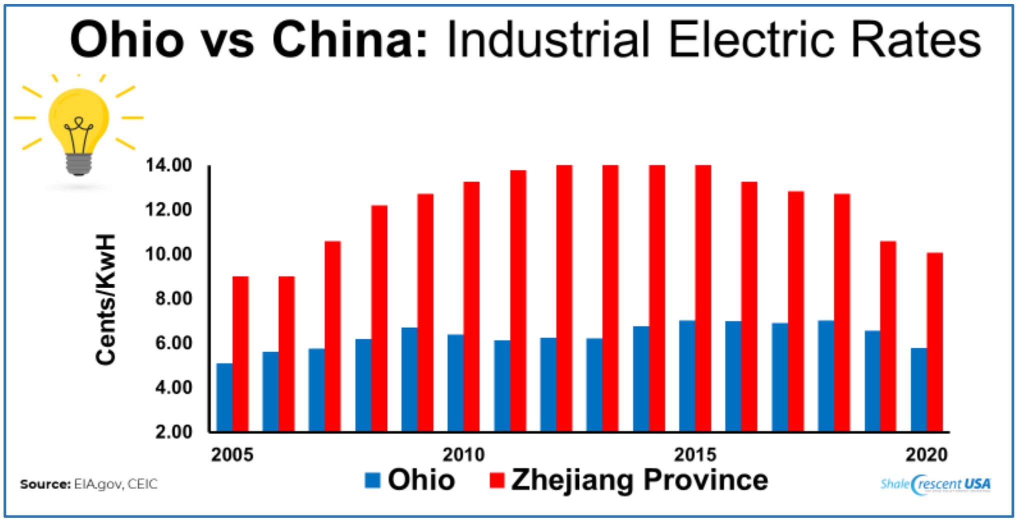


Figure 23: Ohio Vs. China Annual Industrial Electric Rates

FINDINGS

Although China's electric rates have decreased over the past five years, they remain substantially higher than comparable rates in the U.S. and are much more volatile. The most recent available data shows that a Zhejiang plastics-based manufacturing operation will pay an estimated 10.08¢ per kWh, while a similar Ohio based operation will pay much less at close to 6.48¢ per kWh. A discount of more than 35% for industrial electricity in Ohio. However, **the greater advantage for Ohio based manufacturers is the reliability of electricity supply.** For more information on China vs. U.S. electric rates, see the report 'A Comparison of U.S. & China Electricity Costs'.[42]

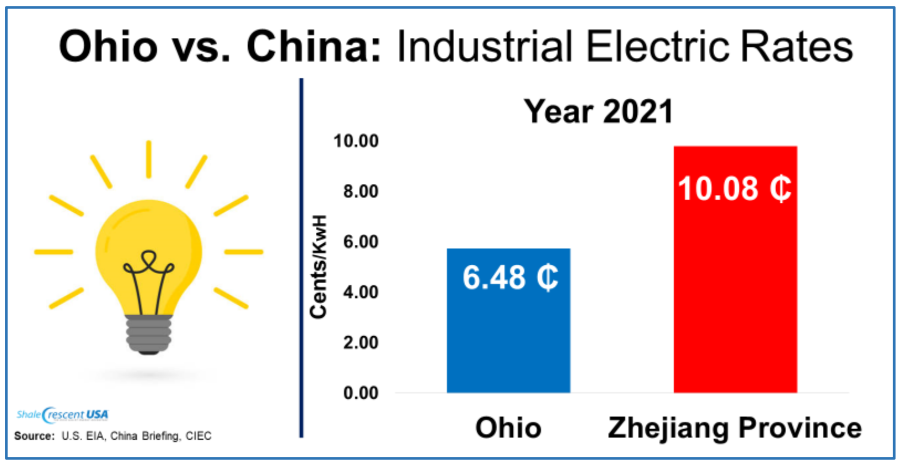


Figure 24: Ohio Vs. China Industrial Electric Rates

> ***Relying on imported energy brings great volatility...Although China's electric rates have decreased over the past five years, they remain substantially higher than comparable rates in the U.S. and are much more volatile.***

[37] Natural Gas Savings to End-Users: 2008-2018: https://shalecrescentusa.com/resources/market-resources/

[38] See Appendix J: Natural Gas: U.S. and Ohio Electric Savings

[39] CEIC Data

[40] See Appendix K: China Regional Electric Rates

[41] https://blsstrategies.com/docs/news/News_181.pdf

[42] https://blsstrategies.com/docs/news/News_181.pdf

7.3 TRANSPORTATION

Transcontinental transportation of manufactured goods is dependent on a sophisticated logistics network that significantly increases the investment of consumer goods production. This cost is ultimately passed on to end-market consumers, and therefore must be considered in the economics of global manufacturing. Unlike other cost factors examined as part of this particular study, **long-haul transportation costs are only applicable to production costs associated with the hypothetical Zhejiang manufacturing facility. Ohio based manufacturing facilities eliminate the need for ocean born transports for domestic consumer markets.** For the purpose of this study, long-haul transportation costs of standard 40' shipping containers have been analyzed. This report does not measure transportation costs incurred from moving finished goods from the Chinese manufacturer to the Chinese ports.

LONG-HAUL TRANSPORT: CHINA TO U.S.

Transcontinental transportation of manufactured consumer goods from China to the Eastern U.S. requires a sophisticated system that comes with a substantial cost. A number of intercontinental sea routes are used to move goods and each route has pros & cons such as transit time, risk, cost, and distance that must be considered. All routes include paths that require thousands of ocean transport miles. **Depending on the route, a standard container of finished goods originating in China will travel by sea a range of 6,500 to 20,000 nautical miles (nm) to reach a U.S port before being processed for national distribution to consumer markets**[43]. A container going to the west coast of the U.S., by way of the Pacific Ocean will travel roughly 6,500 nm. To the U.S. east coast, through the Suez Canal and by way of the Atlantic Ocean, a container will travel roughly 14,000 nm.

In recent years, the general cost to ship a standard 40' metal cargo container from China to the U.S. east and west coasts ranged from $2,500 to $3,500. In the wake of a global pandemic, supply chains have been compromised while consumer demand has increased. Consumer goods, largely manufactured in China have started to reflect the cost of this disruption**. In the early summer of 2021, the price to ship a 40' container from China to the North American east coast sharply rose to an estimated $10,000, a rate nearly 300% higher than the previous annual rate** [44]**.** Just a couple months later prices spiked to over $20,000. In August of 2021, Isaac Larian, CEO of MGA entertainment, the fourth largest toy company in the world, weighed in on these exponential rate hikes in a statement that said, **"The container that cost $3,200 last year is now $22,000"**[45]**.** It is difficult to forecast any eventual leveling of transcontinental shipping prices, but current price dynamics are trending in favor of a significant U.S. cost advantage over competing operations in China. **In the 3rd quarter of 2022, transportation ranged between $6,000 to $10,000.** When looking at total shipping from door to door, the buyer can expect to pay an additional $2,000 to $3,000 on top of the sea borne transportation rate.

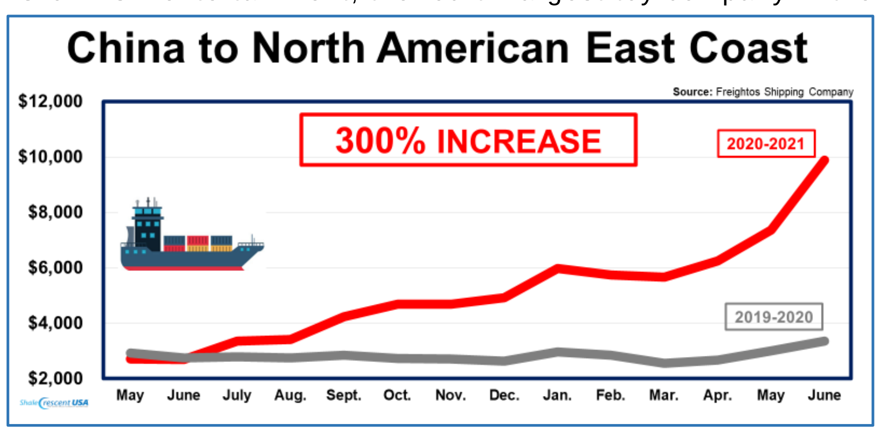


Figure 25: Ocean Transport China to North American East Coast

[43] Ocean Freight Rates: www.ports.com, www.searates.com

[44]Freightos: https://fbx.freightos.com/freight-index/FBX03

[45] CNN: https://www.cnn.com/2021/08/29/business/toy-shortage-supply-chain-shipping-holidays/index.html

OHIO SHIPPING ADVANTAGE

See prior section, *'Shale Crescent USA Location Advantage'.* Ohio manufacturing operations have no static costs associated with sea borne transportation or ancillary investments that must be made to move goods manufactured in China to U.S. based consumer end markets. Their ocean transport cost is zero as opposed to imports from China which conservatively cost between $10,000 to $20,000 per unit in 2021.

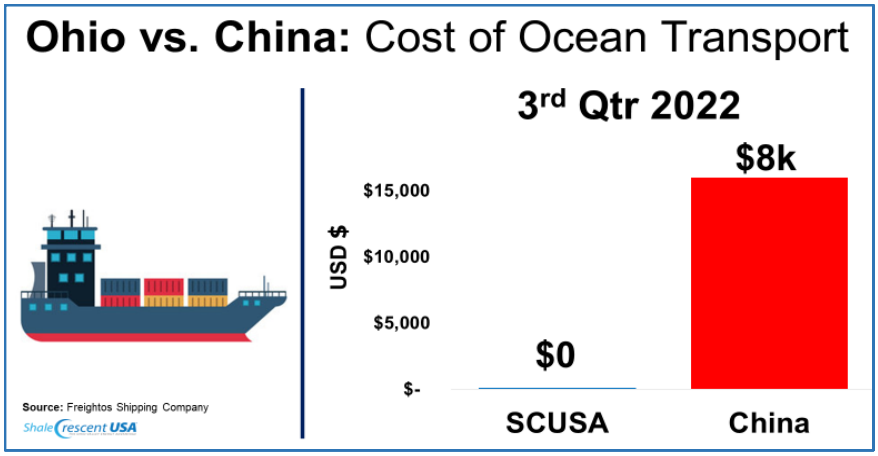


Figure 26: Ohio Vs. China - Cost of Ocean Transport

On the contrary, **Ohio manufacturers can capitalize on the benefit of being located within a day's drive of over 70% of the end-to-end plastics industry supply chain**[46]. This location advantage is further amplified by the proximity to domestic consumers, represented regionally by over 50% of the U.S. population.

7.4 MANUFACTURING SITE LEASE RATES

Manufacturing operations require significant physical space for production, logistics, and related mitigation operations. The large footprint characteristic of manufacturers makes lease rates both a common and a significant factor in this study's hypothetical cost model for the U.S and China. To mitigate lease rates, manufacturers will take location into consideration. An analysis and comparison of viable manufacturing properties and associated lease rates was conducted for both the state of Ohio and the Zhejiang province.

This analysis considered a number of factors that culminate in a final sale price and/or lease rates of suitable real estate. Manufacturing operations must consider common factors including location, potential for expansion, logistics accessibility, existing infrastructure, and utility connectivity.

As part of this analysis, active listings for available manufacturing operation sites in Ohio and Zhejiang were analyzed and compared[47].

Selected listings were chosen based on several parameters that are often required to support typical plastics-based manufacturing operations:

- Industrial operation requirements including existing or available infrastructure and viable options for expansion
- Under roof square footage between 50,000 sq/ft to 100,000 sq/ft
- Existing truck bays
- Railroad access (Optional)
- Resin Storage (Optional)

[46] SCUSA: https://shalecrescentusa.com/wp-content/uploads/2019/12/Public-Executive-Summary-Shale-Crescent-3-19-19.pdf

[47] See Appendix K: China – Zhejiang Real Estate Prices

A common standard metric for lease rate comparison is the dollar cost per square foot. This figure is calculated by using the total yearly lease cost by dollar amount and dividing by the total square footage of physical capital. This results in a lease rate measured in a dollar per square foot unit.

OHIO MANUFACTURING SITE LEAST RATES

The state of Ohio is built on a storied history of manufacturing and continues to be supported by this economic engine with more than ten thousand manufacturing firms located in the state[48]. This robust statewide inventory allowed for an adequate representative sample from which to mine statistically valid data on related lease rates. **A sampling of Ohio manufacturing operations, that met all qualifying criteria, revealed a 2021 annual lease rate that fell in the range of $4-5 per sq./ft.**[49].

CHINA MANUFACTURING LEASE RATES

Lease rates in the Zhejiang province were provided by *NAI – Sofia Group Shanghai*, a global industrial real estate company. A sample of properties meeting the above stated parameters was inventoried. **The data showed that manufacturing operations in the Zhejiang province in 2021 pay a present-day annual lease rate that ranges from $6 – $7 per sq./ft.**[50]. Considering the exponential growth of China's manufacturing sector, a decreased availability of space could be a major contributing factor to inflated lease rates. It is worth noting again that while Zhejiang is comparable in land mass to the state of Ohio, it is home to 8 times the population, totaling an estimated 58.5 million people[51].

The Zhejiang province has seen real estate prices .... increase anywhere from 5 to 10 times value, compared to two decades ago.

China has seen a steady increase in real estate sale value over the past 20 years. Since the turn of the 20th century, China's average commercial property value has tripled[52]. The inflation in China's industrial centers has been even more significant. **The Zhejiang province has seen real estate prices depending on sector increase anywhere from 5 to 10 times value, compared to two decades ago.**[53]

MANUFACTURING SITE LEASE RATES: FINDINGS

China's population density coupled with an increased demand for manufacturing operations have resulted in significant year over year industrial related price increases. **Manufacturers in Zhejiang can expect to pay 40% to 50% more per sq/ft annually compared to a similar Ohio manufacturing operation.** Many characteristics align in the state of Ohio to support this cost advantage including available land, existing infrastructure, quality workforce, and complex logistics systems connected by land, air and water.

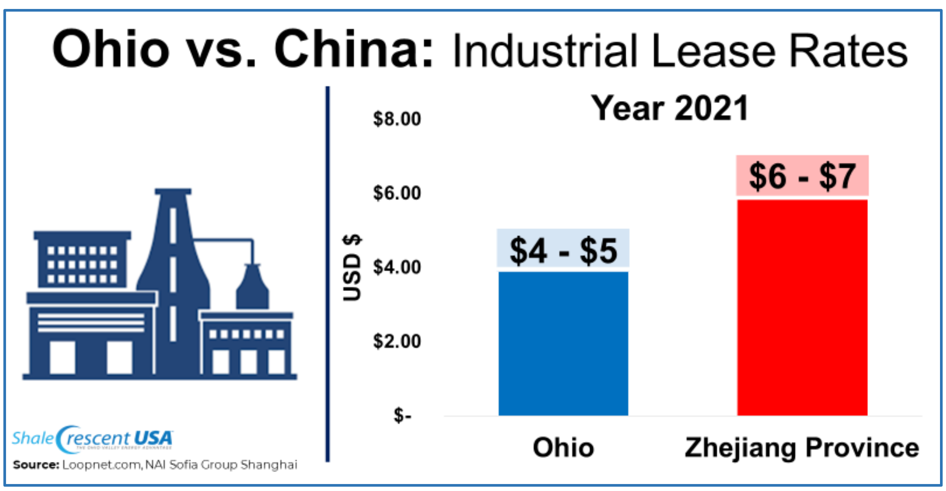


Figure 27: Ohio vs. China - Industrial Lease Rates

48 Global Trade - https://www.globaltrademag.com/top-10-states-for-manufacturing-2019/

49 See Appendix M: Ohio Manufacturing Sites

50 See Appendix N: Zhejiang Manufacturing Sites

51 Zhejiang Provincial Statistics Bureau - https://www.zj.gov.cn/col/col1229216136/index.html

52 CEIC- https://insights.ceicdata.com/Untitled-insight/views

53 CEIC: https://insights.ceicdata.com/Untitled-insight/views

7.5 PLASTIC RESIN COSTS – U.S. VS CHINA

Since the first use of plastics, **resin pricing has been the key cost driver in the plastics-based manufacturing business.** Plastics hold a unique position in modern man-made materials as the largest volume material, lowest cost per unit, and consistently the highest growth material by usage.

Plastics are a commodity in which the market shows no preference as to who produces it, but plastics are also often a specialty designed product manufactured for only one or two unique applications. This report focuses on high volume commodity grades of plastic resin including polyethylene (PE), polypropylene (PP), and polyvinylchloride (PVC). To examine plastic resin pricing trends, we will look at the PE value chain, from which characteristics of other high volume resin products can be extrapolated with consistency.

RESIN PRODUCTION FEEDSTOCK

Plastics are created primarily from two feedstocks 1) Naphtha which is produced from oil or 2) Natural Gas Liquids (ethane, propane, butane). The choice of feedstock affects both capital and operating expenses and largely determines what type of resin is produced. There are many factors to consider as each feedstock has its pros and cons.

More than 80% of PE production costs are dependent on the cost of the feedstock and energy used. **In comparing oil prices to natural gas prices, heat content defined as MMBtus is used to derive a comparable energy equivalent.** The standard rule of thumb is one (1) mcf of natural gas multiplied by six (6) will roughly equal one (1) barrel of oil on an energy content basis. This rule of thumb also roughly applies to the pricing of the two feedstocks which have historically been (1) to (8). To determine cash cost to produce PE resin, natural gas prices in dollars ($) per mcf multiplied by 8 equals crude oil prices in dollars ($) per bbl. Therefore, if the price of natural gas is $4 per mcf, an equivalent value of crude oil would need to be $32 per bbl.

In much of the world, through the last several decades, natural gas and crude oil have remained in price parity. This level field has been supported by both commodity fuels which have significant offtake in various sectors & complementary demand. Exceptions have occurred when natural gas supply has become more abundant than oil supply. **Since the U.S. Shale Revolution, natural gas prices have severely dropped and no longer measure in parity with oil. Now, the price equivalent is roughly 1 to 20. For resin producers, who use natural gas liquids (NGLs) as a feedstock this has led to significant cost advantages over oil/naphtha consuming competitors.**

THE IMPACT OF SHALE GAS REVOLUTION

The North American Shale Gas Revolution has delivered abundant natural gas and natural gas liquids and has led to a boom in U.S. chemical investment.

According to the American Chemistry Council[54]**, since the start of the revolution there have been**:

- **349 new chemical** industry capital investment projects
- **$209 billion** in new capital investment
- **$25 billion** US chemicals trade surplus in 2020.

These investments are expected to lead to nearly 450,000 direct and indirect jobs by 2025. According to IHS Markit, **massive capacity expansions coupled with cost**

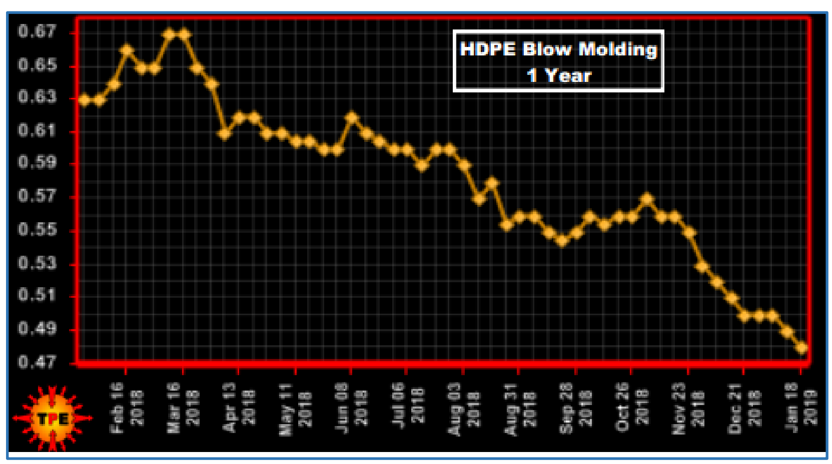


Figure 28: HDPE Spot Price 2018 to 2019

[54] ACC: (https://www.americanchemistry.com/better-policy-regulation/energy/resources/new-chemical-industry-projects-due-to-shale-gas)

advantaged products such as polyethylene led to an export boom with the U.S. and Canada exporting 30% to 40% of production[55].

As large amounts of low-cost production came on stream and supply increased, PE prices in the U.S. began to drop.

Operating rates are also a reliable indicator of the cost competitiveness of global PE resin production. An operating rate is the actual amount of production divided by total production capabilities (capacity).

Cracker plants require maintenance. Operating rates above 90% are unsustainable. Without maintenance, parts will fail causing a unit shut down which may result in prolonged unplanned outages. These types of outages are far more expensive in the long term versus periodic planned maintenance shutdowns.

However, if production of resin is highly profitable, **resin producers will operate at high rates and will take the risk of unplanned outages.** Currently, U.S. resin producers are cost advantaged and experiencing high profit margins. **Thus far, U.S. resin producers have had the strategy of forgoing routine maintenance and prolonging operations in an effort to keep operating rates high and capture as much high margin profits as possible.**

There are numerous companies that for a fee will provide production forecasting and pricing data around commodity and specialty plastic resins. It should be noted many forecasts can also be found from public companies in their quarterly earning presentations where there is much valuable data.

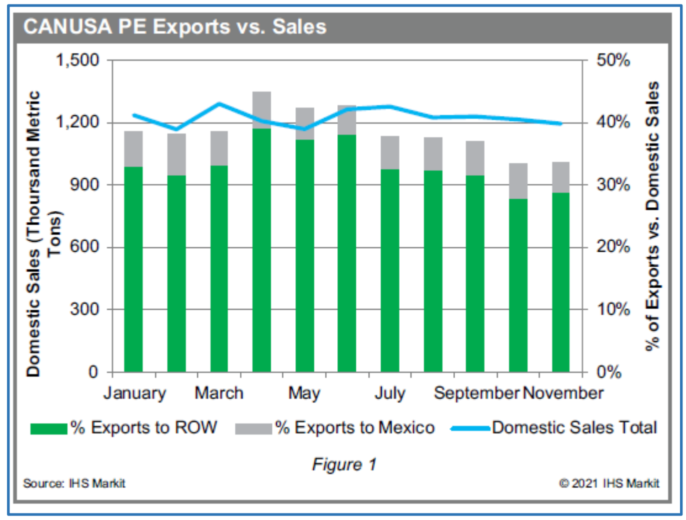


Figure 29: Canada USA PE Exports vs. Sales

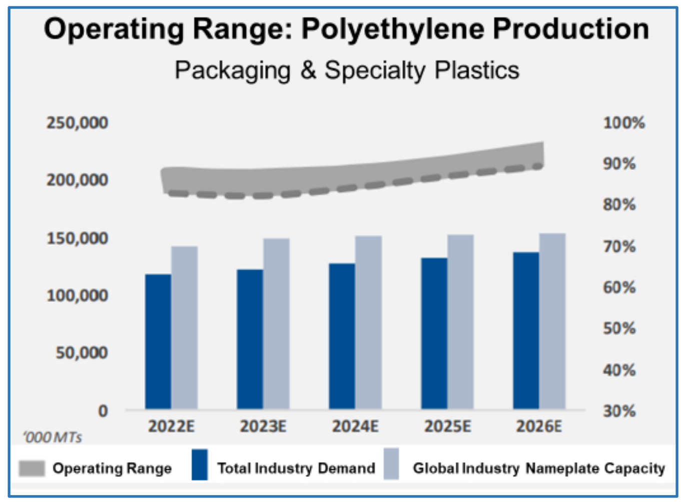


Figure 30: Sample PE Operating Range

CURRENT RESIN PRICING – THE PERFECT STORM

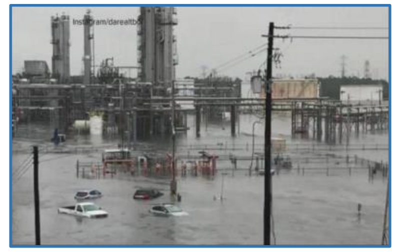
Resin markets have experienced unprecedented changes over the past two years. **A series of unforeseen events, 'the perfect storm', has disrupted both national and international markets.** Demand and supply have been impacted, resulting in significant price increases.

2020 Global Pandemic

The demand for plastic resin increased dramatically as the world reacted to the effects of a global pandemic. Plastic resin was on the front lines defending against the Covid-19 virus in 2020. Demand for personal protective equipment (PPE), tubing, ventilators and test kits skyrocketed – all made largely out of plastics. Plastic bags kept the virus infected material isolated and disinfected equipment safe. Consumer buying behaviors changed, such as ordering carry out food instead of dining and online sales rose. **Overall, packaging and plastics consumption increased dramatically.**

[55] IHS Markit: (https://ihsmarkit.com/research-analysis/polyolefins-markets-in-the-americas-are-at-a-new-extreme.html)

2020 Hurricanes



Two category 5 hurricanes had direct hits on U.S. Gulf Coast resin producers. While plants in the U.S. Gulf Coast are designed for stress well beyond category 5 hurricanes, they are vulnerable to flooding. Flooding destroys pumps, compressors, and other equipment; but has even greater implications as it disrupts and halts the supply chain. Workers, repair crews and equipment struggle to make it on site. Existing product inventory waits out flood waters before shipping to customers. The back-to-back nature of the 2020 hurricanes made flooding linger and resulted in extended shutdowns.

2021 Texas Deep Freeze

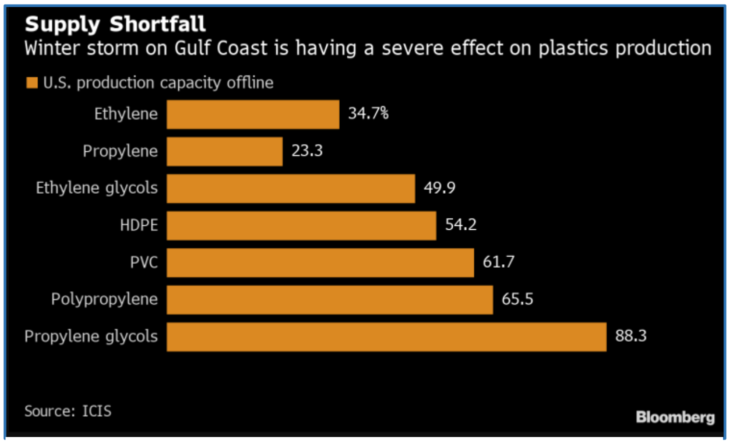


Figure 31: Texas Freeze Impact on Gulf Coast Resin

The Texas deep freeze of 2021 was an unprecedented event that was neither anticipated, nor planned. U.S. gulf coast petrochemical facilities are highly dependent on the electric power grid as purchasing electricity is more economical than the capital investment required for power production. The Texas Freeze shut down nearly the entire electric grid with little to no notice. **For an industry which requires processes to function 24/7 with no interruption, this was catastrophic.**

Equipment was filled with in-process chemicals which continued to interact after unforeseen immediate shut down. In polymerization reactors, entire units became one large polymer chain. Water in equipment such as heat exchangers froze solid breaking equipment and busting pipes. Normal shutdown and restart procedures were not an option as every part and every unit needed to be inspected, cleaned, and tested.

The shutdown and recovery process were exacerbated by a shortage of maintenance workers. The industry relies on a support pool of contract maintenance workers. The industry wide emergency shutdown proved too much repair with too few workers and equipment shortages. Equipment was already in short supply due to capacity expansions and the 2020 hurricane season. **For some plants, the damage and shortages were so significant that it took more than 6 months to repair and restart.**

2021 Hurricane Ida

Hurricane Ida was not the direct hit that the 2020 hurricanes were, but Ida, a category 5, was a flooding disaster. The hurricane slowed dramatically and essentially stalled over the U.S. Gulf coast. The flooding, a significant issue for the industry, had once again led to unplanned shutdowns for extended periods. On the heels of the preceding events, the industry had no inventory buffer and suffered from exponential profit loss.

This perfect storm has resulted in significant demand increase for plastic resins and tremendous supply shortages. The result is high priced and high demand resin.

The Result

This perfect storm resulted in significant demand increase for plastic resins and tremendous supply shortages. **The result was high priced and high demand resin.**

2022 Ease in Prices

In early 2022, resin prices saw steady and moderate declines. As repairs took place, production was resumed, and new resin supplies came online, inventory levels began to rise. Increased U.S. supply of resin has caused resin prices to further decline. Prices are likely to fall below historical cost-plus returns on resin producer's capital investments.

New Challenges

A new set of unprecedented challenges and uncertainty caused a 5-10% uptick in late January and early February 2022.The challenges were due to backlogged logistics of rail and truck which prevented both resin and consumer products from reaching markets. Canadian trucker protests blocked key roadways used to bring product to the automotive sector, a sector which was just ramping up from a computer chip shortage. Furthermore, key parts and equipment for repairing plastic production units and restoring to full capacity were delayed due to issues of long and vulnerable supply chains.

In addition, during the winter months of late 2021 and early 2022, the price of oil and gas (the feedstock for resin production) increased. A cold winter in Europe, inability of OPEC to meet oil production quotas, and politically motivated restrictions of Russian natural gas over Ukraine caused European energy price spikes. The impact was experienced globally. Uncertainty coupled with very low inventory levels led to a global plastics price increase.

PRICING IN THE FUTURE

The last few years have seen rapid changes in U.S. plastics resin pricing. From late 2017 to 2020, PE prices declined. PE pricing was poised at the sub $0.40 per lb. region. Then the perfect storm hit both demand and supply: Covid, 2020 Hurricanes, the 2021 Texas Deep Freeze, 2021 Hurricanes, and Oil & Gas price increases. Prices leapt to over $1.00 per lb. Since then, downward pressures have occurred. As of March 2022, PE resin prices were hovering around $0.80 per lb. Despite massive capacity increases over the past decade, the result has been resin shortages leading to high demand and high-priced resin.

The challenges of the past couple of years are beginning to lift. **Covid is easing, resin plants are restarting and bringing back capacity, and inventory levels are returning to normal.** As the challenges evaporate, it will likely cause downward pricing primarily dictated by ample capacity and a low-cost feedstock position of U.S. plastics resin producers. The Shell Monaca, Pennsylvania and ExxonMobil/SABIC Corpus Christi, Texas world-scale resin units are adding new resin supply in 2022. This sizeable boost in capacity coupled with fading challenges will lead to steadily rising inventory levels. As market confidence of ample supply returns, it is reasonable to expect pricing declines to continue in late 2022 and early 2023.

As always, **the forces of supply and demand will deliver unsympathetic effects on global and local markets.** *Numerous sources such as IHS Markit and ICIS provide more detail on pricing assumptions and forecasting. This report and cost model only provides a high-level overview of resin pricing*

When making decisions about resin production, producers have global strategies. Resin producers could become more profitable by exporting less and focusing on the U.S. market. Though seemingly simple, that strategy has long term implications on their emerging markets point of view. **It would only take one resin producer to break the export model and focus on capturing U.S. market share for the entire industry to begin shifting.**

> ***It would only take one resin producer to break the export model...***

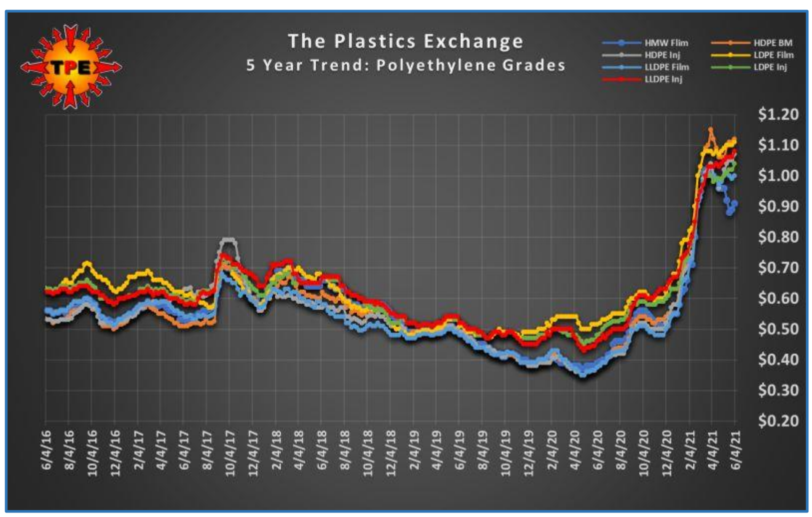


Figure 32: Five Year Trend Polyethylene Grades

RESIN PRICING CONCLUSION AND RECOMMENDATIONS

Global Resin Pricing

The rest of the world has not had to deal with a combination of factors that culminated in a "perfect storm". As a result, they have a slight cost advantage in current day resin pricing. **Relative to the rest of the world and especially Asia, the U.S. has a major feedstock cost advantage that is structural.** As the U.S. moves out of the perfect storm, the U.S. factors should align to produce and sustain a resin cost advantage over the rest of the world. Commodity profit motives should prioritize the U.S. market versus international exports. For use of the model in this report, it is suggested that plastics producers conservatively assume global resin pricing parity until the changes occur.

Plastics based manufacturers are typically far smaller companies than either their resin suppliers or their retail distribution customers with nearly half of their production costs tied to resin. It is easy for plastic product producers to be squeezed between these two bookend giants. **However, there are many resin purchasing strategies to hedge or shift the risk of inflated prices.** These are outside the scope of this study, but all of them require a connection between purchasing and sales strategies.

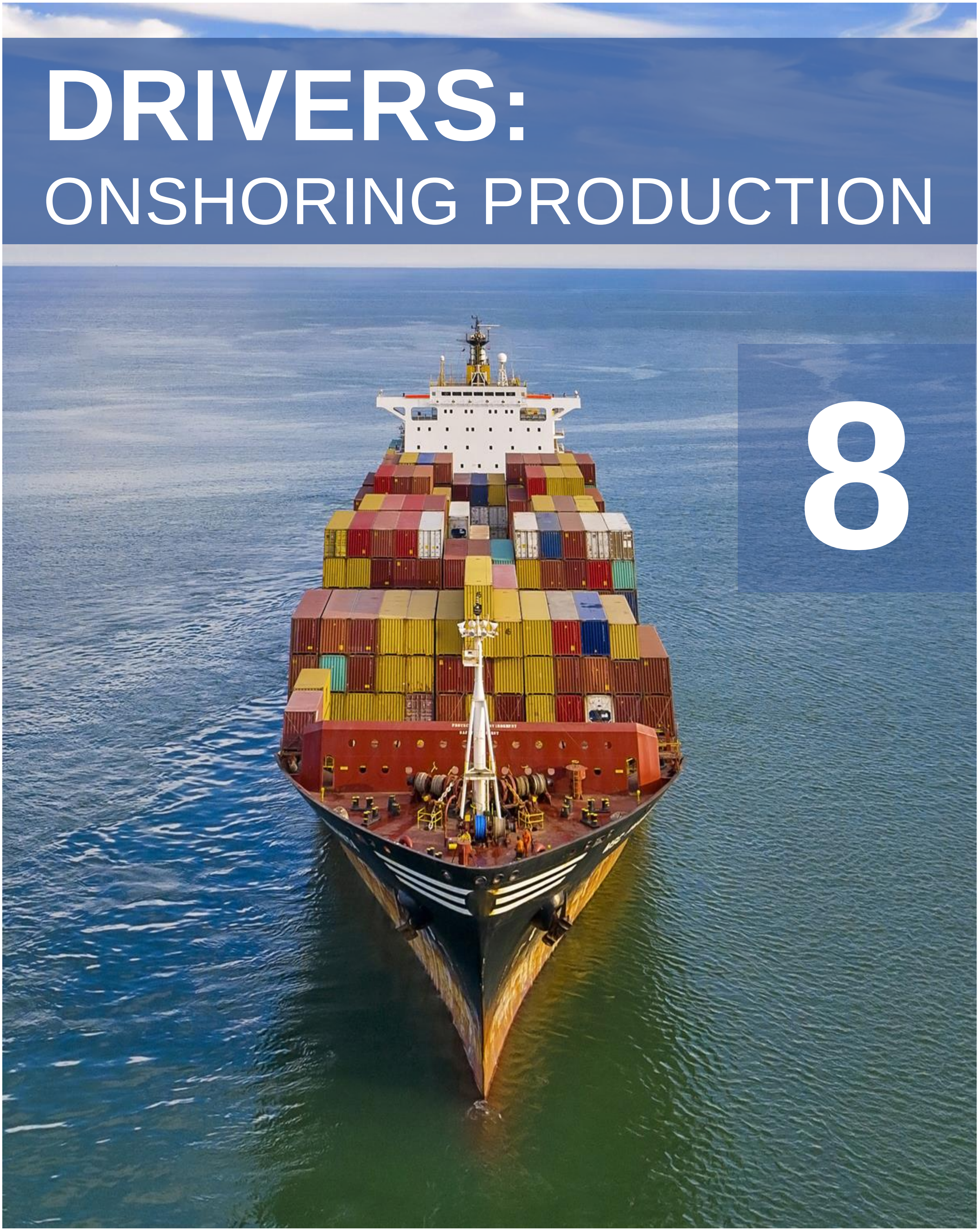
Cost Model Resin Pricing

To support the model comparison that is the focus of this report, the current weekly low spot price for the appropriate PE and PP grades from the *Plastics Exchange* weekly market update was used. This publicly available resource includes comprehensive narrative of timely issues and dynamic factors influencing pricing. It also includes data such as commodity volumes, and the changes in resin feedstock pricing. For more detailed information, visit The Plastics Exchange. As of October 15, 2022, HDPE – injection grade was listed at $0.65, HDPE blow molding at $0.69, PP homopolymer at $0.64, and PP copolymer at $0.74. These are free on board (FOB) prices, but for the purposes of this report cost adjustments are made for transportation.

Assumptions for resin pricing are critical in effectively operating this study's cost model. They also allow testing of different scenarios such as tradeoffs between equipment size and cost versus parts per shot. Because actual historical experience can be verified, processors with knowledge of a products resin consumed and equipment used should replace these assumptions with known factors. It is beyond the scope of this report to provide calculation details for each of the assumptions.

DRIVERS:
ONSHORING PRODUCTION

8



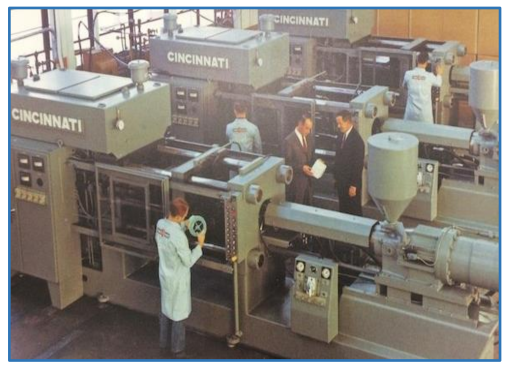
8. DRIVERS: ON-SHORING PRODUCTION

Most companies want to grow and expand while remaining profitable. To enter new markets, C-level executives and decision makers must consider a myriad of variables in their business, their industry, and the overall markets. **Onshoring manufacturing to the U.S. and more specifically to the Shale Crescent USA has become a very real and timely opportunity for growth and expansion within the plastics industry**.

China has lost its manufacturing competitive advantage and the annual $25 billion of exported plastic-based goods from China represent a vulnerable and accessible market share opportunity for U.S. operations**.** Close proximity to low-cost raw materials coupled with direct access to consumer markets provide U.S. manufacturers with significant cost advantages over China-based competitors who must import raw materials and export finished goods. **The elimination of trans-continental supply chains results in cost savings that magnify a U.S. competitive advantage.**

Location is the key advantage, but there are also a number of other factors simultaneously at work pointing to onshoring manufacturing. **Decision makers wanting to seize the early opportunity of capturing market share should begin to act now.**

8.1 OFFSHORING AND ONSHORING HISTORY – WHAT HAPPENED



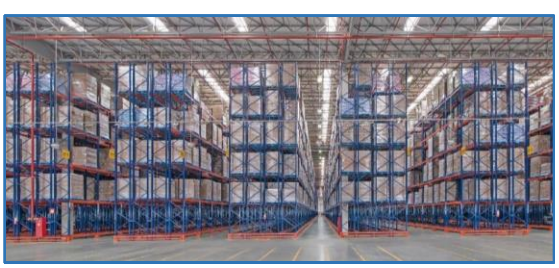
It is often said that history must be studied and understood to avoid repeating mistakes. While this philosophy was originally presented in the context of war, it has become a mantra that commonly applies to business and is repeated among many cultures around the world. This philosophy applies to many of the lessons learned in the process of offshoring plastics-based manufacturing operations.

The offshoring revolution was driven by profit. Labor, utilities, and land were cheap in Asia, and especially China. Asian countries had a culture that was both hard working and quick to capitalize on imitation versus innovation. At the same time, **western developed countries had rising labor costs, increasing regulatory costs, and a deceleration of innovation.**

It seemed an ideal time to widen margins by offshoring. The process would take simple products, duplicate their manufacturing operations in Asia at deeply reduced costs, and import finished parts to the U.S. **Who drove this phenomenon?** Consulting companies recognized the connection and Wall Street emphasized the profit potential, leading to an offshoring tsunami. **Political influence supported the movement as the engagement of growing third world Asian countries, would secure to economically linked allies.** This massive shift in global economics quietly unfolded over a number of decades.

Another major driver and key beneficiary of the offshoring movement was the retail distribution chain. Manufacturing companies had a collection of consumer-accepted products that guaranteed lucrative returns. If these companies could reduce costs, market share and profits would increase.

The significant movement to offshoring resulted in the hollowing out of major manufacturing operations in the developed world. The movement directly affected massive job loss, a plummeting tax base, and a downward spiral of associated economies – local, regional, and nationwide. Consumers in the developing world saw increased purchasing power with cheaper goods. Inflation slowed for the first time in several decades with declining costs. Job losses were offset with consumer satisfaction, which kept political pressure at bay. It was not just an American issue, but all developed countries suffered. China was not the only Asian beneficiary, but they did appear to be driving the bus.



Even as problems and challenges began to surface in the global manufacturing model, companies adapted. Inventories dramatically increased to balance the volatility of a long supply chain. The Asian supply chain was an estimated eight-week process compared to a one-week chain for domestically manufactured products. **In an era of low interest, this was calculated as a minor cost but would result in drastic high and low volumes of inventory that would cause fluctuating prices and often deep discounts at retail.** Alignment of holiday operation fluctuations proved to be problematic as companies adapted to peak seasons that were weeks apart in China and the U.S. For example, Chinese New Year and Western Christmas & New Year are weeks apart.

Product innovation declined in an environment that was quantity versus quality based with little emphasis on research and development. Many operations were duplicating operations for the same products which fueled accelerated costs. Retail distribution chains found themselves back in competition on prices, as they were promoting and moving essentially the same product. **Duplication paved a path to mediocracy and investors began to feel the uncertainty.**

Companies struggled to deal with the innovation challenge. While the use of aircraft supported expedited development chains of pre-production samples, many product delays would add weeks to an innovation cycle. **Product development cycles of less than one year were significantly affected by international dependent timelines.**

Communication was difficult, not only based on language barriers but magnified by cultural differences. Basic design and function of some manufactured goods were difficult to explain i.e., the comfort and grip of a standard toothbrush, as one culture had just recently adopted common use of an American style toothbrush. These cultural disconnects were often the most difficult barriers to efficient operations. Technology certainly plays a critical role in supporting foreign manufacturing and international business with 3D printing, language translators and video conferencing, but these technological advancements did little to address significant cultural barriers.

The long supply chain illusion was shattered with the arrival of Covid-19 and the onset of a global pandemic. In the years leading up to 2020, inventory buffers along the global supply chain were kept minimal. The lack of major supply chain disruptions in prior years led to passiveness around contingency plans.

Precautions mandated as part of the pandemic caused a several weeks pause in consumer goods imports as Chinese and other Asian manufacturing shut down supply. The result of this shutdown could be felt throughout the U.S., and other developed countries, as store shelves sat empty. This unusual shortage triggered extreme consumer behavior that led to unnatural and unnecessary bulk purchases when suppliers came available.

Wall Street had a different picture, a boom in buying at normal profit and then reduced revenue as the retail distribution chain ran out of inventory. CEOs were challenged by investors to find a solution to the impending volatility. **They must keep and move inventory and that meant avoiding the uncertainty of transcontinental supply chains. Two options existed: source local or increase inventory.**

> ***Two Options existed: source local or increase inventory.***

Companies began sourcing locally when and where possible. Products came at a higher cost and those costs were reflected in increased sales price. Although companies experienced reduced profits, Wall Street was quick to reward lower profit as it was a substantial win compared to no profit. **This revelation signified major change in the manufacturing mindset – a pivot point. Source locally, manufacture locally, consume locally.** This fundamental idea, while not always saving pennies day-to-day, was seen as a way to fundamentally reduce risks, stabilize profits, foster innovation, support national security, and increase profits across domestic supply chains - ultimately improving quality of life for all Americans.

SUCCEEDING IN THE NEW ENVIRONMENT

There have been many failure and success points in history. What does it take to succeed in a new and rapidly evolving environment? Costs are paramount but are just part of the picture. Decision makers must consider environmental and social effects of responsible manufacturing operations. **When manufactured products are sourced locally, manufactured locally, and consumed locally, the environmental and social fabric of America's communities benefit in many significant ways.**

Companies succeed on combining two attributes, innovation and operational excellence. The importance of each deserves repetition.

8.2 INNOVATION

America is known as the country of great innovation. **In the Asian model of manufacturing, innovation is not a strength or factor.** The focus is on costs and quantity. Today, consumers can choose from 100s or even 1,000s of nearly identical products that lack any new and real innovation. For example, the toothbrush can be purchased in just about any look, size, and color combination. Innovation has been stymied by the pursuit of low cost easy to replicate items. These items are typically mass produced and have low profit margins, not allowing room for R&D and increased human labor. Amazon is a prime example of consumers being able to choose from copycat style products of all types.

Prior to the Asian manufacturing model, innovation was key. Retailers prioritized innovation and used it as a competitive advantage over others selling similar products. As countries such as the U.S. come into cost parity with Asian manufacturers, **Innovation will begin to reclaim its position as a manufacturing priority.** Developer innovation will reemerge as the differentiator in a fast-paced consumer driven industry.

Innovation in manufacturing thrives on three mutually supporting axes:

- **Unique Superior Product –** Product differentiation that delivers unique benefits and superior value to the customer.
- **Market Orientation** – A market-driven, customer focused new product development process built on a clear understanding of product end market.
- **Product Definition** – A clear, concise, and early product definition.

These supporting factors require an intimate relationship with both the market and the individual consumer. Today's consumers have real-time connectivity to review, react and respond to products. This transparency enforces the need for careful alignment of product quality and desire of end users. When managed effectively, this environment can create a home field advantage for the U.S. as cultural and language divides create barriers to producer and market alignment.

8.3 OPERATIONAL EXCELLENCE

While innovation is a critical component to highly competitive product development, **day-to-day manufacturing operational excellence is an absolute requirement to succeed.** This was once a focal point of the developed world that subsided in domestic operations as it also gained traction in developing countries. It is a reentry point and critical component for competitive manufacturers in the developed world.

Operational Excellence key components include:

- **Well-Conceived, Properly Executed Launch –** With a solid marketing plan to support product rollout.
- **Organizational Structure, Design and Culture** – Aligned with the goal in mind.
- **Synergy and Speed –** Stay in zone, step-out products/projects tend to fail, develop and to market, but not at expense of quality of execution.

Designing, and continuing to enhance an innovative product is just part of the process, producing it in quantity and quality is a requirement to compete on a global stage.

8.4 RETAIL DISTRIBUTION CHAINS – PROXIMITY ADVANTAGED

Products reach their markets via established distribution chains, or market channels. These distribution chains can be as simple as direct shipping from manufacturer to large retail chains, and on to the consumer, such as plastic toys sold direct to Walmart, or industrial products sold direct from manufacturer to Amazon. Distribution chains can also be more complex, moving products via buying groups, sales reps, wholesale warehousing, or consolidators to consumers. **An identical product may reach market via a variety of different distribution methods such as personal protective equipment (PPE) to hospitals, to pharmacies, to retailers, to first responders.** Products may also be bundled together via a value-added re-packer to form an entirely different product – PPE plus other items to form a first aid kit, or poly drums filled with sorbent products, gloves, and other safety equipment to form spill kits.

Today, the internet also affords new and smaller manufacturers, those that may not have an established distribution chain, the opportunity to sell direct to the consumer via their company's website. This process has expanded rapidly in the past 10 years, even among established manufacturers, as import products have flooded the U.S. markets and damaged brand loyalty within the distribution chains. This is now a proven method to introduce new products and enter the market very quickly.

This variety of distribution methods is due to the large number of market segments being serviced – automotive, medical, safety, industrial, consumer retail, aerospace, transportation, energy, government, military - and how each of these market segment's distribution chains have evolved. Even the distributors within each market segment, market and distribute their products in a variety of ways – technical sales reps, warehouses, branch or retail stores, catalogs, internet, tv/radio, trade shows, and others.

A well-established market channel, with historical success in delivery of innovative and quality products, can be a plastics-based manufacturer's most valued asset. This history of success tends to shorten market entry timing for new product offerings, as trust is already established between the manufacturer and distributor and can gain first consideration in competitive new product line reviews.

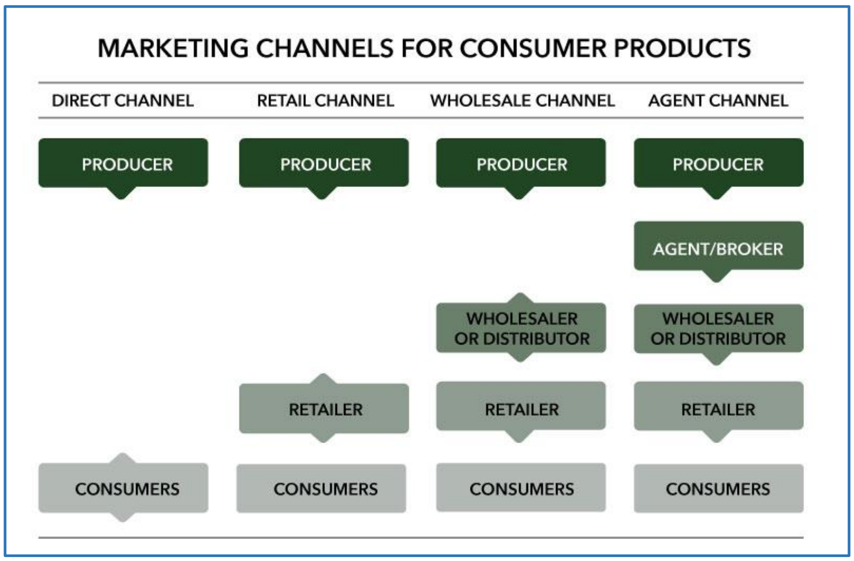


Figure 33: Manufacturer Marketing Channels

PROXIMITY ADVANTAGED

Recent distribution chain trends, like next day delivery, have created higher demands on manufacturers to act as master distributors, maintaining larger work-in-process and finished goods inventories, and requiring the ability to ship same or next day. This highlights what may be one of the Shale Crescent USA region's best distribution chain advantages – **the proximity and integration of its supply chain and distribution chains -** which reduces time, costs, environmental impacts, and risk to manufacturers. As stated earlier, a majority of U.S. manufacturing is in the greater Shale Crescent USA region. **This is augmented by over 50% of U.S. population/consumers within a day's drive.**

Figure 14A: Shale Crescent USA - 1 Day Drive Map

Existing participation and expertise in these complex distribution chains – knowledge of who manages, how items are moved, inventoried, and packaged, and the ability to act as a master distributor – is critical for success and reduced risk to plastics-based manufacturers in Ohio and neighboring states.

8.5 FLEXIBILITY AND INVENTORY ADVANTAGES

Products manufactured overseas have a long distribution chain**. Low value plastic products travel via ocean freight that requires a 3-to-6-week travel time from the manufacturer in China to the U.S. distribution point.** Meanwhile, products manufactured in the U.S. average a 1-week maximum travel time from manufacturer to consumer. **The net difference in this supply line is 2-to-5-weeks.** Long lead times complicate business, increase risks, expose working capital, and add costs. There is reduced flexibility and opportunity to respond to unanticipated market changes. Associated planning must take place on a longer time schedule and requires more careful monitoring, resulting in increased cost. Higher inventory is required to avoid stock out, further increasing costs and risk of obsolete product inventory. In small margin retail business, these factors can easily be the difference between profit and loss.

Plastics based manufacturing operations in the Shale Crescent USA region have shorter lead times on poly resin deliveries in which to look forward. This will create greater financial & operational flexibility while also reducing inventory costs, adding to the new competitive advantages of the region. *The financial benefits on this topic will be covered later in this report.*

8.6 ESG AND THE REGIONS ADVANTAGE

Today, companies must balance economic decision making with many complementary facets of responsibility. The framework that has been built to effectively communicate this responsibility, and related investment, across influential industry sectors is ESG - Environmental, Social and Governance.

ESG investing organically evolved as a method to influence responsible decision making among globally influential companies. It is supplementary to typical financial profit metrics used by investors. Operations that show balanced **ESG behavior have started to influence consumer-buying patterns, such as selecting a ‘green’ or ‘greener’ product over competing products.** While definitions vary and continue to evolve, the following characteristics, outlined below, are core components of ESG:

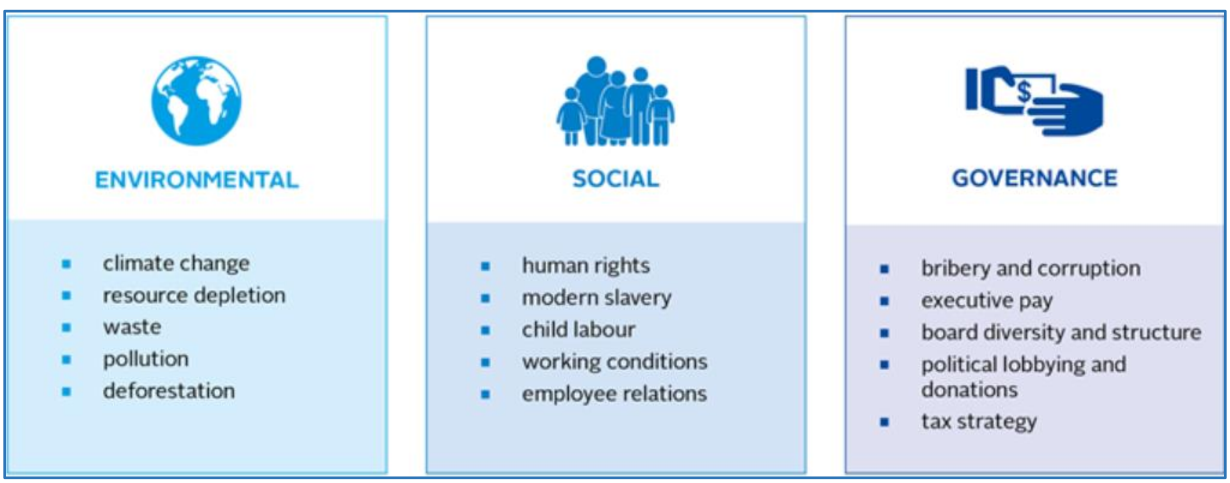


Figure 34B: ESG Characteristics

Some businesses are going to great lengths to meet one or two of these ESG areas at the expense of another, putting the viability of the business at risk**. Ohio based manufacturers have a tremendous advantage and can mitigate and even avoid this issue due to their unique location.**

Ohio’s regional location directly influences environmental and social ESG categories. **Ohio possesses both world class supply and demand in the same region.** This location advantage is powerful in the sense that it leverages ESG advantages and there is no new investment or resources required from the region’s manufacturers. Plastics manufacturers in **Ohio are already naturally well positioned to be leaders in ESG without compromising other core business.**

A significant challenge remains to make this advantage known to retail and third-party companies who currently purchase imported manufactured products. This includes companies that directly interface with consumers such as Walmart in addition to companies that use the retail distribution chain by leveraging a strong brand identity such as Procter & Gamble.

> ***Plastics manufacturers in Ohio are already naturally well positioned to be leaders in ESG without compromising other core business.***

ENVIRONMENTAL

Ohio's shale gas revolution has unlocked abundant energy and feedstock for U.S. manufacturing. **Instead of shipping these resources to the U.S. Gulf Coast or around the world, they can be converted locally into plastic resin and plastic products**. These plastic-based products can be shipped to local consumers who are concentrated within a day's truck drive from the center of the Shale Crescent USA region. **With this local conversion of resources and consumption, unnecessary transportation and associated emissions can be eliminated creating an inarguable environmental benefit**. *More detail on this is provided in the next section.* Environmental emissions continue to lead the conversation around ESG, with various analyses showing the high emissions profile of imported products.

The following chart highlights the level of emissions that are produced from overseas shipping[56]. Producing and consuming regionally would eliminate the need for transcontinental transportation of both feedstock and finished product, thus greatly reducing emissions in the manufacturing supply chain. *Some retailers that would be expected to appear on this chart are absent due to third party purchasing.*

Top 15 Maritime Import Polluters	Climate Emissions (metric tons)				Criteria Air Pollutants (metric tons)					
	TEUs*	CO_2	CH_4	N_2O	SOx	NOx	$PM_{2.5}$	PM_{10}	BC	CO
Walmart	893,390	3,720,355	71.34	215	55,456	99,889	8,082	8,785	298	3,784
Ashley	270,000	2,244,156	43.61	130	34,021	60,408	4,970	5,402	183	2,309
TARGET	600,040	2,051,032	39.45	119	30,906	52,418	4,491	4,881	171	2,088
Dole	230,117	819,074	14.28	45	11,481	23,809	1,602	1,741	54	771
Home Depot	400,100	656,841	12.47	38	10,047	17,424	1,455	1,582	51	663
Chiquita	151,589	572,733	10.25	34	5,673	12,800	845	918	92	548
IKEA	131,684	412,363	7.98	24	5,740	10,876	842	915	32	422
amazon	123,000	391,341	7.33	22	5,804	10,335	839	912	29	391
Samsung	181,328	370,837	7.05	21	5,549	9,982	803	873	30	374
Nike	118,219	313,316	5.97	18	4,641	8,356	673	732	26	317
LG	156,348	259,487	4.94	15	3,986	6,960	577	627	20	262
Redbull	70,700	239,744	4.67	14	3,056	6,365	449	488	19	245
Family Dollar	171,936	220,246	4.12	13	3,359	5,814	485	527	17	220
Williams-Sonoma	88,800	216,419	4.10	12	3,219	5,679	467	508	16	218
Lowes	292,244	210,042	4.15	12	2,957	5,576	433	471	17	217
Totals		12,697,986	241.68	732	185,897	336,690	27,014	29,36	1,056	12,829

* Twenty-foot Equivalent Units, the size of a typical shipping container

Image: Pacific Environment, Stand.earth

Figure 34C: Top 15 Maritime Import Polluters

[56] Business Insider: https://www.businessinsider.com/walmart-target-amazon-among-biggest-maritime-polluters-overseas-shipping-impact-report-2021-7

SOCIAL

Progressive human rights laws in the U.S. related to employment conditions and pay have positioned products "produced in the USA" as not only socially acceptable, but also as superior in quality to those produced in the developing world.

Anchoring a manufacturing operation where the finished product is ultimately consumed completes an important sustainable social circle. Manufacturing jobs provide livable wages for American families, representing the income ultimately used to purchase retail products that increase community tax base and support quality of life. This is a sustainable social circle that promotes prosperity for generations of Americans – a stark contrast to offshored manufacturing that shifts jobs and taxes to countries on the other side of the globe.

According to the National Association of Manufacturers, for every 1 manufacturing job that is created there are 5 jobs created in the direct local economy. And, **for every $1 spent in manufacturing there is another $2.79 added to the economy. This is the greatest multiplier effect of any economic sector.** Additionally, for every $1 earned in direct labor income among manufacturing sector workers, there is another $3.14 in labor income earned in the associated local economy, including indirect and induced impacts[57]. It is not only socially responsible to re-shore manufacturing jobs to historic producing states such as Ohio, but it has an exponentially positive impact on the local and regional economies. **Processors who onshore manufacturing to the U.S. are promoting social responsibility by creating jobs for the people at home instead of offshoring employment opportunities to competing countries.**

GOVERNANCE - PROFIT

Good governance, profitable operations, and sound economics will remain the ultimate driver for business success. The goal of this study has been to highlight the new economic advantage of manufacturing in Ohio over Zhejiang. Previous sections of this report reveal that the factors of manufacturing such as energy, transportation, labor, utilities, and more are competitive if not advantaged toward Ohio manufacturing. **Currently imported products can be manufactured in the region while achieving good "governance".** Positive ESG characteristics are an added value for profitable domestic operations.

8.7 ELIMINATING EMISSIONS

The current and primary environmental focus among the populous is to achieve carbon neutrality. It is the most discussed and visible of the ESG issues. As a result, companies in all sectors are actively working to reduce their carbon footprint.

In manufacturing, carbon emissions are commonly calculated on four levels:

1. **Manufacturing the Product** (Or service provided)
2. **The Product Lifecycle** (This is primarily about the disposal of the product once the life of the product is finished)
3. **Operations of the Product** (The efficiency)
4. **Product Supply Chain** (The feedstock/materials required to produce)

OHIO – SUPPLY CHAIN ADVANTAGED

Ohio manufacturers have a natural advantage in the product supply chain that cannot be duplicated. Ohio possesses world class supply and demand in the same location. This allows Ohio processors to avoid transcontinental transportation and emissions penalty of both feedstocks and finished product.

This study highlights over $53 billion of imported plastic products. The current supply chain for some of these imports is as follows: **1)** Natural Gas Liquids from the Shale Crescent USA region are piped to the U.S. Gulf Coast. **2)** Plastic resin is produced and shipped abroad. **3)** Foreign plastic processors make a finished product. **4)** The finished product is shipped to the U.S. coasts and then transported inland to population

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57 National Association of Manufacturers - https://www.nam.org/facts-about-manufacturing/

centers. *If the natural gas based feedstock is not sourced from the U.S., it is primarily sourced from naphtha based oil from the Middle East.*

Each one of these steps of transcontinental transportation adds to the carbon footprint of the supply chain. **It is estimated that the combined travel of the molecules to make the product and the actual finished product is roughly 20,000 to 30,000 miles.**

A processor in Ohio can experience much different results. It can avoid transcontinental transportation by locally sourcing, locally producing, and locally consuming the product. **The total travel of molecules and finished product is closer to 500 to 1,000 miles.**

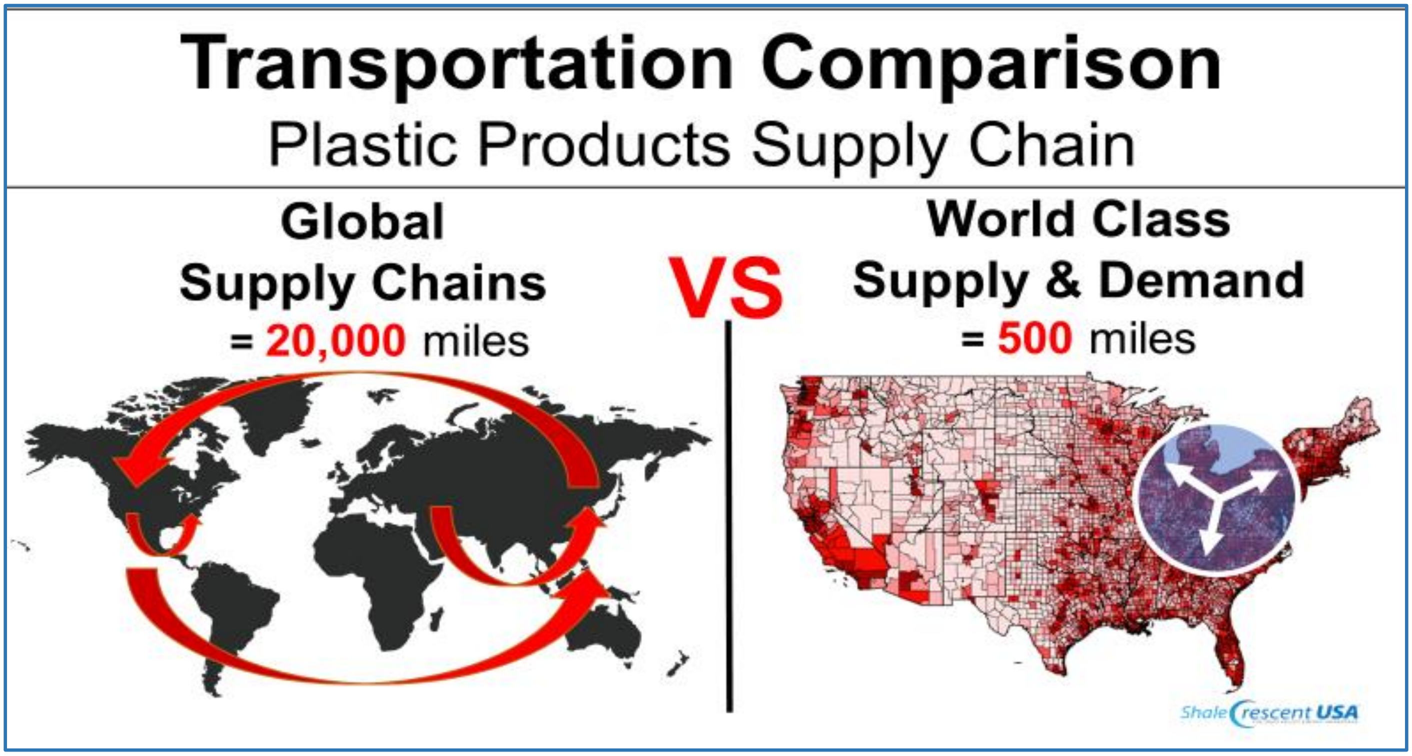
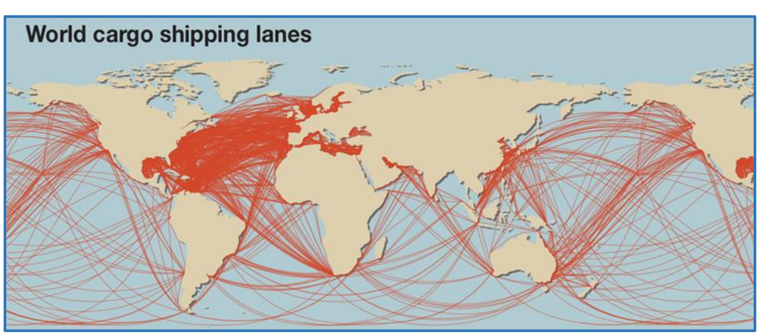


Figure 35: Supply Chain Transportation Comparison - Asia vs Shale Crescent USA

Proximity to supply and demand is an immense environmental competitive advantage over Chinese manufacturers who must import their materials by ship and export their finished product by ship**. Ships emit nearly 1 billion tons of CO_2 annually which is roughly 2% of global energy-related emissions[58]. Offshoring manufacturing from the U.S. exacerbates the emissions while re-shoring mitigates carbon emissions.**

Though a simple concept, reshoring offers an opportunity for businesses to shrink supply chains and lower environmental impact without compromising core business.



[58] EIA: https://www.iea.org/fuels-and-technologies/international-shipping

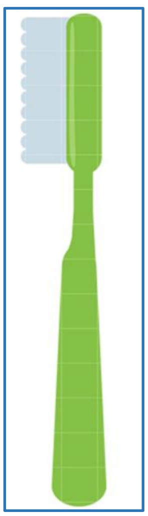
8.8 EMISSIONS ELIMINATION CALCULATION – THE TOOTHBRUSH

As stated earlier, there are many steps in the transportation process for imported products, and for every transportation step avoided, there is a tangible elimination of emissions. This study has analyzed and calculated the emissions savings for one product, the toothbrush, and two major segments of the international transportation process, U.S. inland transport and ocean transport. This model can be applied to other products and other segments of the transportation process[59]. The scope of this calculation was limited to one representative product example. Though this model was thoroughly researched and reviewed, the following calculations on emissions should be used as references and not considered as final and authoritative.

INLAND TRUCK TRANSPORT

The U.S. consumes well over 1 billion plastic toothbrushes each year[60]. A majority of which are imported from China. Toothbrushes from China arrive at either western or eastern U.S. coastal ports in ISO containers (international intermodal container). From the costal ports, they move via land on trucks to distribution centers near U.S. population centers. Distribution centers "break" the bulk ISO containers to supply retail or direct ship customer outlets.

If the same product was produced in Ohio, transportation would be dramatically reduced. Over 50% of U.S. population, is within 500 miles of the greater Ohio region. The average shipping distance from Ohio to major distribution centers is less than shipping from costal ports to the same distribution centers. Since standard overseas ISO shipping containers are 20% smaller than standard U.S. tractor-trailer it takes 20% more trips to provide the same amount of toothbrushes. Tractor trailers are also far easier to obtain backhaul load for product than ISO containers, at 65% versus 10% respectively. **The additional distances, end-to-end trips, and lack of backhaul all translate to more road miles and thus more emissions.**



The net difference is over 6 thousand tonnes of CO2 emissions annually, equivalent to almost 1,300 passenger car emissions. This is just for the internal product shipment within the U.S. and does not consider feedstock transport to the plastics resin producer, the transportation of plastic resin to plastic processor, the transportation of the finished good within China from factory to port, the ocean transport of finished product, or the loading and unloading at the port. For more detailed analysis and calculations, see *Appendix O: Reduced Emissions – Calculations and Sources*

OVERSEAS TRANSPORT

Using the average CO2 emissions of 3.27 metric tons per Twenty-foot Equivalent Unit (TEU) overseas shipping container in the *Pacific Environment/Stand.Earth* analysis *(Section 8.6 Figure 36)* and assuming data related to toothbrush manufacturing, the comparative case study can be expanded. *Note that details behind the analysis from Pacific Environment/Stand.Earth were not available at the time of the report.* It is not certain that the shipments in this analysis all originated in China. The analysis is based on importers, and the data shows retail companies such as Walmart, Amazon and Target which are known to import toothbrushes. Based on reviewing previous emissions studies this provides us with an order of magnitude data.

The annual overseas shipping of toothbrushes in containers is equivalent to an additional 6,200 passenger car emissions. Due to lack of reliable backhaul data and changing nature of container freight

[59] Appendix O: Reduced Emissions Calculation & Sources

[60] Toothbrush: https://www.foreo.com/mysa/how-toothbrushes-affect-environment-infographic/

we did not assume any empty container backhaul penalty, thus this emissions calculation is considered conservative.

The emissions savings from eliminating transportation are substantial and should be considered. Even transporting toothbrushes, a small lightweight and easily shipped product, produces a sizeable amount of CO_2. Logically, bulkier items would have a more dramatic impact especially when analyzing the entire transportation process.

The emissions savings from eliminating transportation are substantial and should be considered.

8.9 SHELL POLYMERS PENNSYLVANIA – RESIN PRODUCER BENEFIT

The world's first cracker plant was constructed in the 1920's by Union Carbide and was erected in West Virginia. The local abundant supply of natural gas drew cracker plants and other petrochemical operations to the region for the next 50 years. Since the energy crisis in the 1970's and a shift in natural gas producing regions, there has been little petrochemical development in the northeastern U.S. Much petrochemical production has been offshored. **However, the Shale Revolution (beginning in 2008) in Ohio, West Virginia and Pennsylvania is reversing the course.** The Marcellus and Utica shale formations underlying these states are some of the most prolific natural gas and natural gas liquids producing basins in the world. Petrochemical companies are beginning to see the opportunity and look at the region for potential projects.

SHELL FACILITY – MONACA, PENNSYLVANIA

In Beaver County Pennsylvania, just northwest of Pittsburgh, Shell Chemical Appalachia LLC has completed construction of **the first U.S. ethylene cracker with a polyethylene derivatives unit to be built outside of the U.S. Gulf coast in many decades.** [61]

Figure 36: Shell Cracker Plant 2021

The Shell facility was completed in late 2022. Upon completion and at full capacity, the facility is stated to consume roughly 100,000 barrels per day of ethane and produce roughly 3.5 billion pounds of polyethylene per year. **Shell has stated the desire to service as much regional polyethylene demand as possible.**

By locating in the Shale Crescent USA region, a cracker facility can locate quite literally on top of its feedstock, and in the center of its customers, thus eliminating unnecessary long-haul transportation of feedstock in and finished polyethylene pellets out. For petrochemical companies who deal in commodities, this is one of the most economical methods to achieve premium profitability for finished product streams. On Shell's project website, the company specifically states:

> *The plant is located close to both its source of ethane and its customer base. More than 70% of North American polyethylene customers are within a 1,100-kilometer (700-mile) radius of Pittsburgh. The plant's Pennsylvania location will provide Shell with a competitive advantage over Gulf Coast operators while providing customers with a shorter, more dependable supply chain*[62].

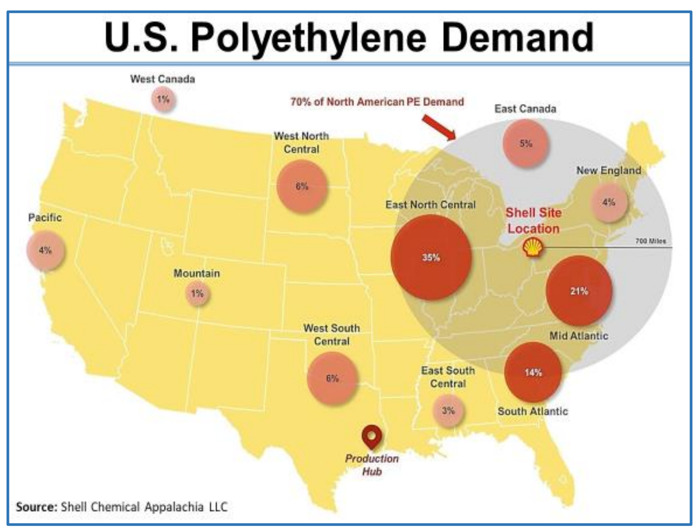


Figure 37: Shell - U.S. PE Resin Consumption Map

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[61] Shell: https://www.shell.com/media/news-and-media-releases/2016/shell-final-investment-decision-petrochemicals-complex-pennsylvania.html

[62] Shell: https://www.shell.com/about-us/major-projects/pennsylvania-petrochemicals-complex.html

GREATER OHIO RESIN SUPPLY

In addition to Shell, PTTGC, a Thai company, is considering building a world scale Ethane Cracker facility in Dilles Bottom, Belmont County, Ohio along the Ohio River. It should also be noted in Sarnia, Canada (about 100 miles away from Detroit), Nova Chemicals operates a sizeable Ethane Cracker plant producing nearly 600k metric tonnes of polyethylene resin per year. The Nova facility sources ethane from the Shale Crescent USA states and supplies regional plastic processors with plastic resin.

Polyethylene and Polypropylene Resin producing facilities in the surrounding-greater Ohio region:

Shell (Monaca, PA)	**1,600kMT PE**
Nova (Sarnia, Canada)	**600kMT PE**
LyondellBasell (Morris, IL)	**625kMT PE**
LyondellBasell (Clinton, IA)	**425kMT PE**
ExxonMobil (Sarnia, Canada)	**400kMT PE**
CPChem (Linden, NJ)	**350kMT PP**
Braskem (Marcus Hook, PA)	**350kMT PP**
Braskem (Neal, WV)	**250KMT PP**

FEEDSTOCK ADVANTAGE FOR REGIONAL CRACKER PLANTS

Regional cracker plants will have logistics advantages for their ethane supply and thus have a feedstock pricing advantage over Gulf Coast competitors. **The Shale Crescent USA region currently comprises over one third of U.S. natural gas production and can produce enough ethane to support at least 5 world scale ethane cracker plants**[63]. IHS Markit forecasts the Shale Crescent USA region will supply 45% of the nation's natural gas and will double in natural gas liquids (NGLs) production by 2040[64]. Ethane is the largest volume NGL produced in the Shale Crescent USA region.

The Shale Crescent USA region currently comprises over one third of U.S. natural gas production and can produce enough ethane to support at least 5 world scale ethane cracker plants.

In the Shale Crescent USA, ethane and natural gas can be consumed at a reduced cost compared to the Gulf Coast. The Marcellus and Utica formations produce a surplus of natural gas and NGLs beyond the region's current market requirements. **Marcellus and Utica natural gas/NGL producers have two options to sell their product:**

1) **Reject their produced NGLs** back into the natural gas pipeline and obtain a heat content (BTU) equivalent price as compared to methane (natural gas). This is well below the premium historically paid by the chemical industry. Due to regulation, there is an upper heat content specification limit which restricts the amount of NGLs that can be rejected further creating excess surplus in the region.
2) **Ship the NGLs via pipeline** out of the region. Currently, there are two major pipelines, the ATEX pipeline to the US Gulf Coast, and the Mariner East pipeline to Marcus Hook / Philadelphia. *It should be noted there are other pipelines to other markets, but they are minor and have not been*

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[63] EIA: https://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FGW_mmcf_m.htm

[64] Shale Crescent USA: https://shalecrescentusa.com/wp-content/uploads/2019/12/ShaleCrescent-ExecutiveSummary-12March20181.pdf

considered for this analysis. Once NGLs reach the U.S. ports they may be shipped to overseas markets. However, the majority of NGLs are consumed by the US Gulf Coast chemical industry – primarily to produce plastic resins. Price for the NGLs is set by the Mt. Belvieu market hub.

FINANCIAL ADVANTAGE FOR REGIONAL CRACKER PLANTS

Ethane is a commodity and the price for ethane producers is set in the Gulf Coast (Mt. Belvieu pricing). Therefore, Marcellus and Utica producers of ethane are paid the market price less the ATEX pipeline transport cost to the Gulf Coast chemical companies. NGL consumers and Appalachian producers on each end of the pipeline pay for the cost of the NGLs plus the cost of pipeline transportation.

Shale Crescent USA based ethane cracker plants and other regional NGL consumers**, can avoid transport costs and acquire their feedstock at a lower total cost than the Gulf Coast market price. This creates an incredible financial advantage for regional ethane feedstock consumers.**

The average price of ethane in 2021 was $0.31/gallon or roughly $13.00 per barrel (bbl). The ATEX pipeline fee to transport from the Shale Crescent USA to the Gulf Coast is around $0.15/gallon or just over $6.00 per bbl *(42 Gallons Per Barrel)*. A Shale Crescent USA based cracker plant's cost of ethane would be the Gulf Coast market price minus the ATEX transport costs. Regional resin producers' have been experiencing ethane at roughly $0.16/gallon ($0.31 less $0.15) or an estimated $7.00 per bbl representing a significant cost savings. **At these prices, cracker plants on the Gulf Coast can currently attribute nearly 50% of their cost of ethane to long-haul transportation.** IHS Markit predicts ethane will be accessible in the Shale Crescent USA region at an estimated 32% discount compared to Gulf Coast pricing over the long term[65].

For an ethane cracker plant that consumes 100,000 bbls. a day of ethane, the savings on transportation roughly equates to $600,000 a day, $200 million per year, and $8 Billion over the life of the facility. The simple calculation below illustrates how substantial the cost savings are when a polyethylene producer can locate on top of its ethane feedstock supply and avoid long haul transportation.

Elimination of Long-haul Transport of Ethane to U.S. Gulf Coast

0.15 $ (Per Gallon) **x 42** (Gallons Per Barrel)

≈ $6.00 Per bbl in Savings

*A World Scale Ethane Cracker Consumes **100,000** bbl/day*

Cracker Plant Savings from Elimination of Transportation

≈ $600,000 - Per Day

≈ $200,000,000 - Per Year

≈ $8,000,000,000 - Over 40 yr. Plant Life

Figure 38: Ethane Transportation Savings for PE Resin Producers

DETAILED FINANCIAL ANALYSIS OF $3 BILLION CRACKER PLANT INVESTMENT

In 2018, IHS Markit conducted a study titled, *Benefits, Risks, and Estimated Project Cash Flows: Ethylene Project Located in the Shale Crescent USA versus the US Gulf Coast*[66]. This study compared two identical cracker plants at nearly $3 Billion in investment size – one located in the U.S. Gulf Coast and the other located in the Shale Crescent USA region.

Using a 15% pre-tax discount rate, **the IHS Markit analysis predicted that an ethylene project in the Shale Crescent USA region would produce a net present value (NPV in 2020) on EBITDA of $930 million**

[65] Shale Crescent USA: https://shalecrescentusa.com/wp-content/uploads/2019/12/ShaleCrescent-ExecutiveSummary-12March20181.pdf

[66] IHS Markit: https://shalecrescentusa.com/wp-content/uploads/2019/12/ShaleCrescent-ExecutiveSummary-12March20181.pdf

over the life of the project, compared to a NPV of $217 million for a similar project on the US Gulf Coast. This represents an NPV cash flow advantage of $713 million for an investment in the Shale Crescent USA project versus a project on the US Gulf Coast. **The NPV cash flow is more than four times higher in the Shale Crescent USA project than in the US Gulf Coast project.** Without considering the time value of money, the pre-tax cash flow of the Shale Crescent USA project from 2020 to 2040 amounts to $11.5 billion, compared to $7.9 billion for a similar Gulf Coast project, **a pre-tax cash flow advantage of $3.6 billion.**

IHS Markit conducted a "stress test" to determine the ability of each project to deal with higher-than-expected capital costs and lower-than-expected plant operating rates. Using the same 15% pre-tax discount rate, the Shale Crescent USA project produced negative NPV returns in only 1% of the 10,000 Monte Carlo simulations, and the Gulf Coast project produced negative NPV returns in 38% of the simulations. A negative NPV indicates that a simulation delivered less than a 15% rate of return.

An ethylene project in the Shale Crescent USA has a comparative advantage because of its access to abundant supplies of locally produced low-cost ethane, which contributes to competitive manufacturing costs of ethylene, and subsequently polyethylene. This advantage is augmented by the region's proximity to over two-thirds of US polyethylene consumption.

The calculated financial returns for a Shale Crescent USA project compared with a Gulf Coast project are higher under all analyzed price scenarios, and these results are robust when considering a range of capital cost, operating rate conditions, and domestic/international sales scenarios. The comparative financial advantage for a Shale Crescent project would be further enhanced if the region experienced more than anticipated development of transportation facilities, natural gas and NGL storage, and pipeline infrastructure in the region. High level findings of the report can be found in *Appendix P: Polyethylene Facility Cash Flows.*

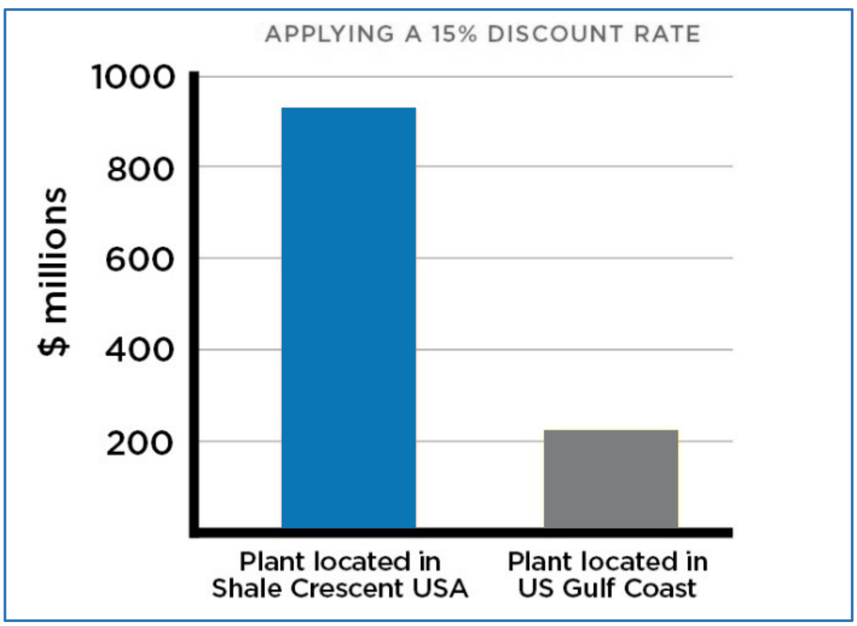

Figure 39: Polyethylene Facility Cash Flows

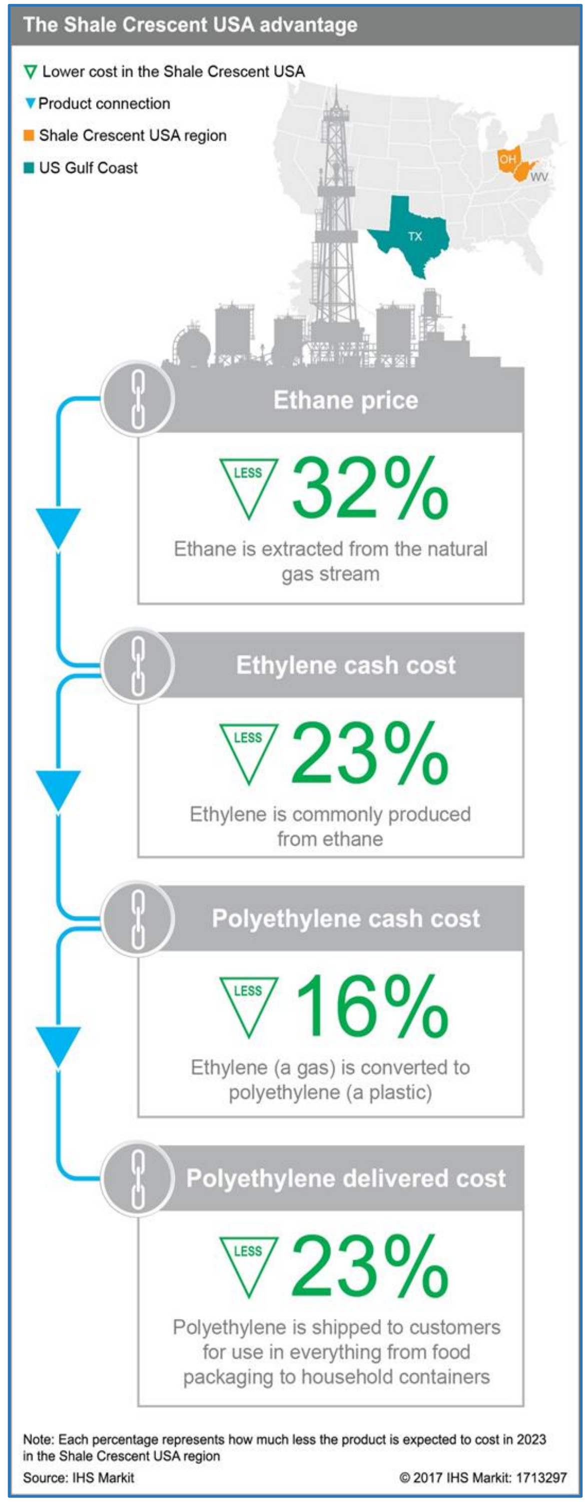

Figure 40: Ethane to Polyethylene Value Chain Savings

8.10 SHELL POLYMERS PENNSYLVANIA – PLASTIC PROCESSOR BENEFIT

Resin producers are not the only benefactors of operations in the Shale Crescent USA region. **Plastics based manufacturing operations stand to greatly benefit from regional resin production.** Over two thirds of Polyethylene and Polypropylene consumption, is within a day's drive of the Shale Crescent USA region. Regional resin feedstock supply creates benefits such as reduced transportation distances, shorter transit times, and other cost saving factors for manufacturers. **The new Shell cracker plant will create a disruption to the current supply chains for many localized manufacturers in a positive way.**

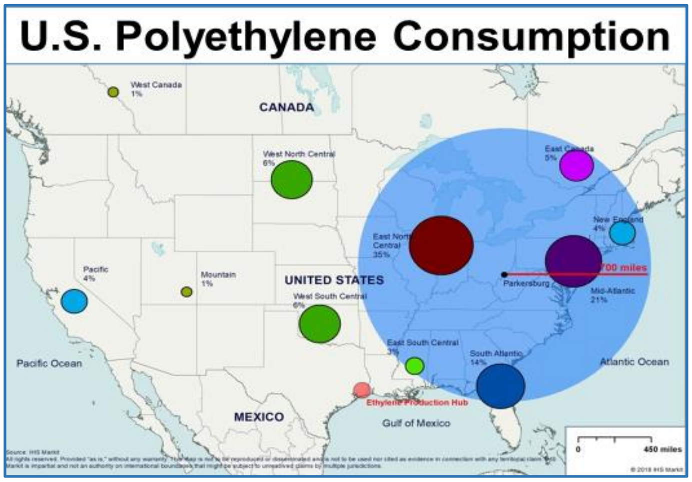

Figure 41: U.S. Polyethylene Consumption

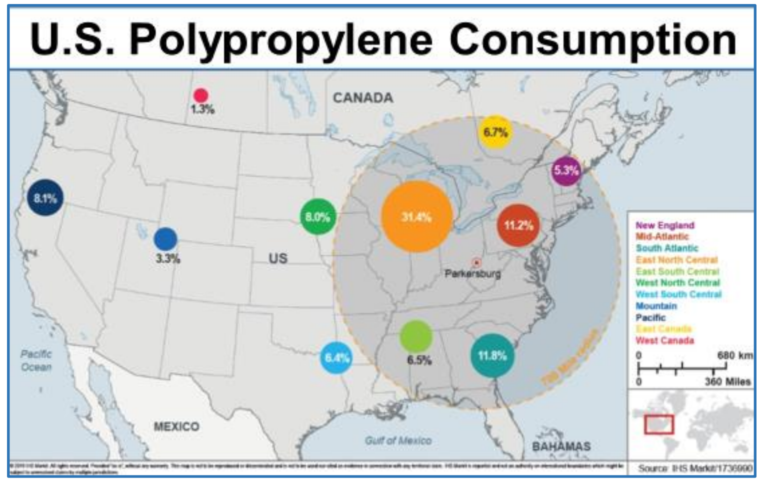

Figure 42: U.S. Polypropylene Consumption

PROJECTED SHIPPING SAVINGS – PER PROCESSING FACILITY

A majority of resin supply for northeast processors comes from the U.S. Gulf Coast via rail and is priced as freight on board (FOB) – with added cost for shipping. Shell's location in the center of its customer base will create a disruption to traditional supply lines. Since customers will be in proximity, **Shell will not only be shipping resin by rail but also by truck, likely allowing for quicker turnaround times and more diverse supplies of resin.**

Shipping costs are typically negotiated between the supplier and transporter and will vary from case to case. Often, the costs are built into the contract delivery price. By using general estimates and making some general assumptions, **a dollar value of savings and benefit of what plastics processors could experience can be projected.** A full rail car holds ≈ 200,000 lbs. and costs roughly \$0.05 per ton/mile to move product. A tractor trailer holds ≈ 40,000 lbs. and costs roughly \$0.20 per ton/mile[67] [68].

This study's hypothetical processing plant located in Cambridge, Ohio consumes 20 million pounds (10,000 tons) of polyethylene per year. Cambridge is roughly 100 miles from the Shell cracker facility in Monaca, PA compared to approximately 1,200 miles from Beaumont, Texas, the primary resin producing region in the U.S. Ten thousand (10,000) tons times \$0.05 (Rail Costs) times 100 miles is \$50,000 in direct transportation costs alone. A simple case study allows for easy comparison of transportation costs by both truck and rail.

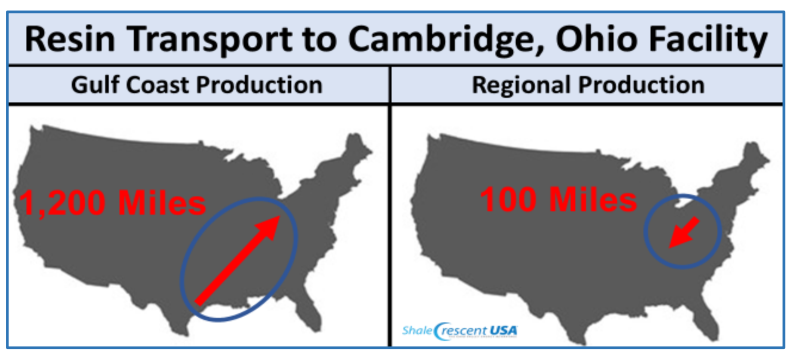

Figure 43: Transport Comparison Map - Gulf Coast vs. Shale Crescent USA

[67] U.S. Department of Transportation, Bureau of Transportation Statistics: https://www.bts.gov/content/truck-profile
[68] Association of American Railroads, Railroad Facts (Washington, DC: Annual Issues)

Hypothetical Ohio Plastics Processor Facility Approximate Resin Transportation Costs (Consuming 20 Million Lbs/10,000 Tons Per Year)		
	Rail Transport ($0.05 Per Ton Mile)	Truck ($0.20 Per Ton Mile)
Regional Transport Shell (Monaca, PA) to Cambridge, OH ≈ 100 Miles	$50,000	$200,000
Gulf Coast Transport Beaumont, TX to Cambridge, OH ≈ 1,200 Miles	$600,000	$2,400,000

Figure 44: Hypothetical Facility - Resin Transportation Costs

By regionally acquiring resin pellets, **the Cambridge, Ohio facility could pay less than 10% of the transportation costs than if it were to acquire resin supply from suppliers in the Gulf Coast.** It should be noted this only includes the direct cost of actual travel transport. It does not include any additional loading/unloading or other transfer fees that may be included in the process of moving resin from producers to processors. **Using rail as the primary mode of transport, a plastics processor in Ohio will possibly save an estimated $550,000 per year.**

In addition to potentially lower costs, Shell's proximity to market and ability to deliver by truck will likely create new opportunities for regional processors who perform short form manufacturing with quick turn arounds, and who frequently need different types/grades of resin. Processors that consistently consume the same bulk resin will likely acquire feedstock by rail.

PROJECTED SHIPPING SAVINGS – FOR PLASTICS INDUSTRY CREATED BY REGIONAL PRODUCTION

Plastics based manufacturers in the northeast and Midwest regions of the U.S. currently source nearly all resin supply from the Gulf Coast, a distance of roughly 1,200 miles. **The Shell facility is projected to produce 3.5 billion lbs. (1.6 million tons) of polyethylene (PE) per year.** As seen in the maps above, a majority of PE and polypropylene (PP) market is within a 700-mile radius of the region. **The Shell facility will be subject to high volume demand from regional consumers & will likely have the ability to sell a vast majority of its resin supply to manufacturers within the region.** A shift to more localized supply chains will disrupt markets & resin supply that currently originates in the Gulf Coast.

Assuming Shell will capitalize on local markets for resin sales we will use standard rail and truck transportation costs to estimate potential savings for the plastics processing industry. For this calculation, the average transportation distance for regional resin supply is set at 350 miles which is half the distance of the 700-mile radius encompassing the majority of U.S. PE demand. One point six (1.6) million tons times rail costs estimated at five cents ($0.05) per mile, multiplied by 350 miles comes to approximately $30 million. This number represents only direct transportation costs. A simple case study allows for comparison of transportation costs by both truck and rail.

By location and proximity to customers, Shell has created a potential significant cost savings opportunity within the plastics industry supply chain. **By percentage, total shipping costs from Shell could be nearly 75% less than shipping from the Gulf Coast.** Stated differently, transporting resin pellets from the Gulf Coast is projected to cost plastic processors over 3x more than if they could acquire supply regionally. **This equates to roughly $70 million a year in rail transport costs that can be eliminated** – this amounts to measurable cost savings that can be shared

Hypothetical & Approximate Transportation Costs/Savings Created by Regional Supply (Shell will Produce 3.5 Billion Lbs/1.6 Million Tons Per Year)		
	Rail Transport ($0.05 Per Ton Mile)	Truck ($0.20 Per Ton Mile)
Regional Transport Shell (Monaca, PA) to Midwest Processors ≈ 350 Miles	$30,000,000	$110,000,000
Gulf Coast Transport Beaumont, TX to Midwest Processors ≈ 1,200 Miles	$100,000,000	$390,000,000

Figure 45: Hypothetical Facility Estimated Transportation Saving Created by Shell

throughout the supply line, experienced by the manufacturers, & passed to consumers.

The transportation savings to the industry is augmented by the other benefits such as shorter wait times, decreased working capital, and greater flexibility in feedstock adjustments and orders. It should also be noted that significant emissions savings will result from the reduced distance of transportation.

8.11 WORKING CAPITAL SAVINGS – PLASTIC PROCESSOR BENEFIT

Working capital is the money that is used to cover a company's short-term expenses such as cash and assets including product inventory. For plastic processors, the inventory is resin. For retailers, the inventory is finished goods. Both benefit from shorter supply chains and faster turnover. Companies that have the ability to shorten supply chains and lead times can reduce the amount of working capital that is required for operating smoothly and meeting financial obligations. This strategy frees up resources for investments back into workforce, operations, and business growth.

PLASTIC PROCESSOR BENEFIT – CASE STUDY

This report's hypothetical processor in Cambridge, Ohio consumes 20 million lbs. of polyethylene per year. That is nearly 1.7 million lbs. of consumption per month. **A general reserve standard for manufacturing operations is to maintain at least two months of inventory support on location**. In this case, that would be roughly 3.4 million lbs. of PE. At the time of this report, PE resin prices were reported at an estimated $1.00 per lb., meaning the Cambridge facility would house resin inventory valued at $3,400,000 on location.

Ohio processors who acquire resin from the Gulf Coast by rail can expect transport time to average between 4 and 6 weeks. This relatively long supply chain segment requires increased working capital as resin supply must include levels that have capacity to address any disruption that may occur over a period of 6 weeks. For the Cambridge facility, **this would require roughly three months of working capital inventory tied up in storage or transport at an estimated cost of over $5,000,000.**

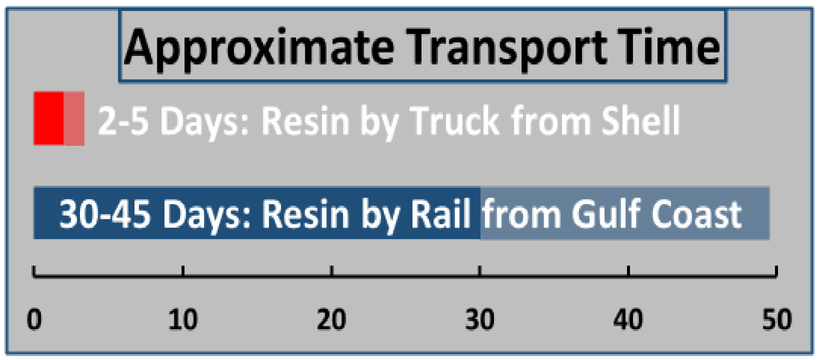

Figure 46: Resin Transport Time Comparison

As stated earlier, **Shell will be disrupting the traditional supply lines by locating near their customer base and delivering by both rail and truck.** What has historically taken over one month of transport from the Gulf Coast could possibly take only a few days by truck from the Shell facility. Rail transport times from Shell to regional processors will logically be shorter than Gulf Coast transport times. Plastic processors in the greater Ohio region who can capitalize on this regional supply chain will mitigate the risk of supply shortages. This will greatly reduce the amount of working capital both in transit and on site. Estimates show that the Cambridge facility could potentially reduce its inventory of working capital by two-thirds (2 months) or in this case roughly $3,400,000.

Assuming a cost of money rate at 5%, there is an additional $170,000 *(.05 x $3.4 million)* in opportunity cost lost to working capital inventory. Though this number is seemingly small, it represents roughly 1% of the $20,000,000 annual cost in resin supply for the Cambridge facility. Said differently, using the simple and conservative assumptions above, **a processor located in greater Ohio that can source resin regionally, can theoretically save 1% alone on resin costs by reducing working capital.**

Hypothetical Ohio Plastics Processor Facility Approximate Inventory by Volume & Costs (Consuming 20 Million Lbs. Per Year)		
	Volume of Inventory (Required for 2 Months Supply of Working Inventory)	Working Capital Cost of Inventory (PE≈ $1.00/lb)
Regional Source Shell (Monaca, PA) to Cambridge, OH Transport Time ≈ 3 Days	≈ 3.4 million/LBs	$3,400,000
Gulf Coast Transport Beaumont, TX to Cambridge, OH Transport Time ≈ 30 Days	≈ 5.0 million/LBs	$5,000,000

8.12 WORKING CAPITAL SAVINGS- RETAILER BENEFIT

Retailers stand to benefit from shorter supply chains in much the same way that manufacturers benefit. Currently, the U.S. imports $500 billion dollars in consumer goods from China annually. This study has identified that over $50 billion of those goods are simple plastic-based products that can be competitively manufactured in Ohio. Importing from the other side of the world requires multiple phased supply lines with many steps that can be impacted for a number of reasons, ranging from weather to geopolitical issues to resource shortages. **For retailers, this ultimately results in lengthier lead times and unpredictable or volatile markets.**

Based on indirect data and a collection of sources that show measurable transportation and logistics rates including delivery routes, estimated travel times, and other sources some approximate numbers can be conservatively produced in regards to the amount of time required for shipments to make it from the door of the manufacturer in China to the retailer/distribution centers in the U.S.

The transportation process and estimated times are as follows:

- 3 Days = Transport Goods from China Manufacturer to Chinese Port
- 2 Days = Unload Goods from Truck/Rail at Chinese Port
- 3 Days = Load Goods from Chinese Port to Ship
- 17 Days = Ocean Transport of Goods – Various Routes and Times[69]
- 3 Days = Unload Goods from Ship to U.S. Port
- 2 Days = Load Goods from U.S. Port to Truck/Rail Transport
- 2 Days = Transport of Goods via Truck/Rail to Distribution Centers

32 Days = Total Transport Time

The total time of transport for international goods from a China based manufacturer to U.S. distribution centers averages just over one month. This average does not consider any unscheduled delays or unavoidable interruptions during the process. In 2020 and 2021, **it has become common to see ocean going ships fully loaded with finished goods waiting just offshore to dock at congested U.S. ports.** Ships have been known to wait for weeks[70].

As imports to the U.S. have increased over the years, coupled with the impacts of Covid-19, transport times and the potential for unexpected delays has also increased. The increased wait times at ports is caused by multiple issues including increased ship traffic to the U.S., a change in consumer buying habits, larger ocean-going vessels, and worker shortages.

As mentioned earlier in this report, over 50% of U.S. population and a majority of U.S. consumer demand is within a day's drive of Ohio. **Retailers who are able to acquire consumer goods from U.S. based manufactures stand to greatly benefit from reduced transport times,** as well as avoiding unforeseen global issues, and potential delays.

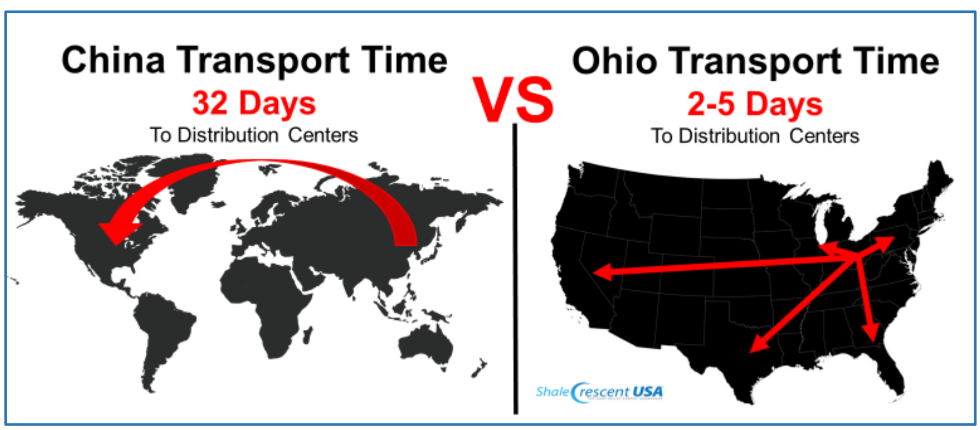

Figure 48: Transport Time - China vs. Ohio

[69] https://www.brlogistics.net/us/ship-container-from-china/to-united-states/los-angeles/

[70] WSJ: https://www.wsj.com/articles/cargo-ships-are-again-idling-off-jammed-southern-california-ports-11629229285

FINANCIAL BENEFIT

There are also substantial financial savings available to retailers who can acquire finished goods from regional plastics-based manufacturers who avoid the cost of global supply chains. Earlier in this report the cost of transporting shipping containers from China was highlighted. What used to cost $2,000 for overseas transportation is now far greater, for several months of 2021 rates saw a 10-fold price increase. **The elimination of costs associated with ocean transport represents a significant economic advantage when goods can be acquired domestically, and more specifically, locally.**

In this study, a detailed analysis of the working capital for retailers was not conducted. However, a macro evaluation on total U.S. plastic imports was performed to provide a reference for general standard costs. The U.S. imports over $50 Billion of plastics-based consumer goods each year. Transit time is approximately 30 days, or 1 month and retailers purchase goods FOB. These standard factors combine to equal over $4.5 Billion *(one twelfth of $54 billion)* of deployed working capital each year for plastic-based goods. Assuming a 5% cost of money**, an additional nearly $3 Billion *(5% times $54 billion)* in opportunity cost is lost to working capital inventory.** These savings are strong incentives for retailers, who are typically the customers of the plastics processor industry, to purchase finished goods regionally as opposed to globally.

POPULATION DENSITY

When retailers make purchasing decisions about product selection and volume of inventory, they must consider seasonality, consumer buying habits and regional demographics. There are many variables to consider in the purchasing process, however, finished consumer goods are largely driven by population. There is a direct ratio of consumer goods sales to population density. The U.S. population, as mentioned earlier, is concentrated in the eastern third of the country. **In fact, 50% of the U.S. population and 30% of the Canadian population, is within a day's drive of central Ohio[71].** This further secures the regional advantage that Ohio plastics-based manufacturers have over Chinese manufacturers.

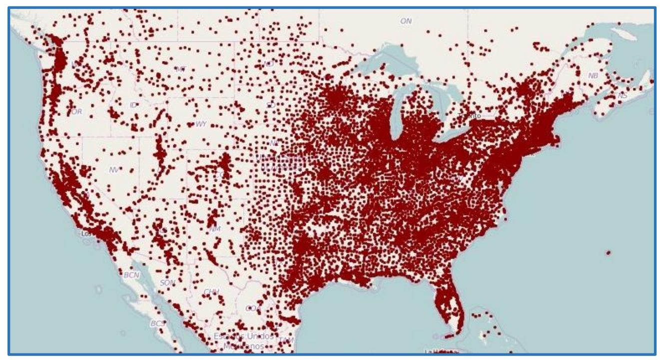

Figure 49: U.S. and Canada Population Map

In fact, 50% of the U.S. population and 30% of the Canadian population, is within a day's drive of central Ohio.

8.13 WALMART AND OTHER MAJOR RETAILERS ARE ONSHORING

Plastics-based manufacturers are becoming aware of the global shifts in favor of onshoring manufacturing to the U.S. However, production is only part of the equation. The back-end factors, sale, and consumption of the manufactured product must be considered. Most manufacturers do not sell finished products directly to consumers. They sell to one of three groups: **1)** Other manufacturers who will produce and assemble the final product **2)** Retailers such as Walmart, Target, Procter & Gamble **3)** Third party sellers who wholesale to retailers. In the effort to onshore manufacturing, the consumers of manufactured products will play a critical role in a successful global shift.

In the 1990's and 2000's, it was largely retailers who influenced the offshoring of manufacturing to China. Companies such as Walmart moved manufacturing to regions with an abundant supply of inexpensive labor. At the peak of offshored manufacturing, it is estimated that 70-80 percent of Walmart's merchandise was from China-based suppliers[72]. Walmart was, and remains, the largest U.S. importer of consumer goods at nearly 1 million shipping containers each year.

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[71] Polymer Alliance Zone: https://pazwv.org/why-the-polymer-alliance-zone/#proximity

[72] Alliance for American Manufacturing: https://www.americanmanufacturing.org/press-release/fact-sheet-walmarts-made-in-america-pledge/

Retailers and wholesalers in the U.S. are beginning to recognize the advantages of onshoring, and the growing demand for American Made products. Retail giant, Walmart, is now leading initiatives to re-shore production. In early 2021, **Walmart announced plans to spend an additional $350 billion on items made, grown or assembled in the U.S. over the next decade**[73] . As part of this commitment, Walmart has identified six consumer product categories, of which **plastics was listed number one**.

WALMART'S REASONING FOR ONSHORING IS THREE-FOLD


Walmart pushes U.S. manufacturing support with $350 billion investment

by Kim Souza (ksouza@talkbusiness.net) March 3, 2021 3:37 pm 983 views

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Walmart on Wednesday (March 3) announced a new $350 billion commitment to support 750,000 U.S. manufacturing jobs over the next decade. The pledge builds on the $250 billion commitment in 2013 for purchasing American-made goods.

1) **American Made** – 85% of Walmart Customers want American manufactured or assembled products

2) **Creating U.S. Jobs** - Walmart estimates the onshoring will create roughly 750,000 new American jobs.

3) **Reduced Emissions** – The Boston Consulting group estimates 100 million metric tons of CO2 will be avoided due to the elimination of long-haul transportation from imported products.

Walmart has roughly 5,000 U.S. stores with more than $300 billion in annual U.S. sales[74] from shelves that are filled with imported products. The retail giant's recent decision to work with and encourage the reshoring of manufacturing creates a huge opportunity for U.S. plastics-based manufacturers who can competitively manufacture plastic products. **Recent domestic surveys indicate a growing preference for 'American Made' goods.** Walmart and other retailers are ultimately first line customers of manufacturers and are positioned to become a driving force in efforts to onshore manufacturing.

PARTICIPATING WITH WALMART

Walmart has created a series of "Open Call Events", both live and virtual. Anyone with a shelf-ready product that supports American jobs can pitch retail sales to Walmart. For more information visit: Walmart's (JUMP): Jobs in U.S. Manufacturing Portal.

They have also created a program called "American Lighthouses"[75]. The concept is to bring together public and private stakeholders to overcome specific product category issues that create barriers to domestic production. The program is designed to create a holistic view of the supply chain to identify bottlenecks and create solutions that streamline efficient U.S. operations.

American Manufacturing Lighthouses:

- Access to skilled labor
- Access to financing
- Access to raw materials and components
- Trade policy and regulations.

Walmart manages the Lighthouse program via invitation only and is only in one product category. Textiles is the first product category in the program. Plastics will be next.

[73] Walmart: https://corporate.walmart.com/newsroom/2021/03/03/investing-in-the-future-of-u-s-manufacturing-our-commitment-to-american-jobs

[74] Walmart 2020 Annual Report: https://s2.q4cdn.com/056532643/files/doc_financials/2020/ar/Walmart_2020_Annual_Report.pdf

[75] Walmart: https://engage.walmart-jump.com/american-lighthouses-walmarts-vision

U.S. IMPORTS:
PLASTICS BASED PRODUCTS

9

9. U.S. IMPORTS

9.1 FEEDSTOCKS TO PLASTICS: ETHANE TO POLYETHYLENE

Plastics are created primarily from two feedstocks **1)** Naphtha which is produced from oil or **2)** Natural Gas Liquids. Natural Gas Liquids (NGLs) include Ethane (also commonly called C2 because it's two carbon molecules), Propane (C3), Butane (C4). Natural Gas is Methane (C1). The petrochemical value chain includes multiple feedstocks. This report largely focuses and discusses the ethane value chain. As discussed earlier in this report, the U.S., and more specifically the Shale Crescent USA region, has a tremendous natural gas and NGL advantage over the rest of the world. Over 99% of U.S. ethane, is produced from natural gas processing facilities. It is important to note that the type of feedstock used has a major impact on production costs of plastic resin.

The diagram below highlights the multiple stages of the process from raw molecules to finished products[76].

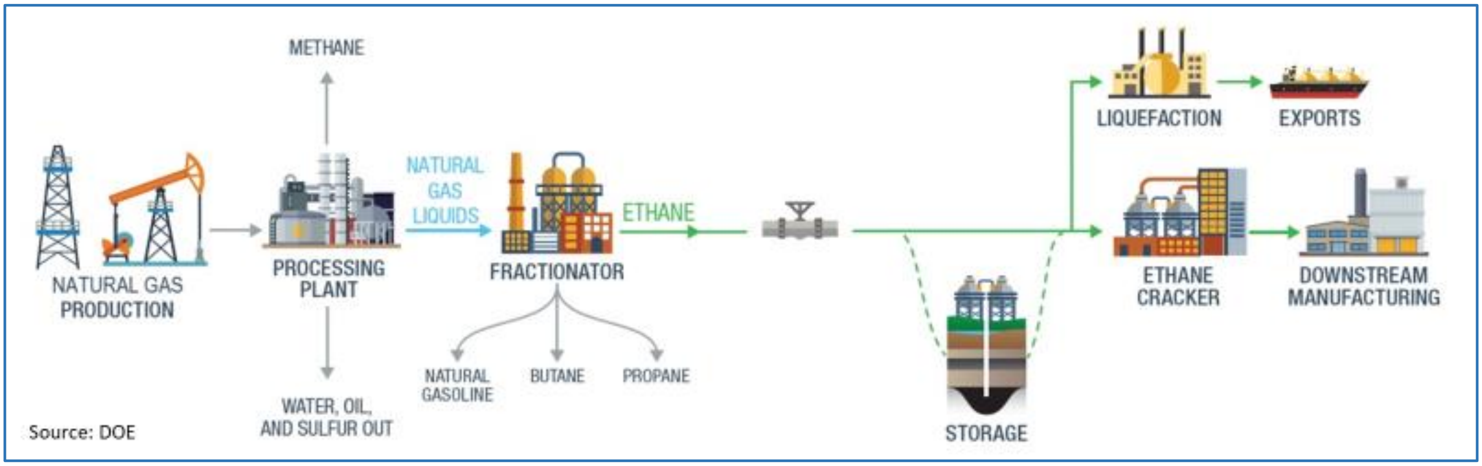

Figure 50: Natural Gas and Natural Gas Liquids Value Chain

ETHANE VALUE CHAIN

In the U.S., the process for producing Polyethylene based plastics starts "Upstream" with the extraction of the natural gas and NGLs. Extracted molecules are then piped to "midstream" processing plants and fractionators where they are separated into purity products (ethane, propane, butane). The resulting products (i.e., ethane) is then piped to a "downstream" Ethane Cracker plant where it is converted to ethylene and ultimately to polyethylene resin. Polyethylene can be produced for different end-product uses with differing chemical and material qualities, types, and grades.

ETHYLENE

The Ethane value chain's key chemical component is ethylene, a reactive hydrocarbon characterized by a carbon-to-carbon double bond, which allows it to act as a glue with other chemicals, including itself, creating longer chained chemicals with unique and more stable properties. The simplicity and ability to glue other molecules together reliably and repeatedly positions ethylene as the most important building block chemical.

Figure 51: Ethane to Polyethylene

[76] DOE: https://www.energy.gov/sites/prod/files/2018/12/f58/Nov%202018%20DOE%20Ethane%20Hub%20Report.pdf

POLYETHYLENE

Polyethylene (PE) is the largest volume and most commonly used plastic in the world, and accounts for around 60% of ethylene feedstock demand in the U.S.[77]. **Polyethylene combines strength, malleability, solvency, water resistance, and the benefit of being a low-cost plastic.**

From ethylene and polyethylene, a number of plastics-based consumer products can be made ranging from hygiene products to bottles, house siding to car parts, electronic parts, and much more[78]. **With the abundant U.S. natural gas supply and the new Shell Ethane Cracker plant in western Pennsylvania, the entire polyethylene value chain is now located within the same region.** This includes the feedstock for production, the manufacturing operations to produce finished goods, and the consumers to purchase products. **This new ecosystem is creating an opportunity for processers in Ohio to competitively produce finished goods that are currently imported from China.**

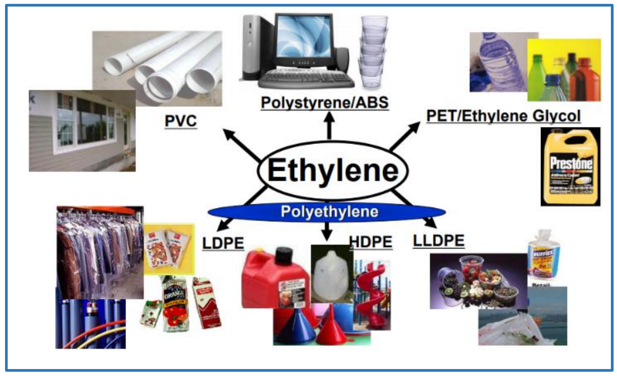

Figure 52: Products Made from Ethylene

9.2 PLASTIC IMPORTS

CAPTURING AND ANALYZING IMPORT DATA

As global supply chains continue to be disrupted and energy markets shift in favor of the U.S., the opportunity to onshore the manufacturing of energy intensive products becomes feasible. The onshoring opportunity can be measured, in part, by understanding the immense volume of imported consumer goods. The *U.S. Census Bureau* is the primary agency for tracking and reporting information related to imported products. Through the *U.S. Census Bureau,* the U.S. government tracks details of imports in *Bill of Lading* forms. To protect trade secrets and competitive advantage for companies, some specific details such as costs of products and other details remain confidential. Details such as the importing purchasing party, the exporting manufacturing company, count, size weight and other product details are separated from macro level import data making it difficult to identify specific products. Third party companies such as, *Descartes: Datamyne*, exist to help navigate and interpret the obscure details of import data to increase its usability.

This report utilized both the *North American Industrial Classification System (NAICS)* and the *Harmonized Tariff Schedule of the United States (HTSA)* to identify plastic product categories. *NAICS* data was used for a macro level review and analysis of import trends. *HTSA* data was used to find specific product categories and the associated dollar amount of imports. Combined, **these data sets provide the ability to highlight which plastic products are the strongest and largest onshoring opportunities.**

HIGH LEVEL IMPORT DATA

In 2020, the U.S. imported $2.3 Trillion in goods from other parts of the world. Of that amount, China accounted for an estimated $500 billion[79].

Over the past 10 years, the U.S. has seen a dramatic increase in the amount of plastic-based imports from the rest of the world.

Over the past 10 years the U.S. has seen a dramatic increase in the amount of plastic-based imports from the rest of the world. Plastic-based imports have more than doubled since 2010 and currently represent over $55 Billion dollars per year. For the purpose of this report, “plastic based goods” does not include items such as laptops, hairdryers, coffee makers, and etc that contain plastic components. For an item to be considered a plastic based

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[77] DOE: https://www.energy.gov/sites/prod/files/2018/12/f58/Nov%202018%20DOE%20Ethane%20Hub%20Report.pdf

[78] IHS Markit: Chemical and Energy Training

[79] U.S. Census Bureau: https://www.census.gov/foreign-trade/statistics/highlights/AnnualPressHighlights.pdf

good, plastic must be the primary material of the product, and the finished good must have few other major components. This category includes items such as, toothbrushes, polyvinyl flooring, kitchen utensils, blinds, buckets and so forth**. Of the $53 billion of annual plastic-based imports to the U.S.**, nearly half originate in Asia **and the majority of that amount comes from China with an estimated value of $25 billion**. This value represents roughly 5% of total Chinese exports to the U.S. In 2010, China was manufacturing and exporting far less plastic-based exports to the U.S. at roughly $8 Billion per year.

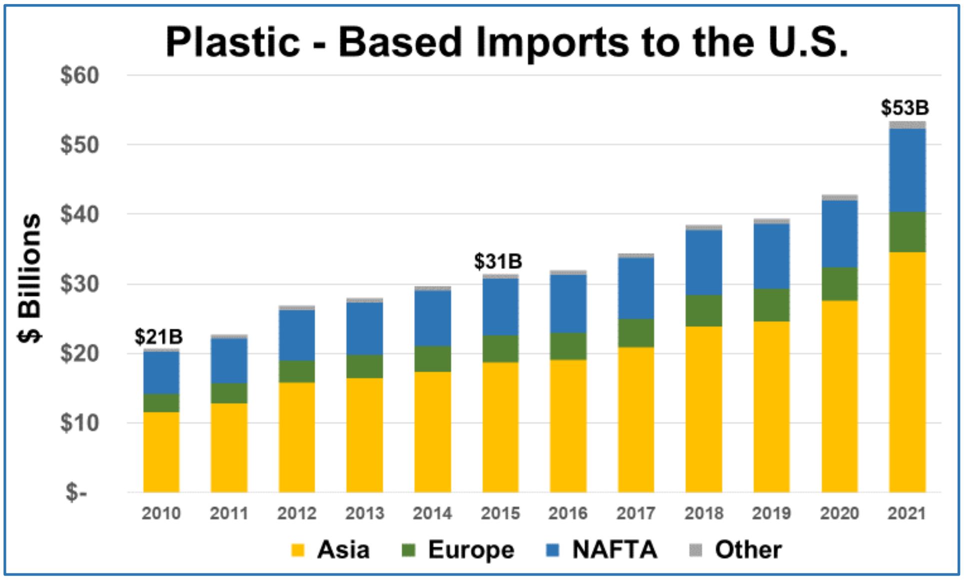


Figure 53: U.S. Plastic Based Imports by Region

During this same period, NAFTA saw its share of plastic-based imports to the U.S. decrease from 29% to 22%. Europe also saw a decrease in market share. Meanwhile **Asia's share increased from 56% to 65%.** In product value, total plastic-based imports to the U.S. increased from $21 Billion to over $53 Billion. This is an annual rate of increase of just under 10%.

Percent of Total of U.S. Plastic Imports												
Region	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Asia	56%	56%	59%	59%	58%	60%	60%	61%	62%	62%	64%	65%
Europe	13%	13%	12%	12%	12%	12%	12%	12%	12%	12%	11%	11%
NAFTA	29%	28%	27%	27%	27%	26%	26%	25%	24%	24%	22%	22%
Other	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Grand Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 54: Percent of Total of U.S. Plastic Imports

MID LEVEL IMPORT DATA

This report examines the Harmonized Tariff Schedule (HTS) to further investigate plastic-based imports. The HTS allows for universal organization of products and breaks categories down into deeper levels of classification. The system is useful in identifying how specific market segments are trending. Import goods increasing or decreasing are good indicators of global trends in the plastics manufacturing industry. The chart below captures Chinese import data to the "4-digit" level.

The U.S. is importing more plastics-based goods from China than ever before, and some plastics-based categories have seen significant growth over the past decade. Categories like 3926 "Articles of Plastics" and 3924 "Tableware and other Household Articles" have doubled. Other categories have seen even greater rates of increase including 3922 "Baths, Washbasins, Lavatory Seats", with a four-fold increase. The chart below shows the top 12 plastic -based categories sorted by greatest import value in the year 2020.

Average annual uncompounded growth rates help identify trends in categories. As seen below, some categories have seen a decrease in value of imports to the U.S. This can sometimes occur due to reclassification of products to different categories. If this is the case the U.S. may not actually be importing less of a specific product, it could be importing more albeit being reported in a different category. To more accurately identify product groupings, an inventory at the "10-digit" level was conducted.

U.S. Import Product List from China - Harmonized Code: 4 Digit ($ Dollar Amount Per Year: 2000 - 2021)						
Product Type (Imported from China)	**Year 2000**	**Year 2010**	**Year 2019**	**Year 2020**	**Year 2021**	**Avg. Annual Growth Rate**
3926 Articles Of Plastics (inc Polymers & Resins) Nesoi	1,234,802,669	3,215,477,294	5,399,284,659	7,530,394,974	8,941,738,310	10%
3924 Tableware & Other Household Articles Etc, Plastics	798442372	2,590,577,363	4,712,671,814	4,738,246,906	5,867,070,705	10%
3918 Floor Cover (rolls & Tiles) & Wall Cover, Plastics	31,827,015	325,781,161	2,881,985,843	3,169,178,125	3,245,030,059	26%
3923 Containers (boxes, Bags Etc), Closurers Etc, Plast	423,562,933	1,652,996,909	2,049,429,870	1,951,813,752	2,148,207,075	9%
9603 Brooms, Brushes, Mops, Feather Dusters Etc	242,583,109	796,895,882	1,292,751,681	1,285,703,244	1,371,669,261	9%
3917 Tubes, Pipes & Hoses & Their Fittings, Of Plastics	14,913,604	207,296,585	492,708,939	456,100,777	571,485,403	22%
3925 Builders' Ware Of Plastics, Nesoi	280,461,167	504,024,448	580,366,108	461,320,805	557,884,439	4%
3920 Plates, Sheets, Film Etc No Ad, Non-cel Etc, Plast	58,617,022	224,159,101	279,334,134	313,411,914	350,390,269	11%
3919 Self-adhesive Plates, Sheets, Film Etc Of Plastics	15136502	155165543	241721508	268220505	311,749,992	17%
3922 Baths, Washbasins, Lavatory Seats Etc Of Plastics	7058499	61279380	205,694,215	248,267,495	294,844,523	20%
3921 Plates, Sheets, Film, Foil & Strip Nesoi, Plastics	9,977,697	199,324,352	236,879,061	241,936,332	281,771,106	20%
9406 Prefabricated Buildings	3960672	33883481	52147936	61166638	78,759,006	21%
9605 Travel Sets For Personal Toilet,etc	17835226	16355094	26,821,994	27,830,090	25,826,278	2%
9606 Buttons, Press Studs Etc, Button Mold & Blanks Etc	6,237,871	17,931,289	9,419,278	7,871,098	10,127,020	5%
9607 Slide Fasteners And Parts Thereof	5721103	6,396,945	7,788,180	6,096,572	8,535,653	4%

Figure 55: Harmonized Tariff Schedule Plastic Imports to U.S. - 4 Digit Level

DETAILED IMPORT DATA

The Harmonized Tariff Schedule (HTS) classifies product categories as deep as the 10-digit level. This is the most specific product grouping data that can be acquired from the U.S. Census bureau without looking at individual Bill of Lading data. Listed below is a table of the top 12 imported plastics product categories from China and the associated dollar amount. Some groupings quickly rise to the top such as 3918101000 "Floor Coverings of Vinyl Tile". This grouping would include the product Poly Vinyl Flooring. In 2010 the U.S. imported roughly $250 million worth. In 2020, that number had increased over 10-fold to $3 Billion. That is an average uncompounded annual growth rate of 97% over the past decade.

Other product categories have also seen dramatic increases in manufacturing and exporting to the U.S. This includes products ranging from Kitchenware and gloves to household hygienic products and ornamental items. In the wake of COVID -19 product grouping 3926201020, "Gloves, Disposable, Medical....", Quadrupled from 2019 to 2020.

The U.S. Census Bureaus has over 350 plastic-based product groupings reported at the 10-digit level. Each one of these groupings is a potential opportunity for onshoring production to the U.S. Using a combination of the dollar amount of imports and the average annual uncompounded growth rate we can identify product import trends. *For a more detailed review see Appendix Q: Harmonized Tariff Schedule Product Imports List by Dollar Amount*

U.S. Import Product List from China - Harmonized Code: 10 Digit ($ Dollar Amount Per Year: 2000 - 2021)						
Product Type (Imported from China)	**Year 2000**	**Year 2010**	**Year 2019**	**Year 2020**	**Year 2021**	**Avg. Annual Growth Rate**
3926909985 Articles Of Plastics Etc, Nesoi (no)				$1,487,031,329	$3,051,252,475	105%
3924104000 Tableware & Kitchenware,of Plastic,nesoi (no)		$1,080,213,630	$2,216,088,928	$2,287,540,143	$2,894,608,413	14.0%
3924905650 Household Hygenic Or Toilet Articles Plastic Nesoi (no)			$1,550,077,239	$1,556,798,586	$1,905,484,936	8.0%
3926201020 Gloves,seamless,excp Surg & Medical,disposabl,plas (dpr)	$56,636,643	$325,485,188	$399,040,662	$1,558,930,931	$1,810,474,709	26%
3918101000 Floor Coverings Of Vinyl Tile (m2)	$26,154,499	$265,769,026	$2,741,919,675	$3,106,564,123	$1,447,005,390	25%
3918101020 Vinyl Tile Floor Covering Rigid Solid Polymer Core (m2)					$1,021,073,373	N/A
3926201010 Gloves,seamless,surgical & Medical,of Plastic (dpr)	$50,023,554	$273,625,819	$159,361,591	$516,912,391	$990,065,712	23%
3926907500 Pneumatic Mattresses & Oth Inflatable Art,nesoi (no)	$165,281,016	$325,206,536	$584,787,338	$548,768,063	$759,998,310	9%
3926400090 Statuettes & Other Ornamental Articles,of Plastic (no)			$423,762,513	$468,813,937	$632,829,783	15%
9603908050 Brooms,brushes,squeegees,etc,nesoi (no)	$72,889,789	$312,871,964	$487,738,804	$537,463,313	$559,933,032	11%

Figure 56: Harmonized Tariff Schedule Plastic Imports to U.S. – 10 Digit Level

COMPANY SPECIFIC IMPORT DATA

Through the U.S. Census Bureau, the U.S. government tracks the details of imports and shipments via Bills of Lading. A Bill of Lading is a legal document between a shipper and carrier detailing the type, quantity and destination of goods being shipped[80]. In 2020, there were nearly 12 million Bills of Lading processed for imports to the U.S. (Vietnam was second with .7 million transactions). Of the 12 million, China accounted for over 5 million of the documents of transaction. The Port of Los Angeles, California received 2.5 million of the total transactions.

Although Bill of Lading data is public, company specific import details and costs are kept confidential by the U.S. government, to help protect companies cost of production information. The use of third-party software, such as *Datamyne*, use algorithms to help pair together detailed *Bill of Ladings* with macro level Census Bureau data. By loosely pairing together Bill of Lading data with U.S. Census Bureau macro level data, these third-party companies help draw correlations that support assumptions around cost and value of specific imported products.

[80] https://www.investopedia.com/terms/b/billoflading.asp

COST MODEL: COMPARISON

10

10. COST MODEL COMPARISON

Leveraging the reported cost data acquired for the two regions: Ohio and Zhejiang, a production cash flow cost model was developed. The model was applied to a handful of representative products allowing for reasonable extrapolation across the industry. Selected products were specifically identifiable as imported products in large volume and produced using a common resin type. Variation in product types and sizes allowed for testing of shot size, equipment size, and processing type.

Milacron, a large global manufacturer of leading-edge plastic processing equipment, was consulted to contribute to details within the model. Milacron contributed their expertise and real-world experience. A collection of industry practitioners and experts from the Shale Crescent USA panel of advisors were used to verify and endorse assumptions and projections within the model.

The cost model has been designed to provide a realistic cost framework that processors can use as an analysis formula. **The model can be tailored using specific products, equipment, resins, and operating factors allowing for a deep understanding of cost drivers specific to a processor's unique situation.** Within the model, the cost factors can all be adjusted to represent current prices.

10.1 COST MODEL ELEMENTS

A profitability analysis has been included in the model for use by plastics processors. This will allow for preliminary identification of the most profitable products on which to focus efforts. In addition, a how to guide for processors has been designed to guide development of a business case centered on profitability.

THE COST PRODUCTION MODEL IS COMPRISED OF THREE ELEMENTS:

- **Product and equipment specifics:**
    - Product information including material and part cycle times
    - Shot mass and parts per shot
    - Equipment type, cycles, hours, and annual parts production
- **Cost drivers:**
    - Equipment capital costs, maintenance, and amortization
    - Labor costs
    - Maintenance costs
    - Energy costs
    - Infrastructure costs including building lease rates
    - Materials cost
    - Transportation of feedstock costs
    - Transportation of finished product costs
    - Packaging costs
    - Working Capital costs
- **Profitability Analysis**
    - Wholesale price
    - Part cost
    - Gross margin

10.2 COST MODEL ASSUMPTIONS

Assumptions and industry experience are critical in effectively operating the model. This insight will allow testing of different scenarios including tradeoffs between equipment size and cost versus parts per shot. Processors with knowledge of particular products, resins, and required equipment can tailor the model to include their process specific data. It is beyond the scope of this report to provide calculation details for each of the assumptions.

PRODUCT SPECIFICS

Data within this section of the model is largely part specific and dependent on a standard type of processing. Two relatively minor and related assumptions are wall thickness and cycle time. Thicker walls increase part strength for the same resin, and cycle time increases with wall thickness. The majority of imported parts covered in this report do not require significant strength, a measurement range of 0.060 to 0.100 inches. The indicated thickness range requires a cycle time between 50 and 60 seconds depending on the type of plastic resin. Using low-pressure foam techniques (injecting nitrogen and a surfactant to create cells) allow for higher wall thicknesses of 0.25 and reduction of cycle times by as much as 30%. Larger parts generally have longer cycle times.

While this report and cost model provide a high-level overview, other sources can be referenced for more specific detail related to manufacturing strength and cycle factors.

EQUIPMENT SPECIFICS AND PRODUCTION CYCLES

Part clamp tonnage requirements and number of parts per shot define the minimum equipment total clamp tonnage. Larger equipment allows more force and the ability to produce larger parts and/or more shots. The model covers several different equipment sizes and a number of shots including low pressure foam injection that reduces clamp pressures.

Planned "operating equipment efficiency (OEE)" is typically 95% for maintained equipment and experienced operators.

Production cycles per hour for the type of products highlighted in this study ranges from 60 to 80. A 3-shift operation was used in this analysis, with each shift equaling 2,000 hours per year in actual parts production.

OTHER EQUIPMENT

Standard equipment including chillers and re-grind were considered as part of the model. For larger products, the model considers investment cost of vacuum robotics to move parts out of the injection mold. *Operator safety protocol eliminates vacuum robotics as a production option, for U.S. manufacturers.*

While other automation is possible, it is outside the scope of this model. Focus should be centered on packaging automation which presents the greatest potential for competitive reshoring. High volume small parts, such as toothbrushes, require packaging automation equipment for efficient operations. This equipment was not included in the model as it is highly dependent on a retail distribution chain in which branded packaging varies widely.

Some retail customers and products do not require postproduction packaging before distribution, while others require individual unit packaging, and sub packaging for retail sales units. This wide variation requires a separate packaging cost model that could be used to complement the scope of this report.

CAPITAL INVESTMENT AND MAINTENANCE

Capital investment in Zhejiang, using a Chinese supplied injection machine, molds and auxiliary equipment are in the base case set at a cost that is equivalent to the Ohio manufacturer's capital investment. Similarly, equipment costs are at parity for sophisticated parts and high levels of automation. Chinese equipment producers are moving up the chain in both areas as they seek to differentiate themselves from less sophisticated Asian competition. In the cost model, sensitivities are used to examine the impact of potentially less expensive Chinese made equipment.

Milacron provided information and data on the equipment, mold and auxiliary equipment costs based on the products produced and assuming a typical seven-year amortization. The cost base also considers 3% of total capital to cover spare parts and maintenance labor costs.

ENERGY REQUIRED

Energy is specific to machine requirements and utilization factor. The total power consumption is that of the equipment operating at maximum demand. The utilization factor accounts for the average amount of time the equipment is operating at that level, which typically averages 50%.

The equipment used to produce the parts represent the prime source of energy consumption in the manufacturing process. Other energy users include HVAC, lighting, chillers, and ancillary operations equipment. Using the electrical energy prices cited earlier in this report, the model assumes an additional 15% energy consumption from operations support.

INFRASTRUCTURE AND FOOTPRINT

The model's equipment footprint including auxiliary equipment, as provided by Milacron, accounts for an estimated 50% of the total required infrastructure space. Other space may include offices, raw materials, finished goods storage, spare parts, and maintenance equipment.

RESIN AND MATERIALS

Resin prices used in the model were sourced directly from The Plastics Exchange as reported on November 3, 2022, FOB U.S. plant sites. As defined in the resin pricing section, an assumption can be made that Zhejiang and Ohio resin prices are comparable. Additives such as flame-retardants, antioxidants, acid scavengers, UV light and heat stabilizers, lubricants, pigments, antistatic agents, slip compounds and thermal stabilizers, and colorants are highly dependent on the part produced and have been estimated at a cost of $4.00 per pound, and a 5% dose rate.

A typical loss rate of 0.5% for an established production process with regrind has also been considered.

LABOR

Labor rates detailed in previous sections of the report have been applied to the model. As the model focuses on per unit production costs, only direct labor operations for parts were included. Additional labor including costs associated with marketing, sales, general, administrative, and supply chain is generally fixed and recovered via sale of wholesale parts at 50% + gross margin.

An employee operator ratio of 1.5 equipment/machines to 1 operator (full time equivalent) was used as part of the model, as well as a shift manager/foreman ratio of 1 shift manager to 8 operators, and a plant manager to shift manager/operator ratio of 1 plant manager to 5 shift managers. This model uses 3 shifts, making the effective plant manager to shift manager/operator ratio 1 to 3.

Users of the model can adjust these ratios to more accurately represent company and product specific shifts and operating capacities. Additional shifts are traditionally used to maximize fixed equipment and infrastructure productivity. It is important to note that the model does not include shift and wage premiums that would be required beyond 3 shifts.

TRANSPORTATION

Transportation includes both incoming raw materials and outgoing finished goods to distribution centers in the U.S. Retailers often directly handle finished goods from distribution centers. That factor has been included in the analysis to arrive at a more comparable total delivered cost of Zhejiang versus Ohio produced products.

To simplify the transportation cost analysis, an assumption was made around comparable shipping costs of the raw materials, resin and additives, transported to plastics producers in both Zhejiang, China and Cambridge, Ohio.

For finished product delivery, the cost model uses a "five distribution center model" to serve U.S. demand. Those centers are located in Chicago, IL- Atlanta, GA- Dallas, TX – Reno, NV – Carlisle, PA.

In the following cost model charts, the transportation cost of a standard 40' shipping container from China to East & West Coast U.S. has been set at $6,000. This is a conservative assumption as costs have greatly fluctuated over the past 24 months. At times, ocean shipping container transportation costs ranged between $15,000 to $20,000.

10.3 COST MODEL CONCLUSIONS

The general conclusions of cost drivers in the Zhejiang versus Ohio manufacturer cost model can be summarized as follows:

- Transportation is a major cost driver in the overall per unit cost for overseas production.
- Resin prices are a significant cost factor.
- Energy, maintenance, and lease costs are important but relatively minor.
- Capital equipment costs are important but have trade-offs in terms of productivity and require a case-by-case basis evaluation unique to the part produced.
- With an increase in automation, labor costs become less of a contributing factor.
- Part size has a major impact on operational costs. As part size increases, the following per unit measurements can be seen:
    - Relative labor costs decrease
    - Transportation costs and resin costs increase
    - Capital equipment costs increase

In comparing Zhejiang versus Ohio, transportation becomes the major differentiator, especially as part sizes increase. The upward trends of labor, energy, and transportation costs associated with Zhejiang produced and imported parts defines a long-term shift from cost advantage to cost parity, and ultimately to cost disadvantage. **For manufacturers, this is an era of transition.** For specific plastics-based goods, cost parity is shifting to cost-advantage for Ohio manufacturers. **The trend of individual cost drivers can be considered long term, fundamental, and protected from volatility for a timeframe measured in decades**.

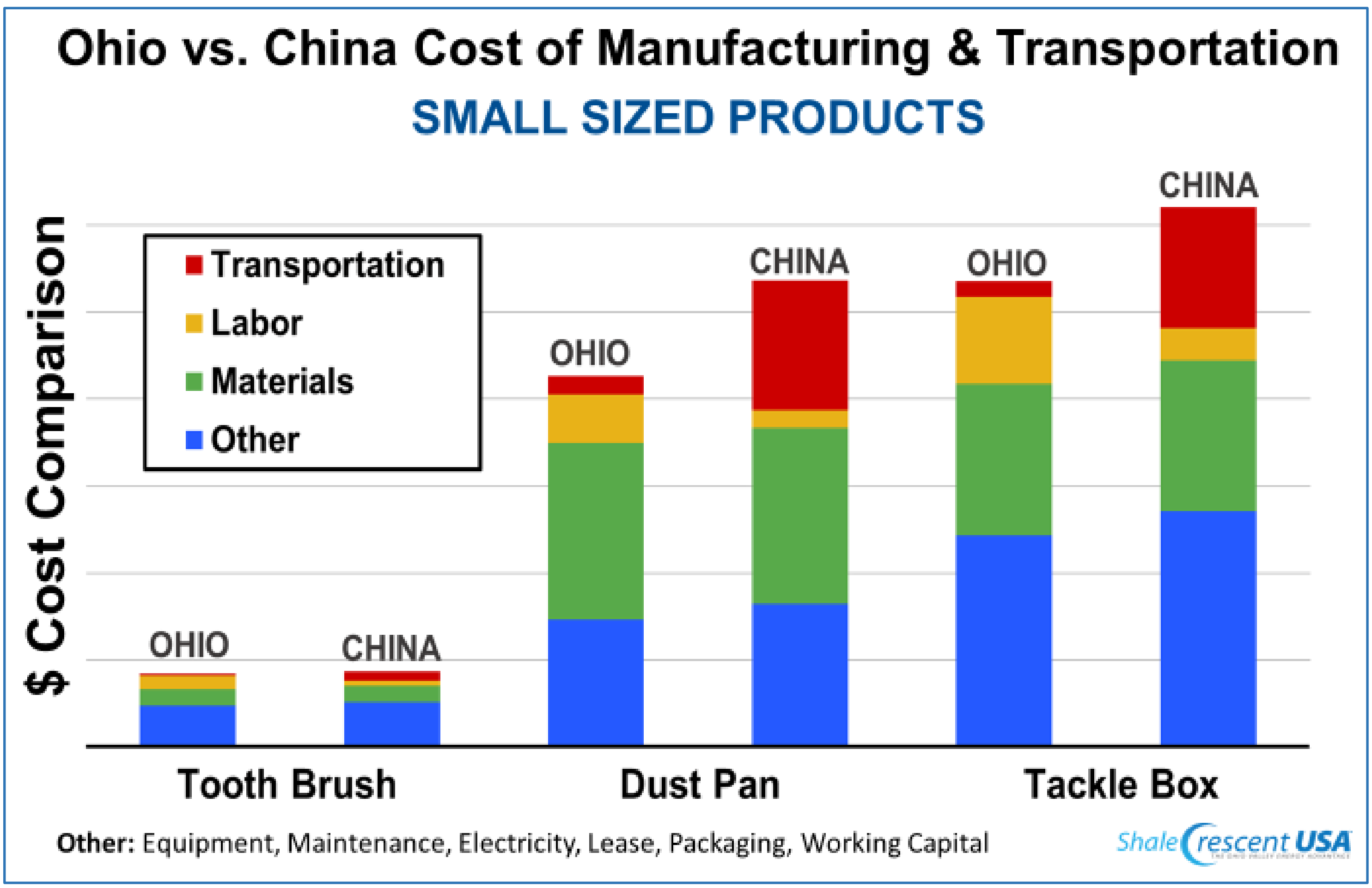


Figure 57: Cost Comparison Chart – Ohio vs. China (Small Sized Products)

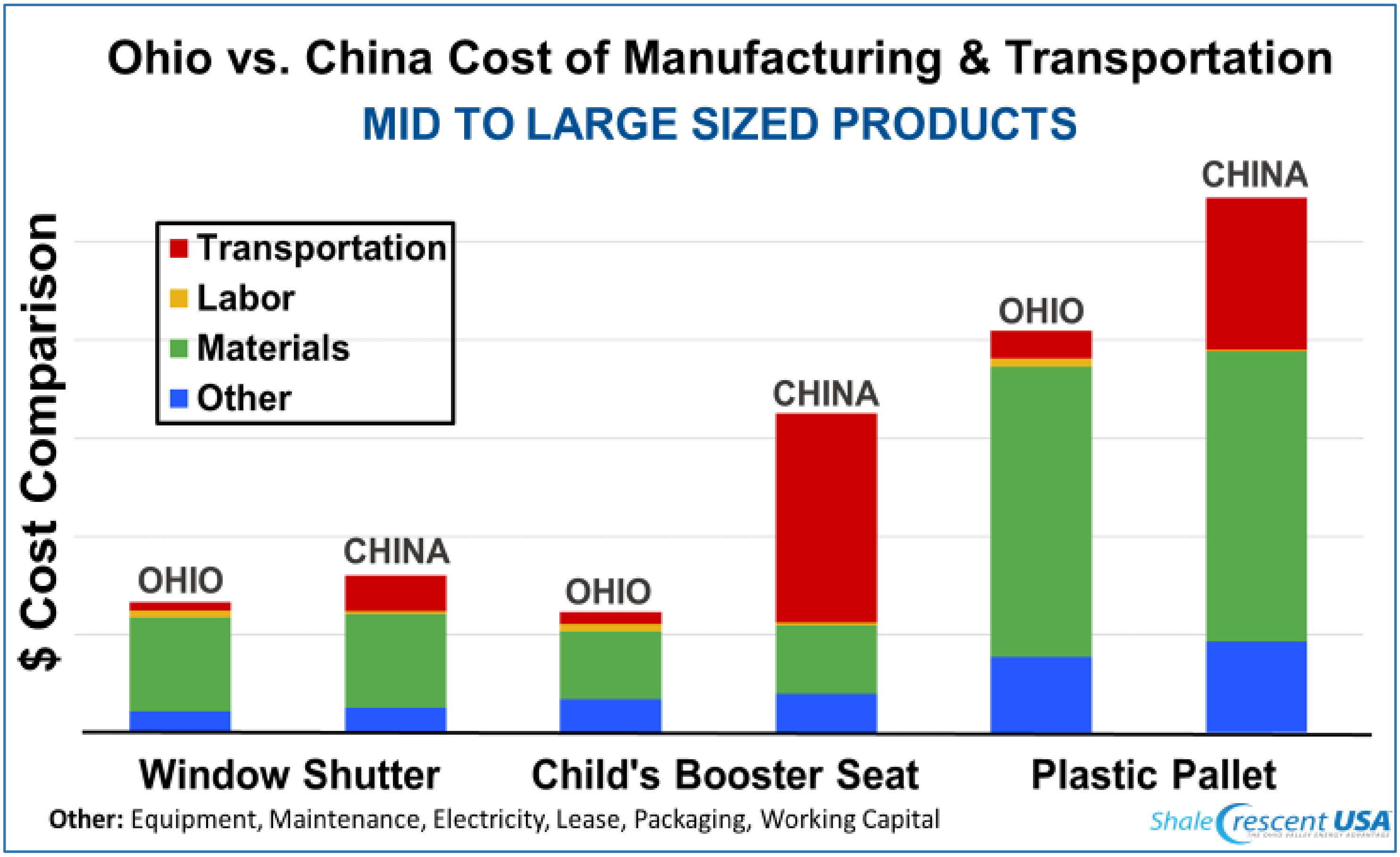


Figure 58: Cost Comparison Chart – Ohio vs. China (Mid to Large Sized Products)

> ***The trend of individual cost drivers can be considered long term, fundamental, and protected from volatility for a timeframe measured in decades.***

10.4 COST MODEL SENSITIVITY

Sensitivity analysis examines how changes in the assumptions of an economic model affect predictions. Key assumptions were based on industry data and industry advisors. However, sensitives were allowed for adjustments where the model could be different from company and product specific parameters. Additionally, sensitivities allow for updates if the assumptions become outdated due to changing economics. For example, there could be a dramatic change in the model criteria such as U.S. resin prices significantly decreasing or global transportation rates fluctuating over a short period of time. With this model, users have the ability to input sensitivities to understand potential risks to their competitive position, allowing for proactive management of those risks.

CAPITAL EQUIPMENT

While confirmation of equipment cost was difficult to compare based on market fluctuations, an anecdotal investigation showed that China made equipment is generally less expensive to acquire but has a consistently higher maintenance cost and lower lifecycle. The model provides a 20% lower equipment cost sensitivity in favor of China.

LABOR

China's labor rates have been on a steep upward trend for more than 25 years and are continuing to aggressively rise. The model provides for a 50% increase in labor sensitivity. U.S. investment decisions should consider historical and trending labor rate data. The labor rates in the report for both Ohio and Zhejiang represent a cost based on 2020 labor rates.

RESIN

Resin prices have been considered a static comparative factor and are based on present day U.S. pricing. A number of historical factors/events (reviewed in this report) have restricted supply and have resulted in what is believed to be temporary inflated prices. Historical resin prices affirm this assumption. U.S. resin supply has capacity to provide for both domestic and significant export demand. However, recent volatility in the market has restricted the availability of resin supply. To accommodate the forecast of reduced resin pricing from increased capacity, a sensitivity adjustment is included. This assumption allows for a model factor of a 50% reduced resin sensitivity in both Zhejiang and Ohio.

TRANSPORTATION

Transportation costs are rapidly rising both in capacity challenged overseas container shipments and in local truck deliveries. The model provides for 200% increase across the board in transportation costs.

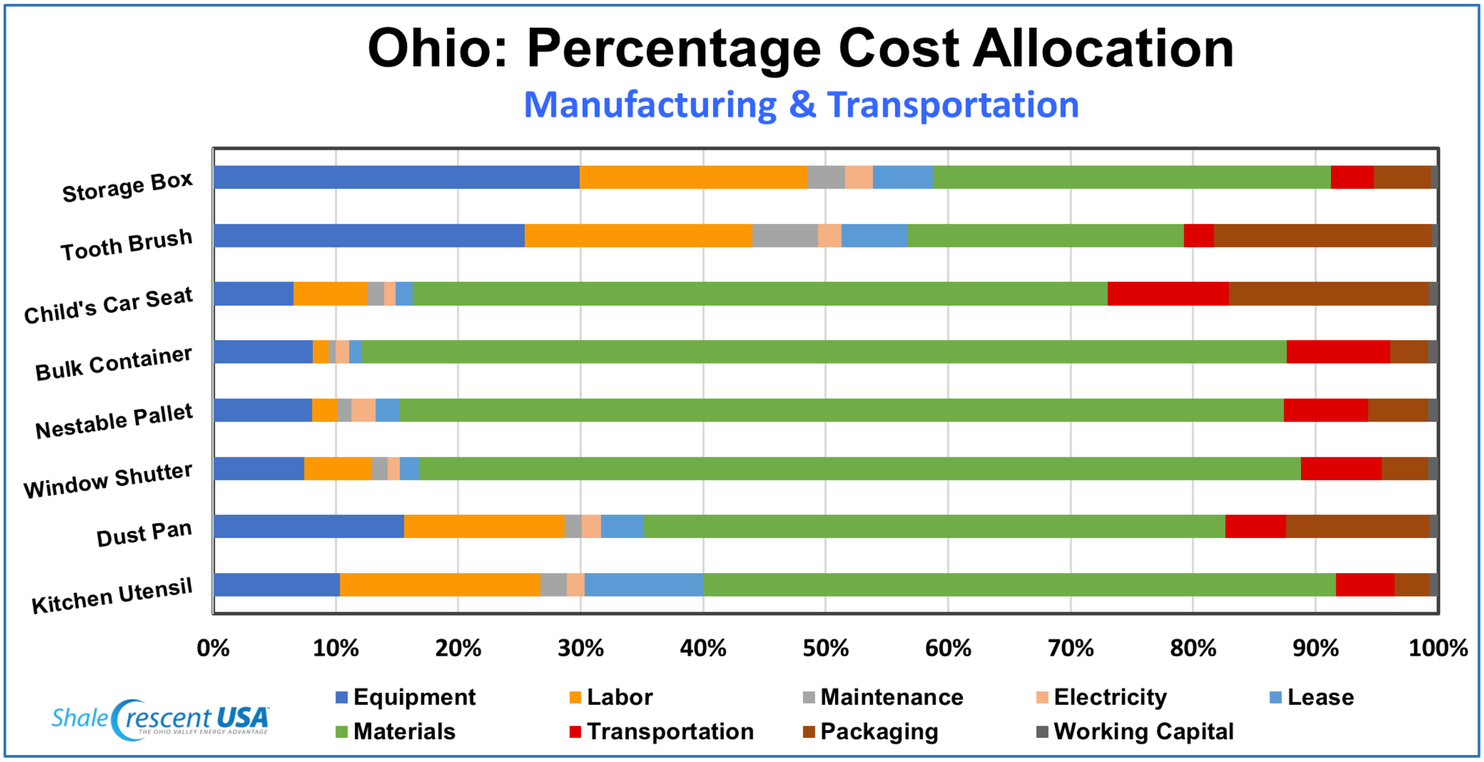


Figure 59: Zhejiang - Percentage Cost Allocation Chart

Ohio: Manufacturing & Transportation Percentage Cost Allocation Table								
	Kitchen Utensil	Dust Pan	Window Shutter	Nestable Pallet	Bulk Container	Child's Car Seat	Tooth Brush	Storage Box
Equipment	10.4%	15.6%	7.5%	8.1%	8.1%	6.6%	25.5%	29.9%
Labor	16.4%	13.1%	5.5%	2.1%	1.3%	6.0%	18.6%	18.6%
Maintenance	2.2%	1.4%	1.3%	1.1%	0.6%	1.4%	5.3%	3.1%
Electricity	1.5%	1.6%	1.0%	2.0%	1.1%	0.9%	1.9%	2.2%
Lease	9.6%	3.5%	1.6%	1.9%	1.1%	1.4%	5.3%	4.9%
Materials	51.6%	47.5%	72.0%	72.2%	75.5%	56.7%	22.6%	32.5%
Packaging	2.9%	11.7%	3.8%	4.9%	3.0%	16.3%	17.7%	4.7%
Transportation	4.8%	4.9%	6.6%	6.9%	8.5%	9.9%	2.4%	3.5%
Working Capital	0.7%	0.7%	0.8%	0.8%	0.9%	0.8%	0.6%	0.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 60: Ohio - Percentage Cost Allocation Table

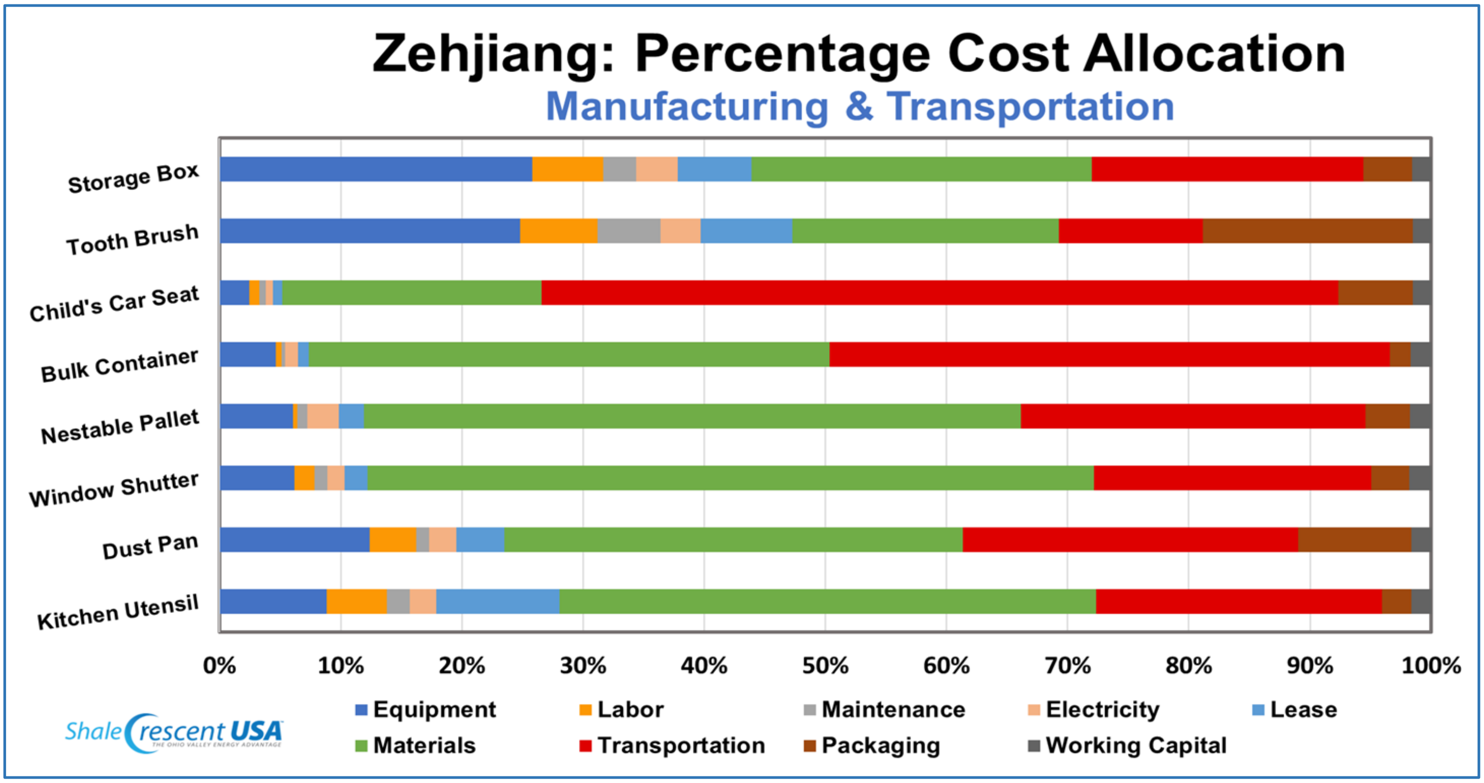


Figure 61: Zhejiang - Percentage Cost Allocation Chart

Zehjiang: Manufacturing & Transporation Percentage Cost Allocation Table								
	Kitchen Utensil	Dust Pan	Window Shutter	Nestable Pallet	Bulk Container	Child's Car Seat	Tooth Brush	Storage Box
Equipment	8.9%	12.4%	6.2%	6.1%	4.6%	2.5%	24.8%	25.8%
Labor	4.9%	3.8%	1.6%	0.3%	0.5%	0.8%	6.4%	5.9%
Maintenance	1.9%	1.1%	1.1%	0.8%	0.3%	0.5%	5.2%	2.7%
Electricity	2.2%	2.2%	1.4%	2.6%	1.1%	0.6%	3.3%	3.4%
Lease	10.2%	4.0%	1.9%	2.1%	0.9%	0.8%	7.5%	6.1%
Materials	44.3%	37.8%	59.9%	54.2%	43.0%	21.4%	22.0%	28.0%
Packaging	2.5%	9.3%	3.1%	3.7%	1.7%	6.2%	17.3%	4.0%
Transportation	23.6%	27.7%	22.9%	28.4%	46.2%	65.7%	11.9%	22.4%
Working Capital	1.6%	1.7%	1.8%	1.8%	1.7%	1.5%	1.5%	1.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Figure 62: Zhejiang - Percentage Cost Allocation Table

10.5 COST MODEL: HYPOTHETICAL PLANT

The cost model analyzes individual plastic part production by a single machine and shift operation – the deepest level. By examining cost at this level, sensitive factors can be measured and compared to provide a more accurate representation of comparison scenarios. From the individual product manufacturing data, a loose projection of an entire manufacturing plant can be created.

The model has been designed for tailored inputs creating flexibility in designing plant operations that represent an entire plant. Factors can be added and removed to reach a realistic measure of output based on the operations i.e., additional production parts, more or less shifts, and capital equipment. The sum of results can model the economics of an entire plant producing multiple products.

DIFFICULTY WITH PROJECTIONS

A financial analysis of both facilities is included. However, it is extremely difficult to accurately forecast revenues and profit margins. A variety of ever-changing factors have significant impacts on projections such as: fluctuating market sale prices of finished products, the brand and exact type of product manufactured, the number of units produced, and the combination of consumer products produced within the manufacturer.

HYPOTHETICAL FACILITY COMPARISON

This model created a hypothetical plant using the data points from this study. The facility is set to consume roughly 20 million pounds of resin per year. The Ohio facility is set as identical to the Zhejiang facility in regard to outputs. The model's facility included a variety of manufactured products, resin types, and machinery to create a range of inputs. It should be noted the variation of products produced has a significant impact on outcomes. For example, "toothbrushes" have little transportation cost, a much less sale price, and consume far less resin compared to a "child's car seat". The selected 'sale price' of products also has a major impact on the 'gross margin' of the products and the hypothetical facility. Pairing these items together into one 20 million lb. plant will skew the results and not accurately reflect individual product data. The following charts should be viewed merely as representatives of the model's capabilities. Users will have the ability to tailor the model to their needs.

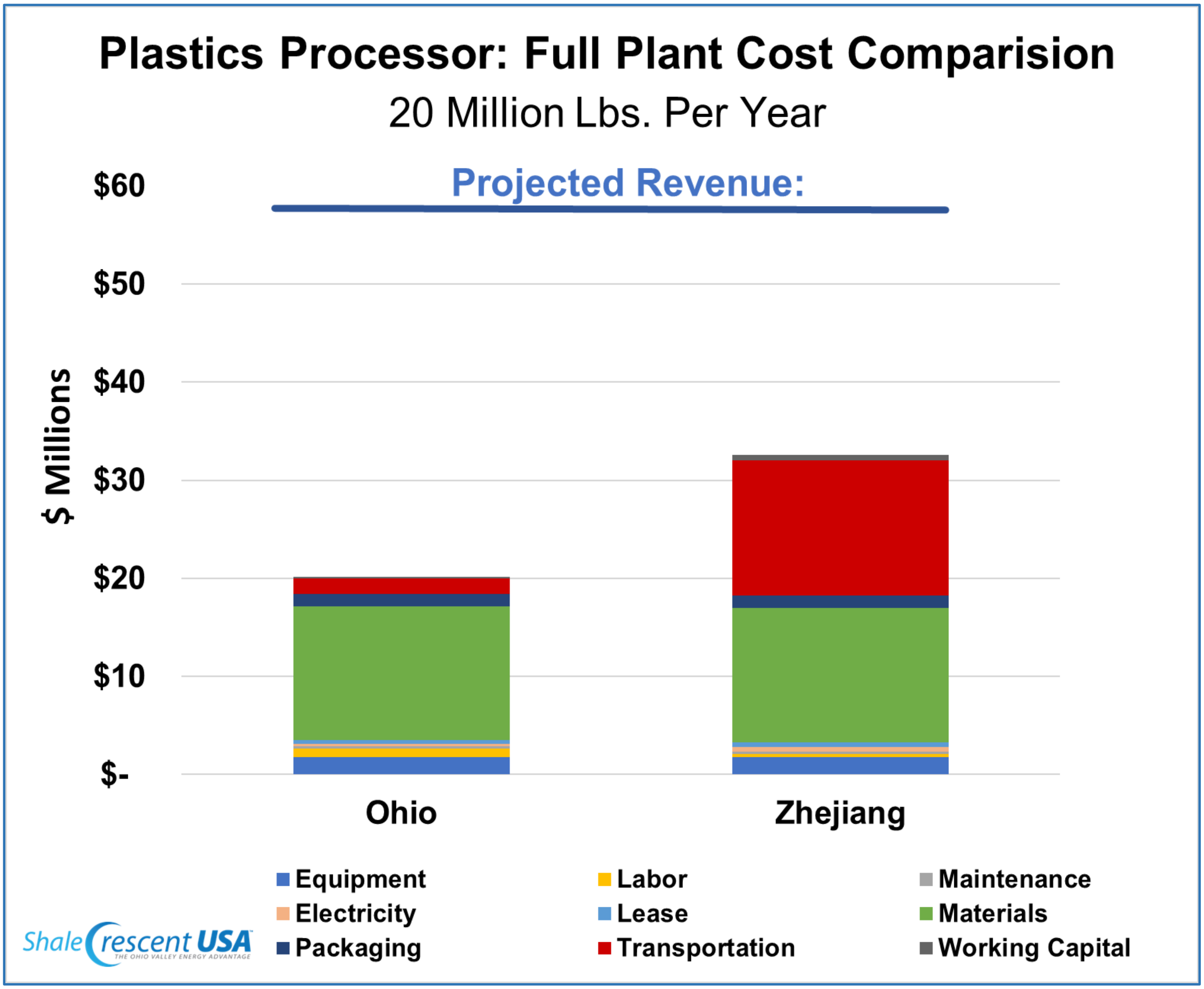


Figure 63: Full Plant Cost Comparison and Revenue Chart

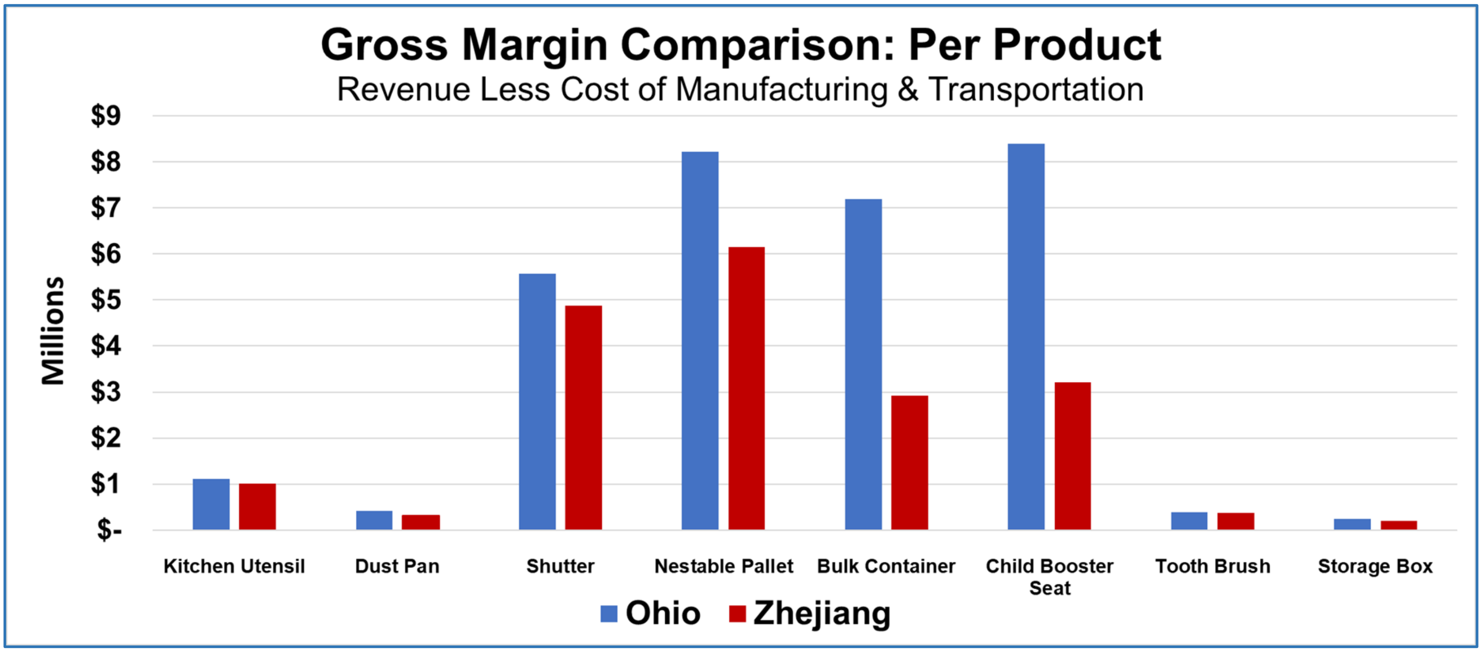
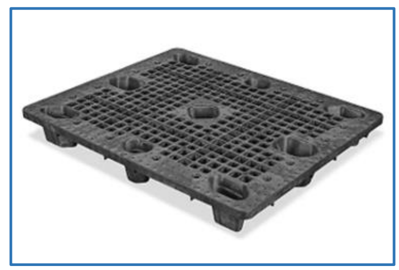


Figure 64: Gross Margin Comparison – Per Product - Chart



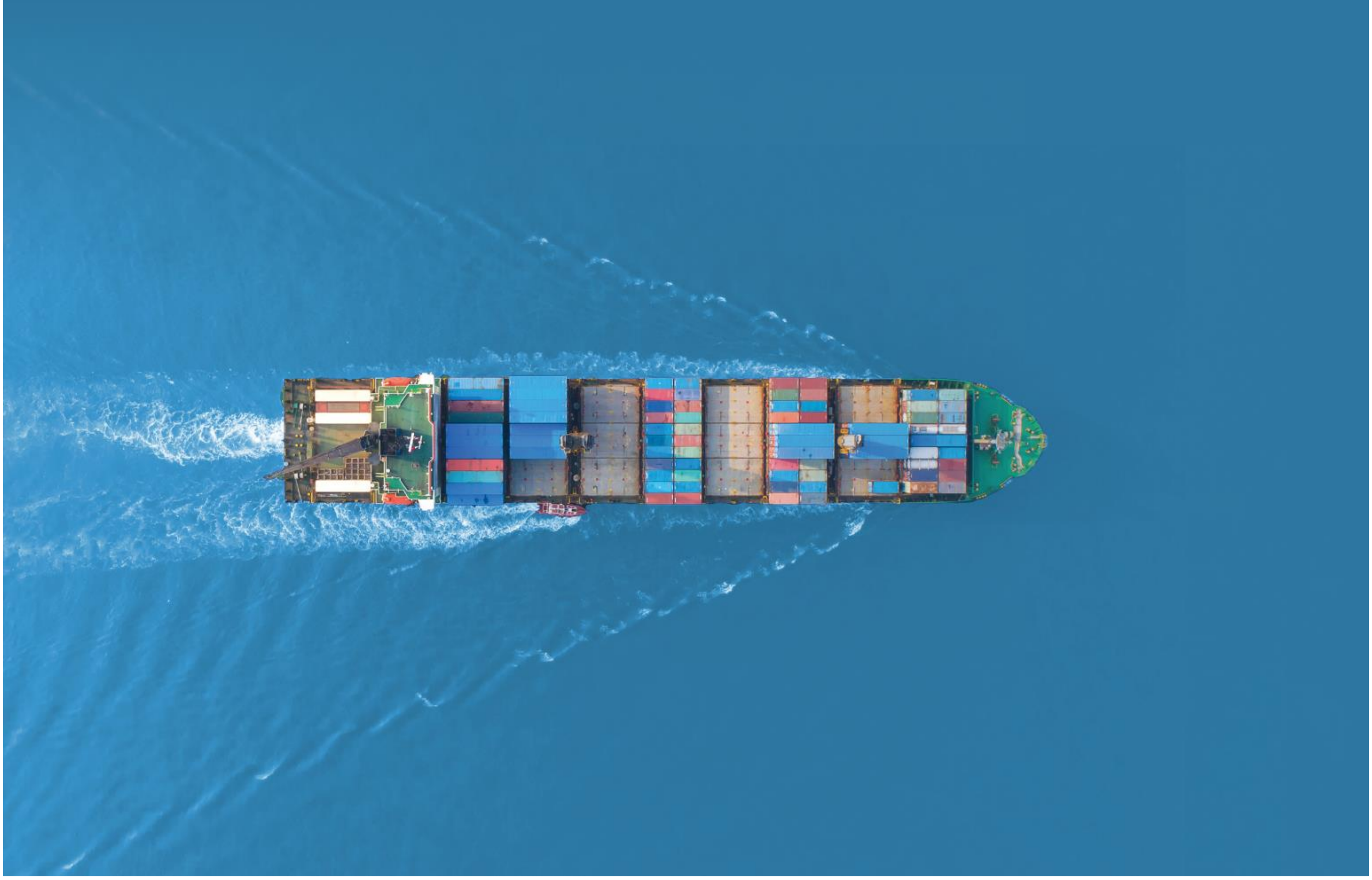





NEXT STEPS:

SIEZING THE OPPORTUNITY

11



11. NEXT STEPS

The research and collection of data throughout this report has provided a compelling case for onshoring and reshoring plastics-based manufacturing operations. This document has been designed to be used by Ohio company executives and their teams to initiate strategic and tactical planning for expanded operations. In addition, this report is an effective tool for manufacturers and/or investors who recognize the growing opportunity to capture imported market share and as a result are considering locating in the region.

NEXT STEPS – THE PROCESS

This section of the report is from the perspective of two former executives in the plastics processing business.

Plastics-based manufacturers can use this report as a tool to rapidly build a business case to onshore production of specific products. To be successful, it will require the efforts of marketing, sales, and production working as a team. A team lead should be identified to manage the process, foster collective understanding, and ensure consistent communication at each stage of the process.

Step 1: Import Data

- Using plastic goods import data identify:
  - Products that offer relatively low risk and minimal ramp up time. i.e., products that use existing production equipment and resin types, and those that share current product market distribution chains
  - Importers of record
  - Annual volumes and CIF (Cost Insurance Freight) value of desired product
  - And determine if the target volume that fits with the company's operations is at the entire market level or only a portion of one importer

Step 2: Obtain Samples

- If possible, obtain samples of the product to confirm resin type, sizes, and weight – in addition to other unique characteristics

Step 3: Consumer Buying Decisions

- Where possible, determine end consumer buying decision influences and related gaps. The internet and social medias can be a good starting point to perform initial research.

Step 4: Design Type

- Consider factors that may influence the decision to produce a direct copy versus a higher margin innovative design. This may include U.S. Patents and Trademarks Office review for clearance of design concepts.

Step 5: Understanding the Distribution Chain

- Talk with the importers of record or distribution chain to determine:
  - Acceptance of new suppliers
  - U.S. made supplier program assistance
  - Branding, packaging, and other supply chain specifics
  - If product innovation is desired
  - How the supplier proposal process works

Step 6: The Economics

- Using the cost model: *(Provided with this Report)*
  - Enter the specifications of the product and operations
  - Using CIF Import value as a wholesale cost starting point, determine product margin as a direct copy

- Update wholesale price/cost to achieve your desired margin (price is usually referenced when discussing the sell side, and cost on the purchase side)
- Determine your realistic production volume limits leveraging existing equipment and infrastructure
- Determine volume break points with investment in equipment and infrastructure
- Decide on what your volume price proposal will contain

Step 7: Sales

- Present a supplier proposal package to one or more of the retail distributors:
  - Company history, key company employees, company financials
  - Sample product if required and or sample of other products produced by your company
  - Volume and pricing proposal
  - Cost and innovation comparison versus existing imported products
  - Operational flexibility improvements with shortened supply chain
  - Emissions benefits with shortened supply chain
  - Inventory reduction with shortened supply chain

Each opportunity to capture the market share of currently imported products will have its own set of unique challenges and obstacles to overcome. However, the general process of exploration and execution will follow similar steps of those listed above. Onshoring and reclaiming lost manufacturing is not an insurmountable task**. The forces that led to offshoring are reversing in favor of the U.S. and plastic processors are positioned better now than in many decades to compete for lost manufacturing.** Furthermore, the changes and trends that are occurring are not temporary- they are fundamental. The U.S. energy advantage, the trending China labor shortages, the desire for shorter supply chains, and the cultural demands for reduced emissions are all critical factors in decision-making for the future. **American plastic processors are positioned to compete and win.**

The forces that led to offshoring are reversing in favor of the U.S., and plastic processors are positioned better now than in many decades to compete for lost manufacturing.

11.1 CONTACT US:

FOR MORE INFORMATION AND TO SPEAK WITH MEMBERS OF OUR TEAM - CONTACT:

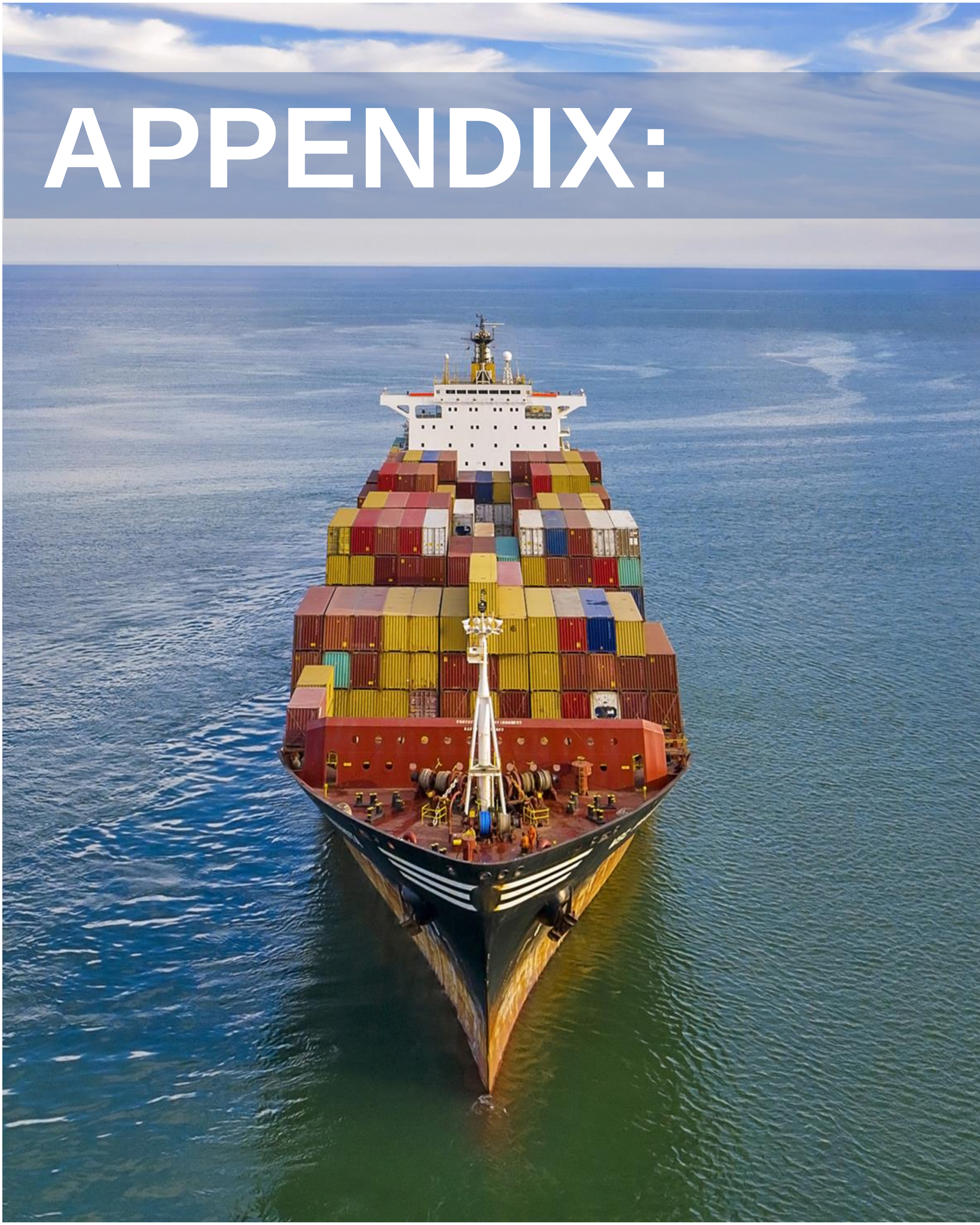
Greg Kozera: Email: gkozera@shalecrescentusa.com Phone: 304-545-7259

www.ShaleCresentUSA.com

info@shalecrescentusa.com

1 (888) 529 - 1650

APPENDIX:



12. APPENDICES

APPENDIX A: MANUFACTURING COST INDEX

SOURCE: The Boston Consulting Group

NOTES: For more information on The Boston Consulting Group's annual manufacturing cost index visit here.

EXHIBIT 1 | The 2019 BCG Global Manufacturing Cost Competitiveness Index

Sources: US Economic Census; Bureau of Labor Statistics; Bureau of Economic Analysis; International Labour Organization; Euromonitor; Economist Intelligence Unit; Oxford Economics; NDRC Price Monitoring Center; International Energy Agency; Eurostat; BCG analysis.
Note: The index covers four direct costs only. No difference is assumed in "other" costs (such as raw-material inputs, and machine and tool depreciation). The cost structure is calculated as a weighted average across all industries. Ukraine, Norway, and Romania were also tracked by the index, but are not shown because they are no longer in Top 34.
[1]Range represents the average for all of China (95) and for the Yangtze River Delta region (97).
[2]Data is for states of the US South.
[3]Productivity-adjusted.

APPENDIX B: PLASTIC PROCESSORS CATEGORICAL RESEARCH: PROCESSING TYPE, MARKET SEGMENT, RESIN/FEEDSTOCK USED

SOURCE: **Database USA, Shale Cresecnt USA, and Proprietary**

NOTES:
Over 1,100 companies in the state of Ohio were reviewed to identify processing type, market segment and resin used.

Ohio based Plastics processors were identified by their North American Industry Classification System (NAICS code). NAICS code 326199 "All Other Plastics Product Manufacturing" is the most pertinent classification for the purpose of this study. If an Ohio manufacturer has chosen to assign and identified under this code, they were included in this research.

Companies can and do assign multiple NAICS codes to themselves and code 326199 may not be their primary identification. This review captured manufacturers who listed 326199 down to the sixth level. Going to this level provided confidence that this review captured a vast majority of plastics manufacturers in Ohio. The initial cut using the 326199 code yielded over 1,100 companies. Manual inspection of the companies found that some companies are no longer in plastics manufacturing, or only in allied areas such as compounding or plastic resin distribution. Eliminating these left approximately 600 plastics manufacturers for deeper review.

Database USA was the search tool that was used to produce the results. *Database USA* sources their data from a number of original sources including: annual reports, SEC filings, corporate registers, public records, and business directories[81]. Other proprietary data from *Plastics News* and *IHS* Markit was used as a reference to confirm and support original research[82].

Total, there were 616 Ohio Manufactures that met the criteria and were further studied to identify processing type, market segment, and feedstock for their product manufacturing.

Findings from the research produced: Processing Type, Market Segment, Feedstock Used, Size by employee count and revenue, location, and contact information

Processing Type and Company Classification:

This is a list of the commonly used processes that are used to make plastic based products.

- **Blow Molding –** is the process of introducing air to heated plastic to generate a balloon type object. Often, the object is contained in a mold to achieve a shape such as a bottle. Other times it creates a continuous long balloon that is cut and sealed, resulting in plastic bag or film.
- **Extrusion Molding** – is forcing heated plastic into a die creating a shape such as pipe, hose, drinking straw, rods, and other shapes.
- **Injection Molding** – is forcing heated plastic into a mold creating a particular shape. That shape could be a bottle cap, car headlight stalk, syringe, remote control, etc.
- **Roto Molding –** is a more sophisticated form of injection molding in which the part is rotated during injection of heated plastic. Parts such as gas tanks or large outdoor play toys are made this way. Smaller parts are typically produced via injection molding and larger parts via roto molding. With roto molding the part has more uniform plastic distribution (less plastic is needed) and higher quality.

[81] Database USA: https://www.atozdatabases.com/dataquality

[82] Plastics News: https://www.plasticsnews.com/TheBook

- **Dip Molding –** is a plastics process technique that is used to create plastic products with a hollow interior or it is used to cover other materials (metal) with a coat of plastic material.
- **Foam Molding** – is a low-pressure foam injection molding process where molten resin is injected with nitrogen gas or a chemical blowing agent
- **Fiber Molding** – is a process in which resin and chopped fiberglass are combined and poured into a mold.
- **Sheet Molding**– is the process of compressing resin and other materials to create flat sheet production.
- **Supporting Businesses to Plastics Processors** (These were not included in the deep dive research)
    - **Compounder** – takes plastic resin and adds colorants, UV stabilizers, lubricants, glass fiber or other to produce a 'compounded resin' that is ready to use as is by a plastics processing company. They often have engineering staff to design a compounded resin for a specific application. The engineering and the compounded resin are sold to smaller less sophisticated plastic processors.
    - **Distributor –** receives resin directly from the big manufacturers and re-sells to plastics processors.
    - **Equipment Manufacturer –** Manufactures and produces equipment that plastics processors use to make plastic based products.

Plastic Types:

This covers the type of plastics and feedstocks used in the production of plastic products. Most companies focus on one or just a few types of plastics:

- Acrylic
- Composite
- Copolymer
- Engineered
- Foam
- Fiberglass
- Polystyrene (PS)
- Polyvinylchloride (PVC)
- Polyethylene
- Polyethylene terephthalate (PET)
- Polypropylene (PP)
- Other
- Many Types

Market Segments:

This is a list of the market segment categories used in this report in which plastic processors are manufacturing.

- Additives
- Auto
- Bags
- Bottles
- Caps
- Cases-Containers
- Contract
- Covering
- Curtains-Barriers
- Film
- Foamed Plastic
- Mats-Flooring
- Medical PPE
- Packaging
- Pallets-Shelving
- Personal
- Pipe
- Recycled
- Resin
- Siding-Window-Door
- Seals-Fittings
- Signs-Sheet
- Toys
- Trim
- Tubing

APPENDIX C: FINDINGS – OHIO PLASTICS PROCESSORS – FEEDSTOCK - RESIN USED

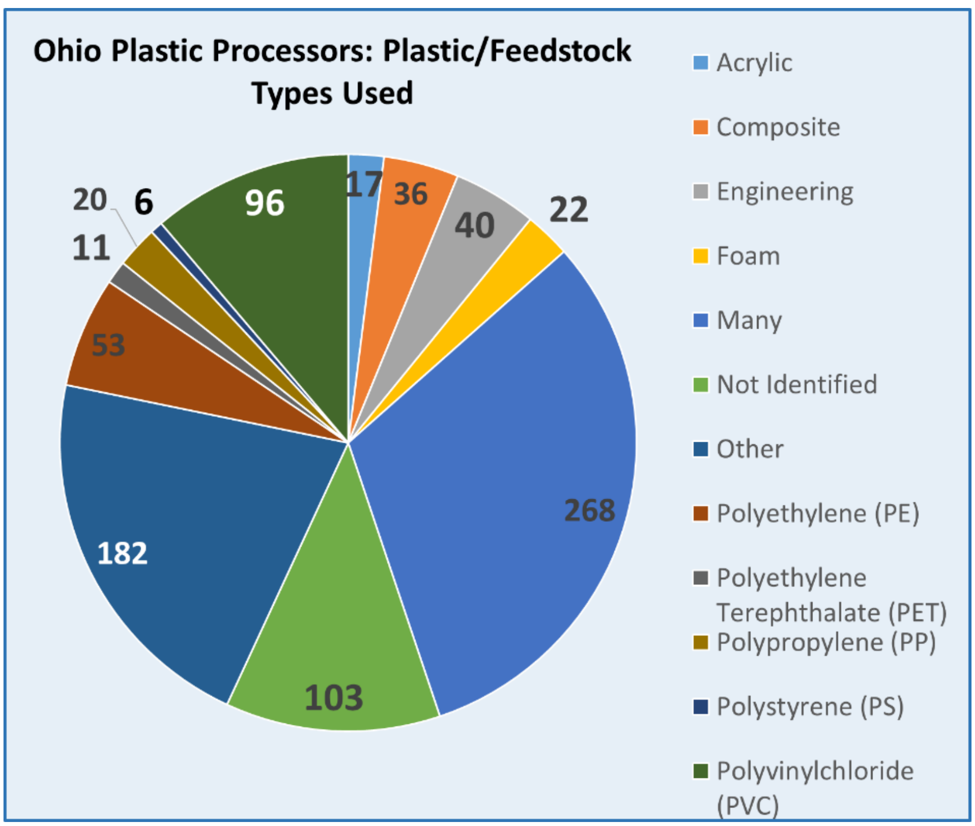
SOURCE: Database USA, Shale Crescent USA, and Proprietary

NOTE:

Companies were counted multiple times if they utilized multiple feedstocks

Over 1,100 companies in the state of Ohio were reviewed. 616 Ohio Manufacturers met the criteria and were further studied to identify type of plastic/feedstock used. Nearly 40% of the manufacturers reviewed use “many” feedstock types for their manufacturing. In the chart, this is labeled under the category of “many”. One will notice in this chart that Polyethylene is a much smaller share than expected. A large amount of the Polyethylene consumers is hidden in the category “many”. **Based on other research the amount of polyethylene consumers in Ohio is around one third of all plastic-based manufacturers.**

Ohio Plastic Processors: Plastic/Feedstock Types Used					
Plastic/Feedstock Types	Plastic Type 1	Plastic Type 2	Plastics Type 3	Total	Percent of Total (854)
Acrylic	16	1	0	17	2%
Composite	23	11	2	36	4%
Engineering	14	22	4	40	5%
Foam	12	9	1	22	3%
Many	240	25	3	268	31%
Not Identified	103	0	0	103	12%
Other	55	103	24	182	21%
Polyethylene (PE)	45	8	0	53	6%
Polyethylene Terephthalate (PET)	6	4	1	11	1%
Polypropylene (PP)	10	10	0	20	2%
Polystyrene (PS)	3	3	0	6	1%
Polyvinylchloride (PVC)	88	7	1	96	11%



APPENDIX D: FINDINGS- OHIO PLASTICS PROCESSORS: PROCESSING TYPES

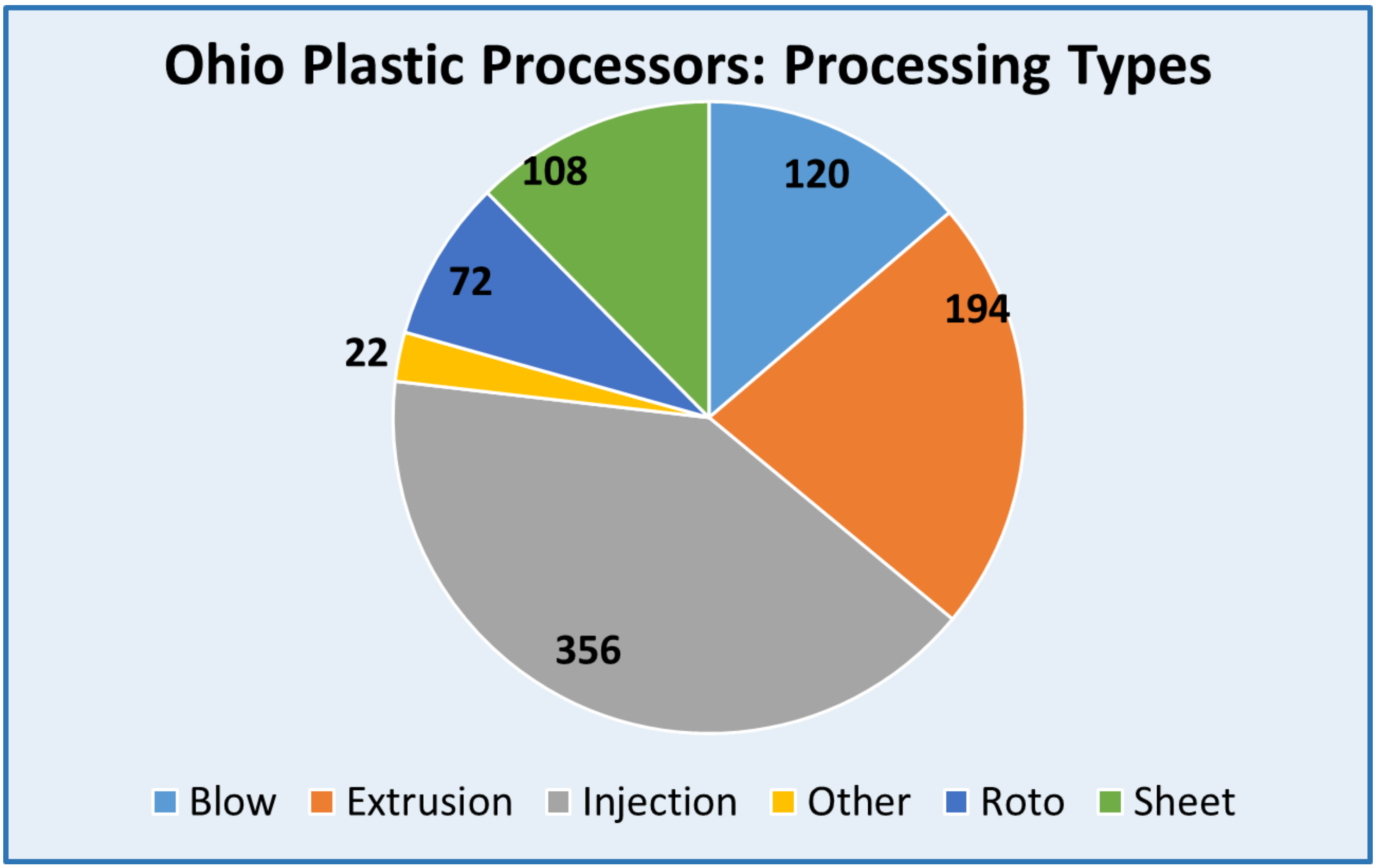
SOURCE: Database USA, Shale Crescent USA, and Proprietary

NOTE:

Companies were counted multiple times if they utilized multiple processing techniques

Over 1,100 companies in the state of Ohio were reviewed. 616 Ohio Manufacturers met the criteria and were further studied to identify processing types for their product manufacturing. Injection molding was by in large the most commonly used process. Almost all the manufacturers utilized multiple processing techniques to produce.

Ohio Plastic Processors: Processing Types Used					
Processing Types	Processing Type 1	Processing Type 2	Processing Type 3	Total	Percent of Total (872)
Blow	82	33	5	120	14%
Extrusion	127	51	16	194	22%
Injection	275	72	9	356	41%
Other	17	3	2	22	3%
Roto	39	30	3	72	8%
Sheet	76	25	7	108	12%



Appendix E: Findings – Ohio Plastics Processors: Product End Markets

SOURCE: Database USA, Shale Crescent USA, and Proprietary

NOTE:

Companies were counted multiple times if they sold into multiple product end markets

Over 1,100 companies in the state of Ohio, were reviewed. 616 Ohio Manufacturers met the criteria and were further studied to identify product end market and market segments. Ohio producers manufacture many different types of products and are not dominated by a few market segments.

Ohio Plastic Processors: Product End Markets

Product End Market Types	Product Type 1	Product Type 2	Product Type 3	Total	Percent of Total (1,091)
Auto	63	28	7	98	9%
Bags	13	5	2	20	2%
Bottles	24	5	5	34	3%
Caps	4	6	5	15	1%
Cases-Containers	60	39	16	115	11%
Contract	139	67	27	233	21%
Covering	10	8	3	21	2%
Curtains-Barriers	4	5	5	14	1%
Film	18	31	5	54	5%
Foamed Plastics	11	3	4	18	2%
Mats-Flooring	12	1	1	14	1%
Medical	9	8	6	23	2%
PPE	0	1	2	3	0%
Packaging	54	16	16	86	8%
Pallets-Shelving	4	7	0	11	1%
Personal	17	17	17	51	5%
Pipe	7	12	1	20	2%
Siding-Window-Door	46	4	2	52	5%
Seals-Fittings	47	30	12	89	8%
Signs-Sheet	28	9	8	45	4%
Toys	9	4	1	14	1%
Tubing	27	28	6	61	6%

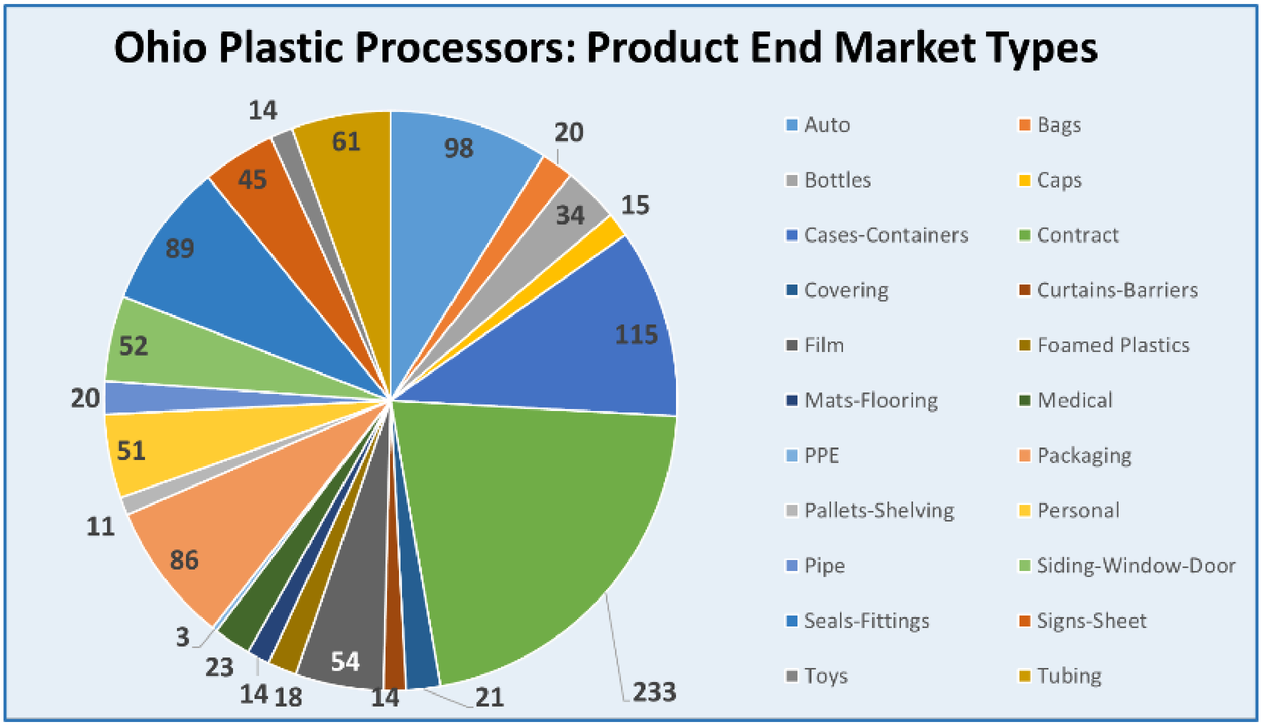
SEE CHARTS ON NEXT PAGE

SOURCE: Database USA, Shale Crescent USA and Proprietary

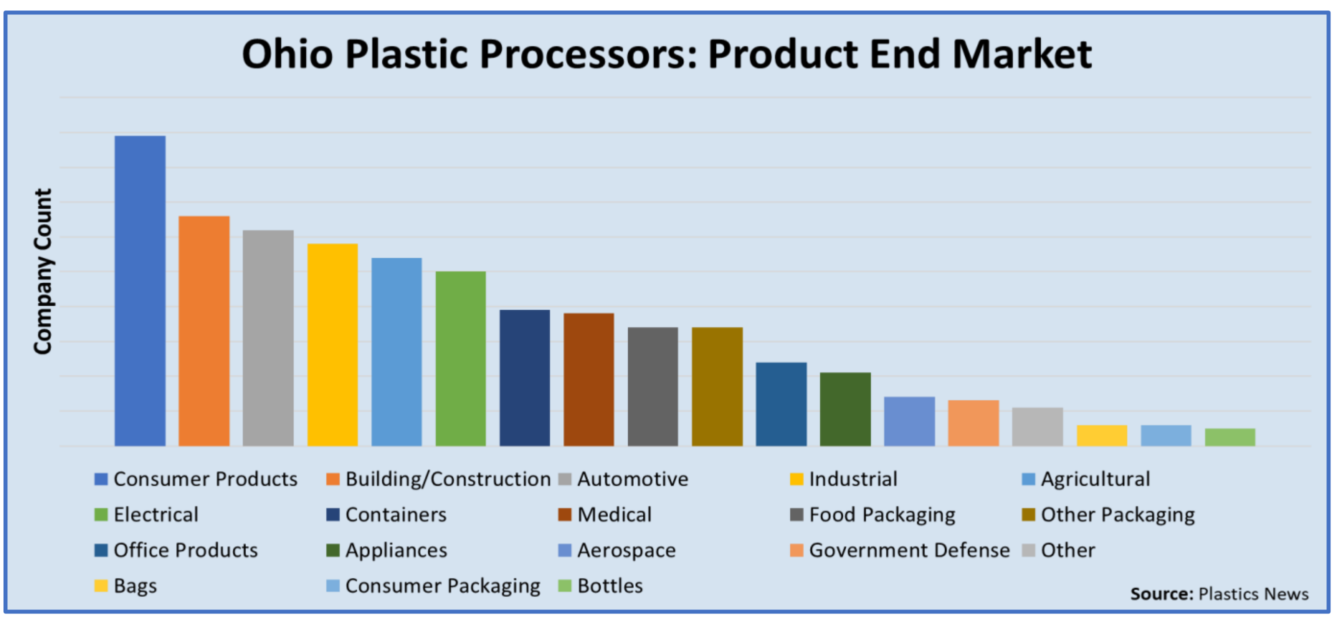
NOTE:

Companies were counted multiple times if they sold into multiple product end markets

Over 1,100 companies in the state of Ohio, were reviewed. 616 Ohio Manufacturers met the criteria and were further studied to identify product end market and market segments. Ohio producers manufacture many different types of products and are not dominated by a few market segments.



Plastics News provides a "general" U.S. database of plastic processors. The following chart contains similar categories to the above original research. The following data can serve as an additional reference point to identifying product end markets within the state of Ohio.



APPENDIX F: CHINA MANUFACTURING POSITIONS, WAGE RATES AND COMPENSATION

SOURCE: German Chamber of Commerce of China. This organization works on behalf of the Federal Republic of Germany and is the primary organization for promotion of German foreign business development in China by both Industry & Region.

CONVERSION RATE: 1 RMB = 0.16 USD $ (As of 2/8/2022)

CHINESE SALARY AND BENEFITS NOTE:

The Chinese wage rates below include the gross base salary as well as the mandatory social security and housing fund contributions by the employer plus any other extra benefits the employer is providing: supplementary health insurance, life insurance, variable bonuses, sales incentives, overtime, children allowances, meal and transportation allowances, supplementary housing funds, skill allowances, retention bonuses, etc. Monthly in RMB based on a 40-hour working week and a 12-month year period.

COMPARABLE PUBLIC DATA:

For more comparable public data released by the German Chamber of Commerce of China see HERE

GERMAN CHAMBER of Commerce in China 中国德国商会

Labor Market & Salary Report
Exclusive Key Findings **2020/21 | 13th Edition**

NOTES TO PRELIMINARY FINDINGS

1. Regions

Regions have been assigned based on the city the company is located at in accordance to responses in the survey. The amount of observations (all positions combined) collected for the variable "Expected Wage Increase 2021": Shanghai 2,360 observations; Other East 2,364; Beijing 517; Other North 1,050; Shenzhen / Guangzhou 494; Other South 522. Overall, 7,307 observations have been gathered for this variable.

2. Positions

Production workers include the following individual positions: Blue Collar, Operator, Shift Leader, Production Supervisor and Production / Plant Manager. Junior professionals are those with 0 to 3 years of job experience; Mid-Level professionals have 4 to 7 years of job experience; Senior professionals are those with 8 or more years. The overall wage increase for a specific level of seniority (Junior, Mid-Level, Senior) is the average of all observations for that level of seniority in the following functional areas: Administration, Sales, Purchasing, Finance, HR, Quality Control, Engineering / R&D, Logistics, and Consultant / Project Manager. Additionally, the expected increases for IT Staff and Legal Staff are included in the calculations for Junior Professionals. IT Manager and Legal Manager forecasted wage increases are included in Senior Professionals. Finally, two roles (Deputy GM / Branch Manager and CEO / GM) are presented individually due to their uniqueness.

3. Industries

The graphic only shows industries with a minimum of 100 observations (all positions combined) for the variable Expected Wage Increase 2021.

Definitions for Job Positions:

PRODUCTION

Blue collar worker: Responsible for line work, packaging, basic assembly; limited work experience.

Operator: Special but limited skills, operate machinery; some work experience.

Shift leader: Responsible for managing parts of assembly, scheduling, training new employees, performing limited quality control, overviewing safety regulations.

Production supervisor: Project planning, overall production supervision, resource allocation (e.g. overtime and material), quality control.

Production manager / Plant manager: Managing production, planning new production methods, investment and maintenance issues.

ADMINISTRATION

Junior admin staff: Responsible for basic administrative and secretarial tasks; 0-3 years of work experience.

Mid-level admin staff: Responsible for administrative tasks, secretarial and support tasks; 4-7 years of work experience.

Senior admin manager: Responsible for acting as secretary to GM or similar, assistant to senior management; 8 or more years of work experience.

SALES

Junior sales staff: Responsible for general sales / marketing, limited technical knowledge; 0-3 years of work experience.

Mid-level sales staff: Responsible for sales / marketing activity, basic technical knowledge; 4-7 years of work experience.

Senior sales manager: Responsible for advanced technical knowledge, managing customers and key accounts / marketing; 8 or more years of work experience.

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GERMAN CHAMBER of Commerce in China 中国德国商会

Labor Market & Salary Report

Exclusive Key Findings **2020/21 | 13th Edition**

COMPENSATION EAST CHINA

Total Cost per Employee in RMB/month (Median values)

PRODUCTION	CHINA	Shanghai	Suzhou	TAI/KUN	Other YRD
Blue Collar					
2020	6,297	7,000	6,020	6,297	6,500
2021	6,547	7,265	6,253	6,562	6,733
Increase %	3.98	3.79	3.87	4.21	3.59
Operator					
2020	7,500	8,500	6,459	6,800	8,150
2021	7,795	8,856	6,688	7,074	8,423
Increase %	3.94	4.19	3.55	4.03	3.35
Shift Leader					
2020	9,753	10,500	9,144	9,025	10,063
2021	10,133	10,918	9,485	9,381	10,418
Increase %	3.90	3.98	3.74	3.94	3.53
Production Supervisor					
2020	15,400	16,800	17,032	14,500	15,961
2021	15,991	17,435	17,590	15,034	16,519
Increase %	3.84	3.78	3.28	3.68	3.50
Production / Plant Manager					
2020	34,836	39,240	36,482	28,000	39,500
2021	36,106	40,576	37,736	28,903	40,941
Increase %	3.65	3.40	3.44	3.23	3.65

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APPENDIX G: OHIO MANUFACTURING POSITIONS, WAGE RATES AND COMPENSATION

SOURCE: Manufactures Association of Plastics Processors (MAPP), Bureau of Labor Statistics (BLS)

NOTE: Calculation for Total Compensation

Wage rates from the Manufacturers Association of Plastic Processors (MAPP) combined with the Bureau of Labor Statistics (BLS) industry benefits standard of 33.6% creates a total compensation. I.E: An operator's salary of $31,200 is equal to 66.4% of Total Compensation. Thus, dollar amount of total compensation is equal to $46,987.

Ohio Manufacturing Wage Rates		
Job Title	**2020 Median Hourly Pay Rate**	**2020 Median Compensation**
Plant Manager	$43.00	$89,440.00
Supervisor	$25.20	$52,416.00
Operator	$15.00	$31,200.00

Ohio Manufacturing Total Compensation		
Job Title	**2020 Median Hourly Pay Rate**	**2020 TOTAL Compensation**
Plant Manager	-	$134,698.00
Supervisor	-	$78,939.00
Operator	-	$46,987.00

SEE CHART ON NEXT PAGE

COMPARABLE PUBLIC DATA: The Bureau of Labor Statistics

For comparable public data on wages and benefits for manufacturers in the Midwest region see HERE:

https://www.bls.gov/news.release/ecec.t04.htm

https://www.bls.gov/news.release/pdf/ecec.pdf

Table 4. Employer Costs for Employee Compensation for private industry workers by occupational and industry group
[Mar. 2021]

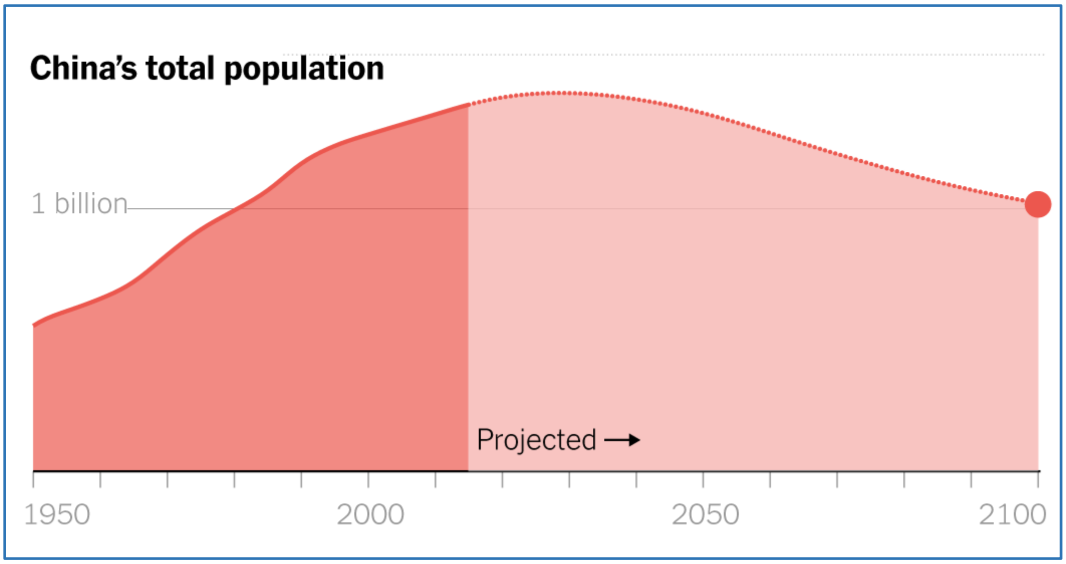
Series	Total compensation[1]		Wages and salaries		Total benefits		Paid leave		Supplemental pay		Insurance		Retirement and savings		Legally required benefits	
	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent	Cost ($)	Percent
Private industry workers	36.64	100.0	25.80	70.4	10.83	29.6	2.72	7.4	1.27	3.5	2.83	7.7	1.25	3.4	2.77	7.6
Occupational group																
Management, professional, and related	62.32	100.0	43.31	69.5	19.02	30.5	5.83	9.4	2.33	3.7	4.45	7.1	2.33	3.7	4.08	6.5
Management, business, and financial	72.88	100.0	50.46	69.2	22.42	30.8	7.09	9.7	3.35	4.6	4.76	6.5	2.67	3.7	4.55	6.2
Professional and related	56.29	100.0	39.22	69.7	17.07	30.3	5.11	9.1	1.74	3.1	4.28	7.6	2.13	3.8	3.81	6.8
Sales and office	28.25	100.0	20.44	72.3	7.81	27.7	1.83	6.5	0.81	2.9	2.37	8.4	0.73	2.6	2.07	7.3
Sales and related	28.51	100.0	21.80	76.5	6.71	23.5	1.60	5.6	0.85	3.0	1.55	5.4	0.59	2.1	2.11	7.4
Office and administrative support	28.06	100.0	19.43	69.2	8.63	30.8	2.00	7.1	0.79	2.8	2.97	10.6	0.83	3.0	2.05	7.3
Service	18.15	100.0	13.93	76.7	4.23	23.3	0.77	4.2	0.38	2.1	1.12	6.2	0.27	1.5	1.68	9.2
Natural resources, construction, and maintenance	38.58	100.0	26.25	68.0	12.33	32.0	2.07	5.4	1.44	3.7	3.14	8.1	2.10	5.4	3.59	9.3
Construction, extraction, farming, fishing, and forestry	39.61	100.0	26.59	67.1	13.01	32.9	1.65	4.2	1.52	3.8	3.22	8.1	2.69	6.8	3.93	9.9
Installation, maintenance, and repair	37.47	100.0	25.87	69.0	11.60	31.0	2.52	6.7	1.35	3.6	3.05	8.2	1.45	3.9	3.23	8.6
Production, transportation, and material moving	30.26	100.0	20.36	67.3	9.90	32.7	1.84	6.1	1.32	4.4	2.98	9.9	1.09	3.6	2.66	8.8
Production	28.94	100.0	19.40	67.0	9.54	33.0	1.78	6.1	1.43	4.9	3.07	10.6	0.83	2.9	2.43	8.4
Transportation and material moving	31.49	100.0	21.25	67.5	10.24	32.5	1.91	6.1	1.21	3.9	2.90	9.2	1.33	4.2	2.88	9.2
Industry group																
Goods-producing[2]	40.59	100.0	27.43	67.6	13.16	32.4	2.64	6.5	1.77	4.4	3.62	8.9	1.79	4.4	3.34	8.2
Construction	40.85	100.0	28.48	69.7	12.37	30.3	1.87	4.6	1.47	3.6	3.08	7.5	2.08	5.1	3.87	9.5
Manufacturing	40.38	100.0	26.82	66.4	13.56	33.6	3.06	7.6	1.90	4.7	3.92	9.7	1.64	4.1	3.03	7.5
Aircraft manufacturing	77.20	100.0	47.99	62.2	29.21	37.8	7.36	9.5	4.30	5.6	7.42	9.6	5.25	6.8	4.89	6.3
Service-providing[3]	35.83	100.0	25.47	71.1	10.36	28.9	2.74	7.6	1.17	3.3	2.67	7.4	1.14	3.2	2.65	7.4
Trade, transportation, and utilities	31.03	100.0	22.02	70.9	9.02	29.1	2.05	6.6	0.96	3.1	2.40	7.7	1.13	3.6	2.48	8.0
Wholesale trade	42.26	100.0	29.87	70.7	12.39	29.3	3.27	7.7	1.58	3.7	3.06	7.3	1.36	3.2	3.11	7.4
Retail trade	21.95	100.0	16.69	76.0	5.26	24.0	1.11	5.0	0.55	2.5	1.35	6.1	0.42	1.9	1.83	8.3
Transportation and warehousing	40.01	100.0	26.42	66.0	13.59	34.0	2.91	7.3	1.30	3.2	3.99	10.0	2.12	5.3	3.27	8.2
Utilities	68.44	100.0	42.20	61.7	26.25	38.3	6.06	8.9	2.25	3.3	6.44	9.4	6.68	9.8	4.81	7.0
Information	57.53	100.0	38.16	66.3	19.36	33.7	5.37	9.3	2.86	5.0	4.95	8.6	2.44	4.2	3.75	6.5
Financial activities	52.58	100.0	35.42	67.4	17.15	32.6	4.60	8.8	3.08	5.9	4.45	8.5	1.77	3.4	3.26	6.2
Financial and insurance	58.76	100.0	39.21	66.7	19.54	33.3	5.28	9.0	3.74	6.4	4.92	8.4	2.12	3.6	3.48	5.9
Credit intermediation and related activities	51.29	100.0	34.02	66.3	17.27	33.7	4.76	9.3	2.87	5.6	4.73	9.2	1.77	3.4	3.15	6.2
Insurance carriers and related activities	52.19	100.0	34.53	66.2	17.66	33.8	4.66	8.9	2.85	5.5	4.77	9.1	2.09	4.0	3.30	6.3
Real estate and rental and leasing	32.38	100.0	23.03	71.1	9.35	28.9	2.39	7.4	0.91	2.8	2.89	8.9	0.61	1.9	2.55	7.9
Professional and business services	44.96	100.0	32.29	71.8	12.68	28.2	3.67	8.2	1.60	3.5	2.90	6.5	1.29	2.9	3.22	7.2

APPENDIX H: SLOWING CHINESE POPULATION GROWTH

SOURCE: The New York Times

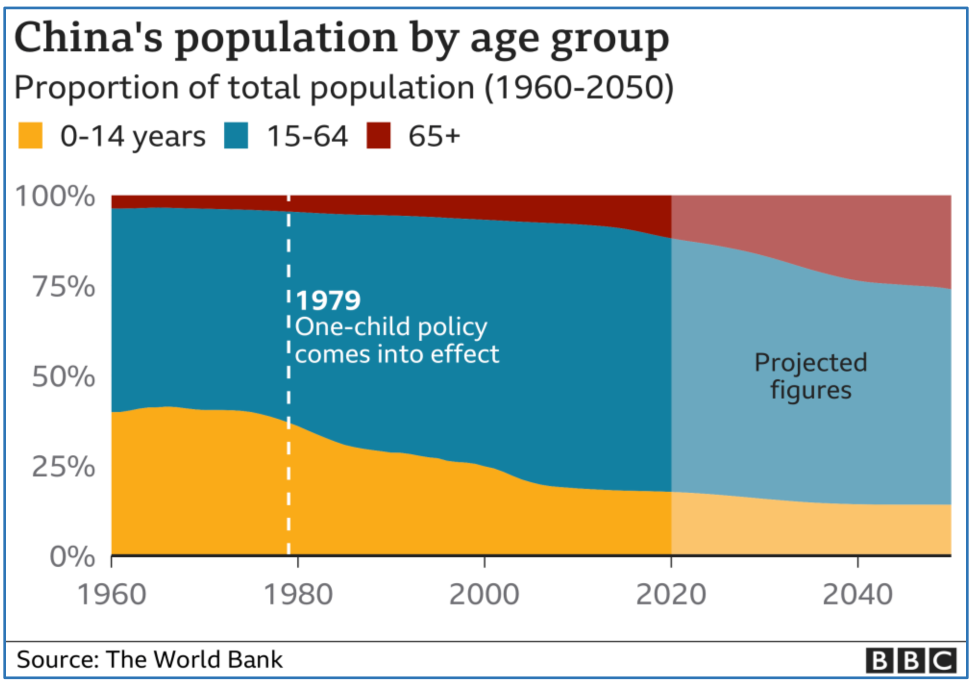
NOTE: China's population has seen a significant deceleration in growth compared to the end of the 20th century, which contributes to a declining available workforce. China's family planning policy is claimed to have averted the increase in population of some hundreds of millions of people, and at the same time has eliminated hundreds of millions of potential laborers. The effects of this trend can be seen in the current workforce. A 2020 study by *The British Medical Journal* predicts the population in China will fall from 1.41 billion to 0.73 billion by the end of the century.

For more information from the New York Times see HERE



SOURCE: THE WORLD BANK

For more information from The World Bank see HERE

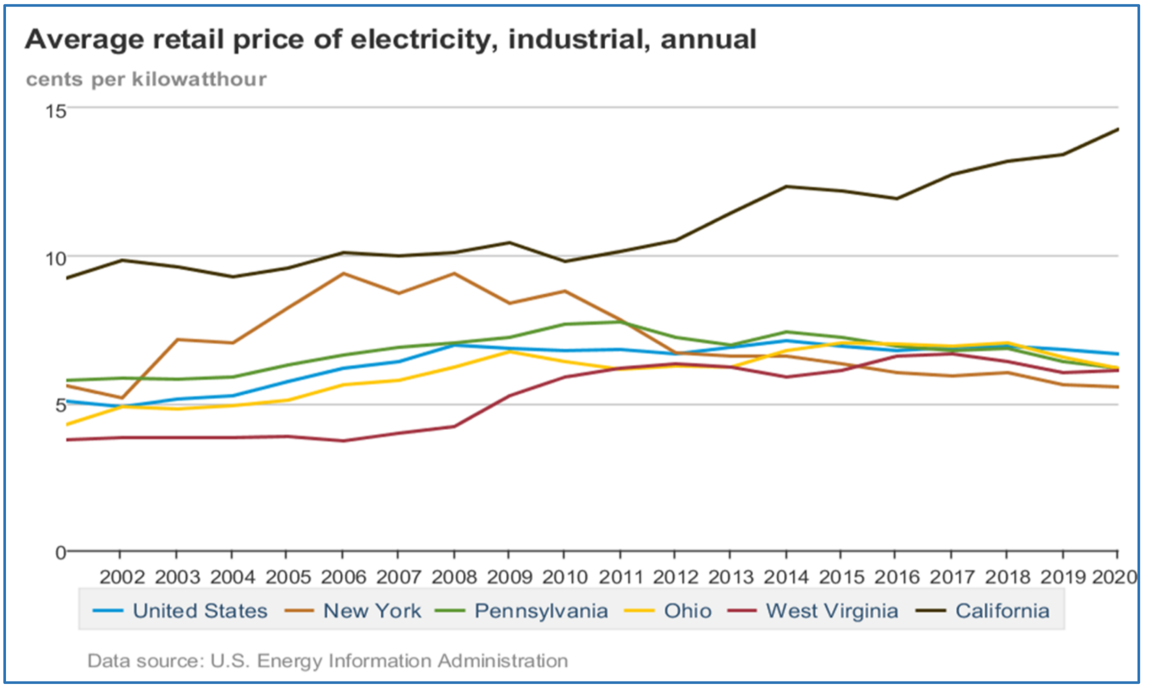


APPENDIX I: U.S. AND STATE INDUSTRIAL ELECTRIC RATES

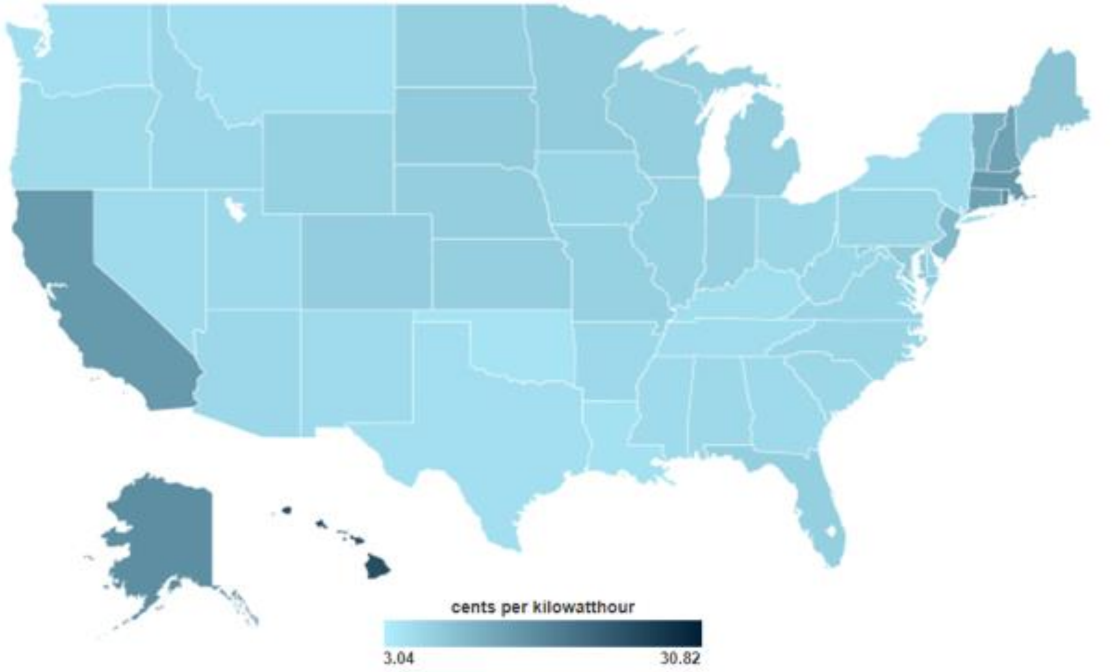
SOURCE: Energy Information Administration

NOTE: Between 2010 and 2021, industrial consumers in the state of Ohio experienced nationally competitive rates ranging from 6.10¢ to 7.00¢ per kilowatt-hour (kWh). Pennsylvania and West Virginia, part of the Shale Crescent USA region, also experience competitive rates. It should be noted that prices vary greatly among U.S. states. During the same period (2010-2021), California industrial rates rose from 9.80¢ to 15.04¢per (kWh).

For more information see HERE



Average Retail Price of electricity: Industrial 2020



APPENDIX J: NATURAL GAS: U.S. AND OHIO ELECTRIC SAVINGS

SOURCE: Kleinhenz & Associates and Shale Crescent USA

For more information see HERE

NOTE:

Since 2008, the U.S. has greatly increased the production of natural gas. Investments made by the natural gas exploration and production industry along with new technologies have made possible substantial increases in supply. Among the benefits are lower domestic end-user prices for customers in the Residential, Commercial, Industrial, and Electric Power Generating sectors. The Shale Crescent is responsible for 85 percent of the net growth in natural gas daily production over the past ten years and now accounts for one-third of U.S. natural gas annual production.

End-users have saved $1.1 trillion over the past ten years due to increased natural gas production that has reduced the price of natural gas in the United States. Several methods of calculating the counterfactual scenarios were explored in order to estimate what would have happened in the natural gas markets had the sizable production of shale gas not occurred. A Henry Hub pricing approach was chosen to investigate the effect of additional natural gas production since it is a national pricing point and best approximates the U.S. natural gas market.

Ohio $ Savings 2009 - 2018

	Ohio Residential Savings	Ohio Commercial Savings	Ohio Industrial Savings	Ohio Electric Power Savings	Ohio Total
			-- dollars --		
2009	981,574,586	539,114,306	780,858,461	126,437,363	2,427,984,715
2010	1,076,251,385	593,343,216	1,021,563,067	220,638,685	2,911,796,352
2011	1,517,180,220	855,846,340	1,421,217,770	492,299,350	4,286,543,680
2012	1,590,521,507	922,355,513	1,676,327,033	1,087,880,167	5,277,084,220
2013	1,830,292,574	1,035,494,267	1,686,625,923	992,045,276	5,544,458,040
2014	1,823,716,076	1,041,687,043	1,725,853,644	996,834,851	5,588,091,614
2015	1,219,061,181	711,860,357	1,179,315,410	889,695,125	3,999,932,072
2016	1,276,321,589	760,716,125	1,373,767,171	1,060,306,907	4,471,111,792
2017	1,255,866,774	762,062,127	1,348,433,299	998,187,353	4,364,549,554
2018	1,766,642,102	1,040,433,577	1,773,603,788	1,873,336,024	6,454,015,490
Total	14,337,427,994	8,262,912,870	13,987,565,566	8,737,661,100	45,325,567,530

Total U.S. $ Savings 2009 - 2018

	US Residential	US Commercial	US Industrial	US Electric Power	US Total End-user
			-- dollars --		
2009	20,031,710,460	13,072,179,891	25,851,725,126	28,807,547,663	87,763,163,140
2010	21,746,195,802	14,107,859,146	31,039,506,387	33,590,403,690	100,483,965,025
2011	23,450,238,902	15,697,175,399	34,794,557,509	37,678,680,337	111,620,652,148
2012	25,924,131,908	18,086,058,525	45,145,799,032	56,919,705,516	146,075,694,981
2013	24,758,595,168	16,659,347,792	37,539,268,001	41,408,251,594	120,365,462,556
2014	22,110,758,374	15,064,989,784	33,230,601,383	35,403,413,548	105,809,763,089
2015	18,779,390,289	13,034,483,471	30,622,194,199	39,136,702,912	101,572,770,871
2016	15,475,002,449	11,070,941,165	27,516,172,623	35,550,201,147	89,612,317,383
2017	16,584,349,842	11,892,752,204	29,878,484,008	34,768,024,936	93,123,610,990
2018	22,061,342,501	15,483,832,564	37,576,436,865	49,004,358,417	124,125,970,347
Total	210,921,715,695	144,169,619,941	333,194,745,133	392,267,289,761	1,080,553,370,530

APPENDIX K: CHINA REGIONAL ELECTRIC RATES

SOURCE: China Briefing

For more information see HERE

NOTE: Prices are in Renminbi, RMB. Electric prices in Zhejiang (the region of comparison in this report) for 35Kv is equal to 10.08¢ per kWh.

CONVERSION RATE: 1 RMB = 0.16 USD (As of 2/8/2022)

Large-Scale Industrial Power Rates by Region

Region	Cost per unit (RMB/kWh)				Fixed charge (RMB/month)	
	10kV	35kV	110kV	220kV	By maximum demand	By transformer capacity
Anhui	0.63	0.62	0.60	0.59	40	30
Beijing	0.68	0.66	0.64	0.62	48	32
Chongqing	0.61	0.58	0.57	0.56	36	24
Fujian	0.58	0.56	0.54	0.52	36	24
Gansu	0.46	0.45	0.44	0.43	28	19
Guangdong	0.61	0.58	0.58	0.56	32	23
Guangxi	0.63	0.60	0.58	0.56	34	27
Guizhou	0.54	0.52	0.49	0.48	35	25
Hainan	0.64	0.63	0.62	0.61	38	26
Heilongjiang	0.59	0.57	0.56	0.55	32	22
Hebei (North)	0.53	0.52	0.50	0.50	35	23
Hebei (South)	0.56	0.55	0.53	0.53	35	23
Henan	0.61	0.60	0.58	0.57	28	20
Hubei	0.61	0.59	0.57	0.55	42	28
Hunan	0.61	0.61	0.59	0.56	30	20
Inner Mongolia (East)	0.45	0.44	0.44	0.43	28	18
Inner Mongolia (West)	0.45	0.43	0.42	0.41	28	18
Jiangsu	0.64	0.63	0.61	0.60	40	30
Jiangxi	0.62	0.60	0.59	0.58	39	26
Jilin	0.59	0.57	0.56	0.54	33	22
Liaoning	0.53	0.52	0.50	0.49	33	22
Ningxia	0.47	0.44	0.41	0.38	32	22
Qinghai	0.37	0.36	0.35	0.35	28	18
Shaanxi	0.55	0.53	0.51	0.51	31	23
Shanxi	0.51	0.48	0.46	0.45	36	23
Shandong	0.62	0.60	0.59	0.57	38	28
Shanghai	0.67	0.65	0.63	0.63	42	28
Sichuan	0.58	0.56	0.54	0.52	39	26
Tianjin	0.68	0.66	0.65	0.64	25	17
Yunnan	0.53	0.51	0.43	0.41	38	27
Zhejiang	0.66	0.63	0.61	0.61	40	30

Graphic© Asia Briefing Ltd.

APPENDIX L: CHINA – ZHEJIANG REAL ESTATE PRICES

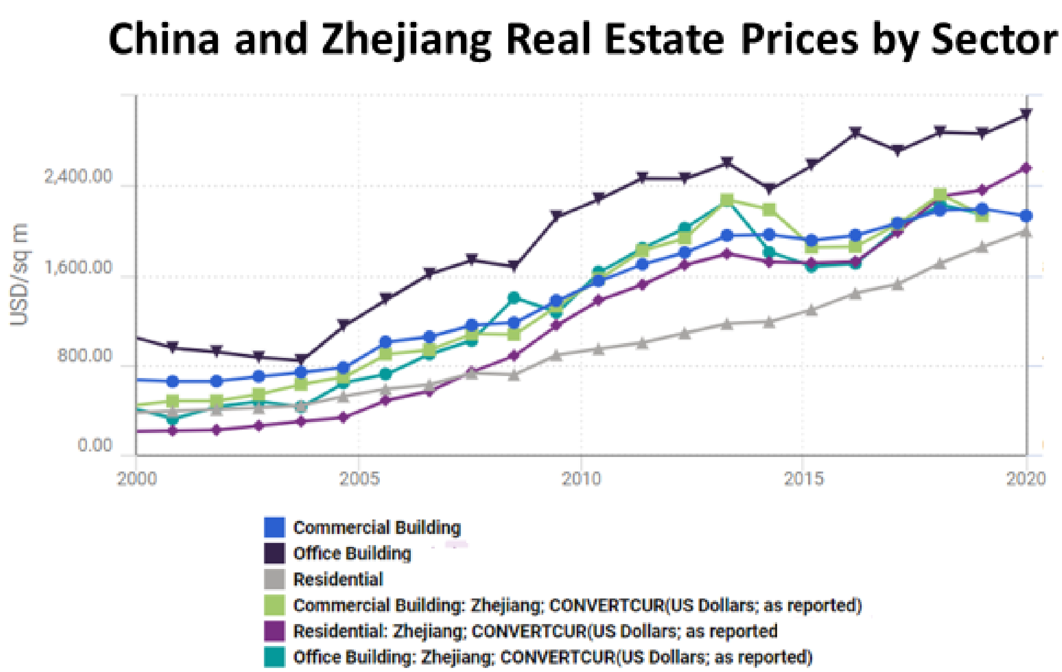
SOURCE: CEIC

For more information see HERE

NOTE: Prices are in USD/sq. meter and RMB/sq. meter

China has seen a steady increase in real estate sales value over the past 20 years. Since the turn of the 20th century, China's average commercial property value has tripled. The inflation in China's industrial centers has been even more significant. **The Zhejiang province has seen real estate prices, depending on sector, increase anywhere from 5 to 10 times value, compared to two decades ago.**

CONVERSION RATE: 1 RMB = 0.16 USD (As of 2/8/2022)



APPENDIX M: OHIO MANUFACTURING SITES

SOURCE: Loopnet.com

NOTE:

Listings and prices were acquired on the date of 5/25/2021. Sites were required to meet the criteria of 35,000 to 110,000 sq/ft. Truck bays were also required. Rail siding and Resin storage (though ideal) were optional. The selected sites were in various location across the state of Ohio.

The state of Ohio is built on a storied history of manufacturing and continues to be supported by this economic engine with more than ten thousand manufacturing firms located in the state. This robust statewide inventory allowed for an adequate representative sample from which to mine statistically valid data on related lease rates. A sampling of Ohio manufacturing operations, that met all qualifying criteria, revealed a 2021 annual lease rate that fell in the range of $4-5 per sq./ft.83.

Ohio Manufacturing/Industrial Sites Actively Listed for Sale - 2021						
Ohio - Site Location	**Size sq. ft.**	**Truck Bays**	**Rail Siding**	**Resin Storage**	**Sale Price**	**Sale Price Per Sq. Ft.**
1501 Morton Ave. Cambridge	38,000	4	yes	no	$ 1,300,000	$ 34.21
12985 Snow Rd. Parma	39,320	6	no	no	$ 2,000,000	$ 50.86
1201 Findlay Rd. Lima	45,547	4	yes	no	$ 470,000	$ 10.32
1750 Baney Rd. S Ashland	49,732	4	no	yes	$ 1,750,000	$ 35.19
19540 Progress Dr. Strongsville	50,413	8	no	no	$ 3,100,000	$ 61.49
1000 Bacon Rd. Painsville	58,097	3	no	no	$ 2,900,000	$ 49.92
2295 55th St. Cleveland	59,000	7	no	no	$ 395,000	$ 6.69
910 Lake Rd. Medina	60,880	6	no	no	$ 1,825,000	$ 29.98
325 Carr Drive Brookville	61,900	3	no	no	$ 1,500,000	$ 24.23
400 Shotwell Dr. Franklin	62,000	6	no	no	$ 3,000,000	$ 48.39
4566 Spring Rd. Brooklyn Heights	66,700	6	no	no	$ 2,985,000	$ 44.75
29125 Hall St Solon	66,960	6	no	no	$ 2,000,000	$ 29.87
2181 Grand Ave. Cincinnatie	67,976	6	no	no	$ 1,450,000	$ 21.33
6399 Broughton Ave. Columbus	78,000	5	no	no	$ 3,400,000	$ 43.59
12500 Berea Rd. Lakewood	80,942	4	yes	no	$ 1,700,000	$ 21.00
8481 Duke Blvd. Mason, OH	82,616	9	no	no	$ 6,800,000	$ 82.31
13700 Broadway Ave. Garfield Heights	84,175	4	yes	no	$ 1,995,000	$ 23.70
1236 Clough Pike Batavia	91,200	9	no	no	$ 3,000,000	$ 32.89
Building 532 925 County Rd. 1A Ironton	92,014	9	yes	yes	$ 3,500,000	$ 38.04
8361 Broadwell Rd. Anderson	92,560	8	yes	no	$ 3,000,000	$ 32.41
945 Lafayette Rd. Medina	94,916	8	no	no	$ 3,750,000	$ 39.51
3691 State Route 4 Bucyrus	95,500	7	no	no	$ 1,650,000	$ 17.28
3734 State Route 133 Williamsburg	103,000	12	no	no	$ 2,350,000	$ 22.82
325 Soldiers Home Miamisburg Rd. Miamisburg	103,000	10	yes	no	$ 1,600,000	$ 15.53
6660 Broughton Ave. Columbus	105,191	21	yes	yes	$ 3,080,000	$ 29.28
1350 Rockefeller Rd. Wickliffe	106,000	11	yes	no	$ 3,900,000	$ 36.79
103 Railroad Ave. Stryker	107,080	13	yes	yes	$ 1,400,000	$ 13.07

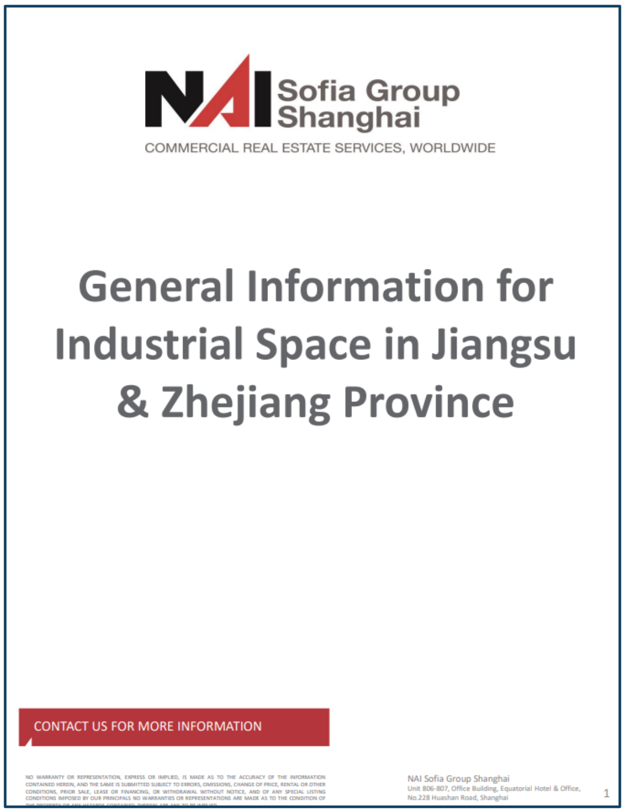
[83] See Appendix M: Ohio Manufacturing Sites

APPENDIX N: ZHEJIANG MANUFACTURING SITES

SOURCE: NAI Sofia Group Shanghai

Note: Listings were acquired from a global real estate agency (NAI) with offices in Zhejiang, China. Properties were required to be in Zhejiang, China and meet the building parameters of 35,000 to 110,00 sq/ft. with truck bays.

A sample of properties meeting the above stated parameters was inventoried. The data showed that manufacturing operations in the Zhejiang province in 2021 pay a present-day annual lease rate that ranges from $6 – $7 per sq./ft. Considering the exponential growth of China's manufacturing sector, a decreased availability of space could be a major contributing factor to inflated lease rates. It is worth noting again that while Zhejiang is comparable in land mass to the state of Ohio, it is home to 8 times the population, totaling an estimated 58.5 million people.



SEE MANUFACTURING LISTINGS ON FOLLOWING PAGES

APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai
COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Lease:
Kunshan German Industrial Park, Kunshan City

Reference Options for Rent:

Property Features

- Newly Built Project with High Western Standard

Recommended Facility

- Recommended property: No. A2+A3 Workshop with a total size of 9,050 sqm (A2 4,300 sqm + A3 4,750sqm), single storey
- Structure: Steel frame
- Rental: RMB 39/sqm/month (including management fee and tax), one month rent free per year
- Ceiling height: 10-11 meters
- Floor loading capacity: 3t
- Fire safety standard: Class C II
- Availability date: Now
- Column grid (meters): 9*24
- Lease term: 3 years (above)
- Expansion possibility: Mid-High
- Access to public transportation: 0.7 km to the bus station
- Distance to current SH location: 52 km
- **Monthly cost including Management fee: RMB 352,950**

APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai

COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Lease:
Kunshan German Industrial Park, Kunshan City

Reference Options for Rent:

Property Features

- Local government developed newly built property with western standard

Recommended Facility

- Recommended property: No. E1+E2 Workshop with a total size of 11,000 sqm (E1 5,500sqm + E2 5,500sqm), single storey
- Structure: Steel frame
- Rental: RMB 35/sqm/month (including management fee and tax)
- Ceiling height: 12-13 meters
- Floor loading capacity: 3t
- Fire safety standard: Class C II
- Availability date: Q2 2022
- Column grid (meters): 7.5*27
- Lease term: 3 years (above)
- Expansion possibility: High
- Access to public transportation: 0.5 km to the bus station
- Distance to current SH location: 57 km
- **Monthly cost including Management fee: RMB 385,000**

APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai

COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Lease:
Huacheng Industrial Park, Kunshan City

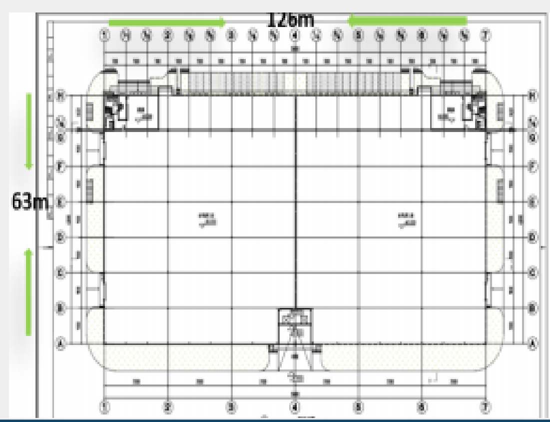
Reference Options for Rent:

Property Features

- Newly renovated property with professional developer

Recommended Facility

- Recommended property: Building A01 workshop with a total size of 8,387 sqm (workshop 7,562 sqm, office 825 sqm)
- Structure: Steel frame
- Rental: RMB 34/sqm/month (including management fee)
- Additional Tax: 5%-6% VAT Tax
- Ceiling height: 10.5 meters
- Floor loading capacity: 2t
- Fire Safety Standard: Class C II
- Availability date: Now
- Column grid (meters) : 21*9
- Lease term: 3 years (above)
- Expansion possibility: Mid-High
- Access to public transportation: 0.2 km to the bus station
- Distance to current SH location: 45 km
- **Monthly cost including Management fee: RMB 299,415.9 - 302,267.48**



APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai
COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Lease:
Huaqiao Pengqing Industrial Park, Kunshan City

Reference Options for Rent:

Property Features

- Newly renovated property with professional developer
- Property certificate is expected in the first half of 2021

Recommended Facility

- Recommended property: Building No. A05 with a total size of 23,389.93 sqm (workshop 22,191.07 sqm, office 1,198.86 sqm), two layers for workshop, three layers for office
- Structure: Steel frame
- Rental: RMB 1.35/sqm/day (70% is rent, 30% is management fee), annually increase 5%
- Additional tax: 6% VAT for management fee, 9% VAT for rent
- Ceiling height (net) (subject to the property certificate): 1F 9 meters, 2F 8.7-10.3 meters (workshop); 1F 3.2 meters, 2F 5meters, 3F 3.2 meters (office)
- Floor loading capacity: 1F 3t, 2F 2t
- Fire safety standard: Class C II
- Availability date: Now
- Column grid (meters) (according to the design drawings) : 1F (5.8*12, 9*12, 11.8*12); 2F (5.8*12, 9*12, 11.8*12, 23.6*12, 29.4*12)
- Possibility to add compartment: Need permission from local government
- Lease term: 3 years (above)
- Expansion possibility: Mid-High
- Access to public transportation: 2.2 km to Line 11 Huaqiao Station
- Distance to current SH location: 36 km
- **Monthly cost including Management fee: RMB 1,038,245.37**

APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai
COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Purchase:
Kuntin Intelligent Manufacturing Industrial Park, Nantong City

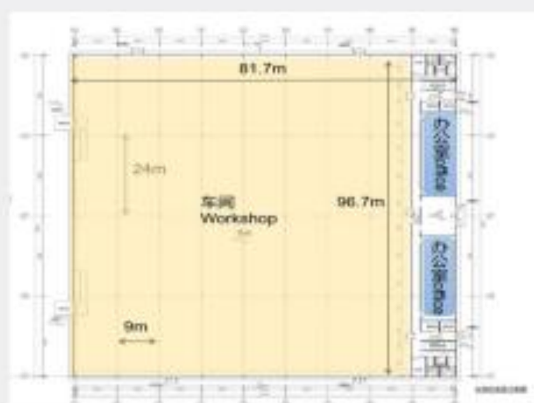
Reference Options for Purchase:

Property Features

- Unique single floor property for sale in Nantong with Western Standard

Recommended Facility

- Recommended property: No. 2 Workshop with a total size of 8,823.9 sqm (Single storey workshop area 7,083.3sqm, office area 1,740.6sqm)
- Structure: Steel frame
- Purchase price: RMB 4,800/sqm
- Management fee: RMB 2/sqm/month
- Ceiling height: 10 meters (workshop), Office- 1F 4.5 meters, 2F 5.5 meters
- Floor loading capacity: 3t
- Fire safety standard: Class C
- Availability date: Now
- Column grid (meters): 24*9
- Expansion possibility: Middle-High
- Access to public transportation: 0.4 km to the bus station
- Distance to current SH location: 92 km
- **Purchase price total: RMB 42,354,720**



APPENDIX N: Zhejiang Manufacturing Sites

NAI Sofia Group Shanghai

COMMERCIAL REAL ESTATE SERVICES, WORLDWIDE

Option for Purchase:
Plainvim International Haimen Industrial Park, Nantong City

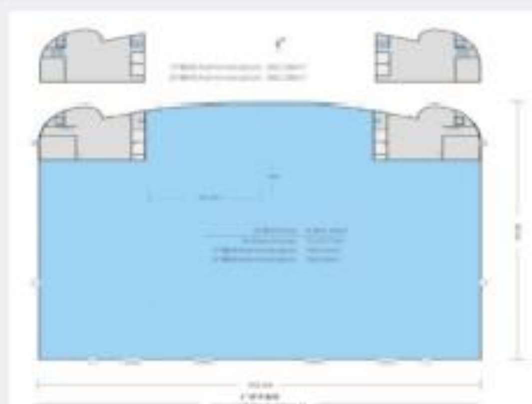
Reference Options for Purchase:

Property Features

- Newly developed project in Nantong with attractive price

Recommended Facility

- Recommended property: No. A2 Workshop with a total size of 9,065sqm (workshop area 7,537sqm, office area 1,528 sqm), single storey workshop, two storey office
- Structure: Steel frame
- Rental: RMB 25/sqm/month (including tax)
- Management fee: RMB 2/sqm/month (including tax)
- Ceiling height: 10 meters (workshop), 4.5 meters (office)
- Floor loading capacity: 3t (workshop), 500kg (office)
- Fire safety standard: Class C II
- Availability date: Now
- Column grid (meters): 25*9
- Lease term: 5 years (above)
- Expansion possibility: High
- Access to public transportation: 2 km to the bus station
- Distance to current SH location: 110 km
- **Monthly cost including Management fee: RMB 244,755**
- **Can be purchased after 10-year lease**



APPENDIX O: REDUCED EMISSIONS CALCULATION & SOURCES

SOURCE: Topline Analytics, Shale Crescent USA and Proprietary

NOTE:

Toothbrush Inland Transport Emissions: Calculation and sources for inland shipping of toothbrushes to regional distribution centers vs U.S. Ports to Distribution Centers.

- Regional Manufacture located in Cambridge, OH vs. Inland shipping from U.S. International ports.
- **Product analyzed – Standard sized toothbrush with packaging**
- Calculation = Amount of CO2 emissions eliminate
- Only U.S. Inland Transportation is included in this model.

C02 Emissions: Difference in US Inland Shipping to Distriburtion Centers vs. U.S. Port to Distribution Centers

#	Tractor Trailer versus ISO Container			US DOT size ft & sq ft			Useable	Useable	assumptions
1	US tractor trailer			8.5x8.5x48	3468	sq ft	90%	3,121	sq ft
2	Standard International ISO			8.5x8x40	2720	sq ft	90%	2,448	sq ft
3									
4	Toothbrush - Packaged				12.5	sq in	90%	124	toothbrush/sq ft
5									
6	US tractor trailer		386,872	toothbrushes			16,369	product weight with packaging	
7	Pallets	48	40	lbs each			1,920	pallet weight	
8	Class 8 US tractor		17,000	Trailer 48ft	12,000	lbs	29,000	tractor trailer weight	
9							47,289	lbs full load	
10									
11	International ISO		303,429	toothbrushes			12,838	product weight with packaging	
12	Pallets	40	40	lbs each			1,600	pallet weight	
13	Class 8 US tractor		17,000	ISO continer 40ft	17,300	lbs	34,300	tracktor, iso and trailer weight	
14							48,738	lbs full load	
15									
16	331,000,000	Americans	4.2	toothbrushes on average		100%	Onshore	1,390,200,000	Toothbrushes
17									
18	Annual	US tractor trailer			3,593	trips		65%	backhaul
19	Annual	Standard International ISO			4,582	trips		10%	backhaul
20									
21	**CO2 Emissions of US Heavy Vehicle Fleet**								
22	US Class 8 day high roof 2017+ standard				89	grams CO2/ton mile			
23	US in service fleet		35%	more	120	grams CO2/ ton mile			
24									
25	**Assumption use US classic one day drive 5 distribution center model**								
26	Chicago, IL	30%	Cambridge, OH	434	miles	Long Beach, CA	2030	miles	
27	Atlanta, GA	10%	Cambridge, OH	646	miles	Savannah, GA	248	miles	
28	Dallas, TX	10%	Cambridge, OH	1119	miles	New Orleans, LA	505	miles	
29	Reno, NV	15%	Cambridge, OH	2303	miles	Long Beach, CA	541	miles	
30	Carlise, PA	35%	Cambridge, OH	278	miles	Norfork, VA	299	miles	
31		100%		749	weight ave		870	weight ave	
32				2,693,104	annual miles		3,986,483	annual miles	
33									
34	**Annual CO2 Impact US Internal Shipments**								
35	Annual grams of C02 Shale Crescent			8,330,293,036	total	7,650,782,416	shipment	679,510,620	backhaul
36	Annual grams of C02 China Import			15,401,068,425	total	11,672,241,203	shipment	3,728,827,222	backhaul
37	Net difference			7,070,775,389	grams CO2	7071	tonnes C02		
38									
39	**Difference equivalent**		**1,470**	**passenger cars removed from the roads**					
40				13,476	average passenger car miles 2019				
41				24.9	average mpg passenger car 2019				
42				8887	grams CO2 per gallon of gasoline				
43				357	grams CO2 per mile				
44				4,809,687	grams CO2 per passanger car annually				

NOTE:

Toothbrush Example: Calculation and sources for inland shipping of products to regional distribution centers vs U.S. Ports to Distribution Centers.

- Regional Manufacture located in Cambridge, OH vs. Inland shipping from U.S. International ports.
- **Product analyzed – Standard sized toothbrush with packaging**
- Calculation = Amount of CO2 emissions eliminated
- Only U.S. Inland Transportation is included in this model

#	Associated Notes and Sources for Calculation
1	https://ops.fhwa.dot.gov/freight/publications/size_regs_final_rpt/
2	https://www.dsv.com/en-us/our-solutions/modes-of-transport/sea-freight/shipping-container-dimensions/dry-container
3	Useable accounts for lost space due to pallets, and room needed to allow fork lift clearance to avoid damage
4	Use standard sized toothbrush, no attempt on modeling various sizes
5	Useable accounts for lost space due standard packaging containers, container thicknesses
6	maxium US gross truck weight 80,000 lbs
7	
8	US DOT empty weight for tractor trailer, flat bed and iso container
9	
10	
11	Guess of product, packaging and pallet weight
12	
13	https://www.dsv.com/en-us/our-solutions/modes-of-transport/sea-freight/shipping-container-dimensions/dry-container
14	
15	https://www.curtmfg.com/trailer-weight
16	US Census, American Dental Association
17	
18	Guestimate of backhaul opportunities
19	Overseas ISO containers historically have low backhaul
20	
21	
22	https://dieselnet.com/standards/us/fe_hd.php
23	US Class 8 day high roof is the most common big rig, potentially lighter rigs could be used but this reduces flexibility in shippers
24	
25	
26	miles via google maps
27	Five distribution center model is widely accepted
28	There are also more distribution center models, but unlikely to change outcome
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	https://www.bts.gov/content/us-vehicle-miles
41	https://www.bts.gov/content/us-vehicle-miles
42	Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QField
43	
44	

APPENDIX P: POLYETHYLENE CASH FLOWS

SOURCE: **IHS Markit**

NOTE: **Study Commissioned by Shale Crescent USA in 2018 – Executive Summary page 1.**

For more information see [HERE:]

The Shale Crescent USA Region

An emerging energy cluster

March 2018—Final

Introduction

The Marcellus and Utica shale plays are some of the largest natural gas resources in the world and underlay the Shale Crescent USA region of Ohio, Pennsylvania, and West Virginia. **IHS Markit forecasts that this region will supply 37% of the nation's natural gas production by 2040.** Furthermore, the United States is the number one producer of natural gas in the world. The natural gas produced in the Marcellus and Utica shales is rich in natural gas liquids (NGL), including ethane. IHS Markit forecasts NGL production from these two plays will increase from 0.53 million barrels per day in 2017 to 1.37 million barrels per day in 2040, an increase of over 150%. Previous studies estimated the region has sufficient ethane feedstock to support up to five world class ethane cracker plants, including the Shell Chemicals plant under construction in Monaca, Pennsylvania. The resource base in the Shale Crescent USA region is attracting energy-intensive industries. **This IHS Markit report examines the economic benefits and risks of significant investments in the region and compares them with competing opportunities in other US and global regions.**

Benefits, Risks, and Estimated Project Cash Flows: Ethylene Project Located in the Shale Crescent USA versus the US Gulf Coast is an independent report by IHS Markit commissioned by Shale Crescent USA to evaluate and compare the financial returns

Marcellus and Utica shale plays

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SOURCE: IHS Markit

NOTE: Executive Summary page 2

For more information see HERE:

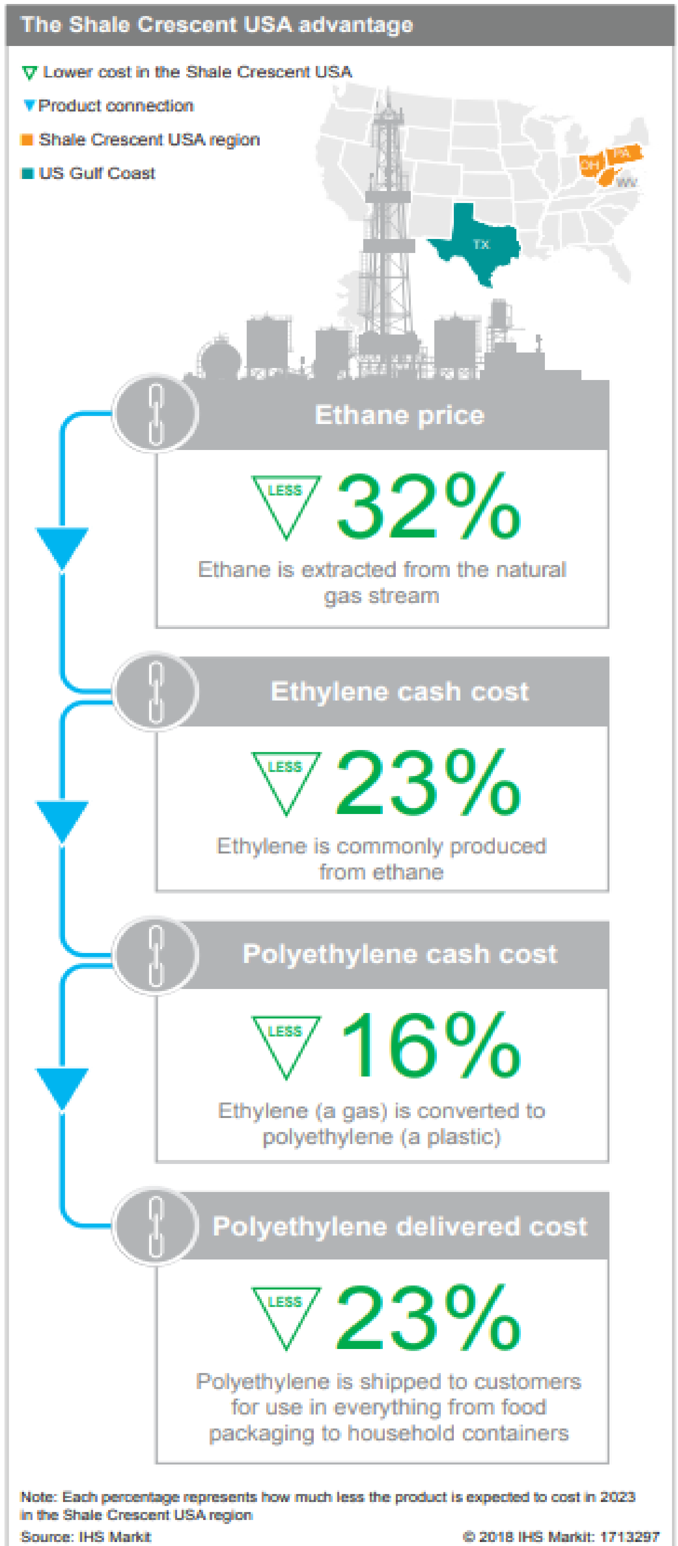
and risks of a major petrochemical and plastics investment in the region with an identical investment in the US Gulf Coast. The US Gulf Coast currently leads the world in petrochemical manufacturing expansion. The questions addressed by this study are:

- Would a nearly $3-billion investment in an ethylene/ polyethylene plant in the Shale Crescent USA earn higher or lower returns than a comparable investment in the US Gulf Coast over a 20-year timeframe?
- Given the uncertainty in future energy and feedstock price levels, how will financial returns change under low- and high-ethane price environments?
- How will other risk factors affect financial returns, such as differences in capital costs, operating rates, proximity to customers, and access to international markets?

The analysis conducted by IHS Markit highlights the economic opportunities for the Shale Crescent USA region based on predicted volumes and prices of natural gas and NGL production in the Marcellus and Utica shale plays, the estimated capital and operating costs to convert ethane (the primary raw material) into its derivative products (ethylene and then polyethylene), and the cost to distribute polyethylene to a mix of domestic and international customers.

Findings

The findings conclude there will be a significant financial advantage for an ethylene/polyethylene investment in the Shale Crescent USA region compared to a similar investment on the US Gulf Coast. An ethylene project in the **Shale Crescent USA has a comparative advantage because of its access to ample supplies of locally produced low-cost ethane**, which leads to a very competitive manufacturing cost of ethylene and subsequently polyethylene. This advantage is augmented because the **Shale Crescent USA region is in close proximity to over two-thirds of US polyethylene consumption.** The financial advantages occur even when the higher capital cost for a Shale Crescent USA ethylene project and the less-well-developed natural gas and NGL pipeline and storage infrastructure are considered. Petrochemical investment will stimulate further economic development in energy and transportation infrastructure and job creation across the region. The study highlights the major benefits, risks, and cash flows.



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SOURCE: **IHS Markit**

NOTE: **Executive Summary page 3**

For more information see HERE:

Financial summary and risk assessment of key variables

Under the assumptions in our base case and using a 15% pre-tax discount rate, **the IHS Markit analysis predicts that an ethylene project in the Shale Crescent USA region will produce a net present value (NPV in 2020) on EBITDA of $930 million over the life of the project, compared to a NPV of $217 million for a similar project on the US Gulf Coast.**[1] This represents an NPV cash flow advantage of $713 million for an investment in the Shale Crescent USA project versus a project on the US Gulf Coast. The NPV cash flow is over four times higher in the Shale Crescent USA project than in the US Gulf Coast project. **Without considering the time value of money, the pre-tax cash flow of the Shale Crescent USA project from 2020 to 2040 amounts to $11.5 billion, compared to $7.9 billion for a similar Gulf Coast project, a pre-tax cash flow advantage of $3.6 billion.**

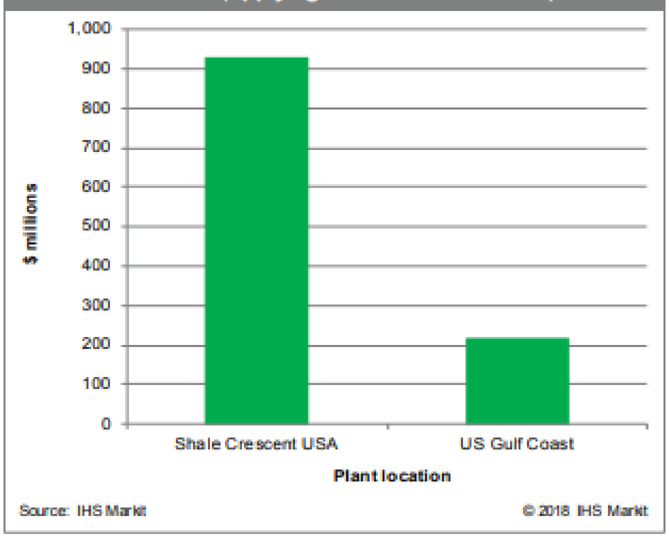
IHS Markit conducted a "stress test" to determine the ability of each project to deal with higher-than-expected capital costs and lower-than-expected plant operating rates. Using a 15% pre-tax discount rate, the Shale Crescent USA project produced negative NPV returns in only 1% of the 10,000 simulations, and the Gulf Coast project produced negative NPV returns in 38% of the simulations. A negative NPV indicates that a simulation delivered less than a 15% rate of return.

The bottom line

The expected financial returns for a Shale Crescent USA project compared with a Gulf Coast project are higher under all analyzed price scenarios, and these results are robust when considering a range of capital cost, operating rate conditions, and domestic/international sales scenarios.

The comparative financial advantage for a Shale Crescent project would be further enhanced if more-than-anticipated transportation facilities, natural gas and NGL storage, and pipeline infrastructure development occurs in the region.

Net present value in 2020, Shale Crescent USA versus the US Gulf Coast (applying a 15% discount rate)



1 EBITDA is defined as earnings before interest, taxes, depreciation, and amortization.

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APPENDIX Q: HARMONIZED TARIFF SCHEDULE PRODUCT IMPORTS LIST BY DOLLAR AMOUNT

SOURCE: U.S. CENSUS BUREAU

NOTE: U.S. plastic-based imports from China by dollar amount during the years 2000 to 2021. The product groupings are categorized down to the ten-digit Harmonized Code (HS) level. This is the most detailed aggregated import data that can be acquired from the U.S. Census Bureau. **The average annual growth rate is calculated from all the years of 2000 to 2021.** Not all categories existed in 2000. Categories are created and become more detailed as imports increase.

U.S. Import Product List from China - Harmonized Code: 10 Digit

($ Dollar Amount Per Year: 2000 - 2021)

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
1	3926909985 Articles Of Plastics Etc, Nesoi (no)				$1,487,031,329	$3,051,252,475	105%
2	3924104000 Tableware & Kitchenware,of Plastic,nesoi (no)		$1,080,213,630	$2,216,088,928	$2,287,540,143	$2,894,608,413	14.0%
3	3924905650 Household Hygenic Or Toilet Articles Plastic Nesoi (no)			$1,550,077,239	$1,556,798,586	$1,905,484,936	8.0%
4	3926201020 Gloves,seamless,excp Surg & Medical,disposabl,plas (dpr)	$56,636,643	$325,485,188	$399,040,662	$1,558,930,931	$1,810,474,709	26%
5	3918101000 Floor Coverings Of Vinyl Tile (m2)	$26,154,499	$265,769,026	$2,741,919,675	$3,106,564,123	$1,447,005,390	25%
6	3918101020 Vinyl Tile Floor Covering Rigid Solid Polymer Core (m2)					$1,021,073,373	N/A
7	3926201010 Gloves,seamless,surgical & Medical,of Plastic (dpr)	$50,023,554	$273,625,819	$159,361,591	$516,912,391	$990,065,712	23%
8	3926907500 Pneumatic Mattresses & Oth Inflatable Art,nesoi (no)	$165,281,016	$325,206,536	$584,787,338	$548,768,063	$759,998,310	9%
9	3926400090 Statuettes & Other Ornamental Articles,of Plastic (no)			$423,762,513	$468,813,937	$632,829,783	15%
10	9603908050 Brooms,brushes,squeegees,etc,nesoi (no)	$72,889,789	$312,871,964	$487,738,804	$537,463,313	$559,933,032	11%
11	3923210095 Sacks And Bags Of Polymers Of Ethylene, Nesoi (ths)		$319,987,153	$353,691,710	$406,372,564	$474,371,930	13%
12	3923500000 Stoppers,lids,caps,& Other Closures,of Plastic (no)	$21,271,799	$155,455,206	$315,679,850	$339,445,216	$423,236,367	16%
13	9401806023 Child Safety Seats, Nesoi (no)			$319,542,307	$341,348,504	$407,160,035	20%
14	3924901050 Napkins,table Covers,mats,etc,of Plastic,nesoi (no)	$81,959,995	$155,013,866	$278,287,478	$295,665,162	$383,388,454	8%
15	9505104010 Artificial Christmas Trees, Of Plastic (no)	$121,737,001	$108,468,038	$247,719,156	$263,604,702	$359,008,835	7%
16	9401806021 Child Safety Seats With Detachable Hard-shell Seat (no)			$272,403,952	$285,886,839	$355,948,265	6%
17	3918101030 Vinyl Tile Floor Rigid Expanded Polymer Core Stn 2 (m2)					$348,964,502	N/A
18	3926100000 Office Or School Supplies Of Plastics (kg)	$90,932,272	$289,435,601	$321,956,476	$332,139,550	$344,560,431	8%
19	3923900080 Art For Conveying Or Packing Of Goods,plast,nesoi (no)	$37,908,624	$311,493,788	$389,218,685	$298,074,711	$341,170,892	13%
20	3918101040 Floor Coverings Of Vinyl Tile, Nesoi (m2)					$301,537,972	N/A
21	3926909910 Laboratory Ware (no)		$22,782,855	$86,659,939	$194,971,931	$281,404,396	31%
22	9603306000 Artists Brushes,writing Br,cosmetic Br,gt.10 Ea (no)	$34,195,243	$133,940,912	$278,723,952	$245,719,060	$278,209,140	12%
23	3924102000 Plates,cups,saucers,soup Bowls,etc,of Plastics (kg)	$59,603,194	$191,453,956	$312,568,912	$236,717,780	$268,332,324	8%
24	3923300090 Carboys, Bottle, Flasks & Similar Articles, Nesoi (kg)	$18,491,571	$110,965,540	$220,228,676	$261,690,165	$260,682,268	15%
25	9403708031 Furniture Of Plastics, Nesoi (no)			$192,920,306	$187,572,211	$212,542,230	2%
26	9403708015 Household Furniture Of Plastics, Nesoi (no)			$159,323,682	$153,950,044	$208,210,340	17%
27	3919905060 Self-adhs Plate,sheet,strip,etc Of Plastics,nesoi (m2)	$3,434,747	$82,738,861	$149,155,262	$172,938,512	$198,990,696	23%
28	3925900000 Builders' Ware Of Plastics,nesoi (no)	$12,311,929	$73,068,306	$144,032,518	$152,698,622	$198,206,343	16%
29	3923109000 Boxes,cases,crates&similar Artc,of Plastic Nesoi (kg)			$196,655,238	$155,616,395	$181,717,464	9%
30	3926305000 Fittings For Furniture,coachwork,etc,plastic,nesoi (kg)	$1,807,803	$26,630,904	$192,207,781	$142,072,591	$179,839,866	27%
31	3924902000 Picture Frames Of Plastics (no)	$79,747,879	$164,469,865	$162,771,381	$165,541,274	$179,363,741	4%
32	9608200000 Felt Tipped & Other Porous-tipped Pens & Markers (grs)	$23,044,268	$107,883,476	$169,657,365	$159,095,838	$177,226,731	11%
33	3926209050 Art Of Apparel & Clothing Accessories,plast,nesoi (doz)	$108,966,054	$235,511,134	$159,568,136	$420,778,430	$160,068,688	8%
34	3923290000 Sacks & Bags(including Cones) Of Other Plastics (kg)	$105,481,409	$155,046,382	$204,427,814	$152,214,418	$157,706,306	3%
35	9608100000 Ball Point Pens (no)	$78,084,457	$216,110,889	$224,954,073	$150,273,068	$149,814,095	5%
36	3925301000 Blinds(including Venetian Blinds)of Plastic (no)	$248,655,813	$356,008,476	$276,713,920	$151,820,817	$149,088,380	-1%
37	3922100000 Baths,shower Baths & Washbasins,of Plastic (no)	$1,605,419	$13,649,759	$97,278,109	$114,031,212	$148,324,656	26%
38	3924901010 Curtains & Drapes,of Plastic (kg)	$70,824,831	$101,166,302	$111,646,891	$125,406,590	$147,067,468	4%
39	9603210000 Tooth Brushes, Incl Dental-plate Brushes (no)	$32,976,626	$117,258,614	$156,772,653	$134,701,896	$140,050,144	11%
40	3920100000 Plates,sheets,etc,noncell, Not Reinf,polm Ethylene (kg)	$4,095,046	$57,544,455	$111,468,546	$113,546,110	$138,263,350	22%
41	9401804001 Children's Seats, Etc Of Rubber Or Plastics, Nesoi (no)			$89,775,398	$115,753,575	$126,227,778	20%
42	3917400090 Other Fittings For Tubes,pipes & Hoses,of Plastic (kg)	$2,352,908	$43,713,369	$86,675,325	$89,651,803	$122,542,347	24%
43	3926204010 Disposable Gloves,of Plastic,nesoi (dpr)	$8,058,482	$25,691,765	$60,933,371	$89,634,718	$111,528,176	15%
44	3923210030 Bags Polyethylene Integral Extruded Closure Nesoi (ths)			$130,330,049	$142,598,161	$110,321,359	11%
45	9603298010 Hairbrushes, Valued Over .40 Each (no)	$41,148,845	$64,242,080	$117,450,994	$89,119,514	$108,976,754	6%
46	3923300010 Carboys, Bottle, Etc. Of Capacity Not Gt= 50 Ml (ths)	$2,889,089	$58,183,203	$132,409,999	$107,734,633	$108,841,230	21%
47	3922200000 Lavatory Seats & Cover,of Plastic (no)	$2,357,072	$35,663,407	$70,324,940	$87,793,065	$101,631,407	22%
48	3917390020 Tubes,pipe & Hose,not Rigd,not Rein W Metal,of Pvc (kg)	$462,099	$41,925,258	$74,294,519	$67,123,593	$95,315,854	48%
49	3917390010 Tubes,pipes & Hoses,not Rigid,reinf With Metal (kg)	$132,961	$11,867,534	$86,451,997	$81,597,337	$90,206,501	57%
50	9603404060 Paint,distemper/siml Brushes Exc Subhdg 960330,nes (no)	$17,871,214	$54,725,913	$65,728,766	$92,404,564	$90,098,048	9%

SOURCE: U.S. CENSUS BUREAU

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U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
51	3917390050 Tubes,pipe & Hose,not Rigid,not Rein W Metal,nesoi (kg)	$1,342,443	$13,899,653	$67,093,857	$64,518,304	$88,178,691	45%
52	3925200010 Doors And Door Frames, Of Plastic (no)	$443,249	$24,383,256	$57,292,208	$63,105,729	$85,129,938	108%
53	3918102000 Floor Coverings Of Polymrs Of Vinyl Chloride,nesoi (m2)	$745,577	$44,176,058	$86,988,326	$23,305,930	$72,101,227	58%
54	3926201050 Gloves,seamless,excp Surg & Medical,not Disp,plast (dpr)	$2,136,329	$7,585,564	$7,917,896	$46,515,422	$71,675,177	45%
55	9615196000 Combs, Hair Slides And The Like, Nesoi (no)	$28,440,517	$63,887,435	$78,648,723	$64,137,490	$70,929,257	5%
56	9615114000 Hairslides & The Like,hard Rubbr/plast,no Imm Gems (no)	$78,258,343	$72,149,473	$59,234,261	$50,049,543	$70,900,578	1%
57	3926904590 Other Gaskets And Washers & Other Seals (no)	$675,929	$16,160,537	$64,221,022	$50,596,366	$65,461,225	28%
58	3921901100 Plates,etc,pls,ex Cel,tex Lt=1.492kg/m2,m-m Gt 70% (m2)		$12,005,342	$43,508,514	$38,694,793	$58,960,733	23%
59	3924103000 Trays,of Plastic (no)	$9,200,274	$35,020,566	$55,705,248	$46,633,576	$56,393,048	10%
60	3920435000 Plates,sheets,etc, Not Rein, <6% Plasticzrs, Nesoi (kg)		$34,328,695	$21,298,326	$41,720,576	$55,999,971	14%
61	3926901000 Buckets & Pails,of Plastic (no)	$793,385	$17,111,199	$51,476,213	$49,635,698	$55,429,451	27%
62	9403704031 Furniture Of Reinforced/laminated Plastics, Nesoi (no)			$72,419,498	$58,106,220	$52,430,704	19%
63	3925305000 Shutters & Similr Articles & Parts,of Plast,nesoi (no)	$14,940,387	$30,621,740	$42,053,577	$34,099,363	$48,948,947	8%
64	3921125000 Plates,sheets,etc,cell,plym Of Vinyl Chlorid,nesoi (kg)	$383,031	$1,908,593	$19,644,307	$27,070,769	$46,459,366	37%
65	3921190000 Plates,sheets,film,foil & Strip,cell,of Oth Plast (kg)	$1,436,093	$16,432,975	$25,387,749	$35,065,044	$46,380,527	21%
66	3917330000 Tubes,pipes & Hoses,not Rigid,not Reinf,with Fit (kg)	$2,331,713	$13,108,506	$70,459,990	$50,494,573	$46,257,914	28%
67	3922900000 Bidets,lavatory Pans,similr Sanitary Ware,plastic (no)	$3,096,008	$11,966,214	$38,091,166	$46,443,218	$44,888,460	19%
68	3925200091 Door Thresholds Of Plastics (no)		$17,177,358	$41,643,217	$34,596,675	$43,855,329	24%
69	3923210020 Bags Of Polyethylene With Slider To Open And Close (ths)			$54,330,357	$46,217,406	$43,590,529	18%
70	3926903000 Parts For Yachts Or Pleasure Boats,etc (kg)	$657,750	$8,051,398	$25,348,359	$23,553,949	$42,650,712	32%
71	9401903580 Seat Parts Of Rubber Or Plastics, Nesoi (no)			$53,293,152	$31,114,070	$41,975,764	-11%
72	3919102055 Self-adhs Plate,sheet,strip,etc In Rolls,w<=20cm (m2)	$3,035,290	$26,736,665	$40,824,450	$35,057,764	$41,936,833	18%
73	3917320050 Tubes,pipes & Hose,not Rigid,not Rein,no Fit,nesoi (kg)		$35,592,299	$50,378,242	$40,002,620	$41,102,180	13%
74	3926301000 Handles & Knobs Of Plastics For Furn,coachwork,etc (kg)	$2,040,133	$27,854,943	$46,566,931	$34,463,334	$40,715,166	21%
75	3926903500 Beads,bugles,spangles,not Strung,etc,& Art Thereof (kg)	$17,149,368	$24,358,194	$47,043,232	$36,495,492	$39,808,015	6%
76	3926904800 Photo Albums (no)		$86,366,704	$37,454,774	$30,790,382	$39,216,638	1%
77	9603500000 Othr Brushes,as Parts Of Machines,appliance,vehicl (no)	$1,819,972	$20,713,971	$29,781,453	$32,534,586	$38,192,825	29%
78	9401806028 Household Seats, Nesoi (no)			$16,334,744	$16,462,067	$36,901,358	14%
79	3926902500 Handles & Knobs,of Plastic,nesoi (kg)	$2,649,283	$16,459,652	$28,483,736	$26,407,340	$35,733,880	16%
80	9505104020 Plast Artcl For Christmas Festivities & Pts & Acc (no)	$61,939,236	$25,747,862	$30,648,758	$26,486,553	$34,714,904	1%
81	9603298090 Shaving Brushes, Nail Brush,etc,valued Over .40 Ea (no)	$5,621,743	$10,615,984	$33,604,723	$31,439,654	$34,700,996	11%
82	3921904090 Plates,sheets,etc,plas,ex Cell,flexible,nesoi (kg)	$1,323,938	$31,700,046	$53,280,960	$39,937,754	$33,248,586	23%
83	9615903000 Hair Pins (kg)	$4,562,638	$32,795,890	$27,881,592	$24,419,539	$32,552,348	12%
84	3925200020 Windows And Window Frames Of Plastics (no)		$2,422,244	$17,810,167	$24,329,988	$31,568,362	42%
85	3920200055 Plates,sheets,etc,noncell, Not Rein,polm Propylene (kg)			$27,744,060	$23,783,090	$31,389,827	-6%
86	9403704015 Household Furniture Reinfrcd/lamintd Plastic Nesoi (no)			$31,728,510	$29,139,259	$30,573,991	16%
87	9401804046 Seats Of Rubber Or Plastics, Nesoi (no)			$22,858,291	$20,005,560	$30,463,340	7%
88	9405920000 Lamps Parts Of Plastics (kg)	$18,774,376	$22,467,855	$34,545,550	$25,005,495	$30,408,319	5%
89	3917320020 Tubes,pipe & Hose,not Rigd,not Rein,no Fit,polyeth (kg)		$5,103,456	$7,404,272	$20,338,571	$29,639,709	28%
90	9401806030 Seats, Nesoi (no)	$5,655,352	$40,847,322	$23,417,153	$18,719,923	$28,486,709	13%
91	3918901000 Floor Coverings Of Other Plastics (m2)	$4,889,130	$11,864,244	$32,608,266	$21,532,631	$28,399,170	14%
92	9401802031 Seats Of Reinforced Or Laminated Plastics, Nesoi (no)			$30,461,697	$21,572,260	$27,626,121	14%
93	9603402000 Paint Rollers (no)	$2,332,999	$17,370,493	$27,553,765	$30,076,000	$27,026,251	17%
94	9615115000 Hair Slides & The Like,hard Rubber/plast,nesoi (no)	$9,514,879	$10,214,338	$13,834,912	$15,495,457	$26,609,215	12%
95	3919102030 Transparent Tape, Length <= 55 M, Width <= 5 Cm (m2)	$3,959,969	$12,571,315	$16,324,661	$22,476,110	$26,204,109	12%
96	9605000000 Travel Sets For Personal Toilet,etc (no)	$17,835,226	$16,355,094	$26,821,994	$27,830,090	$25,826,278	2%
97	3921901950 Plates,etc,plas,ex Cel,tex Lt=1.492 Kg/m2,nesoi (m2)	$3,148,146	$40,263,196	$24,609,011	$22,204,224	$24,483,222	16%
98	3926902100 Ice Bags, Douche Bags, Etc, And Fittings Therefor (no)		$14,517,437	$18,264,521	$18,298,286	$23,213,054	10%
99	3924101000 Salt,pepper,mustard,ketchup & Similr Disp,plastic (no)	$5,824,082	$11,395,437	$15,762,914	$14,931,903	$22,255,280	8%
100	3926209010 Aprons,of Plastic (doz)	$6,561,053	$18,359,944	$25,663,759	$30,231,650	$22,141,662	7%

SOURCE: U.S. CENSUS BUREAU

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U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
101	9505105010 Artificial Christmas Trees, Except Plastic (no)	$21,844,515	$9,737,687	$18,968,322	$18,756,842	$21,337,338	5%
102	9603908020 Upright Brooms (no)	$128,469	$10,454,536	$24,557,325	$22,096,413	$20,145,830	35%
103	3920992000 Film,strip & Sheets,noncel,n Rein,oth Pl,flx,nesoi (kg)	$2,309,967	$14,386,710	$21,574,231	$15,737,048	$19,850,736	15%
104	3918105000 Wall Or Ceiling Coverng,of Polymrs Vin Chlor,nesoi (m2)		$2,780,928	$13,993,213	$13,395,419	$19,815,637	66%
105	3926904000 Imitation Gemstones (kg)	$3,560,742	$11,717,802	$17,718,016	$17,856,882	$19,806,957	12%
106	9401802011 Household Seats Reinforced/laminated Plastic Nesoi (no)			$11,218,687	$15,633,351	$19,564,008	13%
107	9615113000 Combs,val Over $4.50 Pr Gross,plastic (grs)	$8,597,650	$19,050,121	$19,127,657	$17,631,130	$18,482,904	4%
108	9403708003 Play Yards And Other Enclosures Of Plastics, Nesoi (no)			$10,104,119	$18,095,303	$18,464,157	85%
109	3926909950 Plastic Facemasks, Shields, Wipes Disp Medical Etc (no)				$43,998,192	$18,038,966	-59%
110	3920490000 Plates,sheets,etc Of Polymrs Of Vnyl Chlor, Nesoi (kg)		$17,950,145	$18,009,636	$12,217,142	$17,948,408	6%
111	9401804026 Household Outdoor Seats Of Rubber/plastics, Nesoi (no)			$8,659,118	$8,152,819	$17,917,513	13%
112	9615902000 Nonthermic,nonornamental Devices For Curling Hair (no)	$9,696,276	$16,457,139	$14,971,682	$14,071,137	$17,623,075	4%
113	3923210085 Polyethylene Retail Carrier Bags With Handles (ths)		$111,674,666	$25,617,319	$16,608,245	$17,107,627	1%
114	3920620090 Plates,etc,noncel,n Rein,polyethylene Terephthlate (kg)		$19,945,745	$18,174,737	$14,336,362	$15,961,983	25%
115	3926206000 Plast Rainwr,incl Jacket,coat,etc,val N/o $10 Unit (doz)	$51,220,197	$33,929,519	$27,414,986	$16,818,874	$15,668,991	-4%
116	3926904510 O-rings (no)	$251,395	$5,234,028	$16,189,446	$12,505,925	$15,542,306	38%
117	9603304000 Artists Brushes,writ Br,cosmet Br,gt .05,lt=.10 Ea (no)	$3,735,910	$11,427,051	$10,915,916	$14,975,558	$15,486,164	9%
118	9615194000 Combs,valued Over $4.50 Per Gross,nesoi (grs)	$3,457,699	$13,675,968	$15,861,831	$14,643,110	$15,187,487	9%
119	9403704003 Play Yards Etc Of Reinforced Or Laminated Plastics (no)			$7,994,545	$15,730,878	$15,167,187	82%
120	9603404040 Natural Bristle Brushes, Exc Subhdg 9603.30 (no)	$413,472	$671,532	$13,720,531	$14,559,110	$14,485,486	30%
121	9615906000 Parts Of Combs,hair Slides & The Like,nesoi (no)	$13,340,490	$10,664,433	$8,992,430	$8,930,334	$14,246,928	3%
122	3921135000 Plates,sheets,film,etc,cell,of Polyurethane,nesoi (kg)	$140,390	$49,900,493	$5,681,712	$8,150,882	$13,981,932	52%
123	3926203000 Gloves Spec Designed For Sports,of Plastic,nesoi (no)	$1,805,648	$11,830,847	$11,668,882	$13,719,576	$13,350,821	13%
124	3926909930 Ladders Of Plastics/other Materials 3901-3914 (no)		$702,695	$14,163,084	$9,561,038	$13,310,798	38%
125	3921121100 Plates,etc,cell,plm Vy Chlo,m-m Fb Prd,gt 70% Pls (m2)	$444,080	$13,161,509	$13,760,179	$16,760,107	$13,281,713	45%
126	3926903300 Handbags Of Beads,bugles & Spangles (no)	$3,725,356	$7,280,907	$14,399,607	$7,150,930	$13,166,688	33%
127	3919102020 Electrical Tape, In Rolls Not Exceeding 20 Cm Wide (m2)	$692,527	$6,510,366	$11,549,332	$11,412,403	$12,869,278	23%
128	9608408000 Propelling Or Sliding Pencils,nesoi (grs)	$2,016,943	$27,800,477	$18,258,005	$11,421,243	$12,564,492	15%
129	3917210000 Tubes,pipes & Hoses,rigid,of Polymrs Of Ethylene (kg)	$93,678	$1,485,125	$11,515,401	$8,178,886	$12,509,583	66%
130	9401804035 Outdoor Seats Of Rubb/plts, Not Text Cover Seat Mt (no)	$1,800,949	$14,150,198	$11,012,239	$9,738,755	$12,362,285	14%
131	3926901600 Pacifiers (grs)		$5,430,787	$12,964,843	$10,223,220	$12,038,120	5%
132	3920515000 Plates,etc,noncel,n Rein,plymethyl Methacrylat,nes (kg)	$1,116,328	$3,252,472	$6,581,398	$20,371,013	$11,490,442	80%
133	3919905040 Transparent Tape, In Rolls Exceeding 20 Cm Wide (m2)	$475,072	$12,467,234	$5,663,009	$9,284,124	$11,229,113	24%
134	9615904000 Parts Of Combs,etc,of Rubbr/plast,no Gemstones (no)	$11,554,091	$9,061,269	$9,434,743	$8,000,606	$11,171,838	2%
135	9603294010 Hairbrushes, Valued Not Over .40 Each (no)	$16,972,961	$12,623,524	$12,016,145	$10,911,254	$10,799,887	-2%
136	3921905050 Plates,sheets,etc,plas,ex Cell,ex Flex,nesoi (m2)	$1,195,234	$8,079,973	$7,521,723	$13,494,021	$10,769,706	24%
137	3923102000 Bx,cas,crat, Plst Sp Shp Pk Cnv Sh392310/848690 (kg)			$7,706,901	$7,922,453	$10,280,095	7%
138	3917230000 Tubes, Pipes & Hoses, Rigid, Of Polym Of Vinyl Chl (kg)	$1,630,084	$12,074,026	$6,120,062	$6,310,877	$9,759,523	14%
139	3926400010 Bows & Alike Of Plastc For Decor, Includ Gift Pckg (no)			$8,247,499	$7,842,208	$9,717,916	-9%
140	9603904000 Feather Dusters (no)	$1,419,782	$2,089,665	$8,898,271	$7,825,667	$9,443,164	13%
141	3920610000 Plates,etc,noncel,n Rein,of Polycarbonates (kg)		$3,311,804	$5,821,418	$25,001,380	$9,426,368	173%
142	3917320010 Tubes,pipes & Hoses,not Rigid,not Rein,no Fit,pvc (kg)		$8,235,900	$5,959,340	$7,825,245	$9,382,460	16%
143	3917290090 Tubes,pipes&hoses,rigid,of Plastic,nesoi,>=200mm (kg)	$820,976	$5,743,987	$5,785,925	$6,208,273	$9,216,190	21%
144	3926908500 Fasteners,in Clips Suit For Use In Mech Att Device (kg)	$1,180,243	$3,783,677	$6,368,250	$5,800,741	$9,050,202	14%
145	3919901000 Self-adhes Plates,sheet,etc,light Refl,glass Grain (kg)	$2,975,167	$5,105,003	$8,842,114	$8,304,642	$8,765,399	7%
146	9403704002 Toddler Beds, Etc Of Reinforced/laminated Plastics (no)			$1,893,059	$4,671,069	$8,685,833	57%
147	9401806025 Seats For Children, Nesoi (no)			$16,918,199	$7,362,679	$8,403,946	4%
148	3926909905 Elastic Bands Made Wholly Of Plastics (kg)			$6,099,103	$10,894,312	$7,910,428	3%
149	3920620050 Metallized Poly(ethylene Terephthalate) Film, Nes (kg)		$5,966,557	$7,070,293	$5,610,115	$7,689,149	7%
150	3926204050 Gloves,of Plastic,nesoi (dpr)	$946,167	$1,539,050	$5,759,041	$5,261,163	$7,464,293	23%

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Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
151	3917220000 Tubes,pipes & Hoses,rigid,of Polymers Of Propylene (kg)	$458,335	$2,863,501	$4,507,978	$4,288,964	$7,341,354	18%
152	3917310000 Flex Tubes, Pipes & Hoses, Min Burst Pres=27.6mpa (kg)	$213,220	$8,506,051	$14,268,138	$7,288,135	$7,188,683	58%
153	9401804004 Children's Activity Centers, Rubber/plastics Nesoi (no)			$8,765,053	$7,300,181	$6,993,718	382%
154	9401802001 Children's Seats Etc Reinforced/laminated Plastics (no)			$14,544,717	$7,735,259	$6,987,531	34%
155	3923400050 Spools,cops,bobbins & Similar Supports,plast,nesoi (kg)	$13,215,123	$1,809,855	$3,942,336	$5,537,741	$6,573,101	1%
156	3920690000 Plates,etc,noncel,n Rein,of Other Polyesters,nesoi (kg)	$3,348,431	$4,017,098	$3,644,080	$5,222,680	$6,388,413	11%
157	3920991000 Film,strip,shts,noncel,oth Pl,flx,lt .152mm,nt Rol (kg)	$104,912	$631,695	$5,203,778	$4,489,063	$6,360,332	260%
158	3923900012 Plastic Buckets & Pails, With Cap Lt 11.36 Ltrs (no)	$332,968	$5,209,219	$5,984,296	$5,277,128	$6,347,704	19%
159	9603294090 Shaving Brushes,nail Brus Etc,lt=.40 Ea (no)	$4,839,439	$6,929,220	$5,440,314	$5,796,472	$6,335,773	2%
160	9608300039 Fountain Pens,stylograph Pens And Other Pens,nesoi (no)			$5,684,053	$5,709,623	$6,291,760	7%
161	9603404020 Paint Pads (no)	$236,378	$6,869,921	$6,199,632	$5,717,112	$6,039,242	21%
162	3921901500 Plates,etc Pls,ex Cel,text Lt=1.492kg/m2,m-m,nesoi (m2)		$699,597	$15,424,425	$13,688,096	$5,866,695	163%
163	3924905610 Gates, Of Plastics, For Confining Children Or Pets (no)			$6,953,554	$5,631,534	$5,864,728	-5%
164	3921131500 Plates,etc,cell,polyurethan,m-m Fb Pred,nesoi (m2)		$1,859,469	$10,169,311	$8,690,039	$5,745,178	54%
165	9401804015 Outdoor Seats Of Rubber Or Plst, W Text Cover Seat (no)	$1,732,767	$4,935,993	$4,126,727	$3,360,896	$5,447,281	16%
166	3921121500 Plates,etc,cell,plm Vy Chlo,m-m Fb Pred,nesoi (m2)		$153,141	$4,006,082	$4,185,587	$5,125,221	1444%
167	9603908040 Other Brooms,nesoi (no)	$1,336,134	$8,727,522	$8,097,912	$4,436,497	$5,120,952	25%
168	3926906090 Belting & Belts For Machinery,nesoi (kg)	$750,201	$2,378,701	$3,771,110	$3,463,665	$4,702,022	18%
169	3918905000 Wall Or Ceiling Coverings,of Other Plastics,nesoi (m2)	$37,809	$956,515	$5,578,015	$3,771,353	$4,375,856	55%
170	3924900500 Nursing Nipples And Finger Cots (grs)		$2,003,854	$2,809,269	$3,380,358	$4,312,313	13%
171	3920511000 Plates,etc,noncel,n Rein,polymethyl Methacryla,flx (kg)	$1,460,779	$458,764	$723,314	$9,377,114	$4,271,512	145%
172	9608996000 Parts Of Pens,etc,nesoi (no)	$669,299	$3,868,581	$3,214,377	$2,836,775	$4,145,144	19%
173	3926909940 Covers, Rings, Frames For Manholes (no)			$2,442,532	$2,908,909	$3,994,724	75%
174	3920910000 Plates,etc,noncel,n Rein,of Polyvinyl Butyral (kg)		$162,789	$7,030,321	$1,501,395	$3,809,600	118%
175	3926905000 Frames Or Mounts For Photographic Slides (kg)	$3,299,808	$2,089,489	$3,444,311	$2,954,065	$3,806,825	4%
176	3920995000 Plates,foil,noncel,n Rein,of Other Plastics,nesoi (kg)	$1,895,757	$2,384,129	$2,964,401	$2,984,107	$3,788,660	10%
177	9603302000 Artists Brushes,writing Brush,cosmet Br,lt=.05 Ea (no)	$3,309,125	$3,893,087	$3,162,094	$3,171,921	$3,561,295	2%
178	9403704020 Office Furniture Of Reinforced/laminated Plastics (no)	$986,940	$2,974,103	$3,641,448	$2,913,200	$3,559,556	21%
179	9615112000 Combs,val Over $4.50 Pr Gross,of Hard Rubber (grs)	$408,338	$1,140,169	$984,378	$1,257,929	$3,549,410	112%
180	3921110000 Plates,sheets,film,foil,strip,cell,plym Of Styrene (kg)	$38,389	$1,089,434	$2,732,203	$2,108,121	$3,518,742	55%
181	3920200020 Gift Wrap Of Polymers Of Propylene (kg)		$4,920,850	$3,469,117	$2,936,013	$3,330,067	-4%
182	3921902510 Plates,etc,plas,ex Cel,tex Gt 1.492 Kg/m2,gt 70%pl (m2)		$1,202,274	$1,409,206	$1,535,843	$3,287,540	47%
183	3921121950 Plates,etc,cell,plm Vy Chlo,comb W Text Mat,nesoi (m2)	$850,613	$11,819,319	$2,696,622	$3,429,001	$3,275,082	22%
184	3919102040 Transparent Tape Not Exceeding 55m In Length,w>5cm (m2)	$149,018	$3,908,627	$2,793,018	$2,270,117	$3,268,515	23%
185	9608404000 Propelling Or Sliding Pencils,w Mechanical Action (grs)	$3,522,240	$8,267,458	$6,614,762	$4,171,315	$3,263,115	5%
186	9403708020 Office Furniture Of Plastics, Nesoi (no)	$681,907	$3,545,347	$5,151,807	$3,365,249	$3,248,951	18%
187	3919101050 Tape,in Rolls Nt Excd 20 Cm W, Lght-reflect, Nesoi (kg)	$119,878	$1,196,339	$2,125,310	$2,316,672	$3,054,967	32%
188	3926909925 Reflective Triangular Warning Signs For Road Use (no)		$919,815	$2,975,643	$2,270,307	$3,026,880	12%
189	3920300000 Plates,sheets,etc, Noncell,not Rein,polym Styrene (kg)	$1,112,083	$4,996,224	$8,757,543	$3,687,430	$2,795,258	25%
190	3920431000 Plates,sheets, Etc,pvc, Imitation Patent Leather (m2)		$935,647	$914,948	$1,586,532	$2,782,286	26%
191	3923210011 Recl Sacks & Bags Of Ethylene With No Side Gt=75mm (ths)	$625,230	$6,763,406	$4,394,782	$2,530,266	$2,691,970	19%
192	3926907700 Waterbed Mattresses & Liners & Parts Thereof (no)	$3,446,117	$1,577,205	$2,818,057	$3,039,564	$2,673,515	3%
193	9607190060 Slide Fasteners,nesoi (no)	$1,202,946	$2,240,399	$2,556,037	$1,977,162	$2,617,269	7%
194	9606108000 Press-fasteners,snap-fasteners,etc,val Gt.20 Pr Dz (grs)	$694,852	$2,821,790	$2,082,980	$1,755,898	$2,579,475	16%
195	3921131100 Plates,etc,cell,polyurethan,m-m Fb Pred Gt 70% Pl (m2)	$19,319	$1,676,090	$2,068,912	$3,573,101	$2,504,667	162%
196	9608994000 Parts Of Art In 9608.10,9608.31,9608.39 (no)	$608,476	$2,591,151	$5,426,287	$3,021,574	$2,415,575	16%
197	3919905010 Self-adhesive Reflectorized Sheeting Of Plastics (m2)	$74,475	$275,721	$1,318,091	$1,020,869	$2,396,523	43%
198	3921140000 Plates,sheets,film,etc,cell,of Regenerat Cellulose (kg)	$87,243	$108,430	$1,537,677	$1,116,790	$2,147,611	81%
199	9603908030 Push Brooms, 41 Cm Or Less In Width (no)	$12,977	$393,554	$706,271	$1,386,061	$1,934,943	87%
200	9401903510 Parts Rubber/plastics For Highchairs/children Seat (no)			$1,634,815	$1,735,608	$1,917,264	-5%

SOURCE: **U.S. CENSUS BUREAU**

NOTE: **U.S. plastic-based imports from China by dollar amount during the years 2000 to 2021.** The product groupings are categorized down to the ten-digit Harmonized Code (HS) level. This is the most detailed aggregated import data that can be acquired from the U.S. Census Bureau. **The average annual growth rate is calculated from all the years of 2000 to 2021.** Not all categories existed in 2000. Categories are created and become more detailed as imports increase.

U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
201	3926906550 Clothespins,spring Type,val Gt $1.70 Pr Gross (grs)	$495,505	$1,179,471	$1,321,634	$1,831,217	$1,911,856	11%
202	9606216000 Buttons,plastic,not Cov With Textile Mat,nesoi (grs)	$2,231,099	$2,773,006	$1,709,329	$1,470,795	$1,908,058	2%
203	3920920000 Plates,ets,noncel,n Rein,of Polyamides (kg)	$47,092	$819,702	$1,966,755	$1,267,415	$1,788,099	38%
204	9404210095 Mattresses Of Cellular Rubber Or Plastics, Nesoi (no)			$108,827,375	$1,903,370	$1,709,828	-27%
205	3926905900 Belting & Belts,for Mach,cont Text Fibr,nesoi (kg)	$13,838	$308,175	$1,255,086	$2,401,042	$1,671,245	60%
206	9608910000 Pen Nibs And Nib Points (grs)	$17,136	$567,150	$1,785,926	$1,031,727	$1,591,953	82%
207	9607200040 Sliders,with Or Without Pulls (ths)	$290,384	$1,444,213	$1,313,531	$661,159	$1,578,571	20%
208	3920632000 Plates,etc,noncel,n Rein,of Unsat Polyesters,nesoi (kg)	$491,625	$5,586,476	$1,019,982	$1,242,973	$1,577,090	252%
209	3926202000 Baseball & Softball Gloves & Mits Of Plastic (no)	$9,705,963	$4,563,342	$3,573,897	$1,558,765	$1,468,537	-6%
210	3920598000 Plates,etc,noncel,n Rein,of Oth Acrylic Polym,neso (kg)	$90,293	$652,958	$1,129,862	$2,400,326	$1,458,347	88%
211	3919102010 Filament Reinforced Tape, In Rolls, Width<=20cm (m2)	$64,694	$1,656,228	$1,257,015	$1,525,669	$1,412,616	25%
212	3917290050 Tubes,pipes&hoses,rigid,of Plastic, Nesoi, <200mm (ths)	$12,838	$466,694	$1,035,190	$1,391,109	$1,285,870	39%
213	9401804006 Household Outdoor Seat Txtile Cover Rubber/plastic (no)			$1,913,415	$2,014,622	$1,284,611	6%
214	3923900016 Plastic Buckets & Pails, W/cap 22.71 Ltrs Or More (no)	$49,614	$705,379	$2,119,313	$1,597,923	$1,241,406	44%
215	3923210080 Sacks/bags, Polymer Of Ethylene, W/no Side Gt=75mm (ths)	$894,265	$4,638,453	$1,276,597	$763,711	$1,199,972	15%
216	9615111000 Combs,of Hard Rubbr Or Plast,val Lt=$4.50 Pr Gross (grs)	$266,581	$1,220,218	$1,769,759	$1,088,695	$1,125,853	11%
217	3923900014 Plast Buckets & Pails, W Gt=11.36 & Lt 22.71 Ltrs (no)	$72,250	$491,216	$1,374,203	$1,531,399	$1,112,557	52%
218	3925100000 Reservoirs, Tanks, Etc Of Plastic, Capacity>300 L (no)	$2,327	$343,068	$820,501	$669,611	$1,087,140	142%
219	3926908700 Flexible Plastic Doc Binders With Tabs,rolled/flat (no)	$4,171,718	$4,285,541	$1,981,531	$837,983	$1,087,083	-3%
220	9606296000 Buttons,nesoi (grs)	$559,028	$823,092	$964,210	$882,854	$1,040,836	15%
221	9607190020 Slide Fasteners Fitted W Chain Scoops Of Plastic (no)	$1,484,334	$452,439	$1,015,854	$1,106,369	$1,010,282	3%
222	9607200080 Parts Of Slide Fasteners,nesoi (no)	$545,877	$456,019	$874,025	$618,960	$974,367	9%
223	3919905030 Electrical Tape, In Rolls Exceeding 20 Cm Wide (m2)	$147,466	$1,298,883	$806,271	$868,708	$970,970	15%
224	3926909400 Cards,not Punchd,use In Making Jacquard Cards,etc (no)	$65,775	$348,421	$969,741	$632,444	$904,749	62%
225	9606104000 Press Fastener,snap Fastener,etc Val Lt=.20 Pr Dz (grs)	$274,203	$1,215,754	$488,303	$1,038,982	$904,038	20%
226	9607190040 Slide Fasteners Fitted W Continuous Plast Filamen (no)	$232,370	$424,694	$536,872	$775,350	$897,116	32%
227	3926907000 Clothespins,nesoi (grs)	$157,873	$265,435	$592,158	$347,313	$880,932	32%
228	9608600000 Refils For Ball Pt Pens,comrising Ball Pt & Ink Rs (no)	$503,558	$936,856	$1,247,828	$967,490	$870,729	8%
229	3921902900 Plates,etc,plas,ex Cel,tex Gt 1.492 Kg/m2,nesoi (kg)	$43,244	$720,544	$719,053	$948,100	$864,346	55%
230	3921902100 Plates,etc,plas,ex Cel,tex Gt 1.492 Kg/m2,cotton (m2)		$9,925	$1,109,282	$696,507	$857,945	1635%
231	3917106000 Artificial Guts(sausage Casing)of Collagen (kg)		$44,597	$211,421	$651,888	$773,486	116%
232	3920591000 Plates,etc,noncel,n Rein,of Oth Acrylic Polym,flex (kg)	$15,256	$438,229	$1,363,941	$1,399,618	$745,146	42%
233	3926909600 Casing For Bicycle Derailleur Cables; Etc,w/not Cu (kg)		$52,678	$837,560	$744,478	$722,236	48%
234	9403704001 Cribs Of Reinforced Or Laminated Plastics (no)			$368,662	$437,317	$710,956	193%
235	3920730000 Plates,etc,noncel,n Rein,of Cellulose Acetate (kg)	$475,236	$562,370	$519,520	$568,921	$679,080	99%
236	9606214000 Buttons,not Covd W Textil,of Acrylic/polyestr Resn (grs)	$448,178	$335,319	$768,412	$629,150	$673,475	11%
237	3918103150 Wall/ceiling Covr,polym Vin Chlor,m-m Tex,not Wovn (m2)		$58,733	$207,026	$203,772	$672,310	182%
238	9603908010 Wiskbrooms (no)	$136,312	$535,700	$1,311,628	$918,897	$599,508	17%
239	3920795000 Plates,etc,noncel,n Rein,of Oth Cellulos Der,nesoi (kg)	$156,372	$756,725	$750,010	$543,243	$579,237	23%
240	3920631000 Plates,etc,noncel,n Rein,of Unsat Polyesters,flex (kg)	$239,217	$1,985,821	$780,803	$529,581	$482,704	40%
241	9401802005 Children Activity Centers Reinfrcd/lamintd Plastic (no)			$1,484,008	$348,875	$475,164	47%
242	3926905600 Belting & Belts,for Mach,veg Fbr Predom Ov Oth Tex (kg)		$5,596,006	$172,803	$54,126	$450,067	25%
243	3921131950 Plates,sheets,film,foil & Strip,cellular,of Polyur (m2)	$230,818	$1,242,114	$653,815	$213,954	$446,381	44%
244	3920940000 Plates,etc,noncel, N Rein, Of Phenolic Resin (kg)		$161,866	$135,257	$205,487	$445,114	216%
245	3926908300 Empty Cartridge & Cassette, Typewriter & Mach Ribs (no)	$1,131,495	$506,396	$416,559	$433,524	$424,458	22%
246	3920200015 Strip Pckg Decor/wrap Noncel, Nt Rein,polm Propyln (kg)			$344,229	$510,963	$404,210	2%
247	3921904010 Plates, Sheets, Etc, Reinforced W/ Paper Flexible (kg)		$4,250,650	$483,054	$190,854	$399,532	85%
248	3917101000 Artificial Guts(sausage Casings) Of Cell Plast Mat (kg)			$335,550	$126,594	$394,380	115%
249	3918902000 Wall Or Ceiling Coverings,othr Plast,back M-m Text (m2)		$32,418	$149,180	$111,119	$357,272	655%
250	9406900050 Animal Sheds Of Plastic (no)			$305,017	$229,888	$355,288	-6%

SOURCE: U.S. CENSUS BUREAU

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U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
251	9603109000 Brooms & Brushes,of Twigs Or Veg Material,nesoi (no)	$1,030,656	$509,636	$186,254	$258,519	$334,262	9%
252	3919905020 Filament Reinforced Tape, In Rolls Exceeding 20 Cm (m2)	$8,199	$652,379	$428,644	$333,093	$329,261	58%
253	9608992000 Refill Cartridges (no)	$60,335	$216,391	$617,777	$406,437	$323,058	82%
254	3919101010 Pavement Marking Tape In Rol Nt Excd 20 Cm Wide (m2)		$47,922	$634,331	$411,822	$321,712	313%
255	3918903000 Wall/ceiling Covrs,othr Plast,back Textile,not M-m (m2)		$47,255	$241,558	$193,905	$314,233	40%
256	3917400010 Fittings For Vehicle Brake Hoses (kg)		$2,650,314	$3,432	$63,034	$309,050	4212%
257	3926906010 Synchronous Belts For Machinery (no)	$543	$166,348	$211,464	$446,825	$295,432	74%
258	9403708002 Toddler Beds Bassinets & Cradles Of Plastics Nesoi (no)			$11,707,961	$6,660,726	$277,051	55%
259	3926905500 Belting & Belts,for Mach,cont Text Fbr,v-belts (kg)	$244,922	$33,148	$95,928	$171,822	$276,721	29%
260	3920710000 Plates,etc,noncel,n Rein,of Regenerated Cellulose (kg)	$62,416	$256,259	$383,248	$324,430	$276,149	22%
261	3918103110 Wall/ceiling Covr,polym Vin Chlor,m-m Textile,woven (m2)			$153,722	$77,326	$249,189	1081%
262	9404210010 Mattress Cellular Rubber/plastics Crib/toddler Bed (no)			$1,748,911	$347,134	$240,802	-28%
263	3920620020 Gift Wrap Of Metallized Pet Film (kg)		$1,924,734	$277,254	$183,486	$211,857	50%
264	9404210013 Mtrses Of Clular Rbber Or Plstc,w>91c,l>184c,d>8cm (no)			$132,962,386	$472,806	$182,772	-3%
265	3920790500 Plates,etc,noncel,n Rein,of Cellulo Or Der,vlc Fbr (kg)		$106,863	$157,006	$40,646	$164,469	23%
266	3926906510 Clothespins,spring Type,val Lt= 80 Cents Pr Gross (grs)	$331,066	$147,394	$82,418	$108,622	$142,898	20%
267	9608500000 Sets Of Art Frm Two Or More Subhd 9608.10--9608.40 (no)	$4,571,702	$2,182,990	$509,274	$49,203	$116,427	9%
268	9608300031 India Ink Drawing Pens (no)			$92,739	$24,431	$105,311	40%
269	9603101500 Wiskbrooms,brm Corn,lt=.96 Ea,gt=61,655 Dz,cal Yr (no)	$2,840		$26,847	$58,332	$95,366	122%
270	3921905010 High Pressure Paper Reinforcd Decorative Laminates (m2)	$57,514	$695,501	$312,680	$95,942	$92,976	366%
271	9606212000 Buttons,of Plastic,not Coverd W Textiles,of Casein (grs)	$41,282	$325,829	$42,419	$45,203	$90,178	32%
272	9615192000 Combs,valued Not Over $4.50 Per Gross,nesoi (grs)	$25,011	$192,784	$455,927	$108,749	$88,984	54%
273	3917109000 Artificl Gut(sausage Casing)of Hardend Protein,nes (kg)		$16,315	$208,300	$40,971	$81,628	27%
274	9403708001 Cribs Of Plastics, Nesoi (no)			$2,804	$1,200	$78,343	831%
275	3926905700 Belting & Belts,for Mach,m-m Fbr Predom Ov Oth Tex (kg)	$1,401	$197,097	$726,886	$100,587	$73,385	94%
276	3926906520 Clothespins,spring Type,val Gt $.80,LT=$1.35/GROSS (grs)	$898,834	$104,036	$26,785	$70,711	$63,664	7%
277	3918103250 Wall/ceil Covr,poly Vin Chlor,m-m Tex,nt Wov,nesoi (m2)		$37,282	$9,456	$12,828	$58,093	469%
278	9603103500 Wiskbrooms,of Broomcorn,valued Over .96 Each (no)	$25,442	$24,331	$103,199	$84,755	$57,453	420%
279	3921902550 Plates,etc,plas,ex Cel,tex Gt 1.492KG/M2,M-M,NESOI (m2)		$279,858	$141,723	$40,526	$56,176	988%
280	9401806024 Stationary Activity Centers For Children, Nesoi (no)			$20,550	$15,990	$53,562	21565%
281	3918104010 Wall/ceiling Covr,poly Vin Chlo,text,not M-m,woven (m2)			$80,081	$488	$50,731	1256%
282	9603106000 Other Brooms,of Broomcorn,valued Over .96 Each (no)			$30,652	$23,307	$31,824	101%
283	9608993000 Balls For Ball Point Pens (ths)	$290,566	$8,177	$94,030	$41,406	$29,911	50%
284	3918104050 Wall/ceiling Covr,poly Vin Chlo,tex,nt M-m,nt Wovn (m2)		$52,579	$51,329	$9,231	$29,490	461%
285	3920791000 Film,strip & Sheets,lt=0.076 mm Thick,oth Celu Der (kg)	$9,558	$3,919	$21,617	$22,910	$27,337	64%
286	3926906530 Clothespins,spring,val Gt $1.35,lt=$1.70/gross (grs)	$130,771	$58,508	$198,806	$26,140	$27,069	39%
287	3918103210 Wall/ceil Covr,polym Vin Chlor,m-m Text,wov, Nesoi (m2)		$6,123	$5,996		$25,614	-87%
288	3923400010 Photographic Film Reels & Reel Cans,of Plastic (kg)		$12,069	$41,745	$81,217	$14,298	159%
289	3921121910 Plates,etc,cell,plm Vy Chlo,veg Fbr Prd Ov Oth Tex (m2)	$6,443	$42,873	$12,253	$25,173	$11,608	31%
290	9603100500 Wiskbrooms,brm Corn,lt=.96 Ea,lt 61,655 Dz Cal Yr (no)	$91,512	$6,672	$23,580	$24,782	$10,922	12%
291	3921901910 Plates,etc,plas,ex Cel,tex Lt=1.492kg/m2,veg Fb (m2)	$149,360	$22,074	$6,758	$21,104	$5,621	65%
292	3920930000 Plates,etc,noncel, N Rein, Of Amino-resins (kg)		$3,330	$32,592	$60,493	$3,068	460%
293	3920594000 Transparent Sheeting Gt= 30% By Weight Of Lead (kg)	$17,599	$28,173	$1,911	$4,252	$2,000	134%
294	3917105000 Artificial Guts(sausage Casing)of Hardened Protein (kg)						N/A
295	3917322000 Casing For Bicycle Derailleur Cables; Etc,w/not Cu (kg)	$85,842					-65%
296	3917326010 Tubes,pipes & Hoses,not Rigid,not Rein,no Fit,pvc (kg)	$1,169,633					-56%
297	3917326020 Tubes,pipe & Hose,not Rigd,not Rein,no Fit,polyeth (kg)	$511,850					3%
298	3917326050 Tubes,pipes & Hose,not Rigid,not Rein,no Fit,nesoi (kg)	$3,295,024					-39%
299	3920200000 Plates,sheets,etc,noncell, Not Rein,polm Propylene (kg)	$4,095,214					27%
300	3920200050 Plates,sheets,etc,noncell, Not Rein,polm Propylene (kg)		$35,677,897				-6%

SOURCE: U.S. CENSUS BUREAU

NOTE: U.S. plastic-based imports from China by dollar amount during the years 2000 to 2021. The product groupings are categorized down to the ten-digit Harmonized Code (HS) level. This is the most detailed aggregated import data that can be acquired from the U.S. Census Bureau. **The average annual growth rate is calculated from all the years of 2000 to 2021.** Not all categories existed in 2000. Categories are created and become more detailed as imports increase.

U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
301	3920410000 Plates,sheets,etc,noncell,nt Rein,polm Vy Chl,rigd (kg)	$1,706,586					-10%
302	3920421000 Plates,etc,noncell,n Rein,polm Vy Chl,fl,im Pt Lea (m2)	$288,072					-43%
303	3920425000 Plates,sheets,noncell,n Rein,polm Vy Chl,flx,nesoi (kg)	$10,207,646					-47%
304	3920595000 Plates,etc,noncel,n Rein,of Oth Acrylic Polym,neso (kg)						N/A
305	3920620000 Plates,etc,noncel,n Rein,polyethylene Terephthlate (kg)	$25,144,676					-41%
306	3920620010 Metallized Poly(ethylene Terephthalate) Film (kg)						35%
307	3920720000 Plates,etc,noncel,n Rein,of Cellulo Or Der,vlc Fbr (kg)	$126,861					0%
308	3921131910 Plates,etc,cell,polyurethan,veg Fb Prd Ov Oth Text (m2)		$932	$1,850			-32%
309	3921904025 Polyeth Tereph Film,rolls,coatd,for Therm Trn Ribn (kg)	$423,842					-46%
310	3921904050 Plates,sheets,etc,plas,ex Cell,flexible,nesoi (kg)						N/A
311	3923100000 Boxes,cases,crates & Similar Articles,of Plastic (x)	$96,451,642	$279,101,901				0%
312	3923210019 Recl Sack&bags Polym Of Ethylene W Extd Cls, Nesoi (ths)	$18,603,141	$131,459,473				7%
313	3923210090 Sacks&bags Of Polymers Of Ethylene Exc Recl, Nesoi (ths)	$107,276,208					-11%
314	3923900000 Art For Conveying Or Packing Of Goods,plast,nesoi (x)						N/A
315	3924105000 Tableware & Kitchenware,of Plastic,nesoi (x)	$220,188,876					-46%
316	3924905000 Household Articles & Toilet Articles,of Plast,neso (x)						N/A
317	3924905500 Household Articles & Toilet Articles,of Plast,neso (x)	$271,093,241					3%
318	3924905600 Household Articles & Toilet Articles,of Plast,neso (x)		$849,839,887				-24%
319	3925200000 Doors,windows & Their Frames,etc,of Plastic (x)						N/A
320	3925200090 Windows, Their Frames & Door Thresholds Of Plastic (x)	$4,107,462					-11%
321	3926205010 Aprons,of Plastic (doz)						N/A
322	3926205050 Art Of Apparel & Clothing Accessories,plast,nesoi (doz)						N/A
323	3926400000 Statuettes & Other Ornamental Articles,of Plastic (x)	$273,858,357	$251,013,938				-6%
324	3926901500 Nursing Nipples & Pacifiers (grs)	$1,982,327					10%
325	3926902000 Ice Bags,douche Bags,etc, & Fittings Therefor (x)	$2,035,304					11%
326	3926904500 Gaskets,washers & Other Seals (x)						N/A
327	3926909010 Laboratory Ware (x)						N/A
328	3926909025 Reflective Triangular Warning Signs For Road Use (x)						N/A
329	3926909090 Other Articles Of Plastic,nesoi (x)						N/A
330	3926909510 Laboratory Ware (x)						N/A
331	3926909525 Reflective Triangular Warning Signs For Road Use (x)						N/A
332	3926909590 Other Articles Of Plastic,nesoi (x)						N/A
333	3926909810 Laboratory Ware (x)	$2,076,816					4%
334	3926909825 Reflective Triangular Warning Signs For Road Use (x)	$146,963					23%
335	3926909830 Ladders Of Plastics/other Materials 3901-3914 (no)	$119,467					587%
336	3926909880 Other Articles Of Plastic,nesoi (x)	$352,678,803					-3%
337	3926909890 Other Articles Of Plastic,nesoi (x)						N/A
338	3926909980 Other Articles Of Plastic,nesoi (x)		$1,097,041,464				-4%
339	3926909990 Other Articles Of Plastic, Nesoi (no)			$2,489,658,743	$1,237,318,014		-19%
340	3926909995 Other Articles Of Plastic,nesoi (x)						-49%
341	3926909996 Other Articles Of Plastic,nesoi (x)						-76%
342	9401802010 Hshld Seats Of Reinforced Or Laminated Plastics (no)	$6,445,015	$7,294,082				6%
343	9401802030 Seats Of Reinforced Or Laminated Plastics (no)	$1,625,222	$5,301,195				32%
344	9401804005 Hshld Outdoor Seat Of Rubr/plst, W Text Cover Seat (no)	$1,512,117	$2,204,276				86%
345	9401804025 Hshld Outdr Seat Of Rub/plts, Nt Text Cov Seat Mtl (no)	$6,655,139	$13,357,314				6%
346	9401804045 Seats Of Rubber Or Plastics, Nesoi (no)	$22,425,704	$61,662,457				4%
347	9401806010 Household Seats, Nesoi (no)	$7,389,966	$54,300,032				13%
348	9401806020 Child Safety Seats (no)		$291,864,376				67%
349	9401903500 Seat Parts Of Rubber Or Plastics (x)	$8,652,314	$150,109,321				25%
350	9403704010 Househld Furniture Of Reinforced/laminated Plastic (x)	$4,384,329	$28,677,175				15%

SOURCE: U.S. CENSUS BUREAU

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U.S. Import Product List from China - Harmonized Code: 10 Digit

Row #	Product Type (Imported from China)	Year 2000	Year 2010	Year 2019	Year 2020	Year 2021	Avg. Annual Growth Rate
351	9403704030 Furniture Of Reinforced/laminated Plastics, Nesoi (x)	$1,617,409	$16,931,522				46%
352	9403708010 Household Furniture Of Plastics, Nesoi (x)	$23,590,158	$74,272,431				6%
353	9403708030 Furniture Of Plastics, Nesoi (x)	$9,051,365	$182,648,719				26%
354	9404210000 Mattress Of Cellular Rubber Or Plastics (no)	$138,676	$108,275,716				95%
355	9404210090 Mattresses Of Cellular Rubber Or Plastics, Nesoi (no)						2%
356	9406008050 Animal Sheds Of Plastic (no)	$1,964,607	$29,431				184%
357	9501004000 Toys,wheeled Ridden By Children, Nesoi (x)	$261,316,239					-8%
358	9505906010 Hats, Of Paper, Foil Or Plastics (doz)						N/A
359	9603101000 Wiskbrooms,of Brm Corn,<=.45 Ea,<61,655 Dz Cal Yr (no)						N/A
360	9603102500 Wiskbrooms,of Brm Corn,<=.45 Ea,>=61,655 Dz,cal Yr (no)						N/A
361	9603103000 Wiskbrooms,of Broomcorn,valued Over .45 Each (no)						N/A
362	9603104000 Oth Brooms,brm Corn,lt=.96 Ea,lt 121,478 Dz,cal Yr (no)						66%
363	9603105000 Brooms,of Brm Corn,lt=.96 Ea,gt=121,478 Dz,cal Yr (no)	$35,269					9%
364	9603210040 Toothbrushes,mechanical (no)						N/A
365	9603210080 Toothbrushes,nesoi (no)						N/A
366	9603294000 Shaving Brushes,hairbrushes,nail Brus Etc,<=.40 Ea (no)						N/A
367	9603298000 Shaving Brushes,hairbrushes,nail Brush,etc >.40 Ea (no)						N/A
368	9603404030 Paint, Distemper Or Siml Brushes Exc Subhdg 960330 (no)						N/A
369	9608310000 India Ink Drawing Pens (no)	$53,983	$77,899				55%
370	9608390000 Fountain Pens,stylograph Pens And Other Pens,nesoi (no)	$2,961,641	$2,557,111				0.7%
371	9615196010 Hair Slides And The Like Of Textile Matls, Nesoi (kg)						N/A
372	9615196030 Hair Slides And The Like, Nesoi (x)						N/A

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