



March 28, 2022

**Pennsylvania House of Representatives
Environmental Resources and Energy Committee**

Re: PCIC's Testimony on the Byproducts of the Oil and Gas Industry

The Pennsylvania Chemical Industry Council represents chemical and petrochemical manufacturers and related industries in Pennsylvania.

We appreciate the opportunity to address members of the House Environmental Resources and Energy Committee on the downstream opportunities and byproducts associated with natural gas and petroleum.

Industry Overview

The business of chemistry is a \$565 billion enterprise that directly supports more than 25 percent of the U.S. gross domestic product. The U.S. is the second largest global producer of chemicals and produces 14 percent of the world's chemicals.

In Pennsylvania, this industry supports more than \$24 billion in economic activity and 55,000 jobs. The industry ships \$4.68 billion in products to customers around the world and generates \$209 million in state and local taxes and \$398 million in federal taxes annually. Several global chemical companies have chosen Pennsylvania as home for their corporate offices and headquarters, including Covestro, Braskem, Arkema, FMC Corporation and PPG.

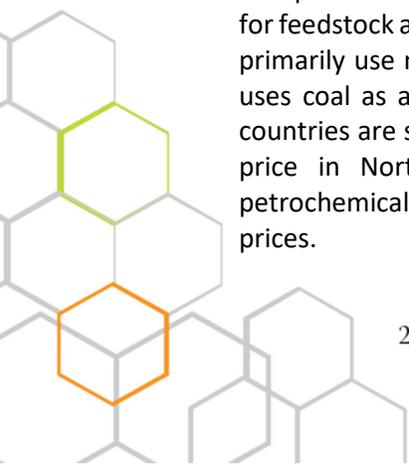
Energy and Chemicals

The business of chemistry is energy-intensive as energy resources are used as both feedstock and to power operations. Chemical manufacturing operations require more power than most other manufacturing sectors because chemistry operators create complex chemical reactions, many of which use large amounts of heat, pressure and/or electricity.

While coal and biomass can be used as hydrocarbon feedstock, petroleum and natural gas account for 99 percent of the feedstock used in chemical manufacturing in the U.S. The business of chemistry accounts for nearly 9 percent of all U.S. petroleum product consumption and is the largest single industrial user of natural gas.

The raw materials, or feedstocks, petroleum and natural gas contain hydrocarbon molecules that are split apart during processing and then recombined to manufacture organic chemicals that serve as the foundational building blocks for more than 70,000 different products.

European and Asian chemical manufacturers primarily use naphtha, a petroleum refinery product for feedstock and so the price is correlated with oil, while North American chemical manufacturers primarily use natural gas and ethane and so the price is correlated with natural gas. China also uses coal as a raw material feedstock. Because petroleum is traded on the world market, all countries are subject to the same price. Conversely, natural gas markets are regional and so the price in North America affects only North American producers. For this reason, U.S. petrochemicals enjoy a competitive advantage when natural gas prices are low relative to oil prices.





Energy costs have a substantial impact on the health of the chemical market, particularly for building block chemicals such as ethylene and propylene where fuel, power and feedstock costs make up more than 70 percent of the total cost to manufacture these chemicals.

Natural Gas and Chemical Markets

The majority of natural gas consumed in the U.S. is produced in the U.S. with a small amount imported from Canada and Mexico. Natural gas, specifically the natural gas in the Appalachian region, has provided the U.S. a competitive edge in the global chemical market.

That has not always been the case. In the early 2000's, natural gas prices quadrupled, forcing closure or idling of almost half of the U.S. methanol and ammonia capacity and 15 percent of the ethylene market.

The discovery and production of Marcellus Shale gas transformed this market and by 2010, the situation had been reversed and the U.S. was positioned to reduce its reliance on feedstock and chemical imports.

Since 2010, there have been more than \$230 billion in new and announced chemical industry capital investments tied directly to shale gas. To date, with 32 percent of these projects online, these investments have resulted in more than \$290 billion in permanent, new U.S. economic output.

Of the completed and announced projects, 70 percent are foreign-direct investments or have a foreign partner. This is unprecedented in recent U.S. history across markets and is directly tied to the affordable and high-value natural gas resources in this region. Companies worldwide are expanding production in the U.S. with most of these investments geared toward production capacity for ethylene, ethylene derivatives, ammonia, methanol, propylene, and chlorine.

The proximity to the feedstock resources for these chemicals has equipped the state of Pennsylvania to compete in global markets. Without the continued intentional effort to localize downstream markets around these resources and continue attracting investments in manufacturing, these resources will be exported, processed and manufactured into products elsewhere and Pennsylvania will only realize a fraction of the supply chain benefit.

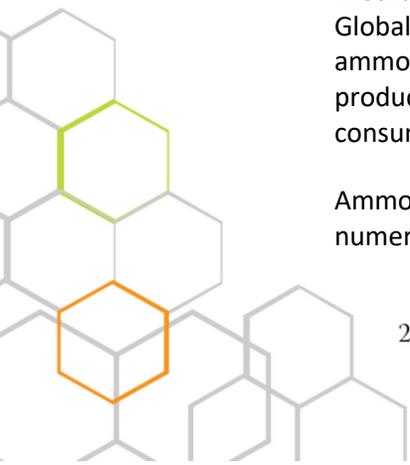
Natural Gas and Petrochemicals

Raw natural gas is produced from the wellhead and contains methane, ethane, propane, butane and some other organic and inorganic compounds. The natural gas liquids are processed from the methane and then furthered processed into their individual components and sold.

Methane as a feedstock

Globally and in the U.S., methane as a feedstock is primarily utilized to manufacture ammonia, one of the most highly produced inorganic chemicals. In 2019, ammonia was produced by 16 companies at 35 U.S. plants. The U.S. is a leading producer and consumer of ammonia, consuming far more than we produce.

Ammonia can be used to produce explosives, plastics, synthetic fibers and resins and numerous other chemical compounds, but the primary application, making up 88 percent





of the market, is for agriculture as a nitrogen fertilizer. Nitrogenous fertilizers include urea, calcium ammonium nitrate, ammonium nitrate and ammonium sulfate. Urea is the most economical option to deliver this important macronutrient into soil for increased agricultural production.

China, Russia, India and the United States rank as the top ammonia-producing countries. The two most widely used feedstocks for current ammonia production are coal or natural gas. Almost all of the ammonia-producing facilities in the U.S. utilize natural gas. In China, the primary feedstock is coal with China's facilities emitting on average, more than double the greenhouse gases than U.S. facilities.

According to The Fertilizer Institute, of all industries that use natural gas as a feedstock, the nitrogen fertilizer manufacturing industry consumes approximately 41% of the total, spending \$1.5 billion on natural gas purchase as a feedstock in 2018. Affordable natural gas is expected to continue to drive an increase in the U.S. market production to \$8.6 billion by 2025. However, the U.S. is not yet a net exporter of ammonia and imports a significant supply from Canada and Trinidad and Tobago.

The global ammonia market is expected to grow at a compound annual growth rate of 7.28 percent increasing from \$45 billion in 2019 to \$68 billion by the end of 2025. Demand for fertilizers make up a significant portion of the projected global market growth over the next few years with much of this demand coming from developing countries for agriculture and food supply that already have strong ammonia markets.

Opportunities for the U.S. to reduce reliance on imports, grow domestic opportunities in fertilizers and explore opportunities in other downstream applications all represent potential markets for Pennsylvania.

Liquid Natural Gas (LNG)

The "wet" properties of shale gas include propane, butane and ethane. Propane and butane have uses as fuel and ethane and propane are primarily used to produce petrochemicals, including ethylene and propylene. These petrochemicals are converted into plastic resins and create thousands of products including plastic bags, film, pipes, fittings, foam products, containers, cushioning and more.

The major end-use markets for these products are building and construction, transportation, furniture and furnishings, packaging and medical markets.

Global Plastic Market Supply and Demand

The global plastic market is valued at \$579 billion and is expected to grow at a compound annual growth rate of 3.4% from 2021 to 2028. The primary growth markets include construction, automotive and electrical and electronics industries.

Market growth can be attributed to regulations on vehicle weights to reduce carbon emissions, making plastic the ideal alternative to steel and aluminum. Additionally, growth in emerging markets and the economies of Brazil, Mexico, China and India have increased the demand for plastic-based construction materials. And finally, the growth of the global middle class plays an important role. This is primarily in India and China where





modern conveniences made possible by plastics are improving living standards, hygiene, nutrition and the quality of life for billions of people and resulting in a demand driver for the industry.

The U.S. plastic industry's primary export markets are Mexico and Canada. In 2020, the industry exported \$13.7 billion to Mexico and \$11.7 billion to Canada, maintaining its largest trade surplus—\$8.2 billion—with Mexico. Because of the competitive advantage of U.S. producers, more than half of new U.S. resin supplies are expected to be exported to markets in Asia, Latin America, and Europe as a result of the expected growth.

However, according to a recent report from the Plastic Industry Association, the U.S. plastic industry experienced a trade deficit of \$5.5 billion in 2020, contrasted with 2019, where the industry trade surplus was \$727 million. At the same time, the U.S. had a \$3.0 billion trade surplus with China with resin. China is still the world's largest resin buyer and a large importer of U.S.-produced resins.

The Social and Environmental Benefit of U.S. Feedstock

According to the United Nations, China's annual greenhouse gas emissions are double those of the U.S. In 2021, China accounted for almost 30 percent of global carbon emissions, while the U.S. produced 13 percent.

The U.S. has some of the most stringent regulatory oversight of natural resource extraction and manufacturing in the world. While the demand for plastic products continues to grow and shale-gas advantaged resin continues to be the most valuable feedstock, the U.S. should be focused on competing against countries with less stringent labor laws and emit more carbon emissions than a U.S. facility.

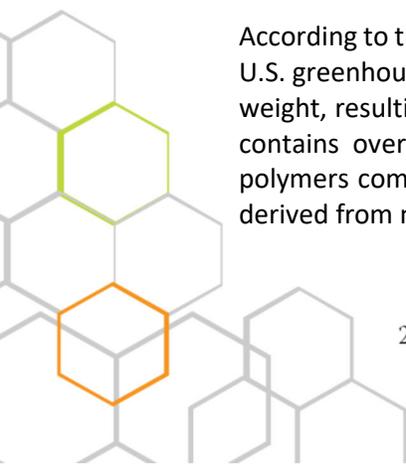
Not only will the U.S. economy benefit, enabling continued investments in carbon technologies, we will also reduce the environmental impact these developing nations will have on the global atmosphere and changing climate.

Ethylene and Propylene Fighting Climate Change

Chemical building blocks such as ethylene and propylene make possible innovations deployed across industries to reduce greenhouse gas emissions.

Ethylene applications are the foundation of most renewable and energy efficiency initiatives. For example in construction, insulation, foams and sealants improve energy efficiency and reduce energy consumption for commercial and residential buildings. Solar power relies on silicon-based chemistry, plastic casing on solar panels improve weather resistance and wind power turbine blades are made using plastics.

According to the Environmental Protection Agency, transportation accounts for 29 percent of the U.S. greenhouse gas emissions. Fortunately, across this sector, plastic parts have reduced vehicle weight, resulting in improved fuel economy and reduced emissions. Today, a typical automobile contains over \$3,100 worth of chemistry, including more than 360 pounds of plastics and polymers composites, nearly 220 pounds of rubber, and 76 pounds of textiles and coatings, all derived from natural gas or petroleum.





Lightweight plastic packaging enables more products to be shipped with less weight and associated carbon emissions. Increasingly, and with the development of the U.S. advanced recycling market, all plastic packaging can be recycled into new chemicals, products, feedstocks and low-sulfur transportation fuels. Additionally, landfills and sites to manage coal ash and other toxic materials are lined with industrial strength plastics to prevent run off into sensitive waterways or drinking water sources.

Efficiency improvements in chemical manufacturing processes drive greater economic output from each energy unit, ultimately helping the world's largest manufacturers transition to a low-carbon economy and companies like Covestro, Braskem and BASF are leading the way.

New materials, applications, and processes are critical to advancements in human development and the chemical industry is one of the largest private-sector industry investors in research and development. In 2020, the U.S. chemical industry invested over \$10 billion in research and development. Because chemicals provide the building blocks for the products we use every day, leadership from this industry has resulted in economy-wide GHG emission reductions that span the entire value chain.

Conclusion

Products manufactured from natural gas and petroleum are the foundation of a healthy and safe modern society. To achieve advancements in science, technology, health care and reduce our impact on the environment, we must focus on the continued production and development of the region's resources. These resources have afforded the U.S. a position as a world economic, social and environmental leader and good policy and continued investments from the private sector will enable us to continue to lead.

Thank you for the opportunity to provide this information.

Sincerely,

A handwritten signature in black ink, appearing to read 'Abby Foster', with a large, stylized flourish at the end.

Abby Foster, President
Pennsylvania Chemical Industry Council





Pennsylvania Chemical Industry Council
Your Advocate for the Business of Chemistry

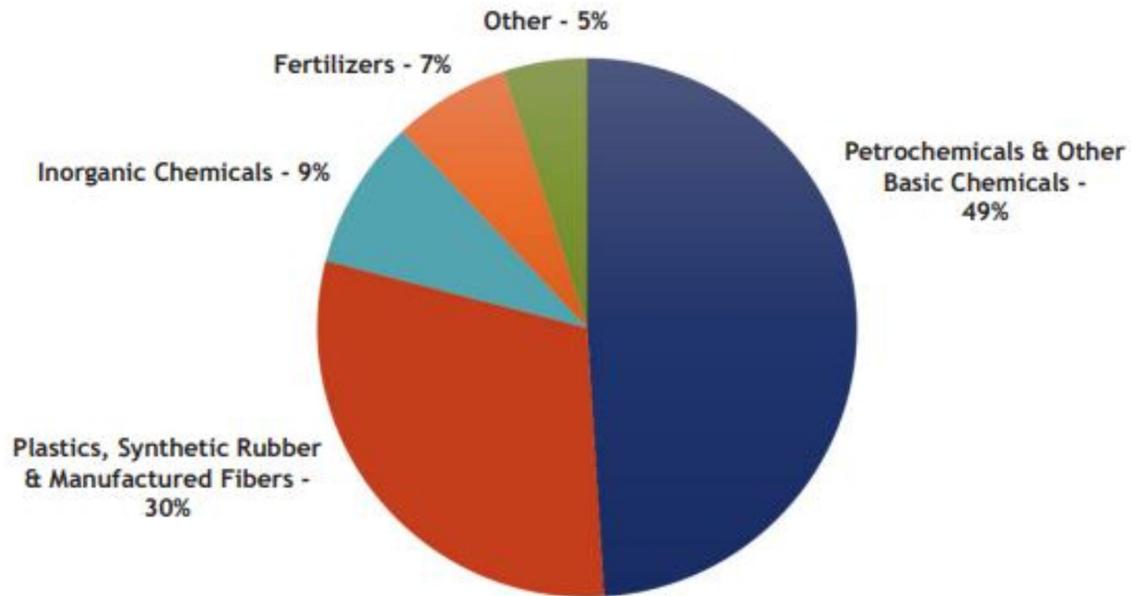
House Environmental Resources and Energy Committee
Downstream Uses of Oil and Natural Gas
March 28, 2022

U.S. CHEMICALS MARKET

- 2nd largest producer of global chemicals (14%)
- Chemicals make up 10% of all U.S. goods exports
- \$565 billion industry
- 529,000 skilled, high-paying jobs

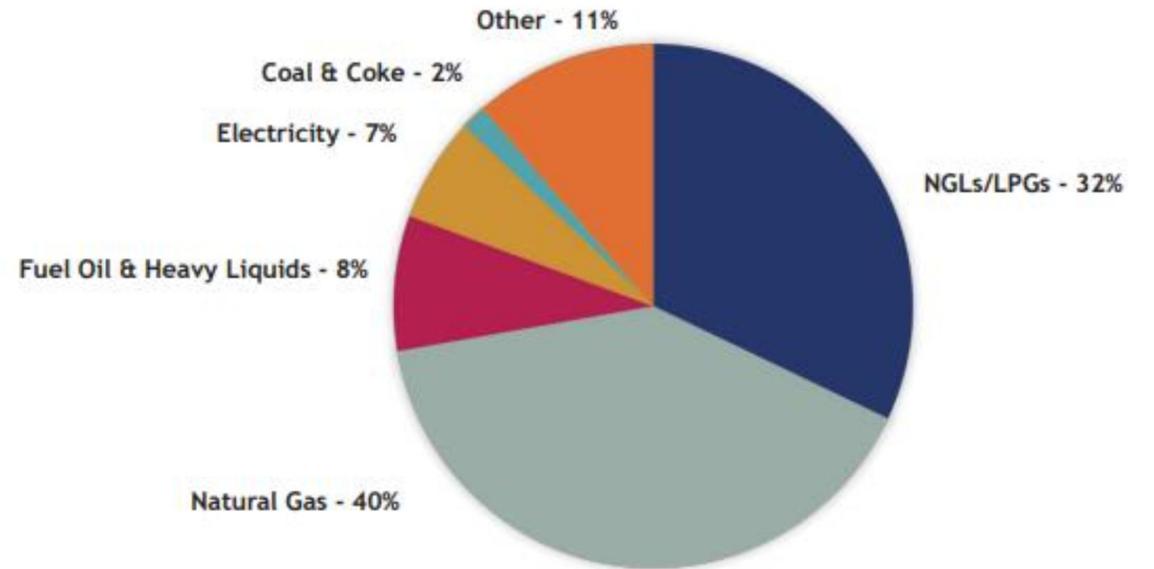
ENERGY & CHEMICALS

Share of Total Energy Consumption by Segment



Source: U.S. Energy Information Administration, Manufacturing Energy Consumption Survey (MECS)

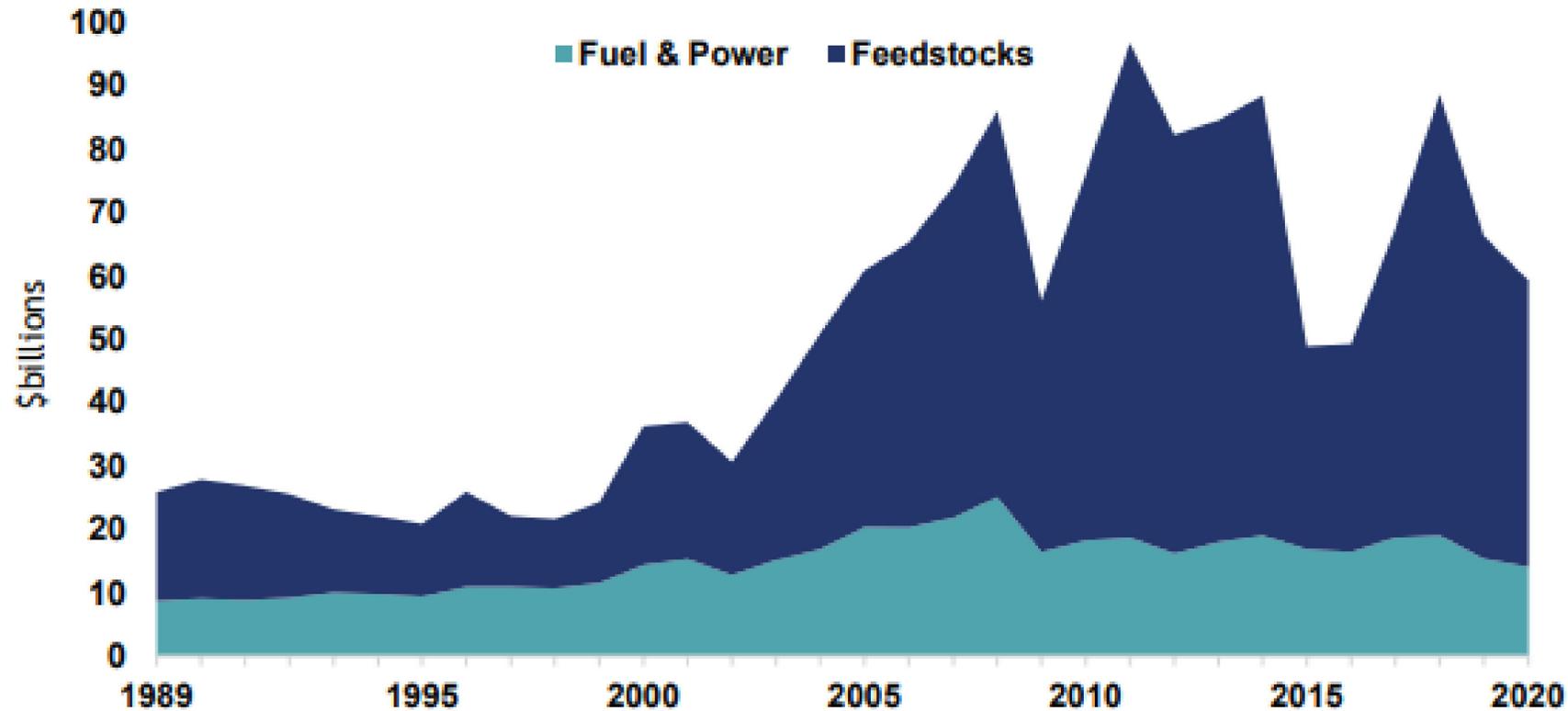
Share of Total Energy Consumption by Source, 2020



Sources: American Chemistry Council, Federal Reserve Board, Bureau of the Census, EIA

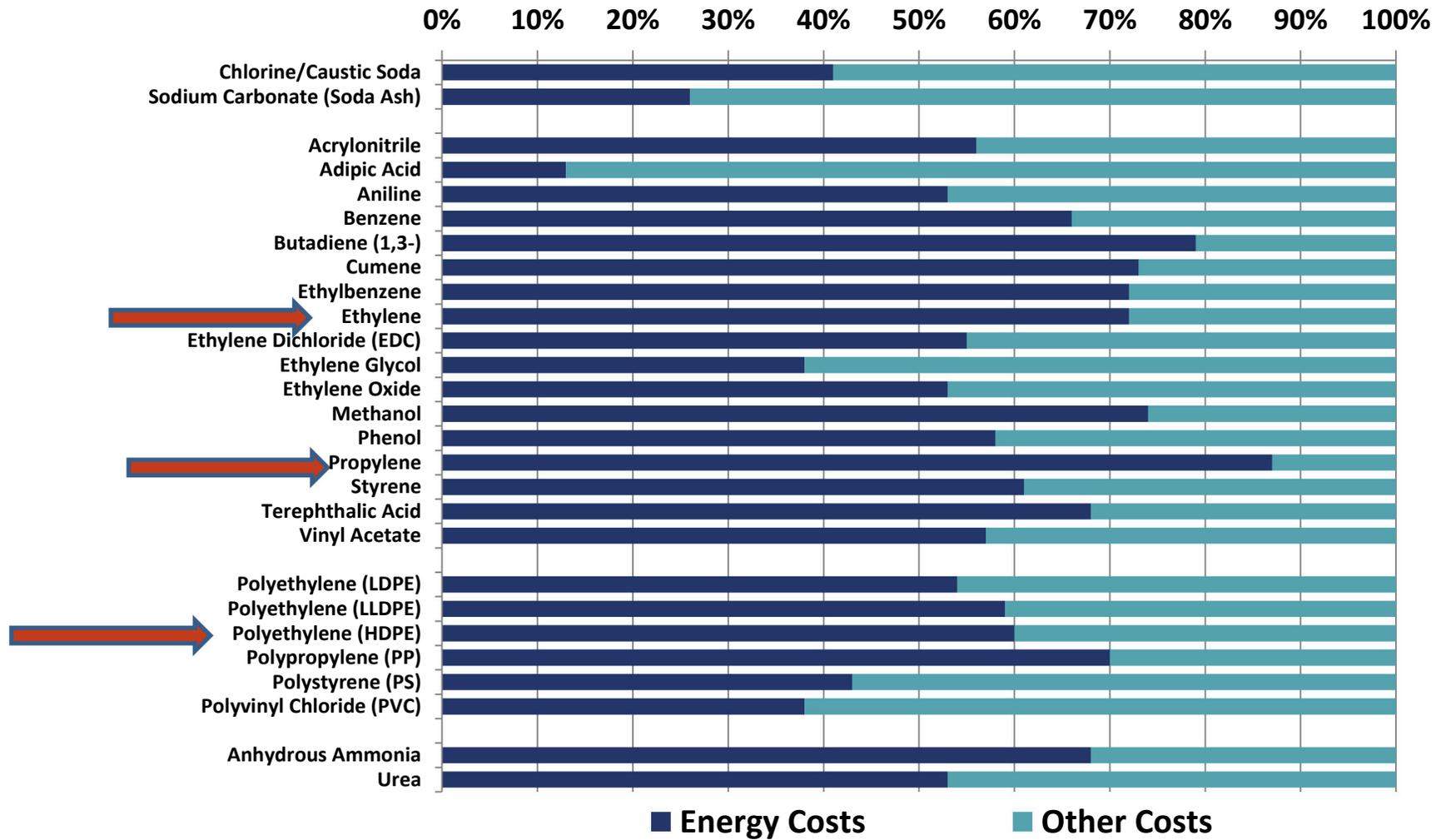
ENERGY & CHEMICALS

Value of Energy Consumed by the Business of Chemistry



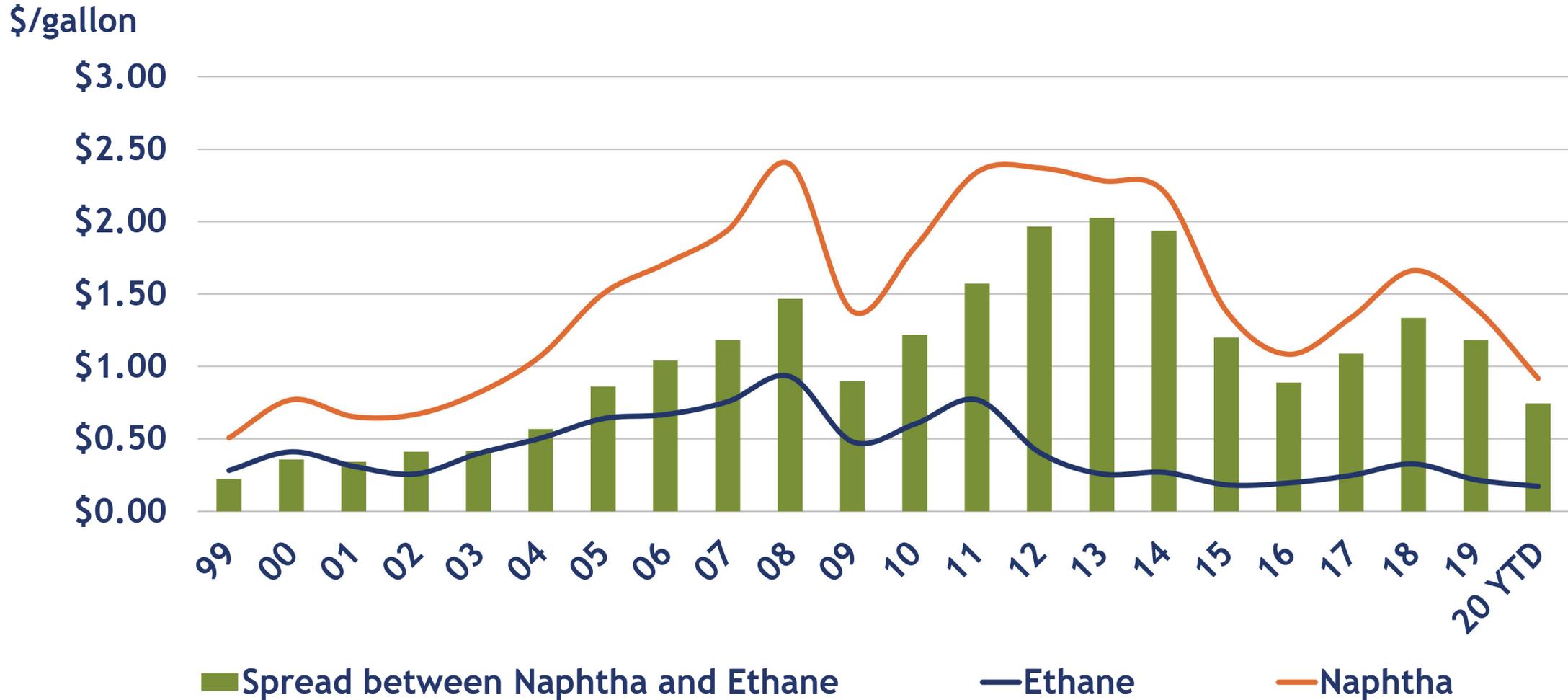
Sources: American Chemistry Council, Federal Reserve Board, Bureau of the Census, EIA

FUEL, POWER AND FEEDSTOCK COSTS (percent of total costs)



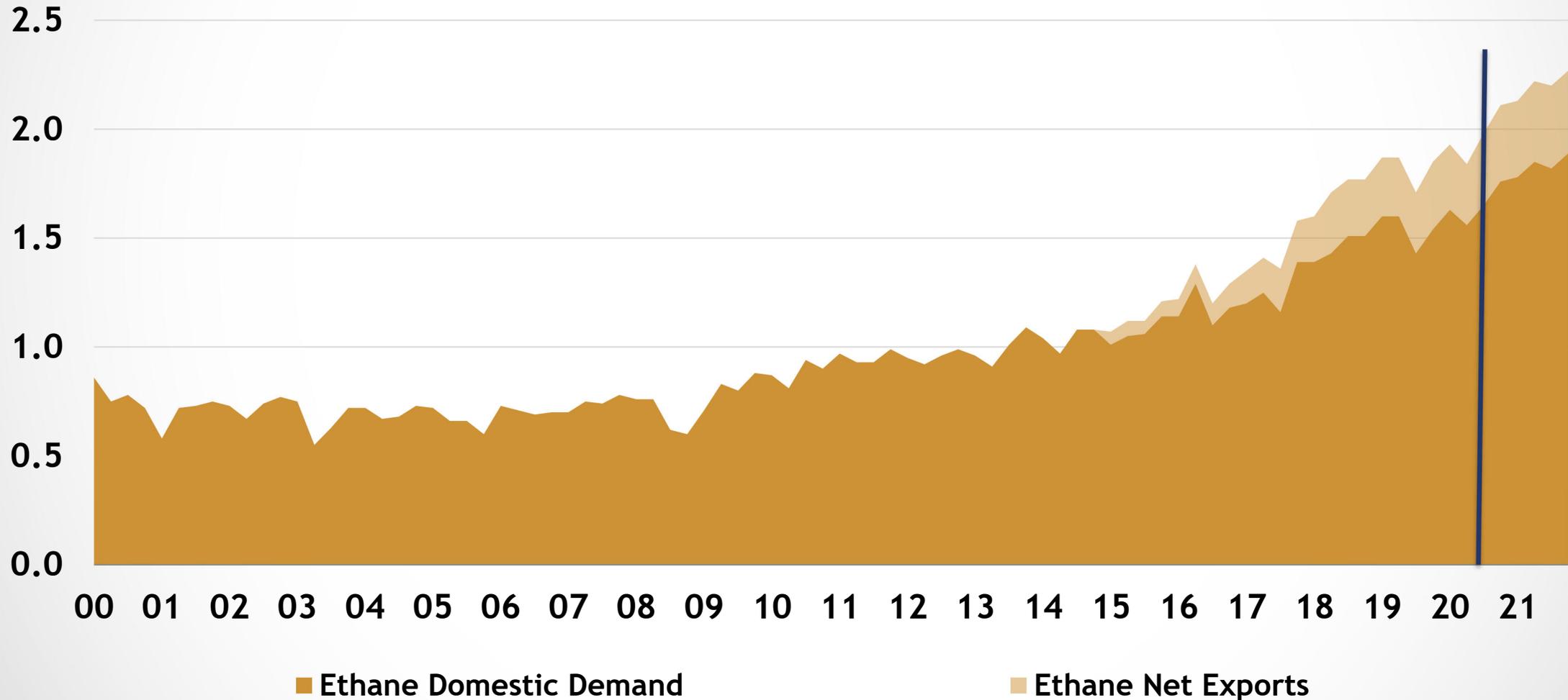
Source: ACC analysis

FEEDSTOCK SPREAD AND PETROCHEMICAL COMPETITIVENESS



ETHANE SUPPLY AND EXPORTS GROWTH

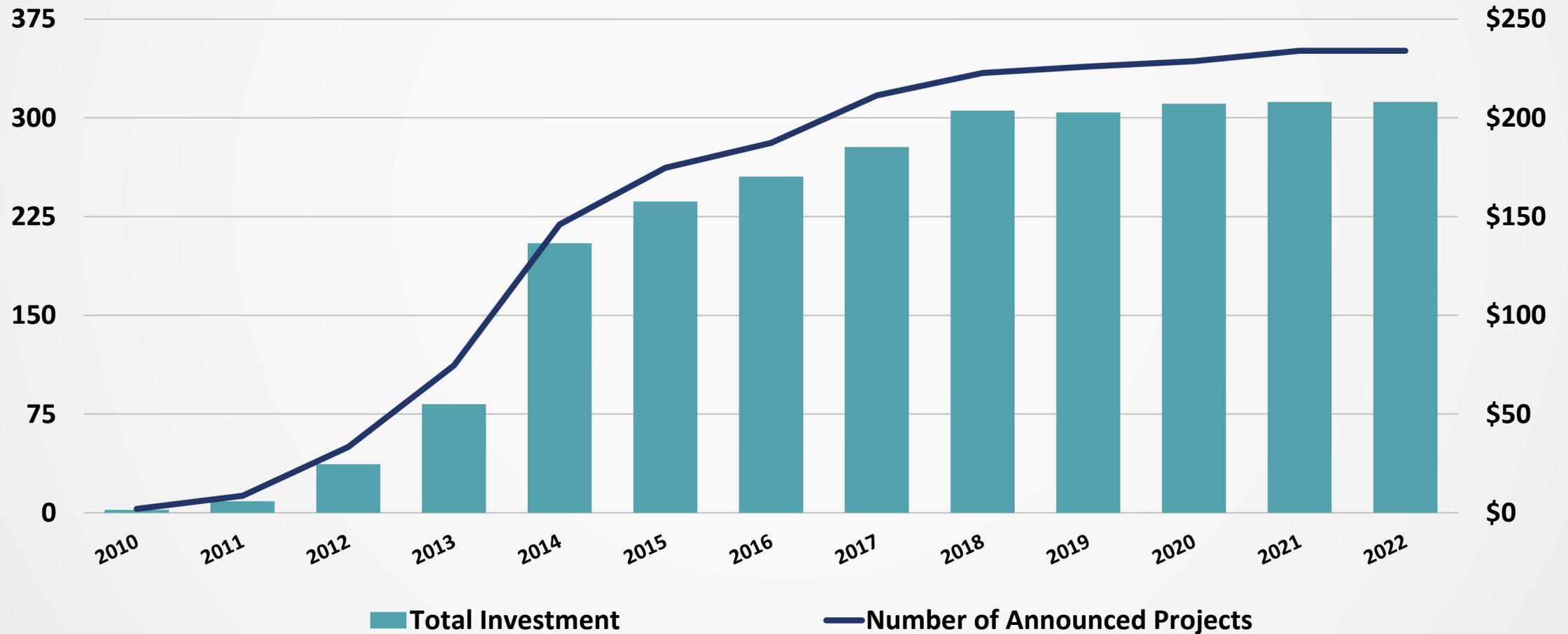
Million Barrels per Day



ANNOUNCED CHEMICAL INDUSTRY INVESTMENTS (resulting from Shale Gas)

Number of Projects

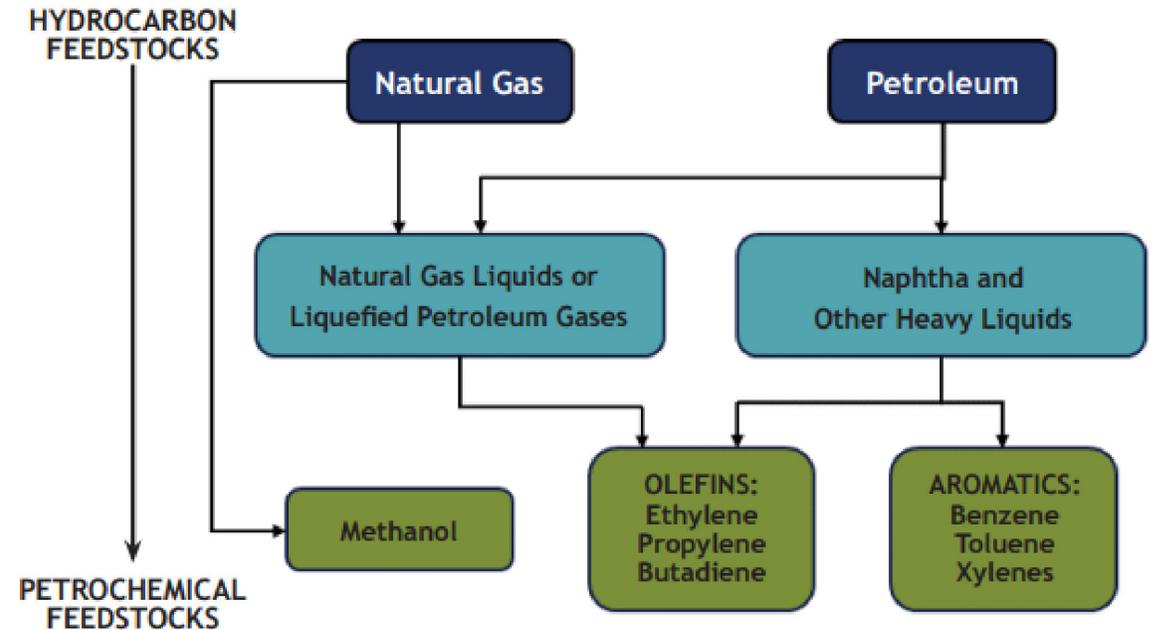
Billions



Source: ACC analysis
As of February 2022

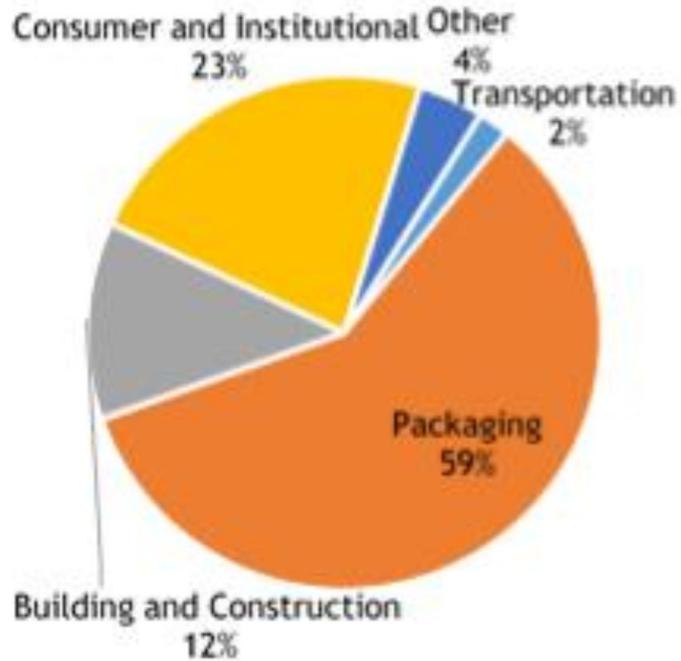
PETROCHEMICAL FEEDSTOCKS

- Processed by ethane and liquid crackers:
 - Olefins (ethylene, propylene, butylene)
 - Aromatics (benzene, toluene, xylenes)
- Directly converted from natural gas:
 - Methane

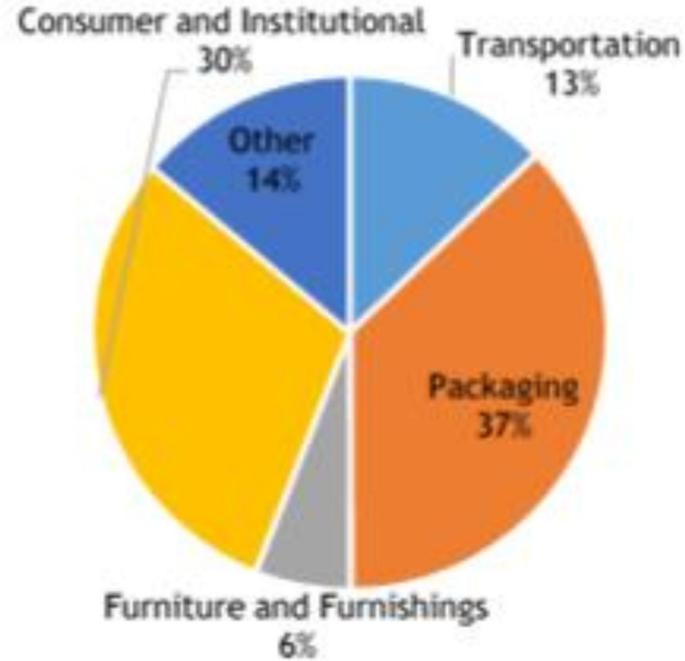


PETROCHEMICAL PRODUCTS

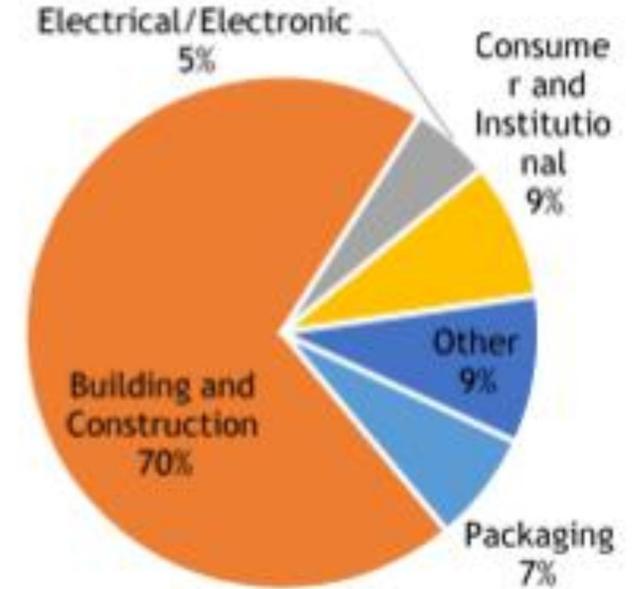
Polyethylene

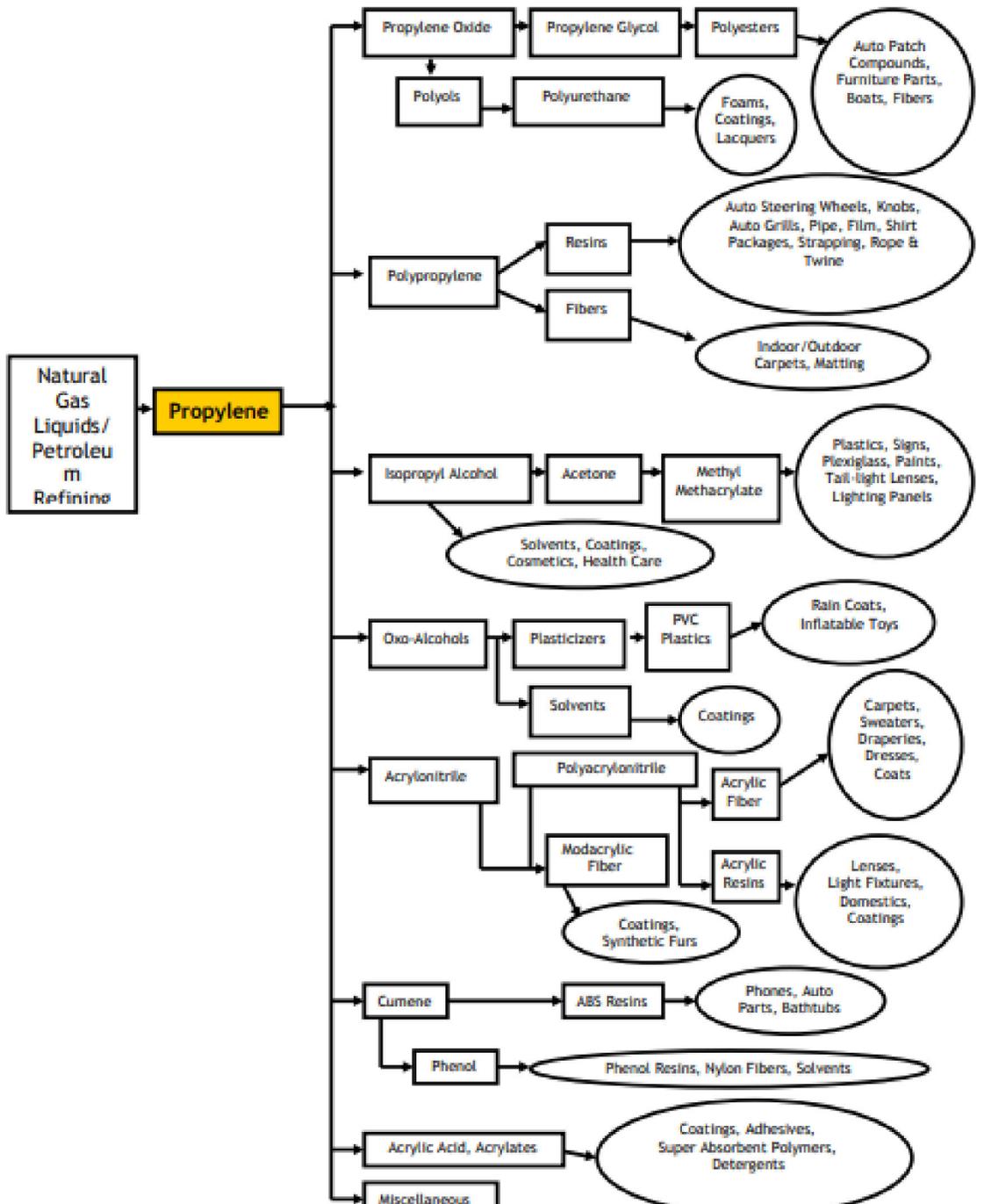
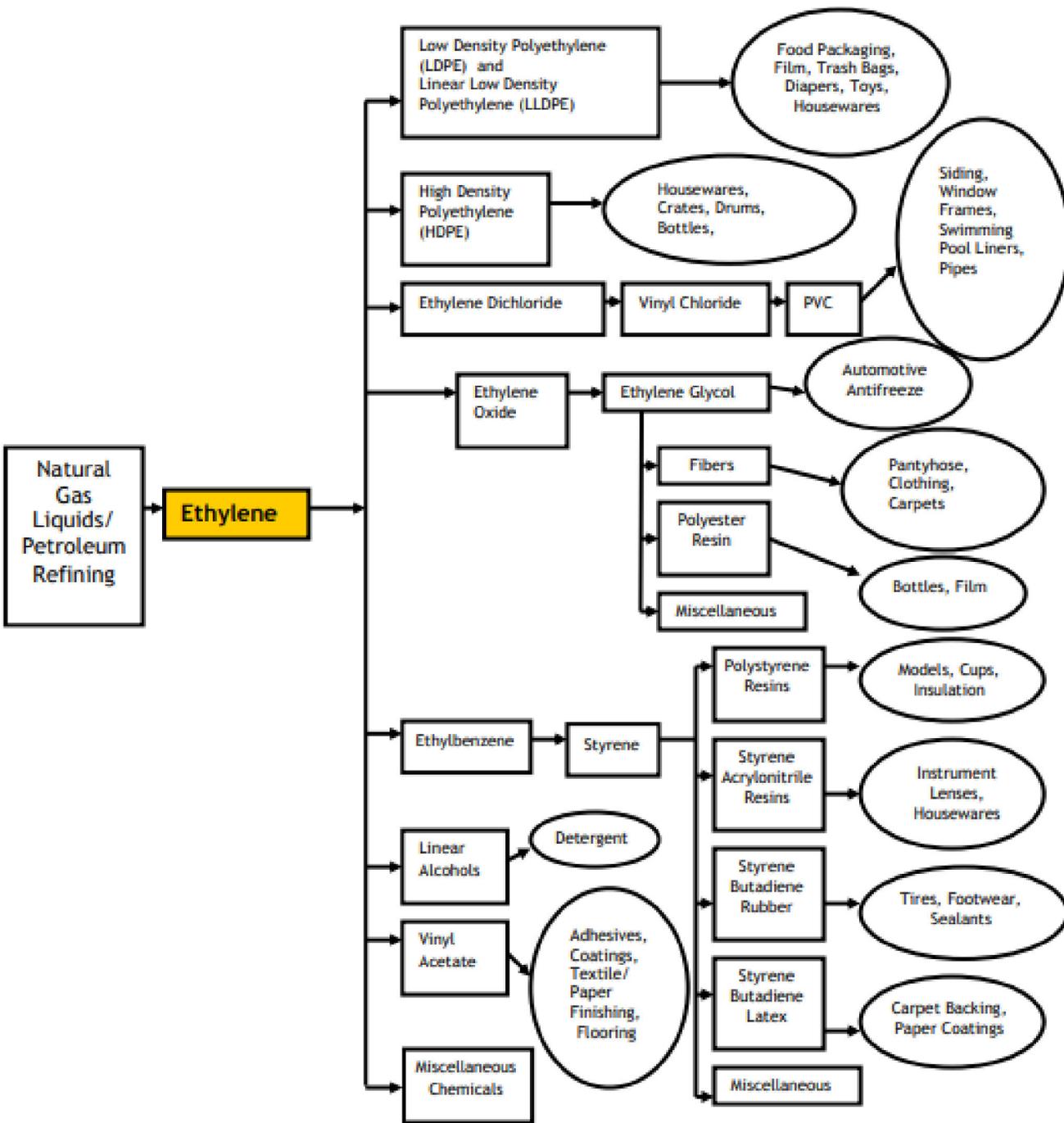


Polypropylene

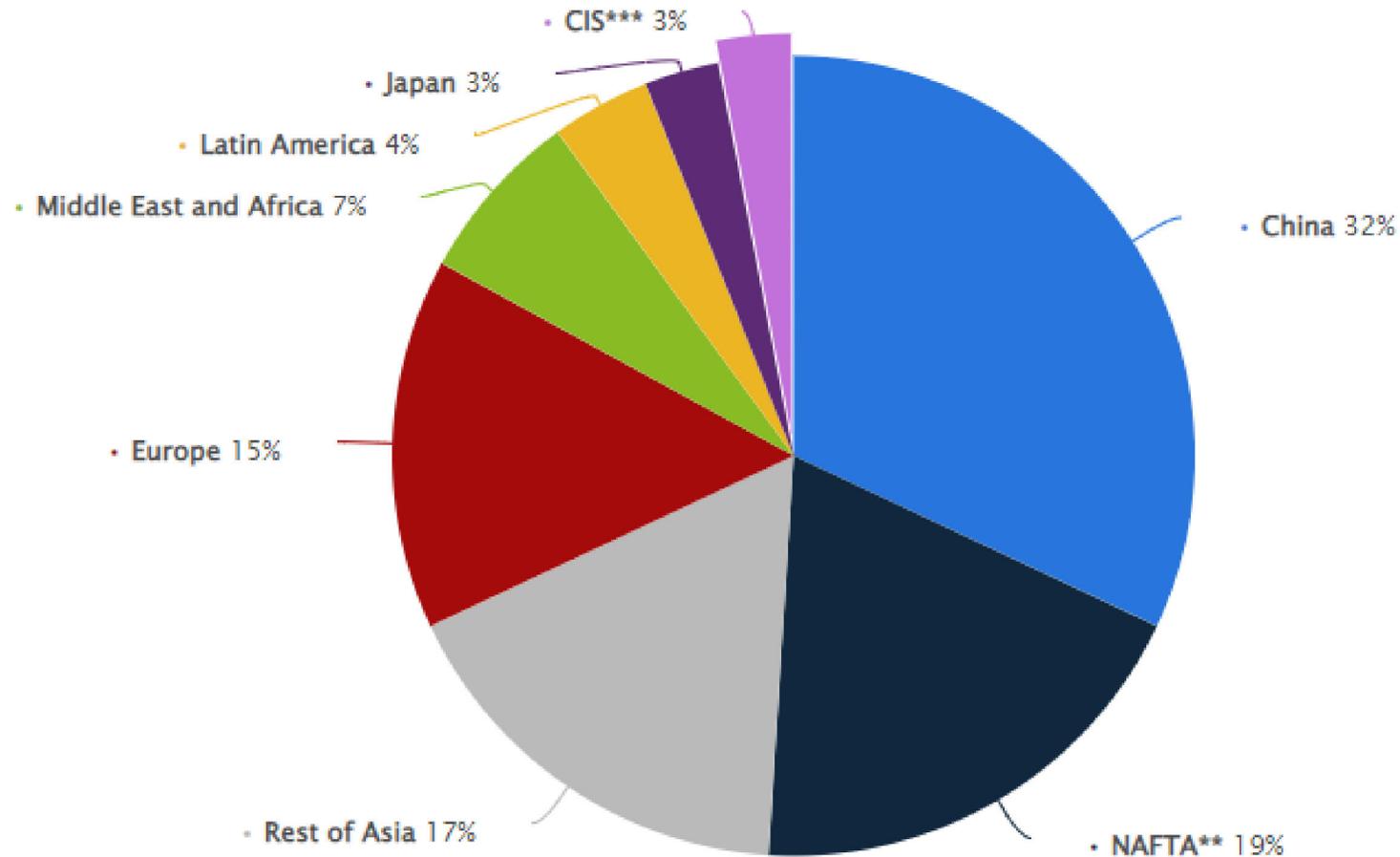


Polyvinyl Chloride

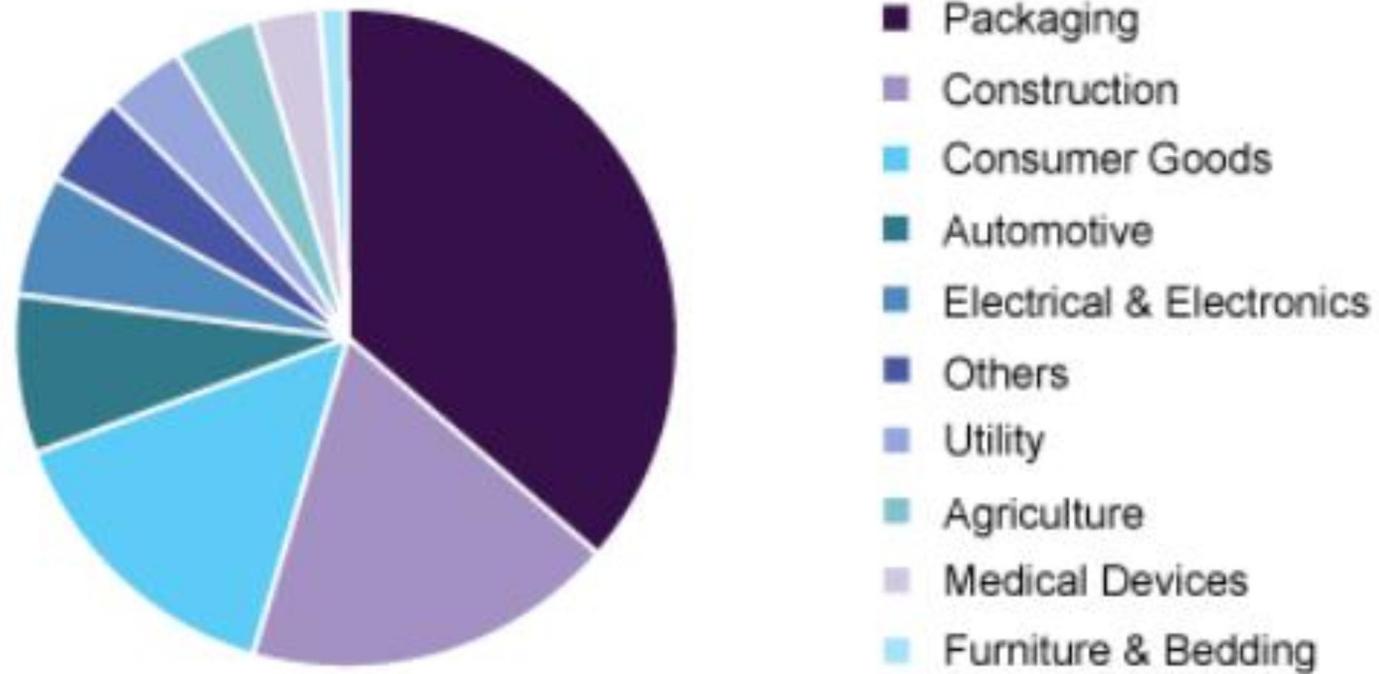




DISTRIBUTION OF GLOBAL PLASTIC MATERIALS PRODUCTION

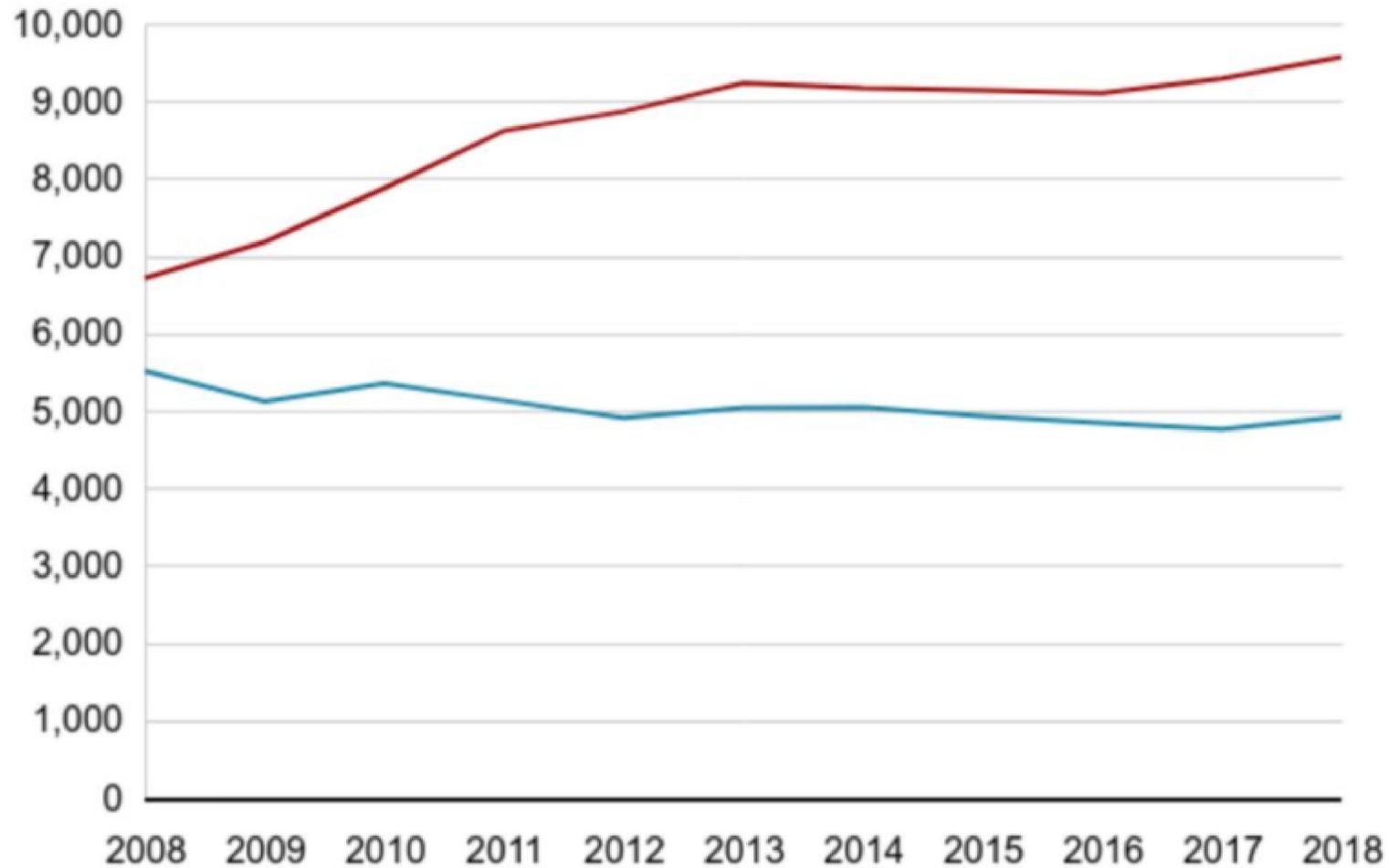


GLOBAL PLASTIC MARKET SHARE BY END USE



Source: www.grandviewresearch.com

CHINA VERSUS U.S. CO2 EMISSIONS



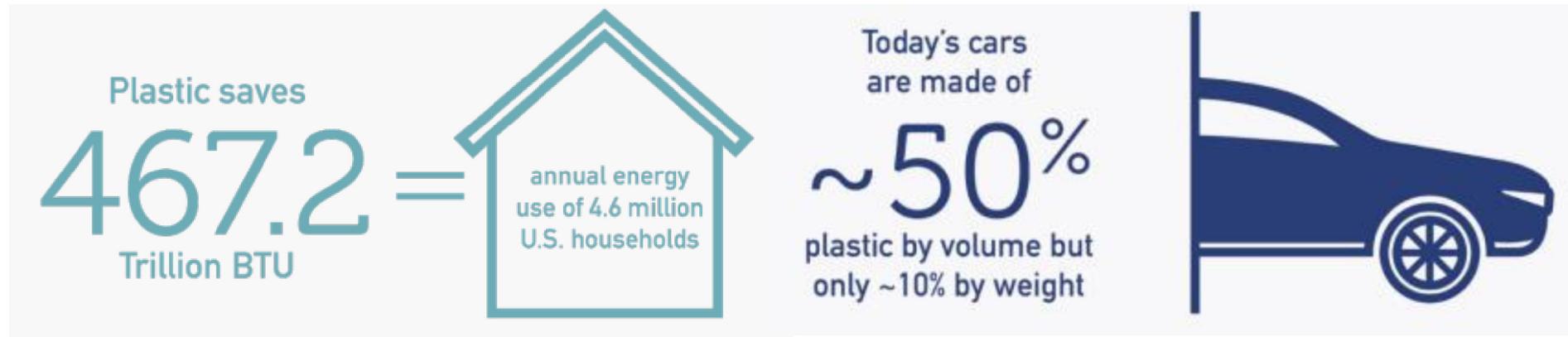
Million tonnes

— China — US

Source: International Energy Agency

BBC

THE ROLE OF PLASTICS IN REDUCING GHGs



U.S. NGLs FIGHTING CLIMATE CHANGE

- Construction – Ethylene-based energy efficient materials
- Transportation – Ethylene-based parts to reduce weight / improve fuel efficiency
- Renewable Energy – Petro/chemical building blocks for solar panels, wind turbines, battery packs
- Advanced Recycling – Utilization of post-use plastics as feedstock for new products
- Made in the U.S.A. = Highly regulated, state-of-the-art facilities, processes and products

OIL & GAS FEEDSTOCKS ARE CRITICAL

- National Security
- Environment
- Economy
- Health and Safety
- Quality of life



Pennsylvania Chemical Industry Council
Your Advocate for the Business of Chemistry



@PAChemCouncil