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Why External Review of Price-Setting Mechanism for Plastic Resins Is Warranted

A First Step Toward Comprehensive Regulation of an Essential Industry With High Health, Environmental, Climate and Financial Costs

Executive Summary

A review of the nation's production and price-setting mechanism for single-use plastics is long overdue. Going into the pandemic, the industry in the United States was oversupplied with new ethylene and polyethylene capacity. Prices and profit margins were low. The plastics industry and its companion, the oil and gas sector, were in financial distress. Demand increased at the onset of the pandemic while production was temporarily impaired by the severe weather conditions of February 2021. Prices rose. As production has adjusted to meet demand and the impact of the severe weather conditions has subsided, basic market forces should be pulling prices downward. They are not.

The major plastics producers send out monthly price announcements to customers. From January through August customers experienced large monthly increases.

The prices for the principal chemical components of single-use plastics—ethylene, high density polyethylene (HDPE), lower linear density polyethylene (LLDPE), low density polyethylene (LDPE) and polypropylene (PP)—are at historic highs. According to short-term price indicators, the price of polypropylene—a key ingredient for such commonly used items as syringes, bottles and snack food packages— has risen by 138% since January 2021. The other plastic resin commodities have seen double-digit increases. In August 2021, after eight months of price increases, the price of each commodity hit a peak and were flat through September.

The prices for components of single-use plastics are at historic highs.

The plastics industry provides a series of rationales to justify why the prices are high and, increasingly, why they may remain high. Even considering the recent market disruptions, however, something is wrong and needs to be investigated:

- Prices are way up, but utilization rates—the key metric for measuring the tightness of the market—are not showing uniform increases that justify these price levels.[1] IHS Markit, a prominent industry group, the Federal Board of Governors and some companies are showing actual and projected utilization rates and price data that suggest prices should be lower.

- When prices are high, CEOs and analysts usually see this as a market sign that new investment in manufacturing capacity is needed. The opposite is occurring. Going into the pandemic, the markets were oversupplied; at this stage of the pandemic, even with profits elevated and claims by corporate officials of strong demand, there is no talk of immediate need for new manufacturing plants. New projects are being delayed, and some CEOs are using the windfall to reduce debt.

- Industry officials claim the pandemic and winter freeze in early 2021 hindered supply and increased demand, causing an unwieldy price spike. Production increased in 2020 for most of the commodities that IEEFA reviewed, and some companies posted record-breaking profits in 2020. For the first two quarters of 2021, the industry posted strong earnings. Recently one trade association referred to current returns as "fantastic."

- Industry leaders assert that strong demand is keeping upward pressure on prices as the economy recovers. Some analysts do see demand improving, but it is not strong. ExxonMobil, for example, saw Q2 petrochemical volumes higher than Q1 but basically flat against the previous three quarters.

- Feedstock costs for plastic resins increased initially during the pandemic and winter freeze, but these prices are coming down and are expected to continue to decline. Feedstock costs are 60% of operating costs. As they decline, prices should come down. So far, this has not occurred, and if the trend of high plastics prices continues while feedstock costs decline, profits will remain extraordinary.

Oil and gas companies are looking to plastics to repair a failing profit model.

These issues point to market irregularities and suggest that the high prices should be coming down. Yet other factors are at play that may be motivating the industry to push prices up and keep them up.

Prices are set by leading industry players like ExxonMobil, LyondellBasell, Braskem, Chevron and Dow. The industry is heavily concentrated, with a handful of

[1] Utilization rates are the industry standard that measure the actual production of a given facility versus its maximum or nameplate capacity. In addition to the utilization rate, the term is often used interchangeably with the operating or capacity rate.

companies sharing 65% to 85% of the ethylene, polyethylene and polypropylene markets. Several of the petrochemical leaders are integrated oil and gas major companies. They have shown a decade of weak performance. Indeed, the underlying financial stress facing the oil and gas industry brought it to an almost complete collapse in the spring of 2020. They are now looking to plastics to repair a failing profit model. It is important to determine to what extent this motivation and any other unknown factors are driving prices up.

Why Does This Matter?

The production and pricing of single-use plastics runs like a thread through some of the most critical public policy issues facing the nation.

The plastics industry has grown in importance to the economy and is now being recognized for both its positive contributions and negative consequences. During the pandemic, the federal government declared the industry essential in large measure due to the industry's significant role in the production and distribution of medical supplies and equipment. Yet the industry has also become a source of public concern due to its contribution to ocean waste, toxic air and water pollution, and carbon emissions.

These larger societal forces create a complex picture of the industry's social license. Decisions about production and pricing, once largely considered insignificant, now have critical implications for questions related to public and environmental health.

The nation's investigation into gasoline price-gouging during Hurricane Katrina contains some highly relevant findings for the current situation. The Federal Trade Commission (FTC) found that the industry did not gouge consumers. Price gouging, unconscionable prices, and excessive pricing are all concepts in law and public policy that are difficult to prove. The FTC nevertheless issued three relevant findings about the nature of the competitive playing field during a time of abnormal market disruption that contain lessons for the current situation. It found that during the period of disruption caused by the hurricane:

- Oil and gas companies ran their production facilities at 100%. Federal data, company statements and expert analysts demonstrate that plastics manufacturers have not run at 100%.

- Company CEOs identified the need for new capacity as a way to reduce high prices. This paper shows that plastics manufacturers today are using robust profits to retire debt while adopting a wait-and-see strategy regarding future investment. No rush to build new capacity is occurring because supply is not tight.

- Oil and gas companies did not withhold gas and oil from the export market to sell into the artificially inflated U.S. markets that produced a huge premium. Market analysts are showing that plastic producers today are withholding product from the export market for just this reason.

While recognizing that the plastics industry and retail oil and gas sectors are very different businesses, the picture that emerges in 2021 regarding the price and production practices of the industry nevertheless raises red flags that should be reviewed.

The plastics sector has not been the subject of a comprehensive review despite its growing importance. Current regulatory oversight consists largely of the FTC's review of mergers and acquisitions as part of its broader mandate to police antitrust practices. The agency also has pursued companies that make false claims about the quality and the use of certain plastic products.

The current imbalances that have surfaced around pricing come as critical questions related to medical and consumer product production and the environment have taken center stage. The industry's positive contribution is offset by growing public concerns about ocean waste, toxic pollution and carbon emissions. The root of the problem is that plastics are made from fossil fuels. The pandemic and weather events are the backdrop as climate and public health risks combine with rising prices of a questionable nature to create a complex problem. The convergence requires a public sorting-out.

The nation needs a solid, affordable, reliable production and pricing system.

The facts in this paper warrant a review of the plastics sector particularly as it relates to the production and pricing of plastic resins that are the major building blocks to single-use plastics. Single-use plastic in certain key sectors has become a public necessity, but it is produced and priced by a set of private sector concerns driven by individual corporate interests. The structure has not been systematically reviewed through a public interest lens.

The nation needs a solid, affordable, reliable production and pricing system to ensure that the nation's medical needs are met and other significant uses are addressed, while responding vigorously and effectively to the adverse climate and environmental impacts of plastics production and waste management. The regulatory issues cut across jurisdictional lines related to commerce, international trade, environment, health, energy and foreign policy. These factors strongly suggest the need for reviews either by federal regulators or state attorneys general (who often have mandates to review financial, consumer and environmental practices).

Table of Contents

Introduction

Why is an external review of the market price-setting mechanism in the United States needed for plastic resins, the principal components of single-use plastics?

Plastics, particularly single-use plastics, are a commonplace part of daily existence. The vast utility of plastic attests to its prevalence. The recent pandemic created a health emergency that intensified the focus on the plastics sector.[2] The production of plastics, its companies and workers are considered essential to the U.S. economy. This contribution comes with costs, however. Environmentalists have long identified a tension between the proliferation of plastics and the need for clean air, clean water and a sustainable climate.

The energy transition has also increased the financial significance of the plastics industry. Plastics are produced largely with fossil fuels. The use of fossil fuels for petrochemical production is a critically important area of earnings growth for the oil and gas industry. Market forces and public concerns are driving capital away from fossil fuels. Petrochemical investments are seen as a potential profit replacement as use and profitability in the transport and energy sector decline.

The prices for the principal chemical components of single-use plastics—ethylene, high density polyethylene (HDPE), lower linear density polyethylene (LLDPE), low density polyethylene (LDPE) and polypropylene (PP)—are at historic highs.[3] For example, the price of polypropylene —a key ingredient for such commonly used items as syringes, bottles and snack food packages— has risen by 138% since January 2020. The other plastic resin commodities have seen double-digit increases.

The plastics industry's explanation of high prices has evolved. The pandemic and last winter's freeze in Texas disrupted production and resulted in rising demand. As the economy recovers, the industry contends that strong demand persists, operational recovery is difficult, fuel prices are high, and trade tensions and logistical bottlenecks stymie recovery. Each of these explanations contains a grain of truth. Upon examination, however, the price level and its duration are highly questionable.

Federal and industry data and expert opinions reveal that prices should be considerably lower.

Prices are set by a small number of producers, and IEEFA's review finds the following:

- The industry recovered rapidly from the pandemic and freezing weather;
- Industry balance sheets remained healthy;

[2] Science Total Environment. Plastics in the time of COVID-19 Pandemic: Protector Pollution. March 10, 2021.
[3] For typical end uses of these resins, see the Appendix.

- Production posted modest increases;
- Performance metrics fail to support high prices; and
- No indicators are visible that plastics producers will build more factories in the near future to meet the purported "strong" demand.

It is clear that the pandemic and weather had a disruptive impact on the industry. It is also clear that the single-use plastics part of the industry avoided the worst of it.

During the pandemic, certain forms of plastic have played a necessary and critically important role in the medical and safety response effort. Yet, at a time when the industry should be providing greater transparency, data about the performance of individual companies and plants is almost impossible to obtain. Information provided in standard federal financial disclosure forms are limited and lack transparency. The federal government provides very limited data on plastics production when compared to other critical resources like oil, gas and coal. Basic data from private sources, in turn, is expensive to obtain and usually has limited transparency.

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Obtaining information on one essential metric—utilization rates—is particularly problematic. Utilization rates measure the intensity of use of a plant. If a company's factory can make 100 million tons of plastic per year but produces only 75 million, it is running at a 75% utilization rate. When utilization rates are high, it usually means the market is nearing oversupply and prices can be expected to rise. It is a key measure for producers, consumers, brokers and investors. The Bureau of Economic Research publishes one table that reports macro utilization rates.[4] It covers a large number of plants and includes many types of plastics and chemicals. Private sources of utilization rates can be obtained at a cost. Even the most prominent source, however, acknowledges that its recovery methods and presentations lack precision and transparency.[5]

[4] St, Louis Federal Reserve. Capacity Utilization: Manufacturing: Non-Durable Goods: Plastics Material and Resin. Last viewed September 1, 2021.

[5] American Chemistry Council. 2021 Resin Review, Disclaimer and Explanation of Disclosure Safeguard. 2021, p. 2. The council's annual review is conducted by a third-party company. Data provided to the third-party contractor by companies is voluntary. It can be a company derived estimate without any assurances of accuracy. The council and its third-party vendor take steps to ensure the integrity of the numbers. No public source, not even one available at cost, provides utilization rates by plant, compiled with uniform consistency across company portfolios and ultimately industry wide. From time to time, companies do reference or even publish capacity, utilization or operating rates, but this is not required under federal Securities and Exchange

The industry has rarely been scrutinized by external government or independent reviewers, who would need to have full access to operations and company data. IEEFA could only prepare this report at considerable expense. Working with that limited data, IEEFA's analysis below identifies critical questions that must be addressed and illustrates that a more comprehensive examination is warranted.

This paper is divided into four subject areas:

- A basic trajectory of recent prices for high density polyethylene (HPDE), low density polyethylene (LDPE), low linear density polyethylene (LLDPE) and polypropylene (PP), which comprise roughly two-thirds of the major polymers produced in the world annually and are the main components of single-use plastics;[6]
- A discussion of the extraordinary nature of current prices in relation to utilization rates and other market signals;
- A discussion of the underlying causes of high prices; and
- A review of public interest concerns regarding plastics in the context of the medical industry, toxic emissions, carbon emissions, waste impacts and the fossil fuel industry.

It closes with a discussion of the purpose and type of external review that is possible and would be useful, and a broader suggestion for reform and regulation.

I. Prices Have Risen to Extraordinary Levels in 2021: Timeline of Recent Price Trajectory

The plastics sector has experienced a growth spurt for more than a decade. Since 2005, the industry has aggressively expanded the plastics production chain.[7] Communities in most major countries have hosted the expansion of dozens of ethylene manufacturing facilities ('crackers') and hundreds of plastics manufacturing plants.

2020

- Prior to the onset of the global COVID-19 pandemic, industry capacity was expanding to the point of oversupply.[8] Prices for the major commodities

Commission reporting rules. Such company disclosures usually lack context and are of limited analytical value. (Proprietary)

[6] IHSMarkit. 2021 World Analysis – Polyethylene. September 28, 2020. (Proprietary)

[7] IHS Markit. Ethylene, World Analysis, 2021. February 2021. (Proprietary)

[8] ICIS. Global PE faces even more new capacity in 2020 oversupply and poor margins. December 19, 2019.

were low and margins shrinking.[9] Some new petrochemical complexes in the United States were at risk of cancellation. [10]

- Despite widespread economic disruption from the pandemic in 2020, a substantial part of the plastics industry maintained production operations.[11] U.S. production of plastic resins in 2020 posted increases. For the polymers that are the focus of this paper, all four in 2020 exceeded prior year production levels and their respective 10-year annual growth rates (See Figure 1). The production increases have been attributed to increased demand for consumer packaging and medical devices and supplies.[12,13]

Figure 1: Production Volume Change, 2019 through 2020[14]

	2019	2020	% Change	10-Year CAGR
Polyethylene - LLDPE	20,377	22,986	12.0%	3.2%
Polyethylene - LDPE	7,606	7,797	2.5%	1.5%
Polyethylene - HDPE	22,145	22,878	3.3%	3.1%
Polypropylene	16,860	17,269	2.4%	0%

Source: American Chemistry Council.

- Demand increase during this period did not produce noticeable stress on manufacturing capacity. Except for LLDPE, the polymers discussed in this report experienced lower utilization rates in 2020. Many companies adapted to changes and maintained operations.[15] Some continued to add capacity, which further reduced utilization rates.[16]

- Plastics resin prices overall showed steady, modest gains during 2020, with some volatility. By year end, prices were rising. For the year as a whole, prices remained low, consistent with the market conditions preceding the pandemic.

[9] ICIS. Insight: U.S. PE Margins remain pressured amid ongoing supply additions. January 21, 2020.
[10] For a more detailed description of the market conditions as they have evolved over the last decade in the United States see: IEEFA. Formosa Louisiana Wrong Products, Wrong Time, Wrong Place. March 2021.
[11] The Conversation. Covid-19 has resurrected single-use plastics - are they back to stay? July 14, 2020.
[12] Science Direct. The COVID-19 pandemic and single-use plastics waste in households: A Preliminary Study. Volume 793. November 2021.
[13] Medical Plastics News. Why single-use plastics have been essential during the Covid-19 pandemic. June 8, 2020.
[14] American Chemistry Council. 2021 Resin Review, Production Volumes and CAGR. 2021, pp. 28, 30. 32,34. (Proprietary)
[15] Plastics News. Plastics industry adapts business during COVID-19. March 13, 2020. (Proprietary)
[16] Utilization rates are the industry standard that measures the actual production of a given facility versus its maximum or nameplate capacity. In addition to the utilization rate, the term is often used interchangeable with the operating or capacity rate. See: American Chemistry Council. 2021 Resin Review, Utilization Rates. 2021, pps. 28, 30, 32,34.

- By and large, 2020 was a good year for the single-use segment of the plastics industry despite the pandemic. As a market factor, some analysts put the pandemic in the rearview mirror. [17]

2021

- At the outset of 2021, it was generally expected that prices would remain low and new capacity additions would continue to place downward pressure on prices and profit margins.[18] The speed of the recovery from the pandemic, however, introduced an element of uncertainty. Of particular concern was the risk to some companies that were planning new petrochemical complexes with projected construction in 2021-2022.[19]

- During the week of February 16, 2021, the U.S. Gulf Coast experienced severe freezing conditions. Oil, gas and petrochemical companies announced plant closures due to disruptions at the plants and widespread loss of power.[20]

- Within days, companies announced damage assessments and began to plan restarts. By March 1, 2021, 14 major facilities that had announced outages or closures restarted their operations under *force majeure*.

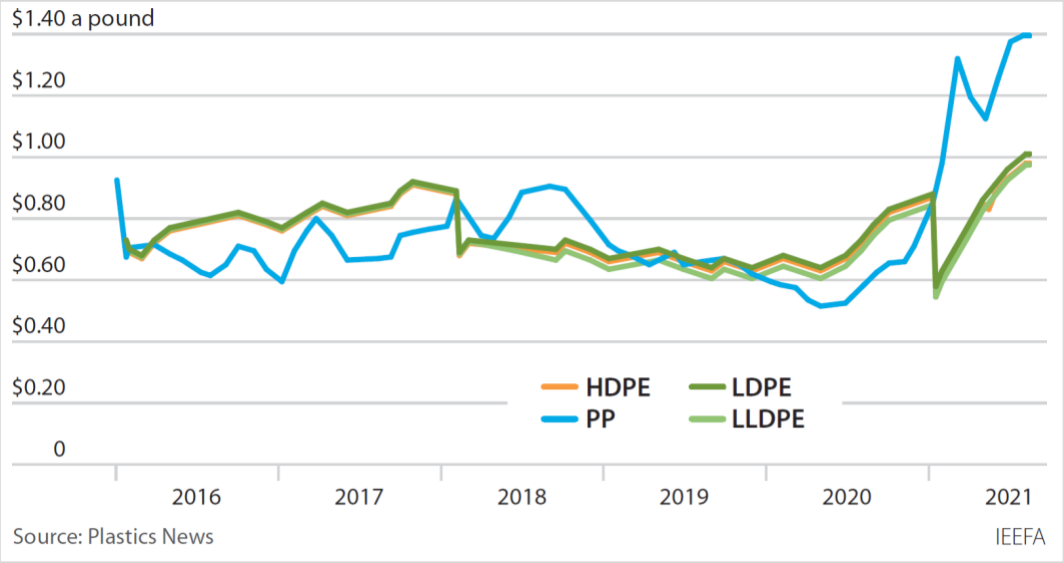
- Most of the major companies posted Q1 2021 gains from the prior year and expressed optimism for Q2 2021 and the remaining year.

- From January 2021 through August 2021, the prices of plastics feedstock (ethylene) and major plastic resins skyrocketed. Polypropylene led the price surge, but every commodity experienced significant price increases.

- Each month brought new notices of price increases from the plastics producers—Dow, Formosa, ExxonMobil, LyondellBasell and Westlake.

[17] Stout. Plastics M&A Activity Rebounds During Second Half of 2020. 2021.
[18] Polymersplace, Outlook for plastic industry 2021-2023, February 3, 2021.
[19] ICIS, Ethylene Wave Slow, March 5, 2020.
[20] Plastics News. Texas ice, cold shut down resin operations. February 18, 2021.

Figure 2: Selected Polymer Price Trends 2016 to the Present (cents per pound)[21]



- Market expectations in January 2021 were that the increases would be short lived, or else the producers risked a drop in demand.[22]
- From the time of the freeze, stories continued to show improving supply conditions for the companies, though many remained in force majeur or maintained tight allocation programs, citing strong demand and depressed inventories.[23]
- Prices continued to rise and demand did not decrease. [24]
- A consensus emerged that the cause of the prolonged price increases was that supply was tight and demand remained robust.[25]
- Information coming from institutional analysts and companies, however, undermined support for this thesis. Two third-party institutional monitors of utilization rates posted rates in the 80 percent to low 90 percent range.[26]

[21] Plastics News, Resin Prices Historical, HDPE, LLDPE, LDPE and PP. Last checked August 6, 2021. (Proprietary)
[22] Plastics News. Price hikes bring unpleasant surprise resin markets in December. January 15, 2021. (Proprietary)
[23] Plastics In Packaging. U.S. Polyolefin Prices Soar After Texas Deep Freeze. March 23, 2021. Also see: Natural Gas Intelligence. Texas Storm Fallout Festers In Petrochemical, NGL Sectors. April 21, 2021.
[24] Plastics News. Don't sound alarm inflation yet but be wary. June 22, 2021. (Proprietary)
[25] WGRZ.com. Texas may thaw after a deep freeze but the ripple effect causes issues for a WNY manufacturer. March 4, 2021.
[26] Rates in the high 80% to low 90% are considered modestly high. Rates that are above 95% or 100% are considered high and would be likely to push prices up to historic levels.

Most individual company reports did not show elevated utilization rates. Dow stated it had upside capacity through Q2.

- Information coming from institutional analysts and companies, however, undermined support for this thesis. Two third-party institutional monitors of utilization rates posted rates in the 80 percent to low 90 percent range.[27] Most individual company reports did not show elevated utilization rates. Dow stated it had upside capacity through Q2 2021. [28] Shell published utilization rates at the 80% levels.[29]

- Bill Wood, a leading industry economist, made it clear that demand has not recovered to pre-COVID levels and that there is likely to be a downward adjustment in single-use plastics demand.[30]

- Anecdotal statements of high-utilization rates appeared from time to time, especially related to polypropylene as an explanation for the high prices. [31]

- Many CEOs of major petrochemical companies are now expecting prices to remain high, even as the economy and markets recover.

- During this period, U.S. ethylene prices—the most important cost factor in plastics production—were volatile and remained elevated, but supply improved. Prices have been dropping and the long-term consensus has emerged that prices will remain low due to the large natural gas surpluses created over the last decade from fracking.

- Futures prices for ethylene are now projected to drop to the low $30s from the high $40s by 2023.

During the transition from 2020 into the fall of 2021, prices have remained high and the explanations offered by industry experts for why prices would decline have largely dissolved. New rationales are emerging, but major trends indicate prices should be coming down even though they remain high.

In mid-August, Plastics Exchange, a prominent industry trade published this assessment:

> "Resin production has returned to robust levels and collective producer PE inventories have reached an all-time high, while PP inventories have well exceeded pre-winter storm levels and now stand at the highest in more than a year. Regardless, with some planned turnarounds ahead and the chance for production disruptions quite possible as we head into the heart of the gulf hurricane season, the vast majority of Polyethylene and Polypropylene

[27] Rates in the high 80% to low 90% are considered modestly high. Rates that are above 95% or 100% are considered high and would be likely to push prices up to historic levels.
[28] The Motley Fool. The Dow Chemical Company Q4 2020 Earnings Call Transcript. January 28, 2021.
[29] Shell. Second Quarter 2021 Results. July 29, 2021.
[30] Plastic News. Are growth rates for plastics starting to moderate? August 9, 2021.
[31] Plastic News. Pricing on the move. July 29, 2021.

> producers are still operating under Force Majeure conditions and/or still have allocations in place, even though many shipments are running at 100% of forecasts."[32]

Focusing on the polyethylene market Plastics Exchange opined:

> "In the meantime, producers have reported fantastic financial results and seem comfortable holding back more material rather than tapping traditional export broker channels. This would require selling resin at levels considerably lower than domestic prices, and that visibility would likely interfere with the huge local premiums."[33]

The pandemic and winter freeze along the Gulf Coast were in many ways unprecedented. The oil, gas and petrochemical industry have seen market disruptions before. Price spikes would not be uncommon under these conditions. As conditions return to normal, supply- and demand-side factors return and price spikes can be expected to abate. This timeline shows that companies were resilient as they managed the problems and maintained profitable enterprises. As market conditions evolved, prices could be expected to decline and many in the industry thought so, as well. Prices, however, continued to increase and as conditions normalized, profits grew to extraordinary levels.

Prices continued to increase and profits grew to extraordinary levels.

II. Prices Are Rising and Likely To Increase Into the Future. Are the Price Hikes Extraordinary?

Since January 2021, some analysts have predicted that the price spike would abate. This has not occurred. Looking at some of the short-term pricing data available during August 2021, all four of the polymers hit their 2021 annual peak this month.[34] Polyethylene has hit 99 cents through $1.07 cents per pound (the reported peak on August 23, 2021), its highest price since 2015. Polypropylene hit $1.39 per

[32] Plastics Exchange.com. Research. August 13, 2021.
[33] *Ibid.*
[34] Plastics Exchange. Market Update. September 24, 2021. Note: Plastics Exchange also posts weekly and monthly price movements. Plastics Exchange reporting shows the same basic trajectory although actual prices vary between the two sources. During the week of August 13, 2021 Plastics Exchange posted prices for HDPE: $1.15; LLDPE: $1.12; PP $1.48 and LDPE $1.14.

pound in August, a peak that exceeded all prices posted in the Plastic News database going back to 2010.[35] September price increases have been announced.[36]

The daily, weekly and monthly price trajectories help to clarify the short-term operations and financial reporting of the companies that make up the industry (Figure 2).[37] The longer-term data (Figure 3) used in this section of the report helps to put those short-term trends into a broader picture and to smooth over day-to-day volatility.

Figure 3: Selected Polymers Price and Utilization Rate: 2015 Through 2021 (estimated)[38]

	HDPE	Util. Rate	LLDPE	Util. Rate	LDPE	Util. Rate	PP	Util. Rate
2015	64	94	72	96	65	96	63	92
2016	58	93	65	97	61	97	61	90
2017	61	86	71	88	64	88	63	88
2018	62	91	71	87	63	87	76	86
2019	52	93	59	87	49	87	58	84
2020	49	92	58	93	47	93	51	84
2021	78	94	87	87	77	87	1.02	87

Source: IHS Markit.

The term "extraordinary" was selected because it denotes an observable incremental change that creates a gain/loss, is outside the normal course of business and unlikely to be repeated. The typical trajectories for utilization rates and prices are that they move in tandem. Utilization rates increase as a production facility approaches its maximum capacity (100% operating rate). Prices typically rise as supply is absorbed by customer orders (demand). In the current environment, prices are up but utilization rate metrics are not showing uniform increases at levels that reflect very high price levels.

Utilization rates, though elevated, have decoupled from prices at these high levels.

[35] Plastics News. Resin Pricing, Current and Historical. Last Visited August 28, 2021. (Proprietary)
[36] Plastics Exchange. North American Resin Producers Seek Additional Increases for PE. August 20, 2021.
[37] The weekly and daily data used in this report is taken from Plastics News, an online periodical that tracks the plastics industry. IEEFA relies on Plastic News for most of the short-term price discussion in this paper. This allows us to capture the ups and downs of the market as they are occurring during the year. Similarly, IEEFA uses Plastics Exchange for short-term market and pricing as a comparative source to Plastics News. For longer-term tracking and market forecasts typically used for corporate planning and financial markets, IEEFA relies upon IHS Markit and other sources. This chapter assessing the role of prices and utility rates to assess companies and the market relies more heavily on these longer-term models and tools. The data on price levels in particular varies significantly from the short-term to the long-term sources. The basic trajectories, however, are basically the same.
[38] IHS Markit. Polyethylene CCMA, 2021 Quarter 2, Price Sensitivity and Operating Rates., August 2021.

IEEFA's research concludes that the current prices are extraordinary for the following reasons:

1. Long-term prices are rising faster than the utilization rate.[39] Within the last five years, each polymer was produced during periods when the utilization rates were at or above the current 2021 estimated levels. In each prior instance when the utilization rate was at or above current levels, prices for the commodity were lower than they are today. The decoupling of the utilization rate from the price is significant. In theory, since price levels have been elevated for more than eight months, utilization rates should be considerably higher than they are reflected in IHS Markit estimates or the Federal Reserve's actual figures.

2. For example, in 2015 polypropylene prices were 63 cents per pound when the utilization rate was 92%. According to IHS Markit's estimate for 2021, the annual price is in the $1.02 cents per pound range and utilization rates are at 87%. The price is significantly higher even though the utilization rate is lower.

3. HDPE resin prices demonstrate the same trend, but at significantly lower variance. When utilization rates were 94% in 2015, the price was 64 cents per lb. In 2021, the estimates are for the same utilization rates but the price is 14 cents higher, at 78 cents per pound.

4. Data compiled and published by the Board of Governors of the Federal Reserve System show a similar trajectory.[40] From January 2004 to March 2005, the price index increased by 60 points at an average utilization rate of 92% for the period. In the current period from January through July 2021, however, the price index increased by 76 points even though the utilization rate averaged 82%.

The sharp price increase has created an economic gain for producers.[41] The increases are outside the normal bounds that could be expected given past performance under similar conditions. While the pandemic and freezing weather had an impact on the producers, the recovery was quick.

Some companies report anecdotally on their utilization rates. For example, Dow publishes a utilization rate chart with its quarterly earnings report. The most recent report shows a utilization rate for polyethylene in the high 80s in 2022, with a potential in the low 90s due to unforeseen industry events.[42]

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[39] The use of long-term data is of particular significance because in some instances, usually short-term in nature, capacity rates can decline due to weather-related outages, planned or unplanned maintenance outages, or specific business disruptions. The use of the utilization-to-price relationship in this paper is to trace the broader trends.
[40] St. Louis Federal Reserve. Capacity Utilization: Manufacturing: Non-Durable Goods: Plastics Material and Resin. Last checked August 18, 2021. Also see: St. Louis Federal Reserve. Producer Price Index by Industry: Plastics Material and Resins Manufacturing. Last visited August 28, 2021.
[41] Plastics Exchange. Market Update. August 13, 2021.
[42] Dow. Dow 2Q 2021 Results. July 22, 2021, p. 8.

Additional information of a qualitative nature should also be considered. When prices rise and utilization rates increase at an industry-wide level to the low 90s, discussion typically ensues concerning new investment to bring utilization rates and prices in line.[43]

Despite extraordinarily high prices and mixed reporting on utilization rates, industry leaders are not sending a message that new capacity is needed. LyondellBasell is indicating that profits will go toward debt reduction.[44] Dow Chemical is taking a wait-and-see view, driven in part by policy formation in Washington.[45]

The market has also yet to absorb facilities that were brought on line just before the pandemic.[46] In addition, Shell is nearing completion of a new petrochemical complex in western Pennsylvania.[47] Further testimony to the lack of demand in the market are the delays that have challenged a proposed new petrochemical facility announced by Formosa in Louisiana,[48] as well as another by PTTGC in Ohio.[49]

III. Why Are Plastics Prices High, and Why Are They Likely To Remain High?

A. Background: Size and Structure of Market and How Prices Are Set

A relatively small number of companies produce most of the feedstock and plastic resins that comprise the single-use category.

Single-use plastic in the United States is made primarily (feedstock) from ethane-based ethylene, a natural gas derivative,[50] and several different thermoplastic polymers. Familiar products include straws, bottles, containers, wraps, packaging and medical equipment.

The top five companies supply 63% of the ethylene market. All top five U.S. ethylene producers are also among the top 10 global producers.

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[43] A chart provided by IHS Markit provides a snapshot of the conditions that are conducive to new construction of polyethylene capacity. See: IHS Markit. North American Resin Markets Trends. January 2014, Slide 11 (outlines the North American market and shows steady, modest annual production increases driving up utilization rates over time creating a market conducive to expansion).
[44] LyondellBasell Industries. LyondellBasell Industries N.V. CEO Bhavesh Patel on Q2 2021 Results – Earnings Call Transcript. July 30, 2021.
[45] The Motley Fool. The Dow Chemical Company Q2 2021 Earnings Call Transcript. July 22, 2021 (Response to Question from Arun Viswanathan, RBC Capital).
[46] Chemical and Engineering News. Sasol finishes last Louisiana plant. November 21, 2020. Also see: S&P Global Platts. Formosa Plastics new Texas cracker starts operating. January 15, 2020.
[47] Blue Sky News. Shell Targets 2022 Opening for $6B Ethane Cracker Plant. April 12, 2021.
[48] Reuters U.S. Army orders environmental review Louisiana plastics project. August 18, 2021.
[49] The Columbus Dispatch. Proposed Ohio cracker plant by PTTGC awaits air permit decision. July 16, 2021.
[50] Minderoo Foundation, Plastic Waste Makers Index. July 2021.

Figure 4: Top Five Companies Leading Single-Use Production in United States

	Polypropylene				High Density Polyethylene				Linear Low Density Polyethylene	
Rank	Company	% of Total		Rank	Company	% of Total		Rank	Company	% of Total
1	Braskem America, Inc.	22.57%		1	Equistar Chemicals, LP	24.34%		1	ExxonMobil Chemical Co.	40.10%
2	Equistar Chemicals, LP	18.16%		2	Chevron Phillips Chemical Co.	21.91%		2	Dow Inc. United States	23.88%
3	ExxonMobil Chemical Co.	12.96%		3	ExxonMobil Chemical Co.	13.24%		3	Chevron Phillips Chemical Co.	9.02%
4	Total Petrochemicals USA, Inc.	12.84%		4	INEOS Americas, LLC	12.95%		4	Formosa Plastics Corp. U.S.A.	8.47%
5	Formosa Plastics Corp. U.S.A.	9.78%		5	Dow Inc. United States	8.63%		5	Equistar Chemicals, LP	5.60%
	Low Density Polyethylene				Ethylene					
Rank	Company	% of Total		Rank	Company	% of Total				
1	Dow Inc. United States	30.05%		1	Dow Inc. United States	16.98%				
2	Westlake Chemical U. S.	15.59%		2	ExxonMobil Chemical Co.	14.04%				
3	ExxonMobil Chemical Co.	15.00%		3	Equistar Chemicals, LP	13.27%				
4	Equistar Chemicals, LP	14.56%		4	Chevron Phillips Chemical Co.	12.37%				
5	Louisiana Integrated PE JV. LLC.	9.46%		5	Formosa Plastics Corp., U.S.A.	6.72%				

The production of single-use plastics—such as films, bottles, sheets, liners and other soft plastics—requires various combinations of ethylene and plastic resins. The manufacturing process relies on ethylene as feedstock and significant quantities of the following four polymers:

- Polypropylene (PP)—Five companies supply 75% of the 17.3 billion-pound U.S. market.[51]
- High density polyethylene (HDPE)—Five companies supply 80% of the 22.8 billion-pound U.S. market.
- Low density polyethylene (LDPE)—Five top companies supply 85% of the 7.8 billion-pound U.S. market.
- Low linear density polyethylene (LLDPE)—Five top companies supply 87% of the 22.9 billion-pound U.S. market.

ExxonMobil, Equistar, Dow and Chevron Phillips dominate most of the U.S. market.

B. Pattern of Announcement of Price Increases

Companies typically communicate price adjustments by letter to customers. The letters are frequently provided to trade association newsletters and publications. Public reports of price increases are scattershot and without context for the uninitiated.

Prices are often announced separately by leading companies, but the announcements from the companies usually occur on or near the same date.[52] For

[51] Company rankings are sourced from IHS Chemical Company Ranking 2020 (proprietary) and market size by pound from the American Chemistry Council, 2021 Resin Review, May 2021. (proprietary)
[52] S&P Global Platts. ExxonMobil Chemical restores USGC production raises polyethylene prices for April. March 23, 2021.

example, when ExxonMobil announced the reopening of its operations that closed due to hurricanes in February 2021, it also announced 7- to 9-cents-per-pound increases across the board on its polyethylene products. The article that announced ExxonMobil's increases noted that Dow Chemical, Formosa Plastics USA, Bayport Polymers and LyondellBasell subsidiary Equistar Chemical had also made announcements effective April 1. It also appears from the article that the amount of the increase was the same for each company.[53]

Smaller market players also announce price increases, but often these are done on the heels of announcements from larger companies.[54]

The ExxonMobil announcements are of particular importance as it is a dominant player in each of the markets. Also, the company's overall revenue performance has been weak over the last several years due to low oil and gas prices and subpar operational performance.[55] In Q2 2021, ExxonMobil posted $2.3 billion in petrochemical earnings and $4.7 billion across its global enterprise.[56]

An industry consensus is emerging that prices will continue to increase in the coming months.[57] Some concerns are being expressed about the high prices,[58] but by and large consumers are paying the increases.

IV. Why Should Prices Be Coming Down?

While prices for plastics remain high, several trends suggest that a more balanced repricing should be occurring. The nature of the market dialogue has been underway since early January when the price spike started. The rebalancing, or a price adjustment, should be the next chapter in the plastics price industry storyline. Price increases for September were announced[59] but they remained flat. Flat pricing at this point is occurring when prices have risen substantially.

A price adjustment should be the next chapter in the plastics price industry storyline.

Several major market indicators—fast company recovery from weather events and the pandemic, lower than expected reported utilization rates, respectable profit levels during periods of economic disruption, a general economic rebalancing of

[53] *Ibid*.
[54] S&P Global Platts. Westlake announces price increase for domestic PVC in February: letter. January 6, 2021.
[55] IEEFA. ExxonMobil's U.S. Upstream Results Underwhelm, Again. August 2021.
[56] ExxonMobil posts quarterly reports back through 2014 on its website. Q2 2021 marked its highest earnings of any quarter since 2014.
[57] Plastics Today. Weekly Resin report domestic prime resin scarce supply. June 24, 2021.
[58] Espositio. Plastic News. August 9, 2021 (Proprietary)
[59] Plastics Exchange. North American resin suppliers seek additional increases for September PE. August 28, 2021.

markets, mixed views on strength of demand, and low natural gas prices—all suggest prices should be lower than they are.

Integrated oil and gas companies, which play an important role in the petchem space, are benefiting from the price hikes at a time of poor performance in the rest of the oil and gas industry. The persistence of high plastic prices are now also raising inflationary concerns.[60]

A. The Pandemic's Damage to the Single-Use Plastic Sector Was Minor. In Fact, Demand Increased for Many Companies.

The negative impact of the pandemic hit the segment of the plastics industry that supplied the automotive and construction industry, as well as other sectors that utilize "hard" plastics.[61] Those areas lost production and business. The portion of the plastics sector that supported the medical and consumer sectors, however, was disrupted but relatively unscathed financially.[62]

Of the four major plastics commodities, three (HDPE, LLDPE, LDPE) saw year-over-year volume growth, and one (PP) posted flat production (2019-2020). Each sector added capacity during the year. Utilization rates dropped for LDPE and PP during the year. Only LLDPE posted an increase in utilization rates from 85.4% in 2019 to 93.8%.[63]

Increased demand was a surprise for the industry. Most expected a collapse in demand during the pandemic as consumer purchasing fell. The opposite occurred. Still, rising demand did not overwhelm manufacturing capacity. During most of 2020, prices rose but the increases were not extraordinary.

Prices began to increase more strongly near the end of 2020, shooting up after the February freeze in 2021.

B. The Freeze in February 2021 Forced Widespread Plant Closures, but Re-openings Occurred Relatively Quickly and Most Companies Declared Q2 Earnings in Their Petchem Operations.

During the week of Feb. 16, 2021, the Gulf Coast was hit with severe freezing weather. The area experienced widespread electricity outages, and most of the petrochemical companies in the region announced plant closures.[64]

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[60] Financial Times. European manufacturers hit by surge in price of resins used to make plastic. February 2021.
[61] Chemical & Engineering News. Plastics during the pandemic. June 22, 2020.
[62] PBS. The Plastic Industry Is Growing During COVID. Recycling? Not so much, February 17, 2021.
[63] Industry production, sales, capacity and inventory data is taken from American Chemistry Council, 2020 Annual Resin Review, May 2021 (Proprietary).
[64] S&P Global Platts. Factbox: U.S. Gulf Coast freeze begins to thaw; plant inspections, restarts ahead. February 19, 2021.

Most of the major companies, however, announced re-openings by March 1, although most continued to work under *force majeure*. During the first and second quarter earnings season this year, most plastics manufacturers reported gains over the prior year. Westlake,[65] ExxonMobil,[66] LyondellBasell,[67] Dow,[68] and Formosa all reported solid 2021 second quarter returns. Some companies did not even mention the outages in relation to their specific operations.

ExxonMobil, perhaps the largest player in the U.S. market, announced "best ever" gains in its second quarter 2021 petrochemical earnings.[69] ExxonMobil had announced it had restored its Gulf Coast capacity by March 23, 2021.[70]

The trade press and other media covering the industry during this period justified the high prices on the pandemic and the freeze. They claimed that the persistence of high prices was due to a slow recovery from these events.[71]

The hurricanes and freeze undoubtedly had a short-term impact on production and deliveries. Nevertheless, the quick reopening of the plants, the strong financial performance of companies during both quarters and the statements by company officials about strong organizational recovery suggest a relatively balanced response. Supply did not collapse and demand did not catapult.

C. General Statements by Companies Asserting the Existence of Strong Demand Are Being Challenged.

During ExxonMobil and Dow's second-quarter 2021 earnings call, both described demand as strong.[72] Plastic News economist Bill Wood, however, has said he finds that consumer spending is not back to pre-COVID levels, thus challenging the argument that demand is uniformly strong.[73] Furthermore, while ExxonMobil's Q2 2021 petrochemical volumes were higher than Q1, the numbers were flat when compared against the prior three quarters.[74]

Broadly, the chemical industry is improving and plastics resins have contributed to recent growth. The growth trajectory, however, is not strong. In July, according to the American Chemistry Council, plastic resin growth increased 1.1% year to year, reflecting only a modest increase.[75] The 10-year compound annual growth rate (CAGR) for these polymers ranges from 0.0% (polypropylene) to 5.2% (LDPE).

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[65] Westlake Chemical Partners. WCP announces second quarter results, August 3, 2021.
[66] ExxonMobil. ExxonMobil earns 4.7 billion in second quarter. July 30, 2021.
[67] El Paso, Inc. LyondellBasell Reports Second Quarter 2021 Earnings. July 31, 2020.
[68] Chemical & Engineering News. Dow, BASF earnings surge in the second quarter. July 22, 2021.
[69] ExxonMobil. ExxonMobil earns 4.7 billion in second quarter 2021. July 30, 2021.
[70] S&P Global Platts. Texas petrochemical restarts continue slowly after freeze. March 1, 2021.
[71] Bloomberg. Plastic Prices Hit Record High to Stoke Inflation Concerns. March 18, 2021.
[72] The Motley Fool. ExxonMobil Q2 2021 Earnings Call Transcript. July 31, 2021
[73] Plastics News. Plastic product demand still not back to pre-COVID levels. July 19, 2021.
[74] ExxonMobil. 2Q 2021 earnings overview. August 2021.
[75] American Chemistry Council. Global Chemicals Output Rises to Start Third Quarter. August 23, 2021.

When summarizing Dow Chemical's position at the end of 2020, CEO Jim Fitterling said:

> "On average, for the whole company, we were above 80% operating rates for the fourth quarter and we continue that strength into the first quarter. We were at higher levels than that in our packaging and specialty plastics business."[76]

He concluded that Dow still had upside going into 2021.[77] This CEO of a leading company saw no oncoming severe market tightness that would send prices soaring. Fitterling said additional capacity coming online in China and the rest of the world should be capable of meeting demand.[78]

In its first quarter 2021 earnings presentation, Dow Chemical estimated its recent utilization for plastic production in the high 80% to low 90% range through 2026.[79] In July 2021, Dow noted that it is seeing higher utilization rates and continued high prices.[80] The company is taking a wait-and-see view regarding new investments contingent on policy actions in Washington.[81]

Shell projected rates for its crackers at 82%, according to its second quarter 2021 reports.[82] Meanwhile, one industry analyst put some polypropylene at utilization rates of 96%,[83] a clear indication of high demand.

Even as conditions rebalance, CEOs are preparing the markets for prices to remain high.

Another component of the strong demand thesis relates to shipping logistics and trade dynamics, particularly with China. U.S. producers are capable of securing high prices in today's U.S. markets. Prices in the Asian markets are lower, which is one reason to keep selling in the United States. Also, a series of logistical, container and shipping problems are making export sales more difficult. Moreover, trade relations with China remain tense.[84] Plastics producers in the United States are

[76] The Motley Fool. The Dow Chemical Company Q4 2020 Earnings Call Transcript. January 28, 2021.
[77] *Ibid*.
[78] *Ibid*.
[79] Dow Chemical. Dow 1Q 2021 Results. April 22, 2021.
[80] Marketwatch. Plastic prices can keep rising as Dow sees demand continuing to outstrip supply. July 22, 2021.
[81] The Motley Fool. The Dow Chemical Company Q2 2021 Earnings Call Transcript. July 22, 2021 (Response to Question from Arun Viswanathan, RBC Capital)
[82] Shell. Second Quarter 2021 Results. July 29, 2021.
[83] Plastic News. Are growth rates for plastics starting to moderate? August 9, 2021.
[84] Associated Press. Firms wrestling with supply bottlenecks consider loosening ties with China. August 5, 2021.

benefitting from holding back products from export markets.[85] And, the complex logistical problems make it more difficult that players along the supply chain can take advantage of low Asian prices by importing semi-finished and other products.[86]

Even as conditions rebalance, CEOs are preparing the markets for prices to remain high.[87] As the high price scenario evolves, the CEO of Westlake Chemicals expects that prices will realign at higher levels.[88]

D. The Economy Is Improving, Bringing Markets Back Into Alignment.

The plastics sector typically rises and falls with the economy. Bill Wood, a leading industry economist, has pointed out that the economy went into recession for two months in 2020 and that it has rebounded with five straight quarters of growth.[89] Growth trajectories are supposed to be slowing down. With the economy coming back into alignment, supply and demand should be rebalanced and some price rebalancing should be anticipated. The pandemic actually improved some of the companies' performance, and it is now more than six months after the freeze. Wood anticipates that the economic slowdown will drive down demand (and IEEFA assumes that it should bring down prices with it).

E. Low Natural Gas Prices Are Likely To Return and Persist. Ethane-based Ethylene Is Likely To Remain an Advantage for the Plastics Producers in the U.S.

Ethane-based ethylene is the principal feedstock for most of the plastic produced in the United States. It also constitutes approximately 60% of the cost of resin production.[90] Hydraulic fracturing, or "fracking," a technological innovation of the oil and gas industry, increased production over the last decade and forced prices of natural gas down dramatically.[91] Plastics manufacturers in the United States have made significant investments in new facilities based on low natural gas prices.[92]

As the pandemic began, the price of ethylene was in the 20 cents per pound range, a historically low level. Since April 2020, prices have more than doubled, to more than 50 cents per pound.[93] Natural gas supplies are ample,[94] and U.S. operating rates are

[85] Plastics Exchange.com. Research. August 13, 2021.
[86] *Ibid*.
[87] Plastics Exchange. Major Resin Producers Expect High Margins to Continue. July 30, 2021.
[88] Seeking Alpha. Westlake Chemicals CEO Albert Chao on Q2 2021 Results. August 3, 2021.
[89] Plastics News. Are growth rates for plastics already starting to moderate? August 11, 2021.
[90] IHS Markit. IHS Markit World Analysis 2021, Ethylene. (Proprietary)
[91] Daniel Yergin. *The New Map*. New York: Penguin Press, 2020, p. 12.
[92] The Motley Fool. The Dow Chemical Q1 2021 Earnings Cal Transcript. April 22, 2021.
[93] ICIS. US March ethylene contracts notch largest increase in 15 years on storm-related production issues. April 2, 2021.
[94] ICIS. Ethylene prices, markets & analysis. Accessed August 6, 2021.

not expected to tighten.[95] Ethylene futures prices are expected to decline through 2023 despite prices that are currently elevated in the $30 range.[96]

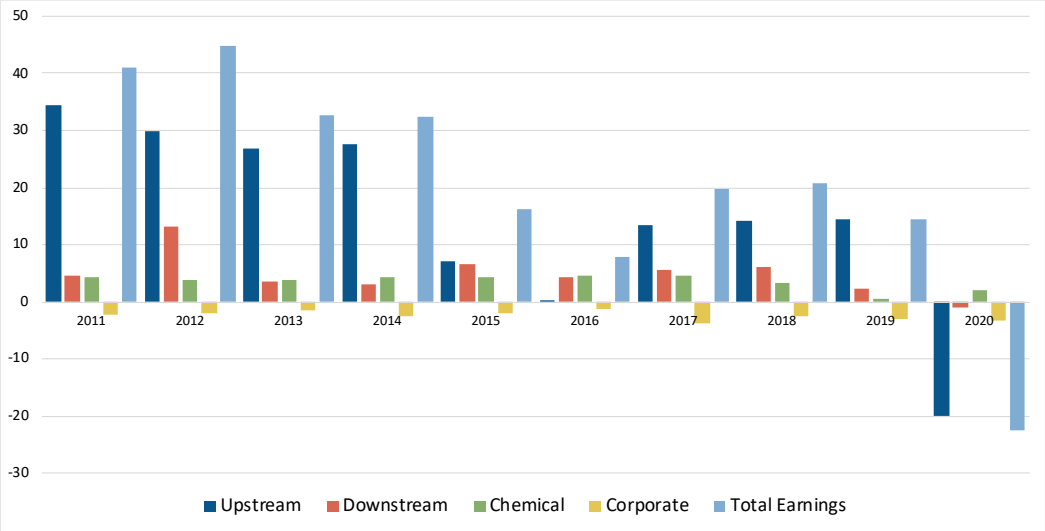
New capacity additions to the United States market are expected to place downward pressure on prices as they are integrated into the market. Shell is expected to open a new ethane cracker and petrochemical complex in Pennsylvania in 2022. Sasol and Formosa have opened plants just prior to and during the pandemic. The market impact of these capacity additions has not yet been tested under typical market conditions. The added capacity, however, is expected to keep ethylene prices low and plastics resin prices competitive.

F. Urgent Financial Pressures on the Integrated Oil and Gas Companies With Petrochemical Segments Are Causing an Increasing Reliance on Plastics as a Revenue Source.

Integrated oil and gas majors like ExxonMobil, Chevron, Shell and TotalEnergies face a future of structural decline. Over the last 10 years, the oil and gas drilling and refining segments have lost billions in share value.[97] The pandemic exacerbated weak performance, with 2020 reflecting some of the worst performances in the history of the industry. When the industry was more prosperous, petrochemicals were seen as a kind of poor second cousin, but now they are appearing to the oil and gas majors as a potential steady, stable source of profit (albeit smaller than the oil and gas profits of the past).[98] In 2021, the integrated oil majors are posting stock market gains attributed to the increase and relative stability of oil prices in above $70 per barrel.

[95] IHS Ethylene CCMA, 2Q 2021 anticipates U.S Ethylene rates at 84% (Proprietary)
[96] CME Group. Mont Belvieu Ethylene (PCW) Financial. October 4, 2021.
[97] IEEFA. Fossil Fuel Investments: Looking Backwards May Prove Costly to Investors in Today's Market. February 2019.
[98] Wall Street Journal. Big Oil is Betting on Plastics. It May Be a Risky Bet. May 23, 2017. Also see: New York Times. Big Oil Is in Trouble. Its Plan: Flood Africa With Plastic. August 30, 2020.

Figure 5: ExxonMobil Segmented Earnings 2011-2020



Source: IEEFA analysis, based ExxonMobil 10-K filings from 201 through 2020.

The internal composition of ExxonMobil's earnings performance is illustrative of this trend. Historically upstream (dark blue) and downstream segments (orange) drove the company's overall earnings (light blue). Chemical's earnings, though reasonably steady, were modest (light green). In 2020 and during the first half of 2021, ExxonMobil's upstream and downstream profits were low. The chemical unit carried the load.[99]

The Wall Street Journal has characterized the dilemma facing the industry:

> "Resigned to more pedestrian returns, integrated oil companies see a strong case for investing in a business that was once a sideshow."[100]

The oil and gas industry has a strong interest in seeing plastics prices remain high. Elevated profits on the end-use side of plastics production flow back through the production chain to support not only the petrochemical segment (plastic resins and ethylene prices) but also support the demand behind drilling operations (natural gas, ethane, oil and naphtha) that face strong, long-term competition from within the electricity and transport sectors.

V. Single-Use Plastics and the Public Interest

The plastics industry is comprised of a conglomeration of companies and private interests. They exert control over an industry that provides basic necessities for the entire population. The allocation of its products in many forms serves an overriding public interest. The industry's positive contributions are counterbalanced by

[99] OilPrice.com. ExxonMobil Beats Earnings Estimates As Its Chemicals Business Booms. July 30, 2021.
[100] Wall Street Journal. Big Oil Flashes the Plastic. July 28, 2019.

plastics as a source of properly and improperly disposed of solid waste and toxic and carbon emissions.

Plastics are a commonplace part of daily existence. Their utility attests to their prevalence. The recent pandemic has created a health emergency and pushed plastics importance to the point where its role in the supply of medical equipment and supplies has amplified its function as a provider of basic necessities. Environmentalists have long identified a tension between the proliferation of plastics and the need for clean air, clean water and a sustainable climate.

In the current economic climate, plastics have also taken on a heightened financial importance. Plastics are produced largely with fossil fuels. The use of fossil fuels for this purpose has become a more important source of profits for the oil and gas industry. Market forces and public concerns are driving capital away from fossil fuels in the transport and energy sectors. Petrochemical investments are being looked upon as a potential profit replacement for these traditional areas of industry earnings.

The use of fossil fuels for plastics production has become a more important source of profits for the oil and gas industry.

The market and price dysfunction outlined in this paper requires a public interest review. Extraordinary prices are being charged for a basic necessity based upon an uncritical acceptance that the abnormal conditions of 2021 created a temporary market dysfunction. The industry's unshackled production has led to worldwide actions to control ocean dumping of plastics. The toxic impacts of new and expanded industrial capacity is causing community backlashes around the globe, particularly in areas where politically weak, racial minorities live. Plans to accelerate fossil fuel-based plastic production are undermining efforts to combat climate change. Finally, a financially weak oil and gas industry is facing financial pressures to increase a deteriorating revenue position.

Despite its growing importance, the plastics industry has never been comprehensively reviewed by external, third-party sources charged with protecting the public interest. The plastics industry lacks a level of oversight that reflects its function as a provider of basic necessities with particular relevance to the national and public interest in the United States. The price dysfunction is the most recent manifestation of its untrammeled license. This red flag provides a reasonable focus for regulatory oversight to assess the industry. A strong financial understanding of the industry is essential to developing the kind of potential public interventions that needed.

A. Medical Plastics and the Public Interest

The medical plastics industry in the United States was valued at $5 billion and worldwide at $30 billion in 2019.[101] The U.S. market is comprised of companies that provide products critical to the nation's hospitals, doctors offices, health clinics, medical equipment suppliers and research facilities.

The number and type of products is extraordinary. Many of the "hard" plastic uses serve as covers, sheaths and coatings for medical devices, beds, doors, bed tables, computers, desks and chairs.

The list for single-use or disposable medical products is longer and includes bed pans, insulin pens, intravenous tubes, tube fittings, plastic cups and pitchers, pill casings and coatings, eye patches, surgical and examination gloves, inflatable splints, inhalation masks, tubing for dialysis, disposable gowns, wipes and droppers, urine continence and ostomy products. The use of plastic materials in hospitals is almost endless.

Both soft and hard plastic end products rely heavily on polyethylene (HDPE, LLDPE, LDPE), polypropylene (PP), polyvinyl chloride (PVC) and polystyrene (PS).[102]

Product manufacturing and innovation is highly cost-sensitive.[103] Typically, plastics have been seen as a cost-effective part of product production. In the current market, the rising price of plastics is being noticed.[104]

Many of the disposable, single-use products are mass produced and have little product differentiation, which leads to competition on price. Medical care devices, equipment and supplies have a major impact on the costs of healthcare and the budgets for Medicare, hospitals and other health facilities.[105] The largest companies worldwide include:

- Arkema Sa
- BASF SE
- Celanese Corp.
- Covestro Ag

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[101] Fortune Business Insights. Medical Plastics Market Size, Share & COVID-19 Impact Analysis, By Application (Medical Disposables, Medical Instruments, Prosthetics & Implants, Drugs Packaging, and Others) and Regional Forecast, 2020-2027. August 2020.
[102] National Institutes of Health. Application of Plastics in Medical Devices and Equipment. December 10, 2013. Also see: Mint. Single-use plastic turns out to be an unlikely her in corona battle. April 13, 2020.
[103] National Institutes of Health. Application of Plastics in Medical Devices and Equipment. December 10, 2013.
[104] Medical Plastics News. Why is it suddenly difficult to buy plastic components in 2021? June 1, 2021.
[105] The Medicare Payment Advisory Commission. An Overview of the Medical Device Industry. June 2017.

- DowDuPont
- Evonik Industries Ag
- ExxonMobil Corp.
- Royal Dsm
- Solvay Sa
- The Lubrizol Corp.

Many of these companies are integrated producing, buying and consuming plastics. Some only consume plastics as part of their production processes.

The pandemic raised the profile of the plastics industry broadly. The large number of stay-at-home people increased their consumption and changed specific use patterns. In addition, the massive pressure placed on the nation's healthcare system caused the demand for medical equipment to soar.[106] The pandemic-driven health crisis created an almost insatiable demand for plastics.

The pandemic raised the profile of the plastics industry broadly.

Once a vaccine was approved, public attention turned to whether the nation had an adequate supply of glass vials and caps to ship the vaccine wrapped in plastic. [107] As the pandemic evolved, the country's manufacturing capability became the backdrop for discussion. The president was called upon to use extraordinary powers to direct what private companies must produce—masks, ventilators, shields and other personal protective equipment. The plastics industry requested and received the status of an essential industry.[108] Its workers were deemed essential by the Centers for Disease Control and Prevention.[109]

Discussion of rising prices has largely been limited to business and trade media.[110] Specific concerns about the impact of rising prices on consumers has also been

[106] British Plastics Federation. BPF Highlights the Plastic Industry's Impressive Response to COVID-19. November 5, 2020.
[107] Plastics Today. A Vaccine, Gift-Wrapped in Plastic. December 18, 2020.
[108] Plastics Industry. Plastics Industry "Essential" As First Line Of Defense With Products To Fight Coronavirus. March 20, 2020.
[109] Centers for Disease Control and Prevention. Vaccines & Immunizations. August 20, 2020.
[110] NTOTank. Resin Material Market Shortages and Rising Prices: Q1 2021. May 20, 2021. Also see: Bloomberg. Plastic Prices Hit Record High to Stoke Inflation Concerns. March 18, 2021. Also see: Plastic News. North American resin prices move, June, 2021. Also see: PTOnline. Prices Up for All Five Commodity Resins. August 20, 2021.
Plastics News, PP PS and O+PVC resins close out august higher prices, August 2021.

limited, but notably Johns Hopkins highlighted rising costs at the onset of the pandemic.[111]

What was and remains a critical nationwide public health emergency evolved into a test of local and state government preparedness, scientific capacity, private sector ingenuity, national unity and the ability of the country to allocate resources to keep the public safe.

The imbalances and weaknesses of the nation's response shook the national security structure.[112] Going forward, the nation's will to improve the country's health readiness is likely to include changes in the economic chain that supplies plastic, company readiness, and the type and scope of production.

B. Plastics, Climate Change and the Public Interest: Greenhouse Gas Emissions

The refining and manufacturing process that occurs at petrochemical facilities produces millions of tons of greenhouse gas emissions (GHGs) in the form of methane, carbon dioxide and other climate-disrupting pollutants. The current federal inventory of greenhouse gas emissions notes that unlike most chemical industries, the petrochemical industry's contribution to climate disrupting pollution has increased. It states:

> "Carbon dioxide and CH4 emissions from many chemical production sources have either decreased or not changed significantly since 1990, with the exception of petrochemical production, Carbon Dioxide Consumption, and Urea Consumption for Non-Agricultural Purposes which has steadily increased."[113]

In 2019, the petrochemical industry in the United States accounted directly for 31.1 million metric tons of CO_2 emissions, up from 21.8 in 1990 and 28.2 in 2015.[114] The industry's expansion plans would cause these emissions to rise even further. For example:

- The proposed Formosa plant in the St. James County, La., would be allowed to emit 12.3 million metric tons (13.6 million tons) per year of GHGs in carbon dioxide equivalents—more than any other oil, gas or petrochemical infrastructure project nationwide since 2012.[115]

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[111] Advisory Board. Johns Hopkins is paying 20X more for hospital gowns (And it's not alone). August 3, 2020. Also see: Vox. Surgical gowns cost my hospital 40 cents before the pandemic. Now they are 9$. July 29, 2020.
[112] Council on Foreign Relations. Improving Pandemic Preparedness. 2020.
[113] U.S. EPA. Inventory of Greenhouse Gas Emissions and Sinks, 1990-2019. EPA-R-21-005. April 14, 2021 (hereafter, "EPA Inventory"), p. 4-3.
[114] *Ibid.*, pp. 2-3 and 2-4, Table 2-1.
[115] Environmental Integrity Project. Tracking Oil and Gas Infrastructure Emissions (last updated May 3, 2021).

- Even the smaller Shell petrochemical plant would emit roughly 2.1 million metric tons (2.3 million tons) of GHGs in carbon dioxide equivalents per year.[116]

The emissions from these two projects alone would represent a 47 percent increase over the level produced by all U.S. ethylene facilities in the United States.

A lifecycle analysis of the climate implications of plastics would have to consider the emissions from land-clearing (to the extent required), well-drilling, fracking to extract natural gas liquids (NGLs) and transport to a petrochemical facility for processing and manufacturing. Fracking or other methods to extract NGLs involves a substantial release of methane, a powerful greenhouse gas that traps more than 84 times more heat during the first 20 years of its presence in the atmosphere than carbon dioxide.[117]

A consortium of environmental organizations led by the Center for International Environmental Law (CIEL) released a report finding that emissions from fossil fuel extraction and production attributed to plastic production in 2015 totaled at least 9.5 million metric tons of CO_2-equivalents (CO_2e) per year. For plastics production throughout the rest of the world, which generally relies on oil rather than gas as the primary feedstock, emissions from fossil fuel extraction and production attributed to plastic production totaled approximately 108 million metric tons.[118]

The analysis would also have to consider disposal. The CIEL report estimates that incineration of plastic wastes in 2015 produced 5.9 million metric tons of CO_2e worldwide. It concludes:

> "If the production, disposal, and incineration of plastic continue on their present growth trajectory, by 2030, these global emissions could reach 1.34 gigatons per year—equivalent to more than 295 five-hundred-megawatt coal plants. By 2050, plastic production and incineration could emit 2.8 gigatons of CO2 per year, releasing as much emissions as 615 five-hundred-megawatt coal plants."[119]

[116] Shell Petrochemical Complex Air Permit, pp. 15 and 24.
[117] The IPCCC attributes to methane an impact 28 times that of carbon dioxide over 100 years, but 84 times that of carbon dioxide over 20 years. Thus, the estimated power of methane's impact on climate change is three times greater in a 20-year timeframe. IPCCC. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change 47. 2014.
[118] Center for International Environmental Law (CIEL), *et al.* Plastic and Climate; The Hidden Costs of a Plastic Planet. 2019 (hereafter, CIEL Report), p. 26.
[119] CIEL Report, *op. cit.*, p. 4. Also see p. 81.

The most current inventory of greenhouse gas emissions in the United States reports that the burning of plastics waste produces roughly 6.6 million metric tons of CO_2e per year.[120]

The burning of plastics waste produces roughly 6.6 million metric tons of CO_2e per year.

The extent to which microplastic waste (discussed in the next subsection) in the oceans may interfere with ability of plankton to fix carbon through photosynthesis—and thus the ocean's capacity to serve as a "carbon sink" to absorb and sequester carbon dioxide—is not well understood but has been raised as a concern.

Note that the American Chemistry Council urges that the GHG emissions from plastics production and management should be offset by some of the efficiencies that plastics bring, such as lightening the weight of vehicles. It cites a Department of Energy statement that a 10 percent reduction in vehicle weight can increase the vehicle's fuel economy by 6 percent to 8 percent.[121]

C. Plastics, Solid Waste and the Public Interest: Water Pollution

Plastic wastes accumulate in waterways and the ocean. Some of this pollution is associated with the manufacture of plastics, and some is associated with post-consumer disposal of plastic products.

Plastic products litter the ocean. A 2016 report by Eunomia, a United Kingdom-based consultancy, concluded that more than 80% of the plastics entering the ocean environment annually comes from land-based sources. The main contributor to this is larger plastic litter (bottles and packaging waste). The remaining 20% comes from plastics released at sea, mostly as a result of fishing activities. Despite the high profile of projects intended to clean up plastics floating in the ocean, barely 1 percent of marine plastics are found floating at or near the ocean surface. Rather, 94 percent of ocean plastic pollution is on the sea floor. Eunomia determined that each square kilometer of sea bed now contains an average of 70 kilograms of plastic.[122]

Nurdles. Nurdles are small plastic pellets used to manufacture larger plastic products. Nurdles are challenging to contain and control, and frequently spill into waterways during plastics manufacturing and transport. A container of nurdles

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[120] U.S. Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks. 2019, p. 3-58, Table 3-25.
[121] American Chemistry Council. Chemistry in Automotive. Accessed August 25, 2021.
[122] Eunomia. Plastics in the Marine Environment. 2016. Also see: Science. Plastic waste inputs from land into the ocean, 347(6223):768-771. February 13, 2015. Also see: C. Pham, *et al*. Marine Litter Distribution and Density in European Seas, from the Shelves to Deep Basins, *PLoS ONE*. 9(4): e95839, 2014.

from a cargo ship fell into the Mississippi River near New Orleans when it broke free of its moorings during a thunderstorm in August 2020. More than 25 tons (50,000 pounds) of nurdles polluted the river.[123] A Formosa Plastics Corporation facility in Texas was the subject of a citizen suit enforcement action settled in 2019 over multiple nurdles releases into the Lavaca Bay and Cox Creek. The court issued an order determining that a declaratory judgment should issue regarding both monetary ($50 million) and injunctive relief to ensure future compliance.[124]

Microplastic contamination. Microplastics include synthetic polymeric particles that are less than five millimeters in diameter, and may include nano plastics, which are less than 100 nanometers in diameter.[125] They originate from direct dumping or discharge of intermediate feedstock, pellets/resin or other by-products into waterways or the ocean and also from degradation of larger plastics dumped in waterways or the ocean. They persist in the environment and contaminate much of the aquatic food web, including bivalves, crustaceans, fish, and mammals. The health risks of microplastics arise from:

- The polymers that comprise the plastics,
- The additives, such as plasticizers, used to enhance their properties,
- The chemical contaminates that the MPs absorbed in the water, which may include polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), or
- The microorganisms that may have colonized their surfaces.[126]

A systemic review of 50 studies, along with a meta-analysis of 19 of the studies, found that overall, PE and PP were the most dominant polymeric compositions, which corresponds with global plastic production trends regarding demand and distribution by resin, as reported by the European Plastics Industry Association. PE was the most abundantly detected polymer in mollusks, closely followed by PP. In crustaceans, PE and PA were most prevalent, and in fish PE and PP were most prevalent.[127]

[123] New Orleans Times-Picayune. With cleanup stalled for weeks, group of volunteers tackles New Orleans nurdle spill on their own. August 21, 2020.
[124] Final Consent Decree, in San Antonio Bay Estuarine Waterkeeper v. Formosa Plastics Group, No. 6:17-cv-0047 (S. D. Tex., Nov. 27, 2019).
[125] Marine Pollution Bulletin. Microplastics: Finding a consensus on the definition, 138:145–147. January 2019.
[126] Environmental Health Perspectives. Microplastic contamination of seafood intended for Human Consumption: A systematic review and meta-analysis, 128(12). December 2020.
[127] *Ibid*. Also see: *Environmental Health Perspectives, op. cit.* Also see Marine Pollution Bulletin. Microplastics as a vector for the transport of the bacterial fish pathogen species *Aeromonas salmonicida*, 125(1-2):301-309. December 2017.

D. Plastics, Toxic Pollution and the Public Interest: Toxic Emissions From Ethane Crackers and Plastics Manufacturing Plants

Most federal air monitoring and enforcement efforts, under the Clean Air Act,[128] focus on a subset of pollutants associated with fossil fuel plant smokestacks and automobile tailpipes that create regional pollution problems, such as sulfur dioxide and nitrogen oxides (NO_x). Comparatively little focus is placed on toxic pollution "hot spots" in local communities. As one study concluded, regulatory agencies have treated air toxics only "as a residual problem to be solved through application of technology-based standards."[129] States and local communities generally are on their own when it comes to monitoring local emissions of air toxics from chemical facilities. Petrochemical plans pose a special risk to local residents because they emit multiple toxic emissions from multiple locations within their operations, with local impacts that are not monitored, for the most part.

States and local communities generally are on their own when it comes to monitoring local emissions of air toxics.

Harmful volatile emissions. Petrochemical facilities engaged in the plastics industry are major sources of toxic volatile organic compound (VOC) emissions. For example, the Shell petrochemical complex in Beaver County, Penn., will be allowed to release 522 tons (1,044,000 pounds) of VOCs each year,[130] making it the largest source of VOC pollution in western Pennsylvania.[131]

In chemistry, unlike in food, the term "organic" does not imply healthy. Organic chemicals are compounds that contain carbon-hydrogen bonds. VOC health effects may include respiratory irritation; headaches; loss of coordination; and damage to the liver, kidneys and central nervous system. Some VOCs are linked to cancer or developmental toxicity.[132] For example, the Formosa petrochemical project would emit ethylene oxide, benzene, 1,3-butadiene, formaldehyde, ethylbenzene and

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[128] 42 U.S.C. §§ 7401 *et seq*.
[129] Environmental Health Insights. Houston's novel strategy to control hazardous air pollutants: A case study in policy innovation and political stalemate, 9(Suppl 1): 1-12. January 27, 2015.
[130] Pennsylvania Department of Environmental Protection. Air Quality Plan Approval for Shell Chemical Appalachia LLC, No. 04-00740A. June 18, 2015 (hereafter, "Shell Petrochemical Complex Air Permit"), pp. 15 and 24.
[131] Pennsylvania DEP. Response to the USEPA's Proposed Designation of an Allegheny County Nonattainment Area for the 2012 Annual PM2.5 National Ambient Air Quality Standard, Enclosure 1. 2014, p. 24.
[132] U.S. Environmental Protection Agency. Volatile Organic Compounds' Impact on Indoor Air Quality.

acetaldehyde[133]—all of which are deemed either national or regional cancer risk contributors.[134]

The Clean Air Act, unfortunately, is ill-suited to address pollution from petrochemical complexes: The act only regulates aggregate VOCs as precursors to formation of ground-level ozone (leading to photochemical smog). No national ambient air quality standard exists for VOCs themselves.[135]

Enforcement against toxic VOC emissions can be weak or delayed. The MarkWest Energy Partners LP's Seneca Gas Plant in Summerfield, Ohio, which separates NGLs such as ethane from field gas (before feeding the NGLs into fractionators), had failed to prevent large leaks from pressure relief devices and pumps. While an EPA inspection in April 2016 found an excessive rate of leaks, the Environmental Integrity Project's review of compliance data found no enforcement had occurred through 2017.[136] Responding to public concern, the federal and state government finally issued a 2018 consent decree to bring the company into compliance.[137]

Hazardous air pollutants. Petrochemical plants emit significant amounts of VOCs and other chemicals that are also classified as hazardous air pollutants—chemicals officially labeled as such because they are known to cause cancer and other serious health effects.[138] The Shell petrochemical complex, for example, will be allowed to emit 30.5 tons per year of "Hazardous Air Pollutants,"[139] exceeding the 25 tons-per-year threshold for definition as a "major source" under the Clean Air Act by 22 percent.[140]

Toxic particulates that penetrate the lungs. Ultrafine particulates (up to 2.5 microns in diameter) are so small that they typically can penetrate the body's respiratory defense mechanisms. These respiratory irritants often also contain toxic metals that condense on the surface of the particles. The pernicious, tiny particles

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[133] Louisiana Department of Environmental Quality. Basis for Decision: Prevention of Significant Deterioration (PSD) Permit and 14 Title V/Part 70 Air Operating Permits for FG LA Complex, FG LA LLC, EDMS 1199845, Agency Interest No. 198351. January 6, 2020.
[134] U.S. Environmental Protection Agency. 2014 NATA Summary of Results. July 2020. Also see: U.S. Environmental Protection Agency. National Air Toxics Assessment. Last updated July 12, 2021.
[135] Because VOCs can react with NO_x in the air to form ground-level ozone, emission sources in areas where the air quality does not comply with the ozone standard may be required to obtain "emission offsets," but the source is sometimes allowed to use NO_x emissions offsets lieu of VOC offsets. This occurred in the permitting of the Shell plant. Under the Shell permit, 513 tons of the required 620 tons/year of VOC offsets—roughly 83%—will be replaced by NO_x emissions credits as a substitute. Shell Petrochemical Complex Air Permit, § C, items 037 and 040-044, pp. 24 and 26.
[136] Environmental Integrity Project. A Year of Environmental Enforcement Under the Trump Administration. February 2018, p. 26.
[137] Consent Decree, *United States of America and Commonwealth of Pennsylvania v. MarkWest Liberty Midstream Resources*, No. 2:18-cv-00529-LPL. April 24, 2018.
[138] U.S. Environmental Protection Agency. What Are Hazardous Air Pollutants?
[139] Shell Petrochemical Complex Air Permit, pp. 15 and 24.
[140] See 42 U.S.C. § 7412(a)(1).

can deliver toxic metals directly into the human lung.[141] Petrochemical plants typically produce large amounts of ultrafine pollution. The Shell facility, for example, will be allowed to release 159 tons (318,000 pounds) per year of ultrafine particulates (PM2.5).[142] Chronic exposure to PM2.5 has been linked to cardiovascular disease, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, dementia, type 2 diabetes, hypertension, lung cancer, pneumonia and premature death.[143] The researchers noted, "The attributable burden of death associated with PM2.5 was disproportionally borne by black individuals and socioeconomically disadvantaged communities."[144] While a federal air quality standard does exist for this category of pollution, it does not protect such communities. The study found the health effects occurring at pollution levels below the Clean Air Act's air quality standard.[145]

Uncontrolled emissions from flaring. Petrochemical complexes use flaring to burn off gases emitted by pressure relief valves in plant equipment. Flaring is also used during startups and shutdowns of equipment. The gas is simply burned, with no technology to capture or filter the emissions. It is a source of carbon monoxide, carbon dioxide, sulfur dioxide, polycyclic aromatic hydrocarbons (PAHs), VOCs, NO_x and particulates.[146] The Shell Petrochemical Complex's air permit application predicted that 45 percent of its VOC emissions, 28 percent of its carbon monoxide emissions and 23 percent of its NO_x emissions would come from its flares and incinerators.[147]

Petrochemical plants release significant amounts of fugitive emissions.

Fugitive emissions—hard to monitor and control. Petrochemical plants release significant amounts of fugitive emissions. These releases are called "fugitive" because they escape from processes, equipment leaks, materials or products, rather than being intentionally released from smokestacks after going through any acid gas scrubber or particulate capture equipment. Most of these emissions are VOCs. The volatile compounds have a high vapor pressure—they evaporate easily, including at

[141] International Journal of Environmental Science and Technology. Assessment of atmospheric particulate matter and heavy metals: A critical review, 15(5):935-948. May 2018.
[142] Shell Petrochemical Complex Air Permit, pp. 15 and 24.
[143] JAMA Network. Burden of cause-specific mortality associated with PM2.5 air pollution in the United States. November 20, 2019.
[144] *Ibid.*
[145] *Ibid.*
[146] Environmental Pollution. Gas flaring and resultant air pollution: A review focusing on black carbon, 216:182-197. September 2016. Also see: ScienceDirect. Carbon dioxide, methane and black carbon emissions from upstream oil and gas flaring in the United States, 13:119-123. August 2016.
[147] Shell Petrochemical Complex Air Permit Application, § 1.1, Table 1.1, p. 1-4. The application disclosed combined projected emissions from flares and incinerators, but the flares have significantly greater capacity than the incinerators.

room temperature ranges, and are adept at escaping through leak points and seeping through many building materials, including concrete.[148] For example, Shell's application specifically disclosed:

- Methane and VOCs may leak from the ethylene manufacturing unit, including the cracking furnace fuel and process equipment, quench water system, cracked gas compression, acid gas removal and drying process, cryogenic separation, C2 fractionation, C22 hydrogenation, and the spent caustic oxidation unit.[149]

- VOCs could leak from equipment in the gas phase polyethylene process, the slurry technology process, and the diesel fuel supply system and complex's storage tanks (flanges, valves and tank seals).[150]

- Fugitive VOCs are expected to be emitted from liquid loadout, component leaks, the process cooling tower and wastewater treatment plant.[151]

- Finally, fugitive VOCs may be emitted from the polyethylene pellet loading operation— which may also be a source of fugitive particulate emissions.[152]

Shell's application noted it expected the facility to emit 47.5 tons per year of fugitive emissions of VOCs, including 5.4 tons per year of fugitive hazardous air pollutants.[153]

Such emissions are difficult to monitor and control. Through settlement negotiations on a lawsuit appealing the Shell permit, the Environmental Integrity Project and Clean Air Council managed to require Shell to place four perimeter ("fenceline") air monitors on the 400-acre site, on segments closest to sensitive community receptors.[154] Advocates fighting a petrochemical project in Ohio (the proposed PTTGC complex), however, were not able to achieve any perimeter monitoring requirement through the regular air permit process. Also, even when such monitors are used, they can only capture a plume of contamination that travels within the sampling range of the monitoring device, and it is difficult to predict the path of a fugitive air contaminant plume. The entire parish (county) where the Formosa petrochemical project would be built has only two air monitors—an ozone monitor in Convent and a sulfur dioxide monitor in Gramercy.[155]

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[148] See discussion in Ohio Department of Public Health, Bureau of Environmental Health. Vapor Intrusion: Answers to Frequently Asked Health Questions. September 2004.
[149] Shell Petrochemical Complex Air Permit Application, § 3.1.2.2, pp. 3-8.
[150] *Ibid.*, §§ 3.2.2, 3.3.2, 3.5.1 and 3.5.2, p. 3-12. 3-16 and 3-18.
[151] Shell Petrochemical Complex Air Permit, p. 15.
[152] Shell Petrochemical Complex Air Permit Application, § 3.6.3, p. 3-21.
[153] *Ibid.*, § 1.1, Table 1.1, p. 1-4. Total VOC emissions are projected to be 522 TPY, and the emissions offsets, at a 1:1.3 ratio for fugitive emissions and a 1:15 ratio for flue emissions, are set at 620 TPY, suggesting that the Pennsylvania DEP expects roughly 130 TPY in fugitive emissions and 392 TPY in flue emissions of VOCs.
[154] *Ibid.*, § 1.3, p. 1-7.
[155] Louisiana Department of Environmental Quality. Current Monitoring Data & AQI in the New Orleans Area.

Risks of explosions, fires, and unauthorized emissions. The air permitting process in the United States does not take accident risk into account in deciding whether to permit a facility. Instead, the permit decision is based on the assumption that the facility will operate safely and in compliance with requirements. The Clean Air Act does require a permit applicant to establish a risk management plan,[156] but—as the Ohio Environmental Protection Agency explained in response to public comments on the proposed PTTGC petrochemical complex—the risk management program is operated through a separate mechanism from the permitting process.[157]

A typical petrochemical complex will include:

- Cracking furnaces to produce ethane;
- A manufacturing line to produce ethylene from the ethane;
- Gas phase polyethylene units to manufacture LLDPE;
- A slurry-based polyethylene unit to manufacture HDPE;
- Natural gas-fired combustion turbines to provide steam and electricity;
- A process cooling tower and cogeneration cooling tower;
- A spent caustic vent incinerator (to burn vapors);
- Emergency diesel generators and diesel-fired fire pump engines;
- Multiple fuel and chemical storage tanks – typically for gasoline, hexane, fuel oil and diesel fuel;
- High-pressure flaring units (ground level and elevated);
- A multipoint low-pressure flaring unit;
- Polyethylene pellet blending, handling, storage and loadout facilities; and
- Liquid loadout facilities.[158]

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[156] The Clean Air Act § 112(r) and the Federal Chemical Safety Information, Site Security and Fuels Regulatory Relief Act require establishment of a Risk Management Plan, 40 C.F.R. §68, when a regulated substance listed in 40 C.F.R. § 68.130 is present in a process at a quantity greater than the listed threshold for the facility. See Shell Petrochemical Complex Air Permit, § B, item 012, p. 12. The plan must be revised every five years. 40 C.F.R. §68.36.

[157] See Ohio Environmental Protection Agency's comment: "The air permit does not regulate safety per se. Instead, other programs regulate the safe operation of the facility," such as the Occupational Safety and Health Administration. The agency's risk management program is operated "through a separate mechanism from the air permit." Ohio Environmental Protection Agency. Response to Comments, PTTGCA Petrochemical Complex Permit-to-Operate, PO124972, § I, Comment 1, Response 3, p. 2, attached to Permit-to-Operate PO124952, Facility ID No. 0607135004.

[158] Shell Petrochemical Complex Air Permit, pp. 23-24.

This diversity of processes and equipment offers many opportunities for maintenance or operational shortcomings and errors. For example, an explosion and fire occurred on June 13, 2020, at an integrated ethane cracker and downstream derivatives complex in Lake Charles, La., in its low-density polyethylene (LDPE) unit. The Sasol Lake Charles Chemical Project, slated to crack 1.5 million metric tons per year of ethane, was in the final stages of commissioning and start-up.[159] A fatal explosion and fire in a propylene fractionator reboiler occurred on June 13, 2013 at the Williams Geismar Olevins Plant in Geismar, La., killing two people and injuring at least 167 others.[160]

Other facilities related to petrochemicals production and storage have problems as well. The ethane hub in Mont Belvieu, Texas, which includes several fractionators that separate individual NGLs, has been plagued with explosions and chemical leaks. Risky conditions have forced the relocation of residents and businesses.[161] Explosions and a fire ripped through a natural gas liquid fractionation plant and storage facility in Mont Belvieu on Feb. 8, 2011, killing a worker.[162] An explosion of a large tank occurred on June 20, 2018.[163] An explosion and fire occurred when a contractor hit an underground pipe at a fractionation plant on July 30, 2020.[164]

E. Plastics, Decline of the Oil and Gas Industry and the Public Interest

The business model of the oil and gas sector proved itself over the years because it could profit in up and down cycles. Up cycles were times of rising prices, margins and building cash reserves; price spikes were an integral part of that storyline. As long as economic growth remained, robust rising upstream and downstream profits could be assumed. The development of a chemicals sector that commercialized byproducts from oil and gas production proved to be steady, modest and lucrative, with a long and deep reach. In down periods, the integrated oil majors could use cash reserves to snatch up low-priced assets from smaller parts of the industry. As an inordinate number of combinations and permutations confronted the company during up and down cycles, an

The development of a chemicals sector that commercialized byproducts from oil and gas production proved to be steady, modest and lucrative.

[159] Oil & Gas Journal. Fire, explosion hit Sasol's Louisiana petchem complex. January 14, 2020.
[160] U.S. Chemical Safety and Hazard Investigation Board. Williams Olefins Plant Explosion and Fire, Report No. 2013-03-I-LA. October 2016.
[161] The New York Times. Chemicals in Salt Cavern Hold Pain for Texas Town. November 28, 1988.
[162] NBC News. Texas petroleum plant ablaze. February 8, 2011. While the worker originally was reported as missing, it was later determined that he had been killed. Also see: Reaud, Morgan & Quinn. Accident Lawyers in Mont Belvieu.
[163] Fox 26 Houston. Tank fire contained in Mont Belvieu. June 20, 2018.
[164] Argus Media. Explosion, fire at Lone Star NGL: Update. July 30, 2020.

overall balance could be achieved. If upstream prices were low, downstream and chemical operations could benefit from lower costs of production. Along the way on any given up or down cycle, there were a series of financial sweet spots so long as the economy grew and the growth was tied to fossil fuels.

The last 10 years has seen a decoupling of economic growth from fossil fuel prosperity. The overall Standard & Poor's 500-stock index has risen prodigiously, but the oil and gas sector has lagged. In short, the economy is growing faster and stronger than the fossil fuel sector. At the same time, the economy currently remains reliant on fossil fuels, an industry with a faltering business model.

In 2020, the Texas Railroad Commission was asked by Pioneer Natural Resources to support a resolution to regulate the supply of oil production in the United States. The measure was debated and defeated. Global markets moved, raising oil prices and improving the current cash position of U.S. oil producers. The trends leading to a decline in demand for oil, however, persist.

This paper discusses another area of stress for the oil and gas sector: The profitability of the petrochemical sector and its contribution to the overall financial health of the oil and gas sector. For the integrated oil and gas majors, rising plastics prices improves the profitability of chemical operations as high prices improve margins and increased feedstock demand can provide some upward pressure on natural gas prices.

Today we see a growing awareness of the plastics industry and its interconnection with questions of the public interest for the nation's medical supplies, environmental, climate and solid waste challenges. Adding to that, and perhaps running like a thread through it all, are the questions of price and profits that are in the domain of the private sector, yet profoundly affect the public interest.

VI. The Need for and Scope of a Third-Party Review

The price issues facing the plastics issue cut across standard market regulatory mechanisms.

The substantive questions are short- and long-term, resting on price setting, inventory controls, emergency management and more. The impacts of the plastics industry touch on matters of environmental compliance, climate change, international trade, consumer, health and medical product supply, and the flawed business model of oil and gas integrated companies.

The Federal Trade Commission's (FTC) scope is typically narrow. It reviews impacts of mergers and acquisitions on industry concentration. Depending on the cycles of the economy, the agency can conduct dozens, if not hundreds, of reviews of such transactions that cover every sector of the economy.

The FTC has conducted more in-depth studies of the oil and gas industries, however, often with the assistance of the U.S. Department of Energy. One such study was conducted in the wake of Hurricane Katrina that oil and gas interests engaged in

price-gouging, which became the subject of congressional hearings. The FTC report found no cause for action regarding post-Katrina price-gouging, but its investigative approach provides useful guidance that can be applied to an investigation of current plastics pricing.

While the market for gasoline and diesel at the pump is different from the market for plastic resins sold by one business to another, three findings in the FTC Katrina report raise potential red flags for the plastics pricing issue:

1. Investigators looked to see if price fixing occurred at the plant or facility level. One of the metrics they used was whether or not the facility was running at maximum capacity given the conditions. The Energy Information Administration's utilization monitor reporting showed that the company's utilization rates were running full out during Katrina, and that this was true for periods before Katrina. The FTC concluded that it was difficult to find manipulation if capacity was running at 100%.[165] This paper notes that the federal Bureau of Economic Research showed utilization rates in the plastics manufacturing industry in the low 80's during the period of heightened disruption. Further research would be needed to evaluate more precisely how companies handled reporting utilization rates during the pandemic period.

2. The FTC found that service stations, refineries and other oil and gas infrastructure were disrupted in a variety of ways that had an effect on prices and services.[166] While the industries are very different, all of the price increases in the plastics sector are basically the same from each company over a period of time. Did they all experience the same outages and disruption and manage to re-open and bounce back at the very same rate?

The current plastics price-setting process is not transparent.

3. The FTC found no manipulation of exports during the Katrina disruption period. Plastics Exchange, however, makes it clear that some producers were "holding back" product from the export market to maximize its advantage in the U.S. market.

The current plastics price-setting process is not transparent. A careful review of the data raises the following questions:

[165] Federal Trade Commission. Investigation of Gasoline Price Manipulation and Post-Katrina Gasoline Price Increases. Spring 2006, p.6.
[166] *Ibid.*, p. 7.

1. Are the utilization rates reported by companies to industry trade analysts accurate? Do they reflect actual run times of the facilities?

2. What extraordinary conditions ensued during the pandemic and freezes, and how did the events influence the utilization rates?

3. How did the changes in plant utilization change price-setting processes?

4. What caused elevated prices for nine months?

5. Are prices competitively set? Would a review of company-by-company price-setting meet standards of independent price-setting? Do any practices signal dysfunction in the competitive process?

6. Do the letter announcements from each company typically specify price, price increases, rates or other amounts that establish new prices? What does a comparison of these prices show?

7. What are the relationships during the pandemic and the freeze between plant shutdown announcements, re-openings, *force majeure* and allocation schedules and pricing?

8. Are reports that producers are withholding export sales to defend short-term price positions accurate? To what extent is this happening? What is the underlying cause of this practice?

9. Have long-term price increases—attributed by the industry to inventory shortfalls, uncertainties in public policy in Washington, new trade dynamics and new capital expenditure allocations—created the need for greater regulatory oversight of prices and other reporting?

10. Are reports that members of the plastics industry are withholding exports important?

11. How are inventory levels managed? What constitutes adequate reserves? What triggers are established for rebuilding reserves?

As the country recognized that the price and distribution of gasoline and diesel oil was essential to the effective running of the nation's households and businesses, institutional resources at the federal government and many state governments were devoted to monitoring prices and business practices. At the FTC, a Gasoline Price Monitoring Project produces reports on gasoline monitoring,[167] and was instrumental in supporting the FTC's response to price-gouging related to Hurricane Katrina.[168] The agency regularly reviews such transactions and sometimes participates in broader academic forums to discuss findings and trends.

[167] Federal Trade Commission. Gasoline Price Changes and Petroleum Industry. September 2011.
[168] Federal Trade Commission. Investigation into Gasoline Price Manipulation and Post Katrina Gasoline Prices. Spring 2006.

The FTC has in recent years reviewed complaints that certain firms have been making misleading claims regarding product quality.169 These reports are largely directed at environmental issues and delve into matters beyond the mandated antitrust analyses disclosed by the industry.

Expansive studies of pricing practices—including examination of the potential for legal violations and taking into account the cumulative set of policy matters identified in this report—will prove useful. The studies must be systematic, over a period of time, to address the substantive policy matters facing the plastics sector and the interconnection with the business practices that currently govern it.

VII. Conclusion

A question emerges that is hard to ignore. Are a handful of companies who control the marketplace and seek a boost in profit margins using the economic disruption to normalize a permanently high-priced environment? Trade papers and company management in the plastics industry, as a matter of consensus, attribute the high price environment to the pandemic and weather events. The pandemic and weather events certainly created economic disruption for the economy as a whole, and the petrochemical industry experienced weaknesses in the hard plastics sectors related to construction and automobiles. The single-use "soft plastics" sector, however, experienced continued market demand during that period, and maintained a supply to support the consumer packaging and medical markets. Today, industry profits are strong.

Are a handful of companies who control the marketplace and seek a boost in profit margins using the economic disruption to normalize a permanently high-priced environment?

The recent inclusion by the Centers for Disease Control and Prevention of plastic on its list of essential economic sectors has changed the way the industry should be viewed. Currently, regulatory oversight of the industry is uneven in scope, and uncoordinated in implementation and enforcement at a time when the sector has become more important. The price issues raised in this paper stem from the unregulated right of the industry to produce, market and sell its products without

169 Federal Trade Commission. FTC Cracks Down on Misleading, Unsubstantial Environmental Claims. October 2013. Also see: Federal Trade Commission. FTC Approves Final Order Settling Charges That N.E.W. Plastics' Environmental Claims for its Plastic Lumber Products Were Misleading. April 7, 2014. Also see: Federal Trade Commission. FTC Approves Final Order in 'Green Marketing' Case Against American Plastic Lumber. July 28, 2014.

regard for how the country uses plastics for lifesaving needs, how and where plastics are made and the life-threatening risks that come with it. A comprehensive regulatory system is required to answer questions: What plastics are needed? Where should production be located? How much should be charged, and what are fair prices and profits? How should capital allocation be made, and what governmental supports are proper to address need and health, environmental and climate considerations?

An external third-party review of the price-setting mechanism within the industry is warranted.

An external third-party review of the price-setting mechanism within the industry is warranted. Policy discussions regarding plastic toxicity and pollution and ocean waste will be improved with the addition of a factual financial profile of the industry. Given the single-use plastic demand in the consumer packaging and medical supply markets, excessive plastics prices have significant implications for household and government budgets, as well as nonprofit and private corporation balance sheets. While the industry requires a much broader, coherent regulatory overhaul a more granular review of the price mechanism, concentrating on price and utilization rates at the company and plant level is a proper place to start.

Appendix: Typical End Use of Plastic Resins Covered in This Report

Plastic Resin	Typical End Use
Low Density Polyethylene (LDPE)	Bread bags, shoe soles, paperboard coating, garment bags, diapers, shrink wrap
Lower Linear Density Polyethylene (LLDPE)	Bags on a roll, food storage bags, toys, chemical tanks, landfill liners, trash bags, container lids, pallet wrap, dish drying racks, produce bags
High Density Polyethylene (HDPE)	Corrugated and drainage pipes, detergent bottles, milk and water bottles, grocery sacks, toys, stadium seats
Polypropylene (PP)	Apparel, auto interior trim, bailing twine, bottles, dairy containers, diapers, medical fabrics, microwave containers, syringes, snack food packages, toys

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