

# HOW FRACKING SUPPORTS THE PLASTIC INDUSTRY



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The plastics industry has reaped under-the-radar benefits from the environmentally destructive fracking boom.<sup>1</sup> The fossil fuel industry has surged over the past decade by employing new techniques and technologies that combine horizontal drilling and hydraulic fracturing (or fracking) to extract oil and gas from shale and other underground rock formations. Fracking injects large quantities of water, sand and toxic chemicals under high pressure to release oil and gas that are tightly held in rock layers.<sup>2</sup>

The fracking boom has also produced an oversupply of cheap ethane in the past few years. This surge has been a boon for the plastics industry, which relies on petrochemical manufacturing to turn ethane (a hydrocarbon present in natural gas) into plastics.<sup>3</sup> Beginning in 2012 chemical companies started aggressively investing in petrochemical plants and export facilities focused on tapping the ethane glut.<sup>4</sup> The petrochemical industry produces hydrocarbon-based chemicals derived primarily from processed natural gas and, to a lesser extent, crude oil. Petrochemicals are the building blocks to manufacture a wide range of goods, including plastic packaging, beverage bottles, tires and more.<sup>5</sup> In 2012 an estimated 221,483,538 barrels of oil equivalent of natural gas and 99,520,690 barrels of crude oil were used to produce plastic resins.<sup>6</sup>

The fracking boom and low-priced natural gas have spawned a resurgence in plastics manufacturing — and the pollution that comes with it. Transforming ethane into plastics and

other products is inherently toxic, polluting the environment and imposing public health risks on petrochemical workers and the communities near the plants.

## Converting Fracked Gas Into Petrochemicals

The fracking boom across the U.S. Midwest and Northeast has produced large volumes of ethane. A few shale plays — including the Utica and Marcellus shale gas reserves underlying vast portions of northeastern Appalachia — contain what the industry calls “wet” natural gas.<sup>7</sup> Natural gas contains primarily methane and smaller amounts of other hydrocarbons, but wet natural gas has higher concentrations of natural gas liquids (NGLs).<sup>8</sup> NGLs — predominantly ethane but also propane, butane, isobutane and pentanes — are the raw materials for manufacturing petrochemicals.<sup>9</sup>

Turning ethane into plastic is an energy-intensive process that requires separation from the other hydrocarbons present in natural gas. Once isolated, ethane is transported to a type of petrochemical facility known as a cracker plant, where a series of processes involving steam (or just heat) “crack” ethane into ethylene.<sup>10</sup> Ethylene is the most frequently produced petrochemical and creates the most common type of plastic.<sup>11</sup> Ethylene then goes through another chemical procedure called polymerization to convert it into small plastic pellets (called polyethylene resin). This resin is used to manufacture plastic products.<sup>12</sup>

## Plastics Industry Surging From the Fracking Boom

The fracking boom has generated a plastics bonanza. According to *Plastics News*, “shale-based natural gas represents a once-in-a-generation opportunity” for the North American plastics market.<sup>13</sup> In November 2013 representatives from the oil and gas, petrochemical and plastics industries convened a three-day summit — the first of its kind — to address the “opportunities and challenges of a ‘coming renaissance’ in North American plastics.”<sup>14</sup>

By 2023 the chemical industry is slated to spend over \$164 billion on 264 new facilities and expansion projects specifically to take advantage of shale gas, according to the American Chemistry Council (ACC).<sup>15</sup> As of April 2016, 40 percent of these had been completed or were under construction, and more than half were in the planning phase.<sup>16</sup> “Thanks to the shale gas production boom, the United States is the most attractive place in the world to invest in chemical and plastics manufacturing. It’s an astonishing gain in competitiveness,” said ACC’s president and CEO Cal Dooley.<sup>17</sup>

Unfortunately plastics production is inherently wasteful. The largest sector of the plastics industry is packaging, which creates materials that are immediately thrown away.<sup>18</sup> Take, for ex-

ample, the bottled water industry, which relies on polyethylene terephthalate (PET) plastic to package its single-serve bottles.<sup>19</sup> On average, each U.S. citizen guzzles 36.7 gallons of bottled water each year.<sup>20</sup> But all this consumption is stacking up as waste in our landfills and garbage incinerators. According to the Container Recycling Institute, 71 percent of PET plastic bottles are not recycled, and in 2010 over 1.5 million tons of PET plastic bottles ended up in the trash (See Figure 1).<sup>21</sup> A 2015 industry study found that under a third of PET bottles are recycled.<sup>22</sup>

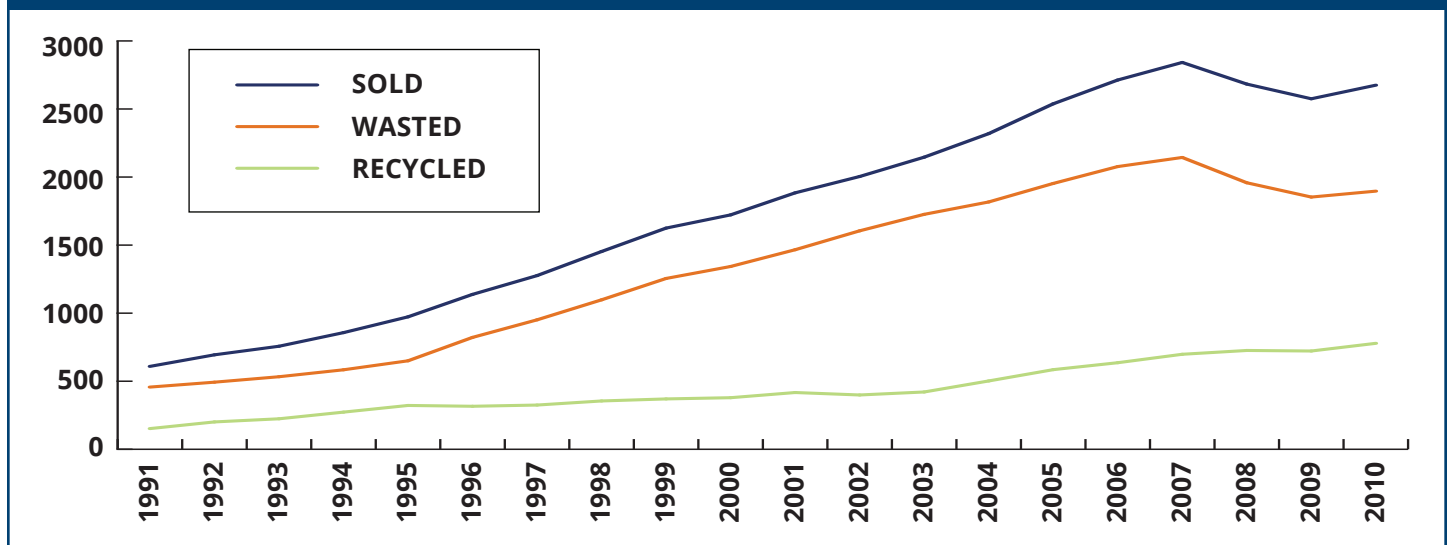
Much of this plastic waste ends up in our oceans and surface waters. A 2015 study estimated that nearly 200 coastal countries generated over 600 billion pounds of plastic waste in 2010 — and between 11 and 27 billion pounds of this ended up in the oceans.<sup>23</sup> In the central Pacific Ocean, a slow-moving “plastic soup” circulates among four major ocean currents. Dubbed the Great Pacific Garbage Patch, it is the world’s largest dump.<sup>24</sup> The fracking-driven industry expansion will likely generate even more ocean plastics as more ethane crackers come online and produce more plastic resins.

## Cracking, Like Fracking, Is Toxic to the Environment and People

The petrochemical boom does more than generate plastic that is overflowing our landfills and spilling into the oceans; the manufacturing process itself releases numerous pollutants into our air, water and land. On top of that, many of the proposed new ethane cracker projects are co-located with fracking and drilling operations, potentially compounding the pollution problems that residents already endure.

Plants that convert natural gas into petrochemicals are known to emit massive amounts of air and climate pollutants including polycyclic aromatic hydrocarbons, carbon dioxide and ozone-creating volatile organic compounds (such as benzene and toluene) and nitrogen oxide.<sup>25</sup> A 2012 study of petrochemical pollution in Houston, Texas by a researcher at Houston

**FIGURE 1: PET Bottle Sales, Recycling and Waste** (in Thousands of Tons)



SOURCE: Container Recycling Institute.

Advanced Research Center found that “large petrochemical flares lead to very rapid ozone formation that, if properly detected, would make attainment of the current federal ozone standard very difficult in Houston.”<sup>26</sup> The study also noted that petrochemical flaring could expose nearby communities to high levels of formaldehyde, a carcinogenic air pollutant and ozone precursor.<sup>27</sup>

Prolonged contact with ground-level ozone is linked to asthma and chronic obstructive pulmonary disease. When mixed with particulate matter, which has been linked to various cancers, smog can form.<sup>28</sup> In addition to asthma, long-term exposure to smog has been connected to premature deaths in adults and to low birthweight in babies.<sup>29</sup> Further, chronic exposure to air pollution can cause various illnesses, including cognitive deficits.<sup>30</sup> Several studies have demonstrated that people’s exposure to petrochemical facility pollutants is associated with heightened cancer risks, acute irritative symptoms (such as nausea and eye and throat irritation) and respiratory-related illnesses, especially for children.<sup>31</sup>

The Houston Ship Channel produces about a quarter of U.S. petrochemicals.<sup>32</sup> In 1999, when Houston’s ozone levels were the highest in the nation, the state of Texas conducted several studies that found large industrial leaks. The worst originated from cracker plants producing ethylene and propylene. “The plants were having 1,000-pound releases, 5,000-pound releases, 20,000-pound releases, in one case 200,000-pound releases,” explained a now-retired University of North Carolina chemist responsible for studying Houston’s air pollution problem.<sup>33</sup>

These studies led regulators to specifically target the petrochemical industry, and, despite some temporary progress, Houston continued through 2015 to fail to meet federal ozone standards.<sup>34</sup> Millions of pounds of pollution are still emitted from these facilities each year. An analysis of data from the U.S. Environmental Protection Agency’s (EPA) Toxic Release Inventory found that in Texas in 2014 and 2015, 28 facilities with the primary function of petrochemical manufacturing released 14 million pounds of on-site pollution each year into the air and waterways and on land. For those two years in the neighboring state of Louisiana, 13 facilities emitted more than 4 million pounds annually (see Appendix on page 5).<sup>35</sup>

## Ethane Crackers and New Infrastructure Coming to Appalachian States

In 2016 all but three ethane crackers in the United States were located in Texas and Louisiana. A 2014 inventory taken by the *Oil & Gas Journal* listed 38 crackers, but, as an EPA employee explains, some plants have multiple crackers and the total number of facilities comes out to 29. The EPA observed that 3 of the facilities are “not major sources” or are shut down, so only 26 plants were subject to the EPA’s federal air regulations.<sup>36</sup>

More than 20 new crackers and ethylene production expansion projects have been proposed in the United States because of the natural gas boom.<sup>37</sup> Most have been proposed for the Gulf region, one is slated for North Dakota, and five more have been proposed in states with large Marcellus and Utica shale plays: West Virginia, Ohio and Pennsylvania (see Table 1).<sup>38</sup>

As the oil and gas and petrochemical industries expand their infrastructure projects (NGL pipelines, storage facilities and crackers) in the Appalachian basin, the industry expects that this development will transform the region into a global hub.<sup>39</sup> The industry and its supporters are seemingly wanting to make western Pennsylvania the next Houston.

Already natural gas proponents are pushing a \$10 million natural gas storage complex, and an associated network of gas pipelines, in the Appalachian region to “take full advantage of chemical and plastic raw materials” found in shale gas and to service the pending regional ethane crackers.<sup>40</sup> The storage complex, which is currently in the conceptual stage, allegedly has bipartisan support from West Virginia lawmakers. It is being endorsed by a non-profit, market-driven research organization that focuses on advancing the petrochemical industry: Mid-Atlantic Technology, Research and Innovation Center (MATRIC).<sup>41</sup> More gas hubs and more plastics factories means building even more pipeline infrastructure to transport NGLs to petrochemical facilities.<sup>42</sup>

Shell is building one of the nation’s largest ethane crackers in western Pennsylvania. It is the first new facility of its type to be constructed outside of the Gulf Coast in two decades.<sup>43</sup>

**Table 1: Ethane Crackers Proposed for the Marcellus and Utica Shale Regions<sup>45</sup>**

Project	Location	Ethane Capacity (barrels per day)	Status and Estimated Start Date
Aither Chemicals	Charleston, WV	16,000	Off Track, 2017+
Appalachian Resins (AR)	Monroe County, OH	13,000 – 15,000	On Hold, 2019
Appalachian Shale Cracker Enterprise (Ascent)	Parkersburg, WV	57,000	Delayed
PTTGC America & Marubeni	Belmont County, OH	57,000	On Track, 2020+
Shell Appalachia Ethane Cracker	Monaca, PA	78,000 – 100,000	On Track, 2019

**SOURCE:** Platts 2016; NaturalGasIntel 2016; Petrochemical Update 2016; OneOK Partners 2016.

The location was meticulously chosen to thrive off of Marcellus and Utica shale gas production from the Pennsylvania, Ohio and West Virginia tri-state area.<sup>44</sup> This ethane cracker would reinforce the northeastern plastics market, generating not only industry profits but also more regional pollution.

## The Human Costs: Shell's Western Pennsylvania Cracker Plant

Pennsylvanians do not deserve another risky natural gas facility. Fracking causes many public health and environmental problems.<sup>46</sup> The last thing that Pennsylvanians need is another way for the oil and gas industry to capitalize on shale at the expense of their health and well-being.

Fracking has expanded rapidly in areas across the United States, especially in Pennsylvania, which has been at the epicenter of the nation's fracking boom, with almost 10,000 shale wells drilled between 2005 and October 2016.<sup>47</sup> Beaver County, where Shell's cracker will be located, is currently home to 69 active unconventional wells.<sup>48</sup>

Once a well is fracked, during oil or gas production, escaping methane from leaks can mix with nitrogen oxide emissions from diesel-fueled vehicles and drilling equipment to form ground-level ozone.<sup>49</sup> When combined with particulate matter of a certain size (less than 2.5 micrometers), ozone can form smog. Chronic exposure can lead to asthmatic conditions and chronic pulmonary disease.<sup>50</sup> These emissions contribute to climate change, and the region's air quality could conceivably worsen once the cracker plant is completed.

Although the cracker plant will bring pollution to the region, the industry, its supporters and Pennsylvania Governor Tom Wolf all tout that it will bring jobs.<sup>51</sup> What they fail to mention is that these jobs are potentially dangerous and hazardous to health.

Some studies have found that certain petrochemical workers and research employees that handle or are exposed to toxins (such as organic solvents, plastic monomers, metals, ionized radiation and aromatic hydrocarbons) are inclined to have a relatively higher risk for brain cancer compared to people employed in other professions.<sup>52</sup> Petrochemical workers also can experience hearing loss and develop liver disease, and are regularly exposed to volatile organic compounds like benzene, toluene and xylene.<sup>53</sup>

Many of the chemicals that petrochemical workers are exposed to can have negative impacts over the long term. Benzene, toluene and xylene are neurotoxic, carcinogenic and classified as "priority pollutants" by the EPA.<sup>54</sup> It is believed that long-term exposure to certain amounts of benzene, a known carcinogen and mutagen, can increase the risk of leukemia.<sup>55</sup> In addition, petrochemical facilities produce and emit dozens of chemicals, including but not limited to: polycyclic aromatic hydrocarbons, nickel, lead, mercury, methanol and naphthalene.<sup>56</sup>

Acute and chronic exposures to these chemicals can have significant health effects. Long-term exposure to methanol, a colorless, flammable liquid, can cause dizziness, insomnia, gastric issues, headaches, nausea, blurred vision and blindness.<sup>57</sup> Exposure to naphthalene, a possible human carcinogen, has been linked to anemia, liver and neurological damage, retinal impairment and the development of cataracts.<sup>58</sup> Lead, nickel, mercury and polycyclic aromatic hydrocarbons are all believed to be endocrine disruptors, which are chemicals that can alter hormone functions and negatively impact the metabolism and the neurological, immune and reproductive systems.<sup>59</sup> Some polycyclic aromatic hydrocarbons are also "reasonably anticipated to be human carcinogens."<sup>60</sup>

In addition to the long-term health impacts of these releases, many of the vapors produced at petrochemical work sites are highly flammable.<sup>61</sup> When petrochemical plant accidents do occur they are frequently large and not only can injure the workers but also can impact nearby communities.<sup>62</sup> For example, in June 2013 an explosion at a petrochemical plant in Louisiana killed 2 workers and injured 167. The fire blazed for three and a half hours, releasing more than 30,000 pounds of combustible hydrocarbons into the air. The damage was so great that the plant had to close down for a year and a half.<sup>63</sup>

## Conclusion

The expansion of drilling and fracking is associated with significant quality-of-life and public health problems and endangers society by exacerbating climate instability. Instead of creating a "bridge" to renewables, shale gas has only substituted one dirty fuel (coal) for another (fracked gas), making climate change even more costly and destructive in the coming decades.

This cheap and dirty fossil fuel is also proliferating its toxic legacy by facilitating the expansion of petrochemical plants, which are polluting and unsustainably producing materials that often end up in landfills. Rather than continually investing in fossil fuels and chemical industries, we must invest in clean, renewable energy.

Our country's leadership needs to enact serious changes, from terminating public funding of the oil and gas industry to enacting aggressive conservation policies to reduce energy demand, including substantial investments in public transportation, community planning and the deployment of energy efficiency solutions.

Consumers also can play a role in securing a sustainable future by making conscientious shopping decisions. People should limit their purchases of non-biodegradable, plastic products, an activity that effectively supports and finances the oil and gas industry.

## APPENDIX

**TABLE 2: Petrochemical Plants in Texas and Louisiana and Their On-site Pollution Releases, 2014 and 2015**

Plant Name	County	Plant's Other Uses	Pounds of On-site Pollution Released, 2014	Pounds of On-site Pollution Released, 2015
<b>TEXAS</b>				
Arkema Inc Clear Lake	Harris		19,388	62,284
BASF Corp Pasadena Plant	Harris		3,430	2,706
BASF Total Petrochemicals LLC	Jefferson		426,381	375,693
BP Amoco Chemical Co.	Galveston		131,311	97,110
Chevron Phillips Chemical Co LP	Harris	Plastics Material and Resin Manufacturing	424,145	384,672
Chevron Phillips Chemical Co LP Sweeny Complex	Brazoria		403,434	492,756
DuPont Sabine River Works	Orange	Plastics Material and Resin Manufacturing, Hazardous Waste Treatment and Disposal	2,114,947	1,525,505
Equistar Chemicals LP	Nueces		114,567	255,507
ExxonMobil Oil Corp Beaumont Chemical Plant	Jefferson		477,068	498,089
ExxonMobil Chemical Co Baytown Chemical Plant	Harris	Industrial Gas Manufacturing, Plastics Material and Resin Manufacturing, Synthetic Rubber Manufacturing	857,274	861,425
ExxonMobil Chemical Co Baytown Olefins Plant	Harris		394,733	498,089
Flint Hills Resources Houston Chemical LLC	Harris		486,612	255,507
Flint Hills Resources Port Arthur LLC	Jefferson		283,646	305,610
Huntsman International	Harris		2,200	2,074
JX Nippon Chemical Texas Inc	Harris		9,089	7,938
Lyondell Chemical Co	Harris	All Other Basic Organic Chemical Manufacturing	5,366,159	4,875,988
Lyondell Chemical Co Bayport Facility	Harris		280,653	308,716
Nalco Co	Bowie		1	10
Nalco Co Odessa Plant	Ector		8,306	7,291
Rohm & Haas Texas Inc	Harris		363,741	434,756
Sasol Chemicals (USA) LLC	Jefferson		1,196	1,262
Sasol Chemicals (USA) LLC (2)	Harris		1,476,627	1,553,425
Shell Chemical LP	Harris		505,332	812,664
South Hampton Resources Inc	Hardin		3,900	8,136
Styrolution America LLC	Galveston		48,025	53,287

**TABLE 2: Petrochemical Plants in Texas and Louisiana and Their On-site Pollution Releases, 2014 and 2015 (continued)**

Plant Name	County	Plant's Other Uses	Pounds of On-site Pollution Released, 2014	Pounds of On-site Pollution Released, 2015
Styrolution America LLC (2)	Harris		44,917	30,036
TPC Group Baytown Plant	Harris		5,230	4,290
Union Carbide Corp Texas City Plant	Galveston		143,522	100,040
<b>TEXAS TOTAL POUNDS OF ON-SITE POLLUTION:</b>			<b>14,395,834</b>	<b>13,814,866</b>
<b>LOUISIANA</b>				
Americas Styrenics LLC	St. James		118,623	122,175
Cos-Mar Co	Iberville		157,566	184,954
DuPont Pontchartrain Works	St. John the Baptist	Synthetic Rubber Manufacturing, Other Basic Inorganic Chemical Manufacturing, All Other Basic Organic Chemical Manufacturing, Artificial and Synthetic Fibers and Filaments Manufacturing	1,200,801	1,138,135
Enterprise Products Operating LLC	West Baton Rouge	Natural Gas Liquid Extraction	32,129	31,587
ExxonMobil Chemical Co Baton Rouge Chemical Plant	East Baton Rouge	Synthetic Rubber Manufacturing	1,644,949	1,812,327
Georgia Gulf Lake Charles LLC	Calcasieu		15,711	18,390
Nalco Co-St. John the Baptist	St. John the Baptist		42,431	5,234
Nalco Co West Baton Rouge	West Baton Rouge		0	0
Shell Chemical LP	Ascension		302,443	312,764
Shell Norco Chemical Plant East Side	St. Charles		746,982	492,169
Shell Norco Chemical Plant West Site	St. Charles		82,855	81,477
Westlake Petrochemicals Ethylene*	Calcasieu	Plastics Material and Resin Manufacturing (Primary)	265,343	152,742
Williams Olefins LLC Geismar Ethylene Plant	Ascension		33,254	556,545
<b>LOUISIANA TOTAL POUNDS OF ON-SITE POLLUTION:</b>			<b>4,643,087</b>	<b>4,908,499</b>
*This facility lists Plastics Material and Resin Manufacturing as a primary use as well.				

**SOURCE:** Analysis of all chemical facilities (NAICS Code 325) that list petrochemical manufacturing (NAICS 32511) as their primary function. Data from U.S. Environmental Protection Agency (EPA). Toxics Release Inventory (TRI). TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), all facilities (of 412) for facilities in NAICS 325 - Chemicals, for All chemicals, Texas, 2014. Available at [https://iaspub.epa.gov/triexplorer/tri\\_release.chemical](https://iaspub.epa.gov/triexplorer/tri_release.chemical). Accessed August 23, 2016; U.S. EPA. TRI. TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), all facilities (of 129) for facilities in NAICS 325 Chemicals, for All chemicals, Louisiana, 2014. Available at [https://iaspub.epa.gov/triexplorer/tri\\_release.chemical](https://iaspub.epa.gov/triexplorer/tri_release.chemical). Accessed August 22, 2016; U.S. EPA. TRI. TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), all facilities (of 412) for facilities in NAICS 325 - Chemicals, for All chemicals, Texas, 2015. Available at [https://iaspub.epa.gov/triexplorer/tri\\_release.chemical](https://iaspub.epa.gov/triexplorer/tri_release.chemical). Accessed November 15, 2016; U.S. EPA. TRI. TRI On-site and Off-site Reported Disposed of or Otherwise Released (in pounds), all facilities (of 128) for facilities in NAICS 325 Chemicals, for All chemicals, Louisiana, 2015. Available at [https://iaspub.epa.gov/triexplorer/tri\\_release.chemical](https://iaspub.epa.gov/triexplorer/tri_release.chemical). Accessed November 15, 2016.

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**Food & Water Watch** works to ensure the food, water and fish we consume is safe, accessible and sustainable. So we can all enjoy and trust in what we eat and drink, we help people take charge of where their food comes from, keep clean, affordable, public tap water flowing freely to our homes, protect the environmental quality of oceans, force government to do its job protecting citizens, and educate about the importance of keeping shared resources under public control.

