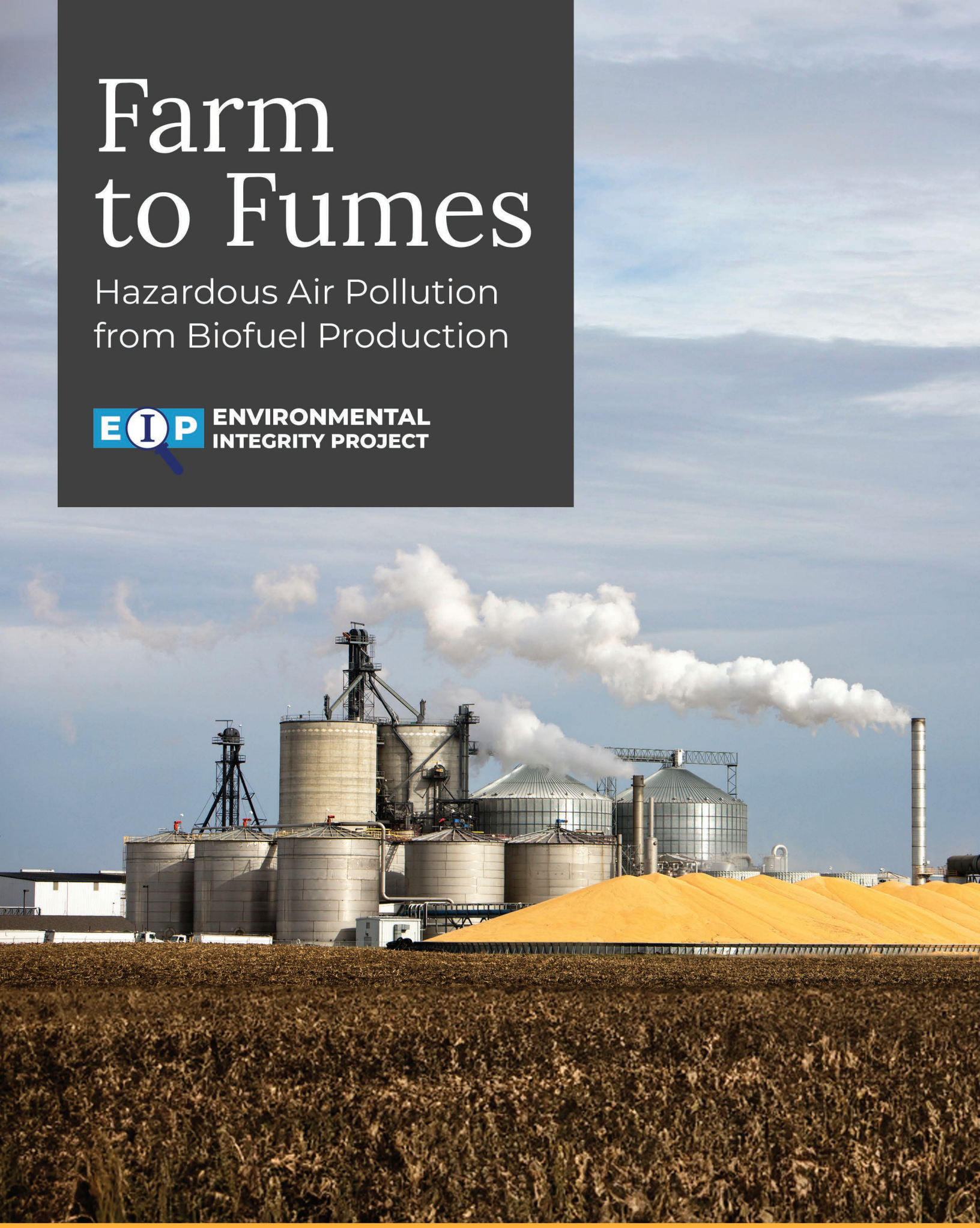
Farm to Fumes

Hazardous Air Pollution from Biofuel Production

ENVIRONMENTAL INTEGRITY PROJECT



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The Environmental Integrity Project:
The Environmental Integrity Project is a nonprofit organization dedicated to protecting public health and our natural resources by holding polluters and government agencies accountable under the law, advocating for tough but fair environmental standards, and empowering communities fighting for clean air and clean water. For more information on EIP, visit: www.environmentalintegrity.org

For questions about this report, please contact EIP Director of Communications Tom Pelton at (443) 510-2574 or tpelton@environmentalintegrity.org.

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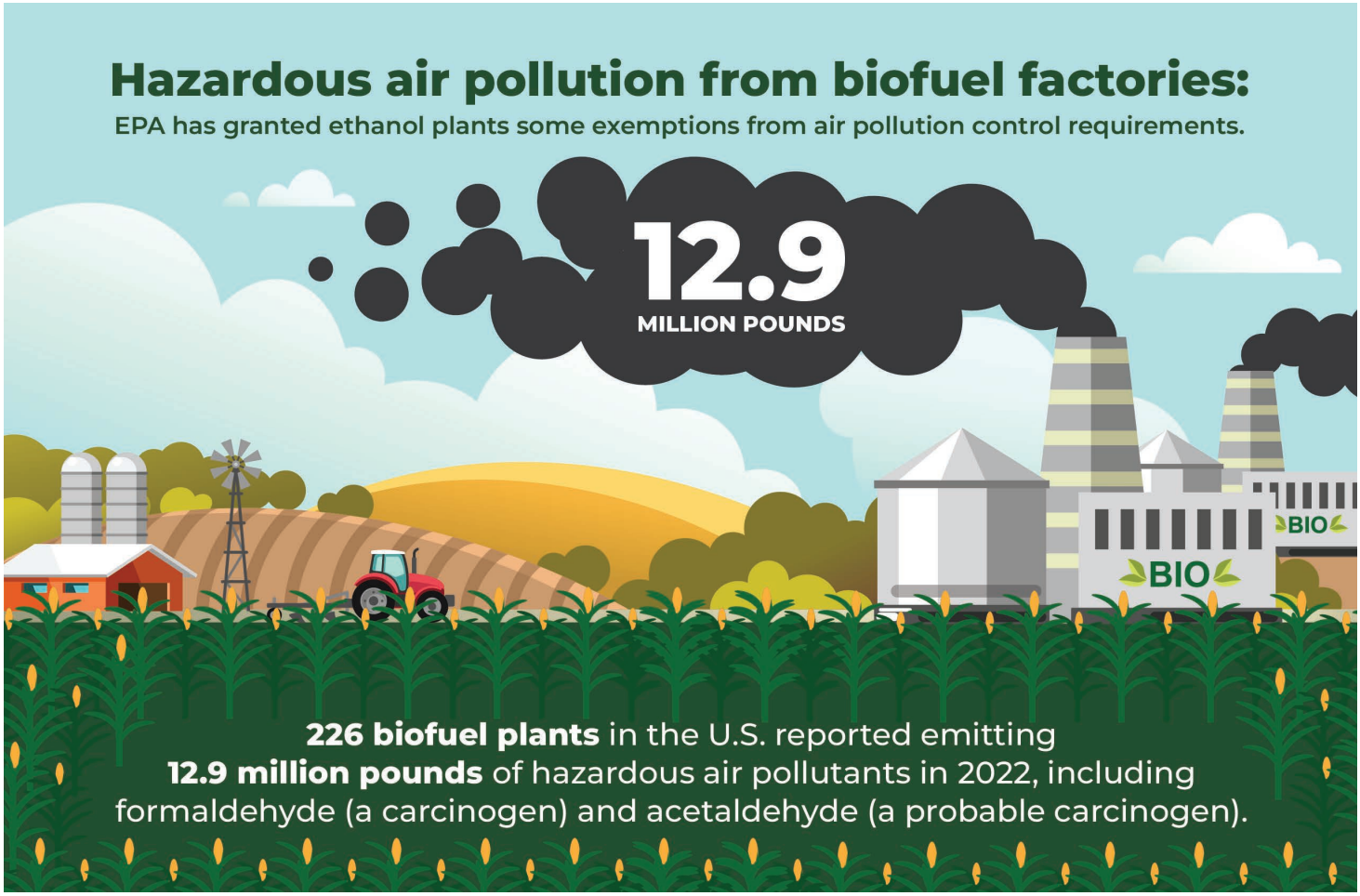
Hazardous Air Pollution from Biofuel Production

EXECUTIVE SUMMARY

Across the spectrum, biofuels like ethanol, biodiesel, and "renewable diesel" are held up by their manufacturers as a greener and more sustainable alternative to petroleum-based gasoline and diesel fuel. The industry is growing rapidly, fueled by federal subsidies, mandates, permitting loopholes and a clean public image of a plant-powered future. But biofuel factories release surprisingly large amounts of hazardous air pollution, often into rural Midwestern communities that suffer from unhealthy air quality despite having no significant pollution sources around them, other than the smokestacks of ethanol refineries.

An examination of emissions records by the Environmental Integrity Project (EIP) found that biofuel manufacturing plants release significantly greater amounts of certain hazardous air pollutants than oil refineries.[1] These include formaldehyde (a carcinogen), acetaldehyde (a probable carcinogen), hexane (which can attack the central nervous system and cause dizziness, nausea, and headaches) and acrolein (which can cause nausea, vomiting, diarrhea, lung and eye irritation, and shortness of breath). More acrolein is emitted from the biofuels industry than any other source in the U.S., according to reporting to EPA's Toxics Release Inventory.[2] The same four pollutants also contribute to the formation of ground-level ozone, or smog, which is linked to a wide variety of respiratory ailments; as well as microscopic, soot-like particulates that can trigger heart and asthma attacks. Many biofuels plants violate their air pollution control permits, releasing illegal amounts of contaminants that threaten the health of downwind communities. And although biofuel facilities release less carbon dioxide on average than petroleum refineries, biofuel plants still emit large quantities of greenhouse gases for an industry that portrays itself as climate-friendly.



Here are some of the key findings of EIP's examination of public records about the U.S. biofuels industry. (For a discussion of how we compiled this information, see the methodology section in Appendix A.)

- **RAPID EXPANSION:** The industry has been growing rapidly. The number of ethanol plants in the U.S. nearly quadrupled and their capacity rose eight-fold[3] in the first decade of this century. As of early 2024, there are 191 ethanol plants, 71 biodiesel plants, and 13 stand-alone renewable diesel plants in the U.S.[4] (For a list with details, click here. For an interactive map, click here.)
- **FUTURE GROWTH:** At least 32 new or expanded biofuels facilities are now under construction or proposed that would increase biofuel capacity by another 33 percent over 2023 levels.[5] (Click here for a map or see Appendix B for a list.) About two thirds of these new facilities and expansions – 23 of the 32 – could make jet fuel from wood or plants to create "sustainable aviation fuel."
- **HAZARDOUS AIR POLLUTION:** Oil refineries, in general, are bigger polluters than biofuel factories. But biofuel manufacturing plants report releasing significantly greater amounts of several dangerous air pollutants. These include more than seven million pounds of hexane in 2022 (the most recent available year), more than two million pounds of acetaldehyde, and more than 200,000 pounds of formaldehyde (see table below for specifics).
- **HEXANE:** The Archer Daniels Midland ethanol and grain processing plant in Decatur, Illinois – one of the largest ethanol factories in the country – was the single largest emitter of hexane in the U.S. in 2022, regardless of industry, releasing 2.2 million pounds of a pollutant that can damage the nerves and cause dizziness and nausea, according to the company's reporting to EPA's Toxics Release Inventory.
- **ACROLEIN:** The Cargill Inc. ethanol plant in Blair, Nebraska, was the largest emitter of acrolein in the U.S. in 2022, regardless of industry, releasing 34,489 pounds of a chemical that can cause shortness of breath and irritate the lung and eyes.
- **FREQUENT VIOLATIONS:** More than 41 percent of biofuels plants (98 of 240) violated their air pollution control permits at least once between July 2021 and May 2024, according to a review of EPA's Enforcement and Compliance History Online (ECHO) database.
- **CLIMATE IMPACT:** In terms of climate-warming pollution, biofuel plants in the U.S. reported emitting over 33 million metric tons of greenhouse gases in 2022 – as much as 8.5 coal-fired power plants burning fuel around the clock or 27.5 average oil refineries.[6]

The following is a table with more specific figures for some of the dangerous pollutants released by biofuel plants, and comparisons to oil refineries. It should be noted that EPA classifies all of these as "hazardous air pollutants" under the federal Clean Air Act and as volatile organic compounds (VOCs). The numbers below are likely underestimates because not all facilities report their emissions. Also, a 2015 study found that VOC emissions from ethanol plants may be five times higher than what companies report.[7]

Table 1. Hazardous air pollution released from biofuel plants vs. petroleum refineries (2022)

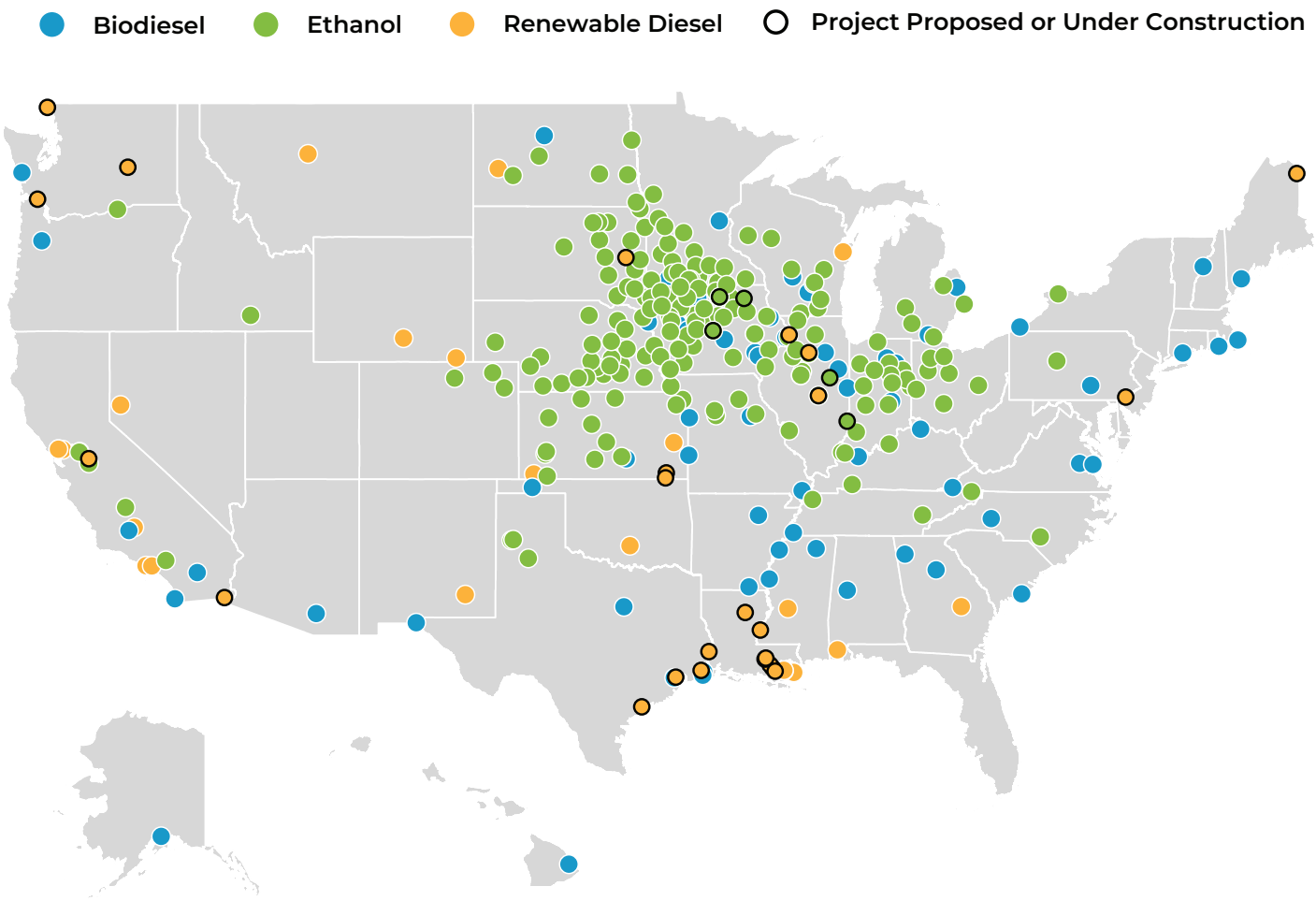
Pollutants	Pounds reported in 2022 (number of facilities reporting pollutant)			
	Ethanol	Biodiesel	Total Biofuels	Petroleum Refineries
Acetaldehyde	2,115,467 (164)	2,486 (2)	**2,117,953 (166)**	**10,420 (2)**
Acrolein	357,564 (92)	-	**357,564 (92)**	**-**
Formaldehyde	234,515 (80)	610 (1)	**235,125 (81)**	**67,774 (5)**
Hexane	3,351,096 (164)	4,336,426 (10)	**7,698,860 (180)**	**2,630,758 (128)**

Source: EPA 2022 Toxics Release Inventory. **Note:** Six renewable diesel plants also reported releasing 11,338 pounds of hexane in 2022, which is included in the biofuels pollution total. Emissions are excluded from facilities that co-produce biofuels and petroleum products. Energy Information Administration (EIA) data show East Kansas Agri-Energy produced ethanol in the 2022 EIA capacity report and renewable diesel in its 2023 report. East Kansas Agri-Energy, which can produce ethanol and renewable diesel, is treated as a renewable diesel facility here.

While most of the petroleum refineries in the U.S. are located along the Gulf Coast or in California, most biofuel plants are located in the Midwest or in rural areas where corn and soybeans are farmed on an industrial scale. (See map below).

As of 2022, 38 percent of corn and 46 percent of soybeans grown in the U.S. were used to make biofuel.[8] Increased demand for biofuels, especially from federal ethanol mandates, has raised the price of food and altered landscapes over the past several decades, replacing forested lands with monoculture crops and causing increased agricultural runoff pollution.[9] Studies have found that growing more corn and soybeans has also increased the use of agrochemicals like nitrogen fertilizer, insecticides, and herbicides.[10]

Map 1. Biofuel Manufacturing Plants Operating, Under Construction, and Proposed



Source: EIA 2022 and 2023 Capacity Reports, EPA ECHO, Permit Documents, State Notices, News Reports.
Note: "Renewable diesel" includes other biofuels excluding ethanol and biodiesel, such as sustainable aviation fuel, renewable naphtha, etc. Locations for some proposed projects may be approximations where permit documents are not yet available. Four new, proposed renewable diesel facilities were excluded from the map due to insufficient location information - Avina Midwest SAF Ethanol Plant (Midwest), Blue Blade Energy (Midwest), SkyNRG (Washington), VertiBlue Fuels (Florida).

Many biofuel plants have a checkered compliance history when it comes to air pollution control laws. EPA considered 22 plants to be 'high priority violators' of the Clean Air Act as of May 2024, according to EPA's Enforcement and Compliance Online (ECHO) database.[11] And all of these — 20 ethanol plants and two renewable diesel plants — had violations that had not been addressed by local, state, or federal agencies as of May 2024. (See Appendix C for a full list of facilities with alleged high priority violations.) One ethanol plant, the Grain Processing

Corp. facility in Muscatine, Iowa, has failed "stack tests" to determine compliance with pollution limits 16 times over the last five years, without being sanctioned by any enforcement actions or penalties, according to the EPA ECHO database.[12] The plant has been out of compliance with the Clean Air Act five of the last 12 quarters (July 2021 - May 2024), according to the database.

This report will discuss these broad environmental problems with the biofuel industry, and then focus on four case studies in California, Iowa, Illinois, and Louisiana (See pages 20-25). In the San Francisco Bay area, an oil refinery was converted into a biofuels plant for the Rodeo Renewed Project and faced opposition from local residents because of the air pollution and greenhouse gas emissions from biofuels manufacturing. In Iowa, Muscatine County – home of the Grain Processing Corp. ethanol refinery that has repeatedly failed air pollution "stack tests" – is one of only a few counties whose air quality violates federal sulfur dioxide standards in the Midwest and the only one to do so in Iowa. In Illinois, the ADM ethanol facility in Decatur has a poor environmental track record and reported releasing three million pounds of hazardous air pollutants in the most recent available year, 2022. In Louisiana, a company proposing to build an enormous refinery that would transform trees into jet fuel is using emission estimates for its hazardous pollutants based on extremely limited lab testing of a single gram of wood.

Momentum to boost biofuels production in the U.S. first began in the 1970s during an oil crisis. It grew in the 2000s to reduce America's dependence on Middle Eastern fuel following the attacks on September 11th, 2001. But even after the spread of new drilling techniques – hydraulic fracturing and horizontal drilling – in following years made America the biggest oil and gas producer in the world, biofuels production also kept expanding, in part because of government ethanol mandates meant to help farmers. At least 25 new biofuel plants have been proposed for the future or are under construction today, along with two refinery conversions, and expansions at five existing facilities. These new and future projects could increase biofuel production capacity by a third – including ethanol production by another 173 million gallons per year and renewable diesel by 4.7 billion gallons per year.

32 biofuel expansion projects are proposed or underway that would boost U.S. production by a third.

Much of this production and expansion is heavily subsidized with federal tax dollars, coming from a variety of programs. For example, the Inflation Reduction Act of 2022 authorized incentives – tax credits – to support the development of "sustainable aviation fuels." Sustainable aviation fuel, like "renewable diesel," can be produced from plants or wood and used in the same engines and pipelines that use traditional petroleum-based fuels. That makes these newer biofuels – sometimes called "drop-in fuels" because they can be dropped directly into conventional engines – different than ethanol and biodiesel, which must be blended with petroleum products or they will cause problems in conventional engines. Nearly all of the recent and proposed growth in biofuel production capacity - 7.2 of 7.5 billion gallons - is attributed to renewable diesel, sustainable aviation fuel, and these newer biofuel products.

Ethanol manufacturing plants also enjoy some exemptions from air pollution permitting requirements, making it easier for companies to expand or build new facilities without installing or upgrading pollution controls to reduce emissions of health-damaging air pollutants. In 2007, EPA removed corn-based ethanol plants from a list of industrial facilities subject to more stringent emission thresholds under the Clean Air Act. As a result, these ethanol plants can emit more than twice as much pollution – up to 250 tons per year instead of 100 tons per year – before they have to obtain a major source permit that requires stronger pollution controls. Plants built before 1970 enjoy even more freedom to expand and increase emissions without undergoing more stringent review and being subject to tighter pollution control requirements.

This report makes the following recommendations to address the environmental problems caused by the biofuel boom:

1. **END PERMITTING EXEMPTIONS FOR ETHANOL UNDER THE CLEAN AIR ACT:** EPA should reverse its 2007 decision to relax major source permitting thresholds for ethanol manufacturers that allow these plants to emit more than twice the level of air pollution before needing to install better pollution controls.
2. **BETTER MONITORING AND CONTROL OF HAZARDOUS AIR POLLUTANTS:** EPA should require large biofuel plants to install air pollution monitoring devices along their fencelines to detect the levels of hazardous air pollutants, like acetaldehyde and acrolein, that could be drifting into nearby communities. EPA should also establish an 'action level' for these and other highly toxic pollutants, that, if exceeded, would obligate these facilities to identify the sources of the emissions and then fix the problems causing elevated concentrations.
3. **STRONGER ENFORCEMENT OF AIR POLLUTION CONTROL PERMITS FOR BIOFUEL PLANTS:** EPA and state regulatory agencies should more vigorously enforce air pollution control permits for biofuel plants, imposing penalties large enough to discourage future violations and protect downwind communities.
4. **IMPROVE THE ACCURACY OF EMISSIONS REPORTING:** Biofuels producers should be required, during the permit review and approval process, to expand their emissions testing and improve the accuracy of their pollution reporting to both EPA and the states.
5. **END BIOFUEL SUBSIDIES AND MANDATES:** Biofuels are growing at a rapid rate in part because of government funding and regulatory mandates for blending ethanol into gasoline. But the environmental benefits of these government supports are questionable at best. All existing subsidies and mandates for ethanol – including the renewable fuel standard – should be halted – and attention focused instead on clean energy sources like solar and wind and the infrastructure needed to support them.

While plant-based fuels have a role in America's future economic growth, their benefits to the climate should not be exaggerated or their environmental problems ignored. Biofuels should not be granted exemptions from pollution control laws or provided taxpayer funds to encourage more rapid growth than is warranted. In the end, most crops like corn and soybeans should be used to provide affordable food for people, not to feed machines. And most trees and forests should be preserved and protected as natural carbon dioxide capturing systems, instead of cut down and mulched into jet fuel. It is healthier to turn to the sun and wind for clean power, and not to reap carcinogens from corn.

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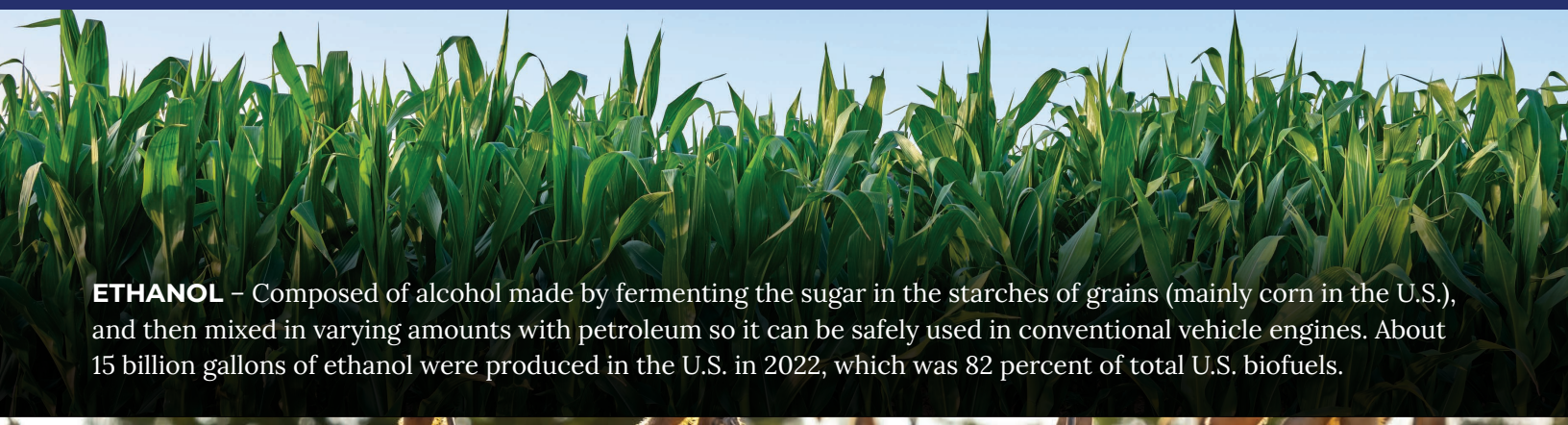
Different Types of Biofuels

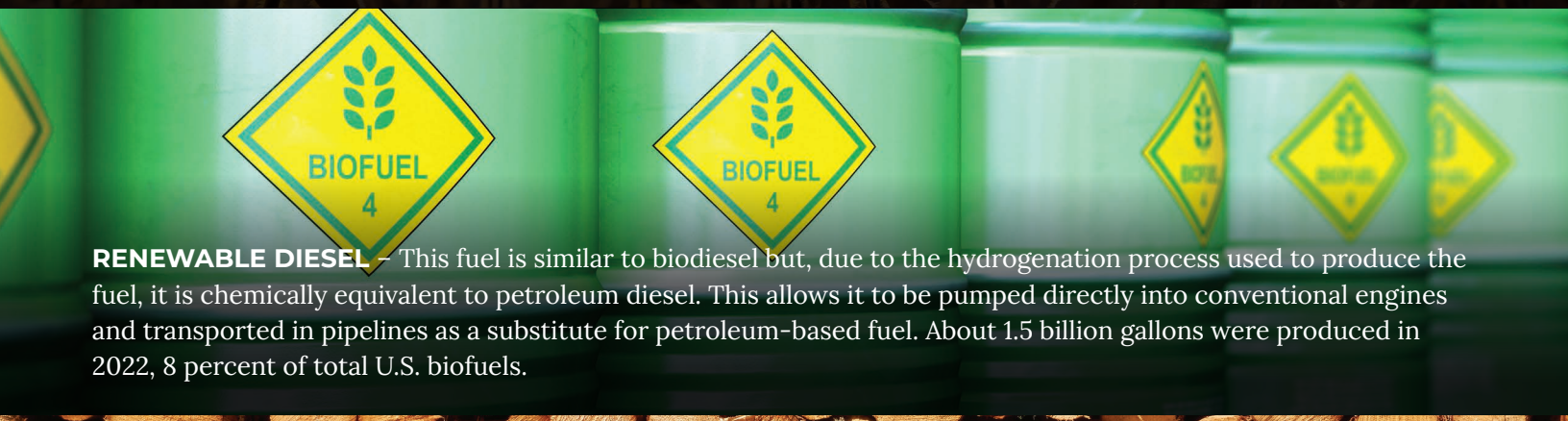
While the term biofuels seems like a simple one, it is an umbrella term that refers to a variety of liquid fuels produced using biomass materials as a feedstock – such as corn, soybeans, or wood – or fuel made from waste products like fat or grease. Industry advocates and government legislation often use different names for the same or similar products, leading to some confusion surrounding the topic.

This report focuses on four categories of biofuels:[13]

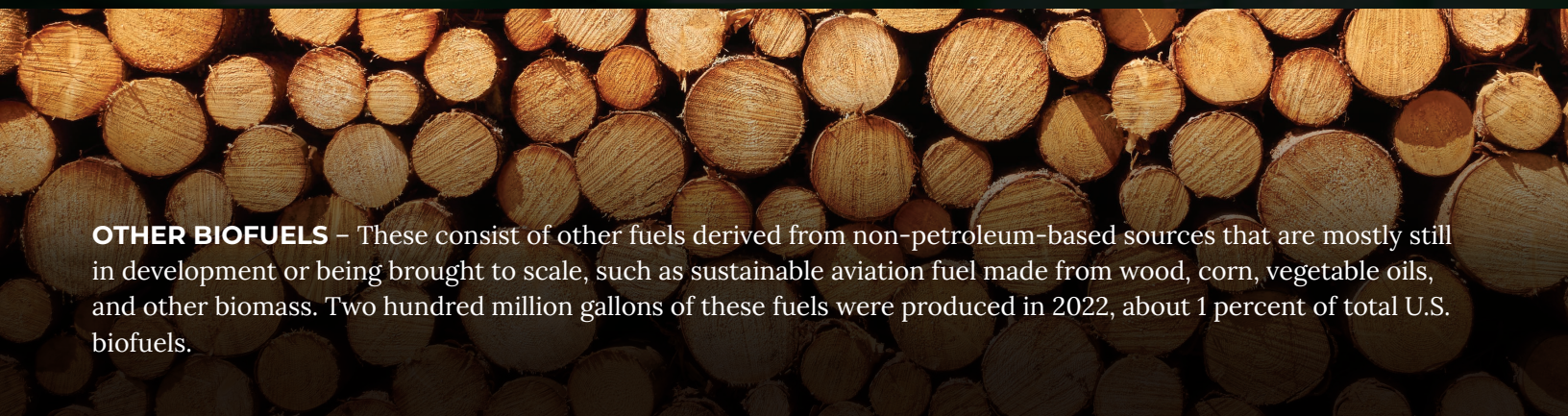


ETHANOL – Composed of alcohol made by fermenting the sugar in the starches of grains (mainly corn in the U.S.), and then mixed in varying amounts with petroleum so it can be safely used in conventional vehicle engines. About 15 billion gallons of ethanol were produced in the U.S. in 2022, which was 82 percent of total U.S. biofuels.

BIODIESEL – Made up of primarily vegetable oils (largely from soybeans) and mixed with petroleum diesel for use in vehicles with diesel engines. Cooking oils and animal fats can be used as a feedstock as well. Biodiesel requires modifications to existing petroleum-based engines and other infrastructure to use. About 1.6 billion gallons were produced in 2022, 9 percent of total U.S. biofuels.



RENEWABLE DIESEL – This fuel is similar to biodiesel but, due to the hydrogenation process used to produce the fuel, it is chemically equivalent to petroleum diesel. This allows it to be pumped directly into conventional engines and transported in pipelines as a substitute for petroleum-based fuel. About 1.5 billion gallons were produced in 2022, 8 percent of total U.S. biofuels.



OTHER BIOFUELS – These consist of other fuels derived from non-petroleum-based sources that are mostly still in development or being brought to scale, such as sustainable aviation fuel made from wood, corn, vegetable oils, and other biomass. Two hundred million gallons of these fuels were produced in 2022, about 1 percent of total U.S. biofuels.

CHAPTER 1

Growth of Biofuel Spurred by Government Incentives and Loopholes

Wood is chipped before being turned into a biofuel.

Growth of Biofuel Spurred by Government Incentives and Loopholes

The U.S. is the world's largest producer of biofuels, churning out about 18.5 billion gallons in 2022,[14] about 40 percent of global production. Brazil follows in a distant second.[15] The Brazilian government was the first to mandate the use of biofuels at a large scale. Back in 1975, during a surge in global oil prices, Brazil – which grows large amounts of sugarcane – started requiring that ethanol created from sugarcane be blended into gasoline to increase its domestic energy security.[16]

The U.S. soon followed suit in trying to promote its own national security through home-grown fuel, instead of relying on petroleum imported from the Middle East and Venezuela. In its origins, the biofuel industry in the U.S. was promoted for geopolitical reasons, not primarily to help the environment. Congress created a tax break in 1978 for gasoline mixed with at least 10 percent ethanol, which in North America is distilled mostly from corn.[17] Congress expanded the subsidy in 1980, providing over $1 billion for the construction of ethanol production plants and a $0.54 per gallon tariff on foreign produced ethanol.[18] Following these government incentives, U.S. ethanol production grew, with a cumulative total of 32.2 billion gallons from 1981 to 2005. Congress passed even more subsidies and mandates in the 1990s and 2000s because of political demands for energy independence following the Gulf War.

The U.S. is the world's largest producer of biofuels, churning out

18.5 billion gallons in 2022

In the Energy Policy Act of 2005, Congress introduced the Renewable Fuel Standard, which mandated the amount of renewable fuels blended into the consumer transportation fuel mix, starting with four billion gallons in 2006 and steadily increasing to 7.5 billion in 2012.[19] The law also made over $1 billion available in grants for renewable fuel production and hundreds of millions of dollars for research and development. By 2008, ethanol production was up 138 percent from 2005 and biodiesel production was up 645 percent.[20]

The U.S. government's support for ethanol – which is politically popular in Midwestern states like Iowa – extends beyond subsidies, tax breaks, and mandates. The industry has also received favored regulatory treatment from EPA. This includes an exemption under a part of the Clean Air Act that requires manufacturing plants to install and operate stronger or weaker air pollution control systems, depending on whether they are considered "major" or "minor" sources of emissions.

In 2007, under significant pressure from the ethanol lobby, EPA decided to make an exception for corn-based ethanol plants. The agency had considered ethanol plants to be chemical processing facilities, which had a threshold of 100 tons of air pollution per year to be considered a "major" source, requiring stronger pollution controls. But EPA relaxed the standard for ethanol plants, changing it to a threshold of 250 tons per year. That meant fewer plants would be required to install "major" source air pollution controls. EPA's rationale for weakening the requirements for ethanol plants was based on maintaining U.S. energy security, not wanting to slow the ethanol industry's growth, and a claim (since disputed) that ethanol has environmental benefits.[21]

Among other government supports for the biofuel industry, the 2021 Infrastructure Investment and Jobs Act signed by President Biden provided $2 billion in grant funding, from 2022 to 2026, for the replacement of conventional diesel school buses with new buses that operate at least in part using alternative fuels, including biofuels.[22] The 2022 Inflation Reduction Act introduced a credit of $1.25 per gallon for producers of "sustainable aviation fuel" that reduces greenhouse gas emissions by at least 50 percent.[23]

In total, there are now 41 federal incentives, programs, laws, and regulations in effect in the U.S. to promote

biodiesel, ethanol, and renewable diesel.[24] These do not include agricultural subsidies for biofuel feedstocks like corn and soybeans – estimated at more than $116 billion for corn and $44.9 billion for soybeans since 1995.[25] Today, more than a third of all corn grown and almost half of all soybeans are used not for food, but for fuel. In addition to the federal subsidies mentioned, states have implemented their own forms of incentives to boost biofuel production. California, for example, has its own Low Carbon Fuel Standard (similar to the federal Renewable Fuel Standard) that is driving a substantial amount of renewable diesel production.[26]

With the tremendous amount of taxpayer support biofuels have been given over the last few decades, the public has received little benefit in return. The price of gasoline has been affected very little by the presence of biofuels, with the price of gas rising at about the rate of inflation since the 1980s, despite mandates for blending corn-based fuel into gasoline.[27] Not only has the public not seen a financial gain from biofuels, but U.S. domestic petroleum production has simultaneously grown, causing more environmental harm and reducing the need for home- grown biofuel for national security reasons.

38% of corn and
46% of soybeans
are used to make biofuel

New Growth in the Biofuel Industry

In reaction to all these government supports, the biofuels industry has been expanding rapidly in the U.S. in recent decades. Recent growth in the sector – historically dominated by ethanol – is now driven by renewable diesel and a new generation of emerging renewable fuels, such as sustainable aviation fuel and renewable naphtha (a liquid that can be used to make jet fuel, plastic, and other products).[28]

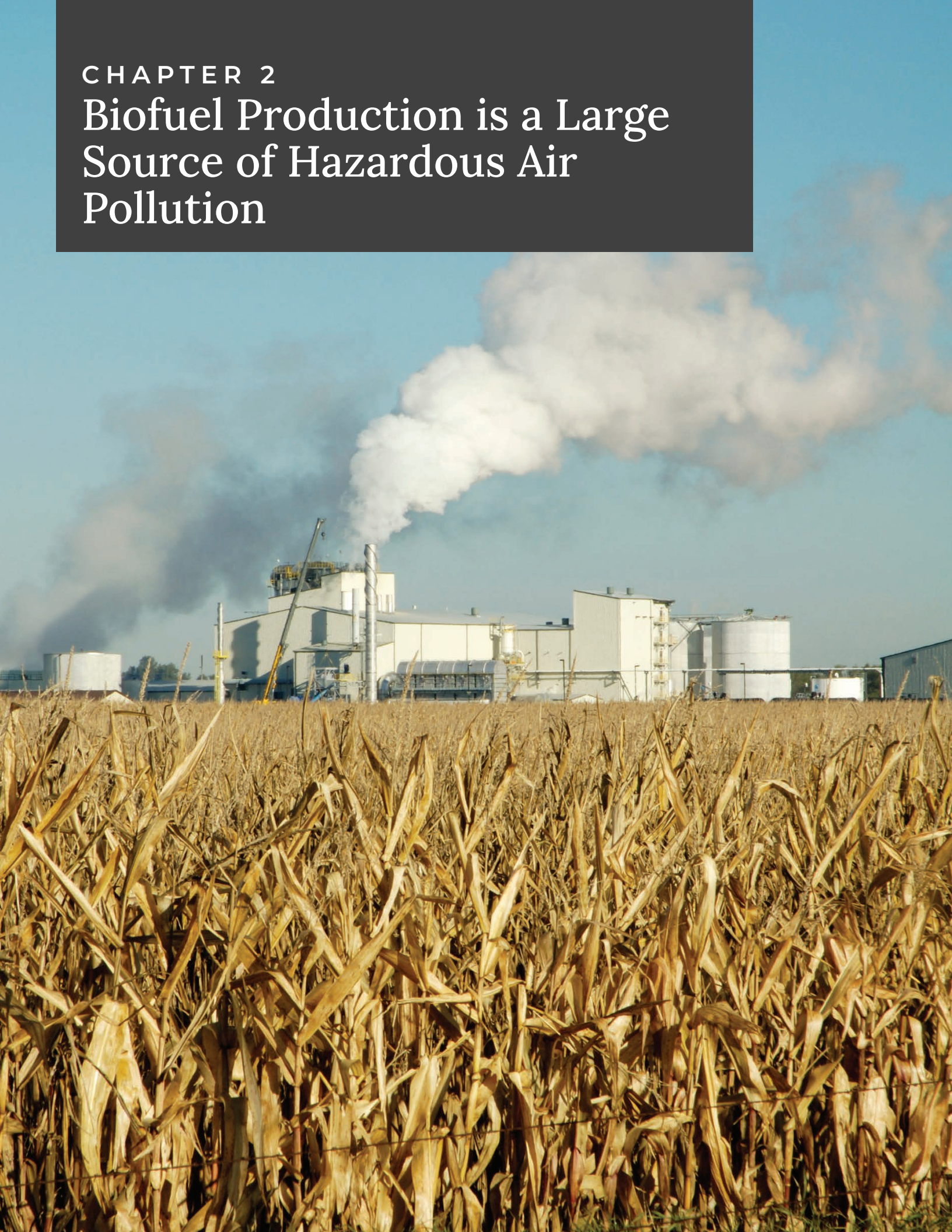
Since 2022, at least five new biofuel plants have been built, four petroleum refineries have completed conversion projects, and three existing biofuel plants have expanded or restarted – increasing U.S. biofuel production capacity by over 2.6 billion gallons a year.[29] On top of this, at least another 25 proposed new plants, two refinery conversions, and expansions at five existing facilities could add another 4.9 billion gallons to annual production capacity, for a combined increase of over 7.5 billion gallons a year, or a 33 percent increase over the 2023 production capacity of 23 billion gallons a year.[30] Nearly all of this growth is in renewable diesel production. The eight renewable diesel projects that came online between 2022 and early 2024 added 2.5 billion gallons per year of capacity. The 27 additional projects in the works could add at least another 4.7 billion gallons. All together, these projects could more than double renewable diesel capacity in the U.S. compared to 2022.

At the center of this growth in renewable diesel is the expansion of "sustainable aviation fuel," made from wood or plants. The Biden Administration has a goal of the U.S. producing three billion gallons of sustainable aviation fuel annually by 2030 and meeting 100 percent of aviation fuel demand – 35 billion gallons per year – by 2050.[31] Supported by incentives like tax credits and grants,[32] companies have at least 23 sustainable aviation fuel projects proposed or under construction across the U.S.

Though emissions data are still limited, permit documents, where available, show that this recent and proposed growth could increase emissions of hazardous air pollutants by up to 139 tons a year. Emissions of volatile organic compounds from the sector could grow by up to 1,421 tons a year and greenhouse gases by millions of tons (with the total not yet clear).[33] These potential emissions estimates are limited to just 27 projects for which permit documents were available. Another 18 projects have been announced but permit and emissions details have not yet been disclosed.

CHAPTER 2

Biofuel Production is a Large Source of Hazardous Air Pollution



Biofuel Production is a Large Source of Hazardous Air Pollution

While the conversation surrounding biofuels frequently focuses on greenhouse gases, little is mentioned of the significant amount of hazardous air pollutants these facilities emit, along with smog-forming volatile organic compounds. EPA defines certain compounds as "hazardous air pollutants" because they are known, or strongly suspected, to cause cancer or have other grave health effects, such as damage to the neurological or respiratory systems. Benzene, for example, is a known carcinogen and is found in gasoline and its production. EPA has identified 188 different pollutants as hazardous air pollutants under the Clean Air Act.[34] In 2022, 226 biofuel plants in the U.S. reported emitting 12.9 million pounds of hazardous air pollutants.[35]

Compared to oil refineries, biofuel factories reported releasing almost

4X more

of four hazardous air pollutants: acetaldehyde, acrolein, formaldehyde and hexane.

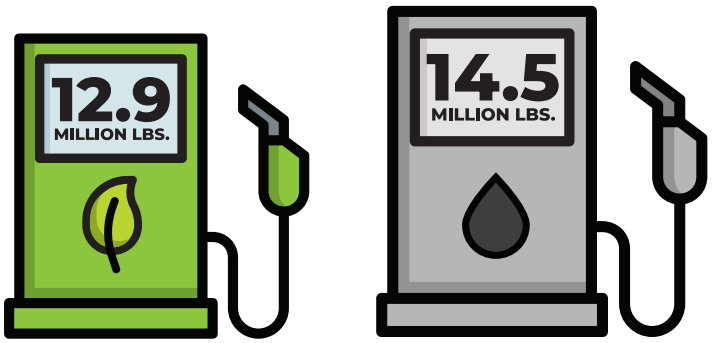
Biofuels plants reported releasing four hazardous air pollutants at levels significantly greater than petroleum refineries.

- **ACETALDEHYDE** is released during the fermentation process of ethanol production, and when ethanol is eventually broken down by vehicles. The primary short-term effect of inhalation exposure to acetaldehyde is irritation of the eyes, skin, and respiratory tract. At higher exposure levels, erythema, coughing, pulmonary edema, and necrosis may also occur. Acetaldehyde is considered a probable human carcinogen based on human studies conducted thus far and animal studies that have shown nasal tumors in rats and laryngeal tumors in hamsters.[36]
- **ACROLEIN** is also created during the ethanol fermentation process. Effects including weakness, nausea, vomiting, diarrhea, severe respiratory and eye irritation, shortness of breath, bronchitis, pulmonary oedema, unconsciousness, and death have been observed upon accidental exposure. Long-term exposure effects can consist of general respiratory congestion, as well as irritation of the eyes, nose, and throat.[37]
- **FORMALDEHYDE** is created in the fermentation process of ethanol production as well. EPA has preliminarily found that formaldehyde poses unreasonable risk to human health.[38] High levels of exposures to formaldehyde can cause health problems when inhaled and if it is absorbed into the skin. Inhaling high levels of formaldehyde for a short period of time can cause sensory irritation such as eye irritation. Inhaling formaldehyde for longer periods of time can damage the lungs and increase asthma and allergy-related conditions and cause cancer.
- **HEXANE** is used to extract edible oils from seeds and vegetables, as a special-use solvent, and as a cleaning agent. As such, it is heavily involved in the production of most biofuel products. Short-term exposure of humans to high levels of hexane causes mild central nervous system effects, including dizziness, giddiness, slight nausea, and headache. Long-term exposure to hexane is associated with polyneuropathy (nerve damage) in humans, as well as numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue.[39]

On a per plant basis, biofuels factories reported releasing, on average, over twice as much acetaldehyde and hexane as petroleum refineries. Biodiesel plants reported emitting over 2,000 percent more hexane than refineries. Ethanol plants reported releasing nearly 150 percent more acetaldehyde than petroleum refineries. Biofuel facilities also reported emitting in 2022 nearly 4,000 pounds of acrolein on average, a pollutant that is not reported by petroleum refineries.

Air pollution from biofuel factories vs. oil refineries

Although biofuels are often portrayed as green and healthy, manufacturing biofuels reported releasing almost as much total hazardous air pollution as oil refineries in 2022.



Hazardous air pollution from biofuel factories

Hazardous air pollution from oil refineries

Note: Biofuel plants release more of four hazardous air pollutants than oil refineries: formaldehyde, acetaldehyde, hexane, and acrolein. But all 188 hazardous air pollutants are included in the 2022 totals above. Totals above are the pollutants reported to EPA Toxics Release Inventory.

Overall, biofuels manufacturing plants reported releasing more than 10.4 million pounds of these four hazardous pollutants in 2022 (acetaldehyde, acrolein, formaldehyde and hexane), which was almost four times as much as oil refineries that year. (See Table 1 on page 4.) However, when other pollutants, such as benzene, are taken into account, oil refineries were, overall, a larger source of all hazardous air pollutants than biofuel plants, although they were relatively close. Refineries reported releasing 14.5 million pounds of all hazardous air pollutants in 2022, compared to 12.9 million pounds from biofuel plants.[40]

In midwestern states like Iowa, Illinois, and Indiana, ethanol refineries are some of the largest sources of these hazardous pollutants, as well as volatile organic compounds. In Iowa and Illinois, the top two highest corn-producing states in the U.S., about 70 percent of all hazardous pollutants reported came from ethanol plants – a total of 5.7 million pounds in 2022. The hazardous air pollutant totals from ethanol plants in Illinois (2.2 million pounds) and Iowa (3.6 million pounds) were similar to the amount reported by oil refineries in Louisiana (2.7 million pounds) that year. Together, the totals from ethanol plants in these two midwestern states were about the same as the amount of hazardous air pollutants reported by petroleum refineries in Texas (5.8 million pounds in 2022).

In Iowa and Illinois,
70%
of all hazardous air pollutants reported come from ethanol plants

Over the course of the last 10 years with data available (from 2013 to 2022), total hazardous air pollutants reported to EPA's Toxics Release Inventory by biofuels facilities rose from 10.8 million pounds to 12.9 million pounds, a 19 percent increase.[41] This came as the number of biofuels plants reporting emissions to EPA increased by 13 percent. Ethanol plants reported an increase from 6.6 million pounds of total hazardous air pollutants to 8 million pounds, a 21 percent increase, as the number of plants reporting rose by 11 percent. Biodiesel plants reported an increase from 4.2 million pounds to 4.9 million pounds, a 17 percent increase, as the number of plants increased by 19 percent. The hazardous pollutants reported by petroleum refineries during this period decreased from 18.1 million pounds to 14.5 million pounds, a 20 percent decrease, while the number of plants reporting fell by five percent.[42]

Top Emitters of Hazardous Air Pollution

As mentioned previously, Iowa and Illinois are home to major emitters of hazardous air pollutants, including acetaldehyde. As can be seen in Table 2 below, six of the top 10 reported emitters of acetaldehyde among biofuel plants nationally in 2022 were located in one of these two states, and all were ethanol plants. Additionally, the

three biofuel plants reporting the most acetaldehyde pollution that year were all among the top 10 emitters of this pollutant nationally, regardless of industry. The Alto Pekin ethanol plant in Illinois was the second largest acetaldehyde polluter in the U.S., ranking second only to Eastman Chemical plant in Tennessee, and releasing more than twice as much as the second highest biofuel plant.

Table 2: Top 10 biofuel plants that reported releasing the most acetaldehyde in 2022

Rank among biofuel plants	Facility	Location	Biofuel Type	Emissions (lbs)	Rank nationally (among all industries)
1	Alto Pekin LLC Wet and Dry Mill	Pekin, IL	Ethanol	295,597	2
2	Archer Daniels Midland	Clinton, IA	Ethanol	128,885	7
3	Grain Processing Corp	Muscatine, IA	Ethanol	113,612	10
4	Archer Daniels Midland Dry Mill and Wet Mill	Cedar Rapids, IA	Ethanol	98,041	11
5	Cargill Inc.	Blair, NE	Ethanol	76,215	26
6	Cargill Inc.	Eddyville, IA	Ethanol	63,789	32
7	Tate & Lyle	Loudon, TN	Ethanol	60,671	34
8	Archer Daniels Midland Dry and Wet Mill	Columbus, NE	Ethanol	58,781	36
9	Poet Biorefining - Hudson LLC	Hudson, SD	Ethanol	20,600	108
10	Poet Biorefining - Shell Rock LLC	Shell Rock, IA	Ethanol	19,092	113

Source: EPA 2022 Toxics Release Inventory.

When it comes to hexane emissions, the locations of the top ten polluters are spread out among six states, as can be seen in Table 3. Most of these facilities are biodiesel plants because hexane is heavily involved in biodiesel production. However, the top reported emitter (Archer Daniels Midland in Decatur, Illinois) is an ethanol plant that produces many other products as well, and is the top reported emitter of hexane in the U.S. regardless of industry.

Table 3. Top 10 biofuel plants that reported releasing the most hexane in 2022

Rank among biofuel plants	Facility	Location	Biofuel Type	Emissions (lbs)	Rank nationally (among all industries)
1	Archer Daniels Midland	Decatur, IL	Ethanol*	2,227,817	1
2	Louis Dreyfus Agricultural Industries, LLC	Claypool, IN	Biodiesel	719,432	10
3	Paseo Cargill Energy, LLC	Kansas City, MO	Biodiesel	622,000	15
4	Incobrasa Industries Ltd.	Gilman, IL	Biodiesel	502,437	22
5	Cargill Inc.	Wichita, KS	Biodiesel	500,000	25
6	Archer Daniels Midland	Velva, ND	Biodiesel	433,821	29
7	Minnesota Soybean Processors	Brewster, MN	Biodiesel	418,537	31
8	Deerfield Energy, LLC	Deerfield, MO	Biodiesel	364,955	42
9	AG Processing	St. Joseph, MO	Biodiesel	308,132	47
10	Cargill Inc.	Iowa Falls, IA	Biodiesel	249,321	56

Source: EPA 2022 Toxics Release Inventory.

*Facility produces more than just ethanol, including citric acid, lactic acid, xanthan gum, dextrose, sorbitol, and corn syrup.

For a listing of the biofuel plants releasing the most acrolein and formaldehyde, please see Appendix D.

Other Air Pollutants Released by Biofuel Plants

Another EPA category of pollutants, called "criteria air pollutants" – namely nitrogen oxides, sulfur dioxide, lead, particulate matter, carbon monoxide – are also produced by biofuel manufacturing plants and can also threaten human health. The biofuel plants studied by EIP reported emitting 47,727 tons total criteria pollutants in 2020 (the most recent available year for those pollutants).[43] This broke down into 14,526 tons of nitrogen oxides, 14,782 tons of sulfur dioxide, 7,740 tons of particulate matter, 10,678 tons of carbon monoxide and 240 pounds of lead that year.

Greenhouse Gas Emissions from the Biofuel Industry

In addition to being a large source of toxic air pollution, biofuel refineries also emit a lot of greenhouse gases. Overall, 191 plants in 2022 reported emitting over 33.2 million metric tons of greenhouse gases (expressed as carbon dioxide equivalent tons). That's as much climate-warming pollution as from 8.5 coal-fired power plants operating around the clock or 27.5 average oil refineries. While this was less than the amount all oil refineries in the U.S. reported in total that year, some biofuel plants reported emitting as much as or more than some individual refineries. Emissions are higher at plants that burn coal or other carbon-intensive fuels to power and provide heat for biofuel manufacturing processes.[44]

For example, the Archer Daniels Midland ethanol plant in Decatur, Illinois, reported emitting over 4.1 million metric tons of greenhouse gases in 2022. It was the fourth-largest source of greenhouse gases in the state, ranking above the Wood River oil refinery, which was the fifth-largest source. Two other plants run by Archer Daniels Midland, one in Cedar Rapids and another in Clinton, Iowa, both reported emitting over two million metric tons of greenhouse gases each, making them the fifth and sixth largest sources, respectively, of those pollutants in Iowa. Only 14 of more than 100 oil refineries in the U.S. reported emitting more than these three biofuel plants. Table 4 lists the 10 biofuel plants that emitted the most greenhouse gases in 2022.

Table 4. 10 biofuel plants that reported emitting the most greenhouse gases in 2022

Facility	Location	Biofuel Type	Greenhouse gas emissions (CO_2e, metric tons)	Fuel type(s)
Archer Daniels Midland	Decatur, IL	Ethanol	4,149,749*	Fuel oils, natural gas, tires, biomass gases, coal
Archer Daniels Midland Dry Mill and Wet Mill	Cedar Rapids, IA	Ethanol	2,845,289	Coal, natural gas, biomass gases, agricultural byproducts, biomass waste byproducts
Archer Daniels Midland	Clinton, IA	Ethanol	2,272,456	Natural gas, coal, agricultural byproducts, biomass waste byproducts
Archer Daniels Midland Dry and Wet Mill	Columbus, NE	Ethanol	1,163,383	Coal, natural gas, biomass gases
Biourja Renewables LLC	Peoria, IL	Ethanol	560,401	Fuel oils, natural gas
Cargill Inc.	Blair, NE	Ethanol	530,151	Natural gas, biomass gases
Marquis Energy, LLC	Hennepin, IL	Ethanol	526,801	Natural gas
Cargill Inc.	Eddyville, IA	Ethanol	378,927	Natural gas, fuel oils
Tate & Lyle	Loudon, TN	Ethanol	376,468	Natural gas, biomass gases
Grain Processing Corp.	Muscatine, IA	Ethanol	351,996	Natural gas, biomass gases

Source: EPA 2022 Greenhouse Gas Reporting Program. "CO_2e" means carbon dioxide equivalent tons. Table excludes biofuel facilities that co-produce petroleum products. *Reported sequestering 428,580 metric tons of greenhouse gases emitted by the ethanol plant.

To reduce greenhouse gases from biofuel production, several ethanol companies have committed to capturing carbon dioxide and piping it across the Midwest to where it can be injected deep underground. Overall, companies behind at least 12 of the 32 new or expanded biofuel plants have indicated their plans to use carbon capture and sequestration. However, carbon capture is expensive and largely unproven, on a large scale, and it is not clear if it will work as a strategy to combat climate change.[45] Congress recently more than doubled public subsidies for companies that sequester carbon, from $37.85 to $85 per metric ton. But current U.S. regulations do not require companies that operate sequestration wells to guarantee that carbon stays underground and monitoring requirements are inadequate.[46]

Even if biofuel facilities are successful at capturing their plant-level emissions and sequestering it underground, the lifecycle emissions from biofuels, especially after accounting for land use changes to accommodate additional corn and soybean production, raise serious doubts about whether biofuels offer climate benefits over fossil fuels. One recent study, published by the National Academy of Sciences, found that corn-based ethanol's life-cycle greenhouse gas emissions are "no less than gasoline and at least 24 percent higher."[47]

EPA has also raised concerns about the trade-offs of producing more ethanol and other biofuels. The agency wrote in a 2024 report: "Replacing fossil fuels with biofuels has the potential to reduce some undesirable environmental impacts of fossil fuel production and use, including conventional and greenhouse gas (GHG) pollutant emissions, exhaustible resource depletion, and dependence on unstable foreign suppliers. Demand for biofuels could also increase farm income. Biofuel production and use has drawbacks as well, including land and water resource requirements, air and ground water pollution. Depending on the feedstock and production process, biofuels can emit even more greenhouse gases than some fossil fuels on an energy-equivalent basis."[48]

Clean Air Act Violations at Biofuel Facilities

EIP surveyed EPA's Enforcement and Compliance History Online (ECHO) database for compliance histories on 276 biofuel facilities in the U.S. and identified data from 240 plants.[49] Based on these findings, as of May 2024, 98 plants had a violation reported at the federal, state, or local level in the last three years, and 45 of these had a "high priority violation" reported in that time. Twenty-two of the plants that reported a high priority violation in the last three years have at least one existing violation that has yet to be addressed.

Additionally, of the biofuel plants surveyed, state or federal agencies brought 121 enforcement actions[50] against 61 plants in the last five years. These have included $4.5 million in environmental penalties against 46 of these facilities assessed over the past five years. Table 5 shows the top facilities – eight being ethanol plants – with the most Clean Air Act enforcement actions.

Table 5. Biofuel plants with the most Clean Air Act enforcement actions in the last 5 years

Facility	Location	Biofuel Type	Number of enforcement actions	Total penalty amount assessed
Pelican Renewables LLC	Stockton, CA	Ethanol	17	$205,500
Pennsylvania Grain Processing LLC	Clearfield, PA	Ethanol	7	$66,744
Alto Pekin LLC Wet and Dry Mill	Pekin, IL	Ethanol	4	$308,374
Alto ICP LLC	Pekin, IL	Ethanol	4	$193,516
Bioenergy Development Group LLC	Memphis, TN	Biodiesel	4	$80,988
Dynamic Recycling LLC	Bristol, TN	Ethanol	4	$13,500
Marquis Energy LLC	Hennepin, IL	Ethanol	4	$0
Archer Daniels Midland	Decatur, IL	Ethanol	4	$0
Biourja Renewables LLC (formerly ADM)	Peoria, IL	Ethanol	4	$0

Source: EPA Enforcement and Compliance History Online database.

It should be noted that these violations and enforcement actions came despite relaxed standards for ethanol plants that EPA put in place in 2007 (as discussed earlier). These relaxed standards allow most ethanol plants to call themselves "minor" sources of air pollution, even though they are often large sources that deserve more stringent air pollution control requirements.

Sixty-five out of 182 biofuel plants with available data (36 percent) failed "stack tests" over the last five years. A stack test measures the amount of a specific regulated pollutant to determine if the emissions are in compliance with permits approved under the Clean Air Act. (Some stack tests also measure the efficiency of air pollution control devices or capture systems.)[51] Table 6 below shows the top five plants with the most stack test failures in the last five years that have not had any enforcement actions[52] taken against them or penalties assessed during this time period, according to EPA's ECHO database.

Table 6. Biofuel plants with the most stack test failures in the last 5 years without enforcement actions or penalties

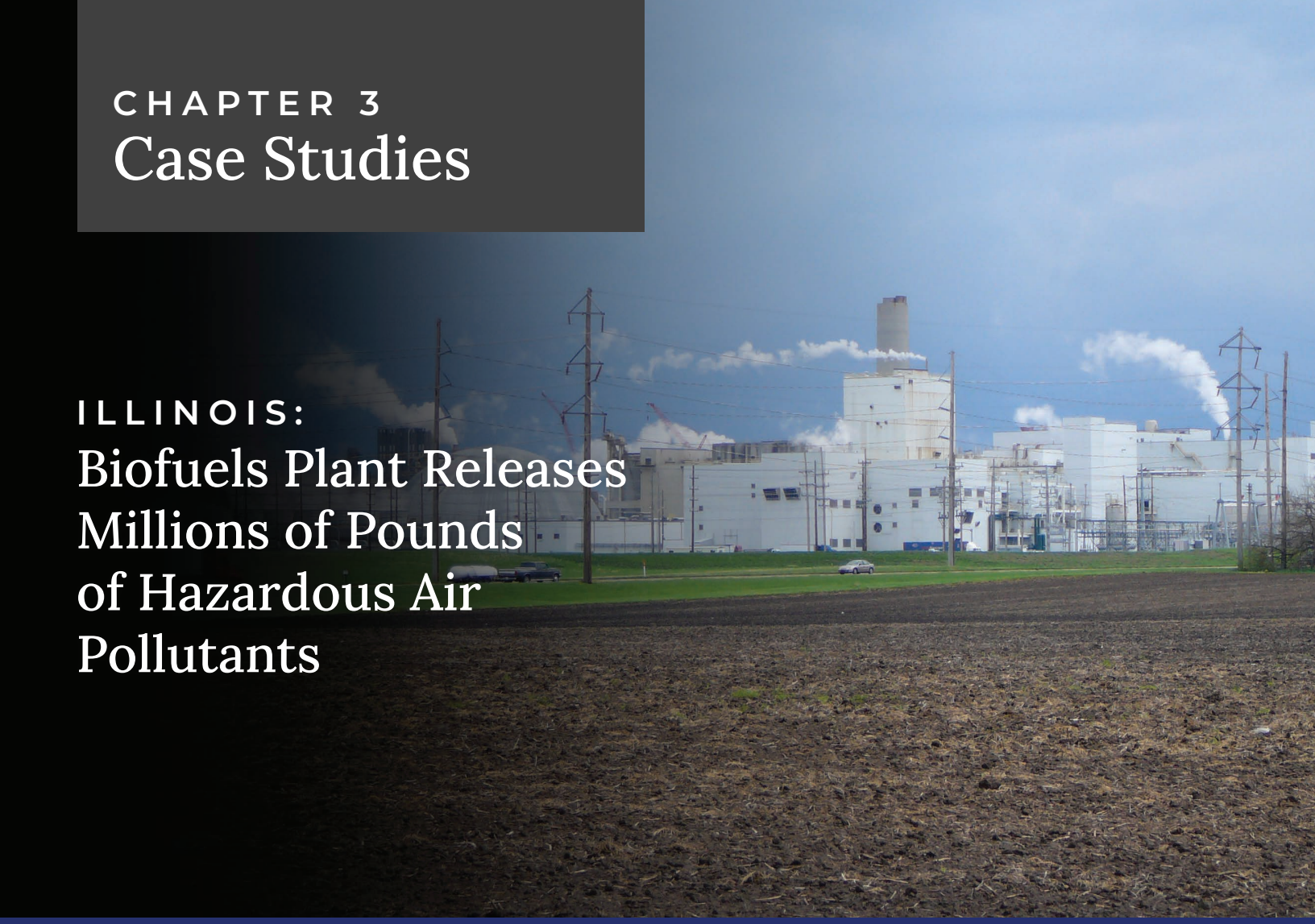
Facility	Location	Biofuel Type	Stack Tests	Stack Test Failures
Grain Processing Corp	Muscatine, IA	Ethanol	78	16
Archer Daniels Midland Dry and Wet Mill	Columbus, NE	Ethanol	29	5
Valero Renewable Fuels LLC	Mt. Vernon, IN	Ethanol	76	5
Poet Biorefining - Marion LLC	Marion, OH	Ethanol	33	5
Golden Grain Energy LLC	Mason City, IA	Ethanol	36	4

Source: EPA Enforcement and Compliance History Online database.

The following are four local examples of environmental problems caused by biofuels plants.

CHAPTER 3

Case Studies



ILLINOIS: Biofuels Plant Releases Millions of Pounds of Hazardous Air Pollutants

The Archer Daniels Midland ethanol plant in Decatur is the largest emitter of hexane air pollution of any industrial site in the U.S., according to the most recent available EPA Toxics Release Inventory data.

Archer Daniels Midland (ADM), one of the world's largest agribusinesses, is headquartered about three hours southwest of Chicago in the central Illinois town of Decatur. There, the company's largest facility globally houses soybean crushing machinery and one of the biggest corn mills in the world as part of its ethanol manufacturing plant. With the capacity to produce 375 million gallons of ethanol biofuel annually, it is among the largest ethanol plants in the country.[53]

The plant is also a major source of pollution, releasing 3,076,416 pounds of hazardous air pollutants and 4,149,749 metric tons of greenhouse gases[54] in 2022, the most of any biofuel facility that year in both categories. It was also the largest emitter of hexane of any industrial site in the U.S. that year, releasing 2,227,817 pounds.

"Industrial ethanol plants like the ADM facility in Decatur negatively impact local air quality," said Hannah Lee Flath, then the Communications Coordinator at Sierra Club Illinois Chapter.[55]

The ADM plant in Decatur, IL, was the largest emitter of hexane of any industrial site in 2022, releasing

2.2 million pounds

"The food and agricultural production that takes place at ADM's Decatur facility requires immense energy," Flash said. "As of 2018, almost half of the company's energy usage came from burning coal. As Illinois looks to transition away from its reliance on fossil fuels, corporations like ADM should join the effort to rely on energy powered more by wind and solar."

A recent study found that the facility might be significantly underestimating its emissions of hazardous air pollutants. Researchers from the National Oceanic and Atmospheric Administration (NOAA) used air monitors downwind from the ADM plant in Decatur to measure three pollutants: nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).[56] The researchers then compared the concentrations of these pollutants to models that relied on ADM's reported emissions. While concentrations of NO_x and SO_2 roughly matched the expected results from the modeling, concentrations of VOCs were five times higher than expected.[57] The researchers believe that the most likely explanation is that ADM had significantly under-reported the facility's VOC emissions.

VOC emissions from the ADM plant in Decatur were

5X higher

than expected, a study by NOAA found.

This result aligns with the fact that many sources of VOC emissions at biofuel plants are not subject to rigorous compliance testing requirements. Air permits also lack adequate monitoring requirements to sufficiently quantify fugitive emissions—i.e. emissions from leaks and other points that do not pass through smokestacks.

The ADM Decatur plant also has a history of safety concerns. An explosion at the facility's West Plant in April 2023 resulted in the hospitalization of three employees and extensive damage to a grain elevator. An investigation by the Occupational Safety and Health Administration determined that a lack of preventative maintenance was a main factor in the explosion.[58]

In recent years, with the aid of government funding, ADM has explored the potential of carbon capture and storage at its Decatur ethanol plant. As of July 2022, ADM has sequestered about 3.9 million metric tons of CO_2 into a sandstone formation at its Illinois-Basin Decatur Project and Illinois Industrial Sources Carbon Capture and Storage Project.[59] But that captured carbon made up only about 10 to 12 percent of the carbon dioxide emitted by the entire plant (including not only from its ethanol production, but also from its power plant and grain processing facilities). That meant that 88 to 90 percent of the greenhouse gas was released into the atmosphere, according to EPA data.[60]

Jennifer Cassel, a senior attorney with Earthjustice's Clean Energy Program based in Chicago, said the carbon stored from the ADM facility has already seeped out of the predicted area, "which bodes badly for how well carbon will be sequestered." She said there are nearly two dozen more proposed sequestration wells, more than a few of which would be operated by ADM, currently under consideration in Illinois.[61]

"The scope of what is being proposed in the state is vastly more than what ADM is currently sequestering," Cassel said. "And they haven't even been able to keep track of their small amount of carbon."

IOWA: Ethanol Plant's Smokestacks Contribute to Rural Area Violating Air Pollution Standards

The Grain Processing Corporation ethanol plant in Muscatine, Iowa.

Muscatine County, Iowa, on the Mississippi River, is one of few counties in the Midwest whose air quality violates federal ozone standards, and the only one in Iowa. The county's unusually high levels of sulfur dioxide may be in part because the county is home to an ethanol refinery owned by the Grain Processing Corporation.

The Muscatine plant reported releasing 83 tons of sulfur dioxide in 2020, as well as 113,612 lbs. of acetaldehyde, 3,548 lbs. of acrolein, 19,210 lbs. of formaldehyde, and 10,878 lbs. of hexane in 2022.[62] These last three are volatile organic compounds (VOCs), a class of pollutants that can contribute to smog.

According to EPA's enforcement database, the plant has failed "stack" tests – monitoring for illegal levels of air pollution – 16 times over the last five years.[63] The plant has been out of compliance with the Clean Air Act five of the last 12 quarters and in violation of the Clean Water Act each quarter for the last three years, according to EPA's ECHO database.[64]

The Grain Processing Corp. ethanol plant in Muscatine, Iowa, has failed air pollution "stack tests"

16 times

over the last five years, without any penalties or enforcement actions.

Beginning in the 2000s, EPA, the state of Iowa, and citizens brought numerous enforcement actions against the Grain Processing Corporation for several Clean Air Act violations. These include for exceeding emission limits and failing to report violations, according to EPA.[65] State inspectors even noted an "obvious blue haze generated by the plant and drifting over Muscatine neighborhoods."[66]

These enforcement initiatives did force the company to install new air pollution controls and, in 2015, to switch from burning coal to natural gas.[67] The company was also hit with a class action lawsuit that resulted in a $45 million settlement.[68] Despite changes at the plant, the facility has still faced at least 15 enforcement actions for violating the Clean Air Act since 2017.[69]

The neighboring communities around the ethanol plant are disproportionately low income and people of color. Although much of Muscatine is home to middle to upper-middle class residents, the neighborhoods immediately next to the adjoining the Grain Processing Corporation facility are in the 86th percentile for low-income households and in the 60th percentile for people of color, according to an EPA database.[70]

CALIFORNIA: East Bay Area Residents Object to Biofuel Projects

Owners of the San Francisco Refinery in Rodeo announced that they were switching from petroleum refining to biofuel production. Local residents would rather have the refineries shut down.

In 2020, a more than century-old oil refinery, owned by Phillips 66 an hour northeast of San Francisco, announced its plans to cease petroleum processing and transition into a biofuel plant.[71]

The owners of the massive facility, located on more than 1,000 acres along San Pablo Bay, said they aim to produce about 800 million gallons per year of renewable diesel and aviation fuel. Deemed the "Rodeo Renewed Project," it would be one of the world's largest biofuel refineries.

However, some local residents protested the plans. And three years after the announcement, the Contra Costa Superior Court ordered Phillips 66 to halt its conversion plans until the company fully complied with environmental review requirements it had previously violated.[72] The Phillips 66 operators then revised their Environmental Impact Report, and in January 2024, the Contra Costa County Board of Supervisors unanimously approved and adopted a "revised final" report, allowing the project to proceed.[73]

More than 75%

of the people living within three miles of the Rodeo Renewed biofuel plant are people of color.

In April 2024, Phillips 66 announced that the Rodeo facility had finally started operations and is now producing 27,000 barrels a day of renewable diesel.[74]

Proponents of the biofuel conversion argue that it will help the state approach its ambitious goal of cutting fossil fuel consumption by a factor of 10 by 2045 and reducing greenhouse gas emissions at least 40 percent below 1990 levels by the year 2030.

The Phillips 66 refinery in Rodeo, along with the nearby Marathon-Tesoro biofuel refinery in Martinez, which also recently converted from a crude oil refinery to a biofuel plant, will require at least 82,000 truck trips, nearly 29,000 railcars, and more than 760 ship and barge visits annually, according to one estimate.[75]

Local residents fear that these projects will lock in traffic congestion and pollution sources that the community has already been dealing with for decades. Local residents opposed to the biofuel plants would prefer the old refineries be shut down altogether. More than three-quarters of the people living within three miles of the Rodeo Renewed facility are people of color.

Kerry Guerin, an attorney with Communities for a Better Environment, a California environmental health and justice organization, said that according to the project's own environmental impact report, the differences in pollution between petroleum and biofuels refining is "small," with some hazardous pollutants actually increasing as a result.[76]

"And then there are the risks of flaring, explosions, and other chemical releases from refineries," said Guerin. "This was made unfortunately and abundantly clear by a recent fire at the Marathon biofuels refinery nearby in Martinez."

Guerin said biofuel conversions like Rodeo's are, "best understood as a last-ditch attempt by oil companies to extract the remaining profits from their otherwise stranded billion-dollar assets and kick the can down the road. They are postponing the day they have to decommission and, critically, remediate these sites, including the soil and groundwater underneath these refineries that have collected decades of pollution."

> "It is a fallacy to suggest that there are environmental benefits that justify the production of liquid biofuels over traditional petroleum-based liquid fuels. **It is hocus pocus.**"
>
> - Gary Hughes, coordinator with the advocacy group Biofuelwatch

The Rodeo Renewed facility has the potential to emit 1,075,100 metric tons of greenhouse gases and 745 tons of criteria air pollutants and their precursors each year, including 72 tons of particulate matter, 216 tons of nitrogen oxides, 111 tons of VOCs, and 295 tons of sulfur dioxide, according to government records.[77] The Martinez Refinery, also located in Contra Costa County, is owned by Tesoro Refining & Marketing Company LLC, a subsidiary of Marathon Petroleum Corporation. It has the potential to emit 813,263 metric tons of greenhouse gases and 333 tons of other air pollutants each year, according to government records.[78]

Gary Hughes, the Americas Program Coordinator with the nonprofit advocacy group Biofuelwatch, said they are strongly critical of the state narrative that incentivizing the production of biofuels at repurposed refineries in the Bay Area offers any relief to local communities or the global climate.[79]

"It is not only about rehabilitating the image of these polluters, it is really fundamentally about California regulatory authorities protecting their stranded assets," he said. "It is a fallacy to suggest that there are environmental benefits that justify the production of liquid biofuels over traditional petroleum-based liquid fuels. It is hocus pocus."

LOUISIANA:
Turning Trees into Jet Fuel, a Fast-Growing Business for Biofuels

Although trees provide many benefits to the environment, biofuel companies want to chop them up to create liquid fuel and fuel pellets.

In Columbia, Louisiana, about four hours north of New Orleans, a company called Louisiana Green Fuels (LGF) is proposing to build an enormous refinery that would transform trees into jet fuel. It would be the first factory of its kind on a large scale.[80]

The $2.5 billion project is an example of one of the fastest-growing segments of the biofuels industry: the use of wood biomass – a euphemism for trees – and other plants as the primary ingredient to produce fuels. Across the U.S., 23 new plants or facility expansions are proposed or under construction to produce "sustainable aviation fuel," and six of them would use wood as an ingredient.

This mirrors the rapid expansion of another "green" fuel over the last two decades: the wood pellet industry, which chops and compresses trees and wood waste into fuel to burn in power plants.[81] The wood pellet industry has a history of underestimating its emissions of hazardous air pollutants and volatile organic compounds and exceeding pollution limits. A 2018 study of the industry's permitting and emissions records found that 52 percent of the wood pellet plants in the U.S. had improperly evaded Clean Air Act pollution control requirements, either by failing to keep emissions below legal limits or failing to install required pollution control systems.[82]

52%

of wood pellet fuel plants violated the Clean Air Act by evading pollution control requirements.

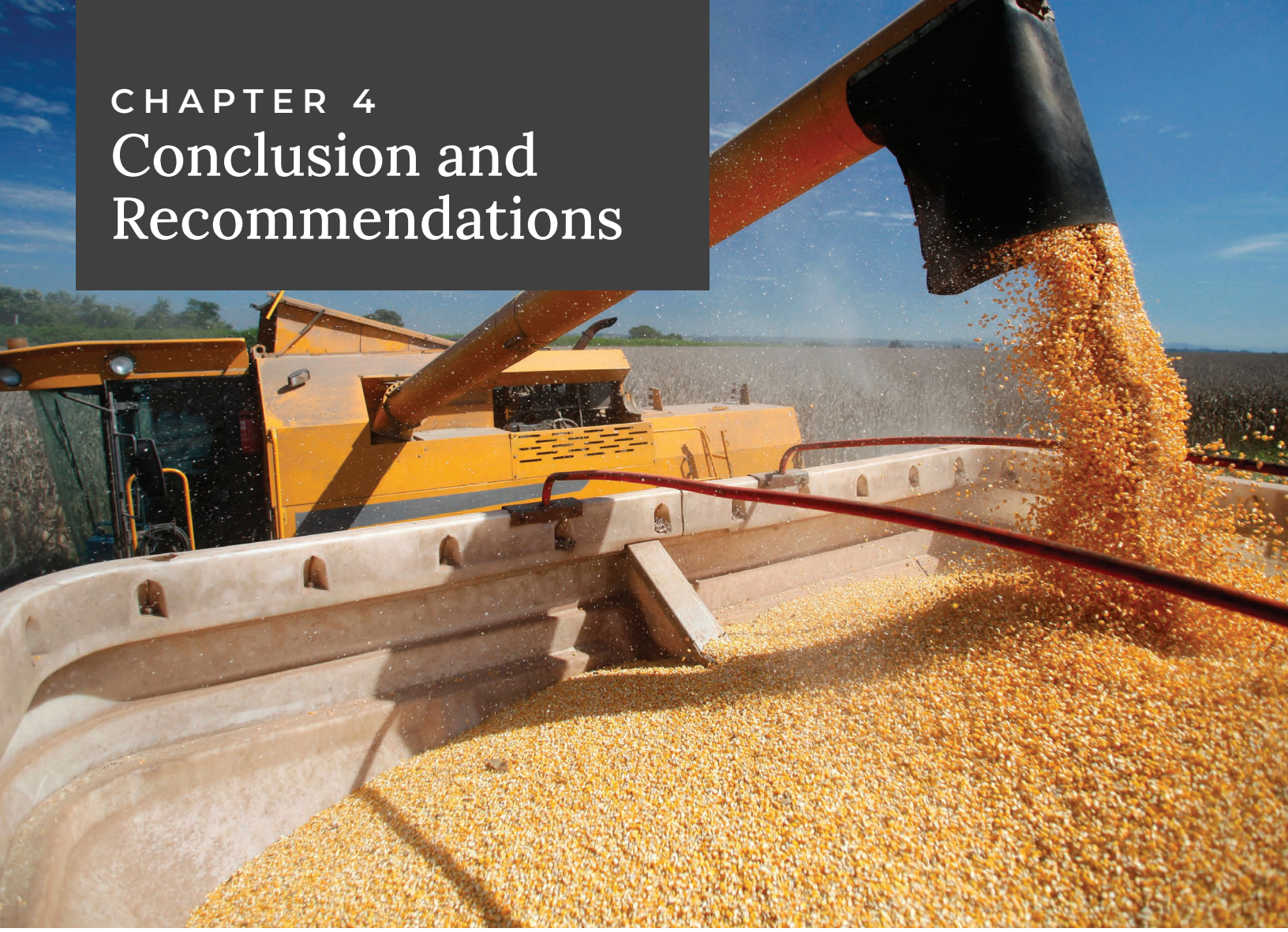
The new wood-to-jet fuel industry appears to be on the same track. For example, the Louisiana Green Fuels facility applied for a permit to operate an 85 megawatt wood-fired boiler, as well as four rotary dryers with a capacity of 665,760 tons per year to convert 1 million tons of trees into 32 million gallons per year of diesel and naphtha (which can be used as a fuel).[83] Despite the large scale of this facility, the company applied for an air permit claiming to be a minor source of both hazardous

air pollutants and VOCs. In particular, the company claimed that the facility would emit about 91 tons of VOCs per year – just below the threshold of 100 tons that would trigger "major" permit requirements for stronger air pollution controls. The plant also proposed to release up to 24 tons per year of hazardous air pollution.

However, the company's emission estimates for VOCs and hazardous pollutants were based on extremely limited laboratory testing of a single gram of wood, which was placed in a sealed glass container and heated for just over an hour.[84] The testing methods did not even measure the most common wood-product VOC and hazardous pollutant compounds. The company then utilized this "laboratory testing" report to estimate the emissions from the facility's massive dryers, which would process 31 tons of wood per hour. That's about 28 million times more wood than was involved in the laboratory testing.

In short, Louisiana Green Fuels' entire premise that the facility would be a minor source of air pollutants was based on clearly inadequate testing. By comparison, EPA has compiled a vast database of real-world emissions testing on wood dryers that indicate the company's dryers will more likely emit around 1,000 tons of VOCs and several hundred tons of hazardous air pollutants per year.[85]

Despite these problems, Louisiana regulators accepted the Louisiana Green Fuels application and permitted the facility as a minor source of air pollution.[86] As of February 2024, the company was expected to begin construction in 2025.[87]



CHAPTER 4

Conclusion and Recommendations

Biofuels like ethanol, biodiesel, and renewable diesel are portrayed as a healthier and more sustainable alternative to gasoline and diesel fuel. Yet, they can increase certain types of hazardous air pollution that threaten the health of local communities. Increased public subsidies and government mandates for biofuels have also contributed to increased agricultural runoff pollution, including from expanded use of nitrogen fertilizer, insecticides, and herbicides.

So far, much of the commentary surrounding biofuels has centered around greenhouse gas emissions. Often overlooked are their toxic emissions and lack of compliance with air pollution laws. Biofuel plants are worse than petroleum refineries when it comes to emitting the hazardous air pollutants acetaldehyde, acrolein, formaldehyde, and hexane. And 41 percent of U.S. biofuels plants (98 of 240) violated their air pollution control permits at least once between July 2021 and May 2024, according to EPA's Enforcement and Compliance History Online database. Twenty-two of these plants were considered by EPA to be "high-priority violators" of the Clean Air Act as of May 2024.

Despite these problems, biofuels such as ethanol and renewable diesel have received a significant amount of government support, in the form of subsidies, mandates and tax credits. The ethanol industry has also benefited from a regulatory exemption from EPA that allows large plants to avoid the most stringent air pollution control systems. The result is rapid growth that could lead to the construction of dozens of new biofuel manufacturing plants across the U.S. without adequate emissions controls to protect downwind communities.

We recommend the following policy steps to better control pollution from the biofuels industry:

- **END EXEMPTIONS FOR ETHANOL UNDER THE CLEAN AIR ACT:** EPA should reverse its 2007 decision to relax major source permitting thresholds for ethanol manufacturers that allow these plants to emit more than twice the level of air pollution before needing to install better pollution controls. The ethanol industry has already been heavily subsidized by the public, with little actual benefit for the public. It is wrong for EPA to also allow ethanol plants to release significantly greater amounts of toxic pollutants into surrounding communities than should be permitted.

- **BETTER MONITORING AND CONTROL OF HAZARDOUS AIR POLLUTANTS:** EPA should require large biofuel plants to install air pollution monitoring devices along their fencelines to detect the levels of hazardous air pollutants, like acetaldehyde and acrolein, that could be drifting into nearby communities. EPA should also establish an 'action level' for these and other highly toxic pollutants, that, if exceeded, would obligate these facilities to identify the sources of the emissions and then fix the problems causing elevated concentrations.

- **STRONGER ENFORCEMENT OF AIR PERMITS FOR BIOFUEL PLANTS:** EPA and state regulatory agencies should more vigorously enforce air pollution control permits for biofuel plants, imposing penalties large enough to discourage future violations, which today are common. Tougher penalties would provide an economic incentive to follow the law.

- **IMPROVE THE ACCURACY OF EMISSIONS REPORTING:** Biofuels producers should be required, during the permit review and approval process, to expand their emissions testing and improve the accuracy of their emissions reporting to both EPA and the states.

- **END BIOFUEL SUBSIDIES AND MANDATES:** Biofuels are growing at a rapid rate in part because of government funding and regulatory mandates for blending ethanol into gasoline. But the environmental benefits of these government supports are questionable at best. All existing subsidies and mandates for ethanol – including the renewable fuel standard – should be halted. Federal efforts and funds should be focused instead on clean energy sources like wind and solar and improving our nation's clean energy infrastructure.

While biofuels have been sold as a clean and green alternative energy source, the reality is quite different and the public should be aware of it. Regulators need to carefully scrutinize the industry and vigorously enforce pollution limits, as biofuel plants pose a serious health threat to the people who live downwind from them. And legislators need to cut off the subsidies and mandates that artificially support this industry.

Appendix A. Methodology

Facility Identification:

EIP identified ethanol, renewable diesel, and biodiesel facilities through several data sources.

Existing facilities were identified from EIA's 2022 biofuels production capacity reports released August 8, 2022, updated from EIA's 2023 capacity reports, and reflects operable capacity as of January 1 of each report year. EIA capacity reports combine "renewable diesel" and "other biofuels." For the purposes of this report, "renewable diesel" generally refers to renewable diesel and other renewable fuels (e.g., sustainable aviation fuel, renewable naphtha, etc.). EIA facilities were matched with facilities in EPA's Enforcement and Compliance History Online (ECHO) data. In some cases, a facility may be inconsistently treated as a single or multiple facilities by EIA and EPA. We combined facilities that EIA treated as two plants where EPA data treated the facilities as one (e.g. Archer Daniel Midland's wet and dry corn mills in Cedar Rapids, Iowa). We excluded facilities that news reports or EPA have identified as closed facilities. After reviewing EIA reports and ECHO, we narrowed our universe of "existing facilities" to 191 ethanol plants, 71 biodiesel facilities, and 16 renewable diesel producers. Eight of the 16 renewable diesel producers also co-produce fossil-fuel based petroleum products. Emissions and compliance data for these renewable diesel/petroleum facilities were excluded in our summary analysis to avoid skewing data, but are included in this linked spreadsheet. We identified one additional ethanol plant and 8 additional renewable diesel plants that have started operating but were not included in the 2023 EIA Capacity Report. Four co-produce fossil-fuel based petroleum products.

We identified new, under construction, and proposed facilities from Oil & Gas Watch, news sources and industry/trade websites, and some state agencies. Oil & Gas Watch facilities are limited to oil, gas, and petrochemical projects and, for the purposes of this project, could only be used to identify some renewable diesel projects, requiring the use of additional sources for other facilities. We identified nine new five new biofuel facilities, four refinery conversions, and one facility that restarted operations after idling for several years that have started operating but are not reflected in the EIA/ECHO data among "existing facilities." This is in part due to reporting delays - as in, facilities started operating in recent years (2023, 2024) after the most recent year of emissions data. Three projects started operating in 2022 but were not reflected in the most recent 2023 EIA Capacity Report. As such, we've treated these as "new" facilities.

Facility Information:

Facility information for operating biofuel facilities comes from 2022 and 2023 Biofuel Capacity Reports and EPA's Enforcement and Compliance History Online database. Data collected includes, but is not limited to: operable capacity, emissions data, compliance, permit information, etc.

Facility names in our data reflect EIA and ECHO. Datasets may use different names to identify a facility. For example, Paseo Cargill Energy LLC in an EIA Capacity Report and Cargill Energy in EPA's TRI.

The capacity values reflect EIA's estimated total operable capacity, as of January 1 of each reporting year, not actual/total production in that year.

In EPA ECHO data, many facilities have more than one FRS ID, or facility ID – for example, one ID linked to the Clean Air Act (CAA) permit number and compliance and others for the various emissions data sources (see below). Facilities with multiple FRS IDs may therefore have multiple ECHO facility pages. We combined data where necessary - see the shared spreadsheet for more information.

Some biofuel facilities may produce other products, such as animal feed, in addition to biofuels. EPA emissions and compliance data are reported at the facility-level and do not differentiate between emissions or violations associated with biofuel production vs. other industrial processes. We have excluded emissions and violations from biofuel plants that also produce petroleum products throughout the report, unless otherwise noted.

Emissions

Emissions data for operating facilities were collected from multiple EPA sources: 2022 Toxics Release Inventory (TRI) for HAPs, 2022 Greenhouse Gas Reporting Program (GHGRP) for greenhouse gases, and 2020 National Emissions Inventory (NEI) for criteria air pollutants. These reflect the most recently available data. Particulate matter data used consists of particulate matter with a diameter of 10 micrometers or less, consisting of both filterable and condensable materials. Where data appeared erroneous, we referenced state emissions reports. Specifically, we identified a likely error and outlier for particulate matter emissions reported in the 2020 NEI by Blue Flint Ethanol in North Dakota (6,849,956 pounds) and used data from the 2021 North Dakota state emissions inventory (51,600 pounds).

Emissions data for operating facilities likely underestimate actual emissions across the sector due to varying reporting thresholds and requirements for emissions inventories. Notably, not all facilities may be required to report. NEI reporting requirements differ depending on how a facility is categorized: Type A sources (> 250 tons of VOCs, PM_{10}, $PM_{2.5}$, or NH_3 per year; or > 2,500 tons of SO_2, NO_x, or CO per year), Type B (> 100 tons of SO_2, NO_x, VOCs, PM_{10}, $PM_{2.5}$, or NH_3 per year; > 1,000 tons of CO per year; or > 0.5 tons of lead per year), or a Non-Attainment Area source emitting certain pollutants over certain thresholds (Table 1 to Appendix A of Subpart A of Part 51).[88] Further, some pollutants, such as hazardous air pollutants (HAPs), are included by states at their own choice and are only estimates (40 CFR 51.15(a)(4)).[89] The same is true with GHGRP and facilities' GHG emissions, as facilities are required to report under 40 CFR 98 only if they meet the threshold of 25,000 metric tons of CO_2 equivalent per year.[90]

Clean Air Act Compliance

Compliance data used was downloaded from EPA's Enforcement and Compliance History Online data on May 23, 2024, and reflects the data as it was at that time, covering Quarter 3 in 2021 to Quarter 2 in 2024.

It should be noted that a facility's given high priority violation status when downloaded is not necessarily indicative of where it stands currently, as a facility can be identified as having "addressed" their violations in the data downloaded, but when visiting that facility's given detailed facility page in ECHO violations are still listed as ongoing. In these instances, we opted to identify a facility's high priority violation status based on the detailed facility page instead.

Additionally, in the compliance section of the report, we consider enforcement actions to be "formal" enforcement actions, as defined by EPA's Enforcement and Compliance History Online database.

New Projects:

The projects identified during our research are not exhaustive - there may be additional projects we did not identify – and reflect those we identified through March 2024. We limited projects to those that increase production capacity at an existing facility, the construction of a new facility, and conversions (i.e. from fossil-fuel based diesel production to renewable diesel). Not all conversions are full refinery conversions; some refineries may continue to co-produce petroleum-based fuels alongside biofuels. As described above, we identified projects and project details through several sources, including Oil & Gas Watch, industry trade and news sites (e.g., Biomass Magazine, Biodiesel Magazine, Renewable Fuels Association), and state agency websites. We also reviewed public notices, pending

permit applications, and draft permits - as available - on state agency websites for the following states: AR, IA, IL, KS, LA, MI, SD, and WI.

Newly operating and constructed projects were included in some cases as they were completed in 2022-2024 to provide emissions information that would not be reflected in data for Operating/Existing facilities from EIA and EPA. Three new facilities (the Artesia Renewable Diesel Unit, the Great Falls Montana Renewable Diesel Plant, and New Rise Renewables) and one expansion (Cargill, Inc. in Wichita, KS) began operating in 2022 but were not reflected in the 2023 EIA Capacity Reports, and were therefore treated here as a new, but operating, project.

Potential emission increases reflect emissions for the projects alone, not facility-wide emissions. Not all projects have applied for construction permits (i.e. announced projects) or permit documents are not yet readily available, and therefore emissions information may still be unknown. Greenhouse gas emissions for the POET Biorefining facility in Cloverdale, IN were unavailable in permit documents, and reflects a 5-year average from 2014-2018 GHGRP data before the facility shut down in 2019 and restarted in 2023.

Location information and coordinates may be approximate where permit documents are not yet available (e.g., based generally on the city identified in a news article). Where proposed locations are limited to a state or region, EIP did not approximate coordinates and these projects were excluded from all maps.

Appendix B: Biofuels Projects Under Construction and Proposed for the Future

Project	Location	Type of Project	Biofuel Type	Planned Capacity Increase (Mmgal/yr)	SAF Announced?	Construction Status
Homeland Energy Solutions LLC	Lawler, IA	Expansion	Ethanol	42	No	Proposed
One Earth Energy LLC	Gibson City, IL	Expansion	Ethanol	50**	No	Proposed
Lincolnland Agri-Energy LLC	Palestine, IL	Expansion	Ethanol	3	No	Under Consturction
Verbio North America Corp	Nevada, IA	New Facility	Ethanol	60	No	Under Construction
New Energy Freedom	Mason City, IA	New Facility	Ethanol	19	No	Proposed
Trainer Refinery*	Trainer, PA	Conversion	Renewable Diesel	TBD	Yes	Proposed
Shell Convent Manufacturing Facility	Convent, LA	Conversion	Renewable Diesel	TBD	Yes	Proposed
Chevron Renewable Energy Group	Geismar, LA	Expansion	Renewable Diesel	325	No	Under Construction
BP Products North America - Cherry Point*	Blaine, WA	Expansion	Renewable Diesel	150	Yes	Proposed
New Energy Chemicals	Port Lavaca, TX	New Facility	Renewable Diesel	TBD	Yes	Proposed
Gron Fuels' Low Carbon Intensity Renewable Fuels Plant	Port Allen, LA	New Facility	Renewable Diesel	920	Yes	Proposed
NEXT Renewable Fuels Refinery - Port Westward	Clatskanie, OR	New Facility	Renewable Diesel	767	Yes	Proposed
Summit Next Gen	Houston, TX	New Facility	Renewable Diesel	526	Yes	Proposed
CVR Energy Coffeyville*	Coffeyville, KS	New Facility	Renewable Diesel	500	Yes	Proposed
DG Fuels Sustainable Aviation Fuel	St. James, LA	New Facility	Renewable Diesel	178	Yes	Proposed
DG Fuels Sustainable Aviation Fuel	Limestone, ME	New Facility	Renewable Diesel	175	Yes	Proposed
HOBO Renewable Diesel	Clinton, IA	New Facility	Renewable Diesel	138	Yes	Proposed
Blue Blade Energy	Midwest	New Facility	Renewable Diesel	135	Yes	Proposed
Azure Cherryvale SAF	Cherryvale, KS	New Facility	Renewable Diesel	135	Yes	Proposed
Marquis Sustainable Aviation Fuel	Hennepin, IL	New Facility	Renewable Diesel	120	Yes	Proposed
Avina Midwest SAF Ethanol Plant	Midwest	New Facility	Renewable Diesel	120	Yes	Proposed
Aemetis Carbon Zero 1	Riverbank, CA	New Facility	Renewable Diesel	120	Yes	Proposed
VertiBlue Fuels	Florida	New Facility	Renewable Diesel	70	Yes	Proposed

Project	Location	Type of Project	Biofuel Type	Planned Capacity Increase (Mmgal/yr)	SAF Announced?	Construction Status
Texas Renewable Fuels Refinery	Fawil, TX	New Facility	Renewable Diesel	66	No	Proposed
Gevo Net-Zero 1	Lake Preston, SD	New Facility	Renewable Diesel	65	Yes	Proposed
CE+P Sugar Valley Energy	Imperial Valley, CA	New Facility	Renewable Diesel	61	Yes	Proposed
Velocys Bayou Fuels	Natchez, MS	New Facility	Renewable Diesel	35	Yes	Proposed
Louisiana Green Fuels Renewable Fuels Plant	Columbia, LA	New Facility	Renewable Diesel	32	Yes	Proposed
Port Allen Renewable Gasoline Refinery	Port Allen, LA	New Facility	Renewable Diesel	31	No	Proposed
SkyNRG	Washington	New Facility	Renewable Diesel	30	Yes	Proposed
Spindletop Renewable Gasoline Refinery	Nederland, TX	New Facility	Renewable Diesel	15	No	Proposed
Twelve E-Jet	Moses Lake, WA	New Facility	Renewable Diesel	0.04	Yes	Under Construction

Source: Oil & Gas Watch, industry trade and news sites, and state agency websites. See spreadsheet for additional details related to these projects, such as feedstocks, potential emissions, and permit status. Renewable diesel includes sustainable aviation fuel, renewable naphtha, and other biofuels excluding ethanol and biodiesel.

*Facilities that will co-produce petroleum products after project completion and projects that are co-located at petroleum refineries.

**The One Earth Energy LLC expansion is expected in two stages, expanding capacity by 25 million gallons per year, then another 25 million gallons per year after completing the first stage.

Appendix C: High Priority Violators with Existing Violations, July 2021 to May 2024

Facility	Location	Biofuel Type	Quarters with Violations Reported in the Last 3 Years	Quarters with High Priority Violations Reported in the Last 3 Years
Grain Processing Corp	Washington, IN	Ethanol	12	12
Green Plains Mount Vernon LLC	Mount Vernon, IN	Ethanol	12	12
Archer Daniels Midland Dry and Wet Mill	Columbus, NE	Ethanol	12	12
Valero Renewable Fuels LLC	Mount Vernon, IN	Ethanol	12	12
Element LLC	Colwich, KS	Ethanol	12	12
Pelican Renewables LLC	Stockton, CA	Ethanol	12	12
Alto Pekin LLC Wet and Dry Mill	Pekin, IL	Ethanol	12	12
South Bend Ethanol LLC	South Bend, IN	Ethanol	12	12
Altair Paramount LLC	Paramount, CA	Renewable Diesel	12	12
Cardinal Ethanol LLC	Union City, IN	Ethanol	12	12
Seaboard Energy Kansas LLC	Hugoton, KS	Renewable Diesel	12	12
E Energy Adams LLC	Adams, NE	Ethanol	11	11
Green Plains Wood River LLC	Wood River, NE	Ethanol	10	10
Siouxland Ethanol LLC	Jackson, NE	Ethanol	9	9
Central Indiana Ethanol LLC	Marion, IN	Ethanol	8	7
Poet Biorefining - Fairmont LLC	Fairmont, NE	Ethanol	7	7
Redfield Energy LLC	Redfield, SD	Ethanol	6	3
Alto ICP LLC	Pekin, IL	Ethanol	6	5
Quad County Corn Processors Coop	Galva, IA	Ethanol	5	4
Hub City Energy LLC	Aberdeen, SD	Ethanol	3	3
Tate & Lyle	Loudon, TN	Ethanol	3	1
Poet Biorefining - Shell Rock LLC	Shell Rock, IA	Ethanol	2	2

Source: EPA Enforcement and Compliance History Online. Note: Numbers current as of May 2024.

Appendix D.

Top 10 biofuel plants that reported releasing the most acrolein in 2022

Rank among biofuel plants	Facility	Location	Biofuel Type	Emissions (lbs)	Rank Nationally (Among all Industries)
1	Cargill Inc.	Blair, NE	Ethanol	34,489	1
2	Cargill Inc.	Eddyville, IA	Ethanol	20,772	2
3	Archer Daniels Midland Dry Mill and Wet Mill	Cedar Rapids, IA	Ethanol	16,094	3
4	Calgren Renewable Fuels LLC	Pixley, CA	Ethanol	13,151	6
5	Poet Biorefining - Menlo LLC	Menlo, IA	Ethanol	11,050	7
6	Poet Biorefining - Shell Rock LLC	Shell Rock, IA	Ethanol	10,075	8
7	Poet Biorefining - Shelbyville LLC	Shelbyville, IN	Ethanol	9,205	9
8	Southwest Iowa Renewable	Council Bluffs, IA	Ethanol	8,966	11
9	Archer Daniels Midland Dry and Wet Mill	Columbus, NE	Ethanol	8,873	12
10	Green Plains Wood River LLC	Wood River, NE	Ethanol	7,811	13

Source: EPA 2022 Toxics Release Inventory.

Top 10 biofuel plants that reported releasing the most formaldehyde in 2022

Rank among biofuel plants	Facility	Location	Biofuel Type	Emissions (lbs)	Rank Nationally (Among all Industries)
1	Cargill Inc.	Blair, NE	Ethanol	30,587	44
2	Archer Daniels Midland	Clinton, IA	Ethanol	20,848	91
3	Grain Processing Corp.	Muscatine, IA	Ethanol	19,210	101
4	Cargill Inc.	Eddyville, IA	Ethanol	10,322	195
5	Archer Daniels Midland Dry Mill and Wet Mill	Cedar Rapids, IA	Ethanol	9,536	206
6	Alto Pekin LLC Wet and Dry Mill	Pekin, IL	Ethanol	9,403	207
7	Heartland Corn Products	Winthrop, MN	Ethanol	5,330	286
8	Tharaldson Ethanol	Casselton, ND	Ethanol	5,129	289
9	Calgren Renewable Fuels LLC	Pixley, CA	Ethanol	4,666	301
10	Marquis Energy LLC	Hennepin, IL	Ethanol	4,565	303

Source: EPA 2022 Toxics Release Inventory.

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