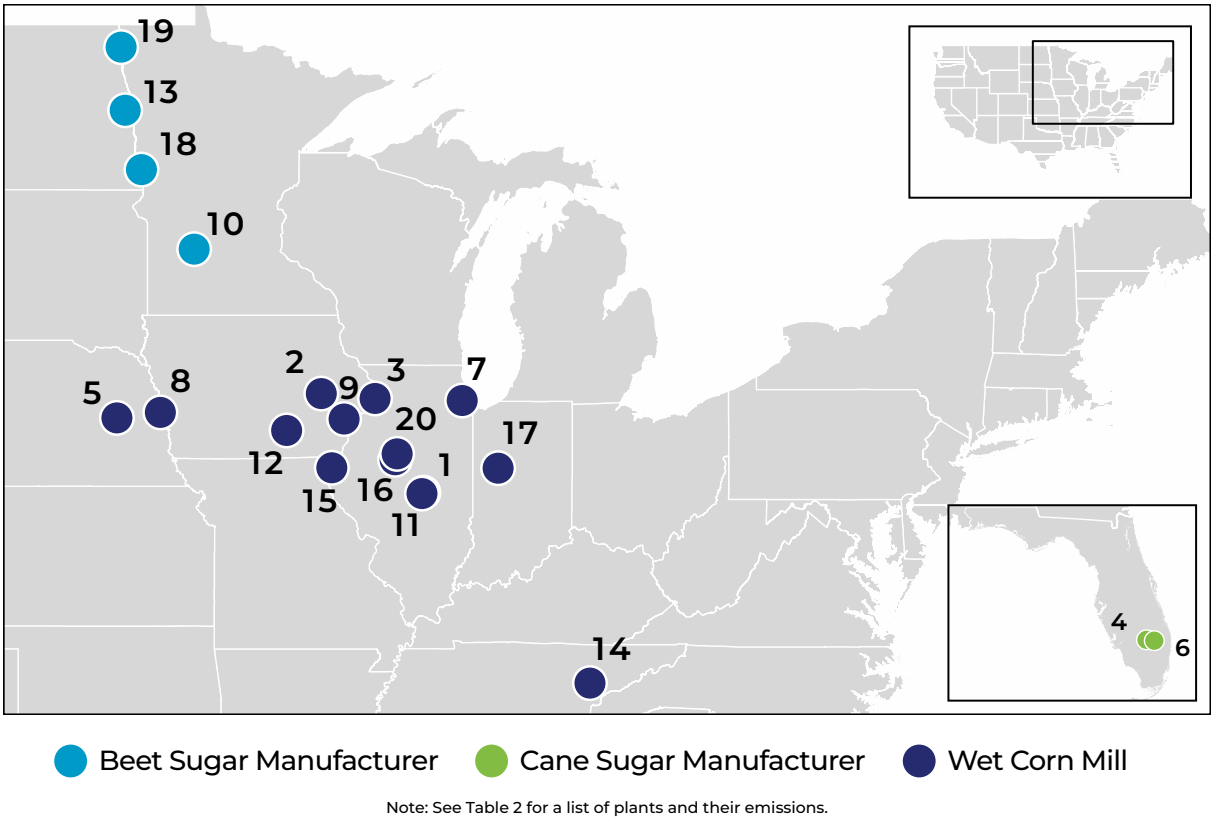
Pollution from Outdated Industrial Boilers and Heaters in the Food and Beverage Industry

April 17, 2025

Food and beverage manufacturing is one of the United States' largest and most energy intensive industrial sectors. According to the United States Department of Energy, there are over 30,000 food and beverage manufacturing facilities across the country - this includes everything from plants that mill grain to industrial bakeries that produce snacks sold in convenience stores.[1] Unfortunately, many of these manufacturing plants have old and outdated heating system components – specifically boilers and process heaters – that burn fossil fuels and release far more health-damaging air pollution and greenhouse gases than they should.

The Environmental Integrity Project (EIP) examined 20 of the biggest emitters in the food and beverage sector in the U.S. and found that they released 17.8 million metric tons of greenhouse gases (as carbon dioxide equivalents, or CO_2e) in 2023, as much as 4.1 million cars and trucks running for a year. These top 20 plants were all food processors, including 14 wet corn mills and 6 sugar refineries. The plants we examined also reported emitting 11,683 tons of nitrogen oxides and 9,957 tons of volatile organic compounds that year, both of which contribute to smog. Much of this pollution was unnecessary and often caused by outdated boiler systems. See Table 2 for a list of plants and their emissions.

Top 20 Food and Beverage Plants



Note: See Table 2 for a list of plants and their emissions.

Our analysis found that 80 percent of the boiler and heating systems at the 20 largest food and beverage processing plants were outdated, with the oldest built in 1934 and the average age about 31 years – well beyond the industry's recommended 15-year efficient service life. Many of these units also run on dirty, pollution-heavy fuels such as coal. This is a problem that can be addressed. State and federal regulators should require companies to modernize their plants and install more efficient systems that run on cleaner fuels, including those powered by electricity generated by solar and wind power.

Background

Within the food and beverage sector some industrial processing units are dirtier and more energy-intensive than others, and boilers and process heaters are among the worst. According to data from the Energy Information Administration, in 2024 the food and beverage sector accounted for over 5 percent of all industrial carbon dioxide emissions in the United States.[2] A 2023 report from the Renewable Thermal Collaborative estimated that process heaters and boilers are responsible for, respectively, 28 percent and 21 percent of sector-wide fuel carbon dioxide emissions.[3] In addition to greenhouse gases, process heaters and boilers emit dangerous, health-harming air pollution like nitrogen oxides, particulate matter, hexane, and formaldehyde.

Recent technological advances have provided more energy-efficient and cleaner alternatives, like heat pumps, that can replace conventional fossil-fuel powered boilers and process heaters. A 2024 analysis by the American Council for an Energy-Efficient Economy found that boilers rated below 240 million British thermal units (MMBtu) per hour could be replaced by currently available industrial heat pump technologies.[4]

To identify where this modernization would make the largest impact – replacing the dirtiest, least efficient, oldest boilers and process heaters – EIP created a unit-level inventory of process heaters and boilers at the country's top 20 dirtiest food and beverage manufacturing facilities. Our analysis is based on a review of Clean Air Act permit documents and EPA emission data for the 20 largest greenhouse gas emitters in the U.S. food and beverage sector.

Top Emitters in the Food and Beverage Sector

Wet corn milling and sugar refining were the top sources of greenhouse gas emissions from the food and beverage sector in 2023. Although our review included both food and beverage manufacturers, all of the top 20 emitters were food manufacturing plants. Fourteen of the top 20 facilities were wet corn mills, a type of facility that separates corn kernels into their component parts to produce various products such as corn starch, corn syrup, or gluten feed. Four of the top 20 facilities were beet sugar manufacturers and two were cane sugar manufacturers. These 20 facilities alone were responsible for around half of the total stationary combustion emissions, or emissions from burning fuels in boilers, heaters, engines, or other similar units, reported by the entire sector (about 369 plants – see methodology section below). Of the top 20, six had a violation of the Clean Air Act in the past year, and three others had at least one unaddressed Clean Air Act violation.

Archer Daniels Midland Co. facility in Decatur, IL. Photo by Tobias Higbie/ Flickr

In total, EIP identified 157 boilers and process heaters at these 20 facilities. The number of units at each facility varied greatly, with each plant having between two and twenty-nine boiler and heater units. The majority (118) of these units were boilers used to generate steam

and hot water for various manufacturing processes. Steam can be used to generate electricity and as part of the manufacturing process. At a wet corn mill, boilers provide heat throughout the milling process, for corn steeping or drying, while in sugar manufacturing, provide heat used to boil and evaporate beet or sugarcane juices, resulting in concentrated sugars.[5]

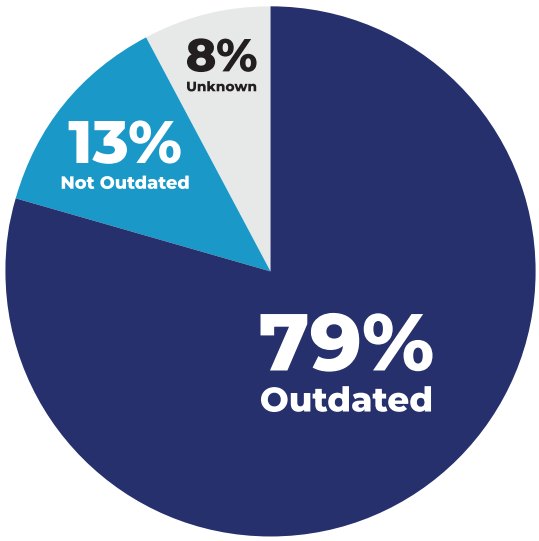
While every facility had at least two boilers, not every plant had process heaters. In total, EIP identified 39 process heaters at 13 plants. Over 60 percent of all identified process heaters were located at the five highest emitting facilities. Eleven were dryers located at wet corn mills. These dryer units, which are used to remove moisture from the corn components after processing, are not typically considered process heaters. However, they were subject to state or federal regulations for process heaters. The reason for this is unclear but it may be because these dryers had relatively large burners compared to other dryers. In addition, we identified 21 furnaces, most of which were used to regenerate spent activated carbon. The remaining process heaters were mostly hot oil or water heaters.

Boilers and Process Heaters

The amount of pollution released by industrial boilers and heaters is influenced by many factors, such as size, fuel type, and age. Boiler and heater size is often measured in heat input capacity, defined as the maximum amount of fuel the unit can burn. Among the top emitters, the size of the boilers varied greatly from facility to facility. The average boiler had a maximum heat input capacity of 354 MMBtu per hour. However, the size of the boilers varied from as low as 3 MMBtu per hour up to 1,500 MMBtu per hour. In comparison, the process heaters were generally much smaller, with an average maximum heat input capacity of 39 MMBtu per hour. Process heaters ranged in size from 1.5 MMBtu per hour up to 125 MMBtu per hour.

As boilers and heaters age, they become less efficient, releasing more pollution during operation. For example, while a boiler can be operated for 10-40 years, industry experts consider them outdated after about 15 years. By this guideline, a majority of the boilers and heaters identified at the top 20 emitting plants would be considered outdated. Of the boilers, 83 percent (98 out of 118) of the boilers were considered outdated, and 2 were of unknown age. On average, a boiler at one of these plants was about 32 years old. The two oldest boilers were originally constructed in 1934 at the BioUrja Renewables plant in Peoria, IL. Two-thirds (27 out of 39) of the process heaters were at least 15 years old (installed in 2010 or earlier). EIP was unable to determine the age for 10 of the identified heaters. The average process heater was about 26 years old. Most of the oldest process heaters were furnaces; 9 of the 11 process heaters installed in or before 2000 were furnaces, and the oldest process heater – circa 1976 – was a furnace. Other types of process heaters tended to be less than 20 years old.

Graph 1. Outdated Boilers and Heaters at the Top 20 Plants



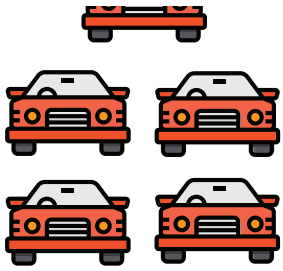
In addition, the type of fuel combusted in a process heater or boiler contributes to the amount and types of pollution they emit. For instance, a coal-fired boiler will release more carbon dioxide than a natural gas-fired boiler with the same capacity. Most of the boilers and heaters at the top 20 facilities burned natural gas, but there were several exceptions. In many cases, units were either burning or authorized to burn more than one type of fuel. Twenty-nine units at nine plants were permitted to use coal, either as the primary or secondary fuel, with most of these being older units installed more than 25 years ago. However, two of the coal-fired units, at the Archer Daniels Midland plant in Columbus, Nebraska, were constructed as recently as 2009. Three plants had units burn biogas, usually generated as a byproduct of the industrial processes. For example, two of these plants captured methane biogas from wastewater treatment.

At other plants, a few units were authorized to burn other types of fuels, such as agricultural byproducts, tire-derived fuels, or even petroleum coke. At the cane sugar plants, nine units burned fibrous sugarcane residue, also known as bagasse. Some of these fuels can be especially dirty. Petcoke, a waste product from oil refineries, not only produces more carbon dioxide (CO_2) emissions, or CO_2 than coal when burned, but also contains sulfur and heavy metals.[6] Burning bagasse or other agricultural byproducts generates what is considered "biogenic" CO_2, or CO_2 that is part of the natural carbon cycle. However, biogenic CO_2 emissions do still contribute to the facility's overall greenhouse gas footprint. Even if the greenhouse gas emissions were considered "neutral," burning bagasse still produces significant air pollution, including nitrogen oxides and carbon monoxide.[7]

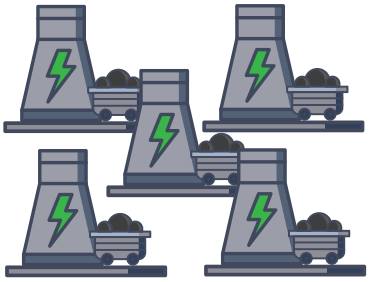
In total, 125 boilers and heaters were outdated, of which 80 have maximum heat input capacities below 240 MMBtu per hour. Most of these burned natural gas, sometimes in conjunction with fuel oil or biogas. One used bagasse, other sugarcane residues, and fuel oil. Six burned coal. These include the two oldest boilers at the BioUrja Renewables plant in Peoria, Illinois. These 187 MMBtu per hour boilers were originally installed more than 90 years ago, in 1934, though they were modified in 1983 to burn natural gas as a backup fuel. Both boilers were still operating as of 2023. The 210 MMBtu per hour bagasse-fired boiler at the Sugar Cane Growers Cooperative in Belle Glade, Florida was also one of the oldest boilers, installed in 1966.

Greenhouse Gas Emissions from the Top 20 Plants

The top 20 facilities reported emitting **17.8 million metric tons of greenhouse gases** from stationary combustion in 2023, equivalent to the annual emissions from:



4.1 MILLION
average gasoline-powered passenger vehicles driven for one year



5 COAL-FIRED POWER PLANTS
operating around the clock

Emissions

The top 20 facilities reported emitting 18.2 million metric tons of greenhouse gases in 2023. Stationary fuel combustion accounted for the majority of these emissions, about 17.8 million metric tons, equivalent to the annual emissions from 4.1 million average gasoline-powered passenger vehicles driven for one year or 5 coal-fired power plants operating around the clock.[8] EIP was able to attribute over 75% of the total greenhouse gas emissions – 13.6 million metric tons – to boilers and process heaters. However, due to the difficulty in isolating boiler and heater emissions, this percentage is an underestimate of the true proportion. At six of the plants, EIP was unable to separate emissions from boilers and heaters from the other units at the plant, and at several others, EIP was only able to isolate emissions for certain units. Despite data issues causing underestimates, we found that industrial boilers and heaters were responsible for one-third to virtually all stationary combustion emissions at each facility where emissions could be attributed.

The facilities with the highest greenhouse gas emissions were generally larger plants with more boiler and heater units. For example, the number one emitter, Archer Daniels Midland in Decatur, Illinois,[9] had 29 units, almost double the facility with the second most units, Archer Daniels Midland in Clinton, Iowa (the third highest emitter with 16 boiler and heater units). Both of these plants also make ethanol fuel. In addition, facilities with high greenhouse gas emissions often burned coal or alternative fuels such as bagasse.

The top 20 facilities reported emitting 71,557 tons of criteria air pollutants in 2020, of which 40,686 tons were known to come from industrial boilers and heaters. At 19 facilities, boilers and heaters were responsible for between 13 to 99 percent, on average about 50 percent, of the total criteria air pollutant emissions. The proportion was even higher among the cane and beet sugar manufacturers, with an average 72 percent of criteria air pollution coming from boilers and heaters. Due to gaps in the data, EIP was unable to identify emissions of criteria air pollutants from boilers and heaters at one facility.

The plants we examined reported emitting 11,683 tons of nitrogen oxides and 9,957 tons of volatile organic compounds, which are both precursors to ozone. Around 85 percent of the nitrogen oxide pollution and 6 percent of volatile organic compounds could be attributed to boilers and heaters. One facility, the Ingredion Argo Plant in Bedford Park, Illinois, was located in a nonattainment area for ozone. This plant reported emitting 370 tons of nitrogen oxides and 532 tons of volatile organic compounds. Boilers and heaters were responsible for 93 percent of the plant's total nitrogen oxide pollution.

These plants also reported emitting 5.6 million pounds of hazardous air pollutants (HAPs) in 2020, of which 1.5 million pounds were known to come from industrial boilers and heaters. Of the 19 plants that had detailed data available, the share of facility HAP emissions from boilers and heaters varied widely, from less than 1 percent to 100 percent of the total facility HAP emissions, with an average of about 40 percent of total facility emissions. Boilers that burned coal or bagasse were among the largest sources of HAP emissions; at these plants, boilers and heaters often contributed more than 90 percent of the facility's total HAP emissions. The most common hazardous air pollutants emitted by boilers and heaters were cadmium, arsenic, lead, formaldehyde, and chromium. However, in terms of the amount emitted, 1.3 million pounds of HAP emissions from boilers and heaters were comprised of just hydrochloric acid, methanol, hydrogen fluoride, formaldehyde, and hexane.

Table 1. Total Emissions From the 20 Highest Greenhouse Gas Emitters in the Food and Beverage Sector.

Total Facility Emissions		Known % of Emissions From Boilers and Heaters
Greenhouse Gases (metric tons CO_2e):	17,846,419	76%
Criteria Air Pollution (tons):	71,557	57%
Hazardous Air Pollution (lbs):	5,572,826	27%

In some cases, it was difficult to ascertain if a unit was shut down or still permitted. For some units, emission data suggested that the unit was not operating, but EIP was unable to confirm that the unit had been shut down. This is often because permits are outdated. In Illinois, for example, operating permits were often over a decade old, with more recently installed units operating under a construction permit. This makes it difficult to track which units have been shut down in recent years versus units that are still permitted but are not operating. In total, 8 units were potentially still permitted, but not operational.

Conclusion

This analysis underscores the significant pollution impact of industrial boilers and heaters in the food and beverage sector. The majority of the heat and steam-producing units located at these facilities are outdated and inefficient, contributing a significant proportion of the sector's emissions. But this impact can be dramatically reduced by replacing units with lower- or no-emission alternatives. At the 20 plants analyzed in this report, 67 boilers, or around half the boilers, have maximum heat input capacities below 240 MMBtu per hour, meaning they may be good candidates to consider replacing with industrial heat pump technologies.[10] In addition to curtailing greenhouse gas emissions, replacing these units could dramatically reduce about 4,000 tons of criteria air pollution and 75,000 pounds of hazardous air pollution currently being emitted. In other cases, dirty boilers and heaters could be replaced with newer, more efficient units that burn cleaner fuels or run on electricity generated from renewable sources like wind and solar.

Table 2. Detailed Emissions for the Top 20 Emitters in the Food and Beverage Sector

Map #	Location	Facility	Fuel Type(s)	Number of Outdated Heaters & Boilers	Facility Emissions		% From Heaters & Boilers (if known)	Air Compliance Status
1	Decatur, IL	Archer Daniels Midland Co. [1]	Coal, natural gas	29 out of 29	Greenhouse Gases (metric tons CO_2e):	3,831,170	89%	No Violation Identified
					Criteria Air Pollution (tons):	16,912	66%	
					Hazardous Air Pollution (lbs):	3,102,650	23%	
2	Cedar Rapids, IA	ADM Corn Processing	Coal, natural gas, fuel oil (startup)	7 out of 9 (2 unknown)	Greenhouse Gases (metric tons CO_2e):	2,751,083	81%	No Violation Identified
					Criteria Air Pollution (tons):	3,546	57%	
					Hazardous Air Pollution (lbs):	215,266	54%	
3	Clinton, IA	ADM Corn Processing	Coal, natural gas, petroleum coke, tire derived fuel, biomass fuels, fuel oil	13 out of 16 (3 unknown)	Greenhouse Gases (metric tons CO_2e):	2,059,802	93%	Violation within 1 Year
					Criteria Air Pollution (tons):	3,080	73%	
					Hazardous Air Pollution (lbs):	265,122	37%	
4	Clewiston, FL	Clewiston Sugar House	Bagasse, wood chips, no. 2 fuel oil, natural gas	2 out of 5 (2 unknown)	Greenhouse Gases (metric tons CO_2e):	2,035,614	100%	No Violation Identified
					Criteria Air Pollution (tons):	4,595	98%	
					Hazardous Air Pollution (lbs):	129,005	97%	
5	Columbus, NE	Archer Daniel Midland Company	Coal, natural gas, coal mixed with biomass, petroleum coke, tire-derived fuel	12 out of 12	Greenhouse Gases (metric tons CO_2e):	1,124,222	87%	No Violation Identified
					Criteria Air Pollution (tons):	1,747	37%	
					Hazardous Air Pollution (lbs):	64,020	9%	
6	Belle Glade, FL	Sugar Cane Growers Cooperative Of Florida [2]	Bagasse, fuel oil, natural gas, other sugarcane residues	6 out of 6	Greenhouse Gases (metric tons CO_2e):	567,839	99%	No Violation Identified
					Criteria Air Pollution (tons):	7,653	100%	
					Hazardous Air Pollution (lbs):	200,127	99%	

Map #	Location	Facility	Fuel Type(s)	Number of Outdated Heaters & Boilers	Facility Emissions		% From Heaters & Boilers (if known)	Air Compliance Status
7	Bedford Park, IL	Ingredion Incorporated Argo Plant*	Natural gas	5 out of 6	Greenhouse Gases (metric tons CO_2e):	536,533	91%	High Priority Violation
					Criteria Air Pollution (tons):	4,303	37%	
					Hazardous Air Pollution (lbs):	702,605	16%	
8	Blair, NE	Cargill Corn Milling North America	Natural gas	6 out of 7	Greenhouse Gases (metric tons CO_2e):	511,632		Violation within 1 Year
					Criteria Air Pollution (tons):	1,445	33%	
					Hazardous Air Pollution (lbs):	123,969	0.2%	
9	Muscatine, IA	Grain Processing Corp	Natural gas, biogas	9 out of 10	Greenhouse Gases (metric tons CO_2e):	471,401	64%	Violation within 1 Year
					Criteria Air Pollution (tons):	1,648	32%	
					Hazardous Air Pollution (lbs):	141,608	7%	
10	Renville, MN	Southern Minnesota Beet Sugar Cooperative	Natural gas, no. 6 residual oil, coal	2 out of 3	Greenhouse Gases (metric tons CO_2e):	441,794	94%	No Violation Identified
					Criteria Air Pollution (tons):	2,563	76%	
					Hazardous Air Pollution (lbs):	20,232	46%	
11	Decatur, IL	Primary Products Ingredients Americas	Natural gas, distillate fuel oil (backup)	6 out of 10 (1 unknown)	Greenhouse Gases (metric tons CO_2e):	415,180	82%	No Violation Identified
					Criteria Air Pollution (tons):	4,496	34%	
					Hazardous Air Pollution (lbs):	128,291	14%	
12	Eddyville, IA	Cargill	Natural gas	3 out of 8 (3 unknown)	Greenhouse Gases (metric tons CO_2e):	399,264		No Violation Identified
					Criteria Air Pollution (tons):	3,323	18%	
					Hazardous Air Pollution (lbs):	244,647	6%	
13	Hillsboro, ND	American Crystal Sugar	Coal, biogas	2 out of 2	Greenhouse Gases (metric tons CO_2e):	398,806	74%	No Violation Identified
					Criteria Air Pollution (tons):	5,164	24%	
					Hazardous Air Pollution (lbs):	11,196	91%	
14	Loudon, TN	Primary Products Ingredients Americas	Natural gas, no. 2 fuel oil, PDO byproduct	4 out of 4	Greenhouse Gases (metric tons CO_2e):	385,541		Violation within 1 Year
					Criteria Air Pollution (tons):	1,678		
					Hazardous Air Pollution (lbs):	77,180		
15	Keokuk, IA	Roquette America	Natural gas, coal, petroleum coke, agricultural byproducts, biomass, waste timber, waste paper, tire-derived fuel	4 out of 7	Greenhouse Gases (metric tons CO_2e):	351,512	36%	Violation within 1 Year
					Criteria Air Pollution (tons):	1,217	50%	
					Hazardous Air Pollution (lbs):	6,831	50%	

Map #	Location	Facility	Fuel Type(s)	Number of Outdated Heaters & Boilers	Facility Emissions		% From Heaters & Boilers (if known)	Air Compliance Status
16	Pekin, IL	Alto Pekin	Natural gas, no. 2 oil	1 out of 3	Greenhouse Gases (metric tons CO_2e):	351,264	71%	High Priority Violation
					Criteria Air Pollution (tons):	1,337	13%	
					Hazardous Air Pollution (lbs):	23,830	30%	
17	Lafayette, IN	Primary Products Ingredients Americas (aka Primient)	Natural gas	4 out of 4	Greenhouse Gases (metric tons CO_2e):	323,932		High Priority Violation
					Criteria Air Pollution (tons):	2,093	37%	
					Hazardous Air Pollution (lbs):	41,571	8%	
18	Wahpeton, ND	Minn Dak Farmers Cooperative	Coal, natural gas, biogas, oil	4 out of 5	Greenhouse Gases (metric tons CO_2e):	315,529		No Violation Identified
					Criteria Air Pollution (tons):	1,731	54%	
					Hazardous Air Pollution (lbs):	35,780	46%	
19	Drayton, ND	American Crystal Sugar Company	Coal, natural gas	1 out of 4 (1 unknown)	Greenhouse Gases (metric tons CO_2e):	304,457	96%	No Violation Identified
					Criteria Air Pollution (tons):	2,157	81%	
					Hazardous Air Pollution (lbs):	16,403	100%	
20	Peoria, IL	BioUrja Renewables	Coal, natural gas	5 out of 7	Greenhouse Gases (metric tons CO_2e):	269,843		Violation within 1 Year
					Criteria Air Pollution (tons):	870	30%	
					Hazardous Air Pollution (lbs):	22,493	0.7%	

*located in a nonattainment area for ozone.

[1] A natural gas-fired power plant is being planned near the Decatur facility. Many of the boilers may be shut down once the plant becomes operational.

[2] This facility is co-located with a fiber products plant. In the past, the fiber products plant was permitted alongside the sugar plant, and so the emissions from 2020 and 2023 include both plants. However, as of early 2025, the plants were being split up into their own permits, so the boiler and heater count here is only for the sugar plant.

Sources: 2023 Greenhouse Gas Reporting Program, 2020 National Emission Inventory, Clean Air Act permits, 2008 Boiler MACT Database

Methodology

The 20 plants discussed in this report were identified, using EPA's Greenhouse Gas Reporting Program (GHGRP), as the top emitters for stationary combustion greenhouse gas emissions. The sector was defined using the North American Industry Classification System (NAICS) codes for food manufacturers (311), breweries, wineries, distilleries (312), and ethyl alcohol manufacturers (325193). Ethanol plants were only included if they also were wet corn mills or soybean processers. In this analysis, EIP included biogenic carbon dioxide (CO_2) emissions, or CO_2 emitted from the burning of biomass.

EIP reviewed permit documents to identify boilers and process heaters at each facility. Dryers, roasters, and comfort heaters were excluded unless they were subject to a state or federal rule governing process heaters. Furnaces, however, were always included as process heaters. Permit data was supplemented with information from the EPA's 2020 National Emissions Inventory (NEI), the 2023 GHGRP, and the Boiler MACT database from 2008. In many cases, information was outdated or inconsistent across the different datasets. Where applicable, we used our best judgment, deferring to permit information when possible. Additionally, there were several instances where data were missing. Please see table 2 for a complete summary of the data.

References and Endnotes

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[6] Environmental Integrity Project. "The Long Shadow of Oil Refinery Waste," p. 4, 13. July 24, 2024. Link: https://doi.org/10.1016/j.scp.2023.101028

[7] Costa, M. et al., "Emission analysis of sugarcane bagasse combustion in a burner pilot." February 16, 2023. Link: https://doi.org/10.1016/j.scp.2023.101028

[8] U.S. Environmental Protection Agency, "Greenhouse Gas Equivalencies Calculator." Accessed March 26, 2025. Link: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[9] The Archer Daniels Midland facility is a large manufacturing facility that also has an on-site cogeneration plant, powered by coal-fired boilers. However, a natural gas-fired power plant is being planned near the Decatur plant that will provide the facility with electricity and steam. Many of the ADM boilers may be shut down once the power plant becomes operational. Link: https://broadwingenergy.com/

[10] Chen, H. & Hoffmeister, A., *Net-zero industry by 2050: A scenario of analysis of boiler replacement with industrial heat pumps*, American Council for an Energy-Efficient Economy (2024). Link: https://www.aceee.org/sites/default/files/pdfs/net-zero_industry_by_2050_-_a_scenario_analysis_of_boiler_replacement_with_industrial_heat_pumps.pdf