A Paper Trail of Pollution

U.S. Paper Industry Stained by Aging Infrastructure, Dirty Fuels, and Hidden Climate Impact

ENVIRONMENTAL INTEGRITY PROJECT

MAY 29, 2025

Acknowledgments:
This report was researched and written by Courtney Bernhardt, Ari Phillips, Vincent Bregman, Tom Pelton, and Louisa Markow with design by Alexandria Tayborn.

The Environmental Integrity Project:
The Environmental Integrity Project is America's environmental watchdog. We are a nonprofit organization dedicated to protecting public health and our natural resources by holding polluters and government agencies accountable under the law. We advocate for tough but fair environmental standards and empower 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.

Photo Credits:
iStock Photos; Adobe Stock; Tom Pelton and Ari Phillips, Environmental Integrity Project; Greg Nance, Catawba Riverkeeper.

Cover and inside cover image: The Smurfit Westrock paper mill in Covington, Virginia, has a boiler that dates back to World War II and is a major source of air pollution that impacts the quality of life for local residents.

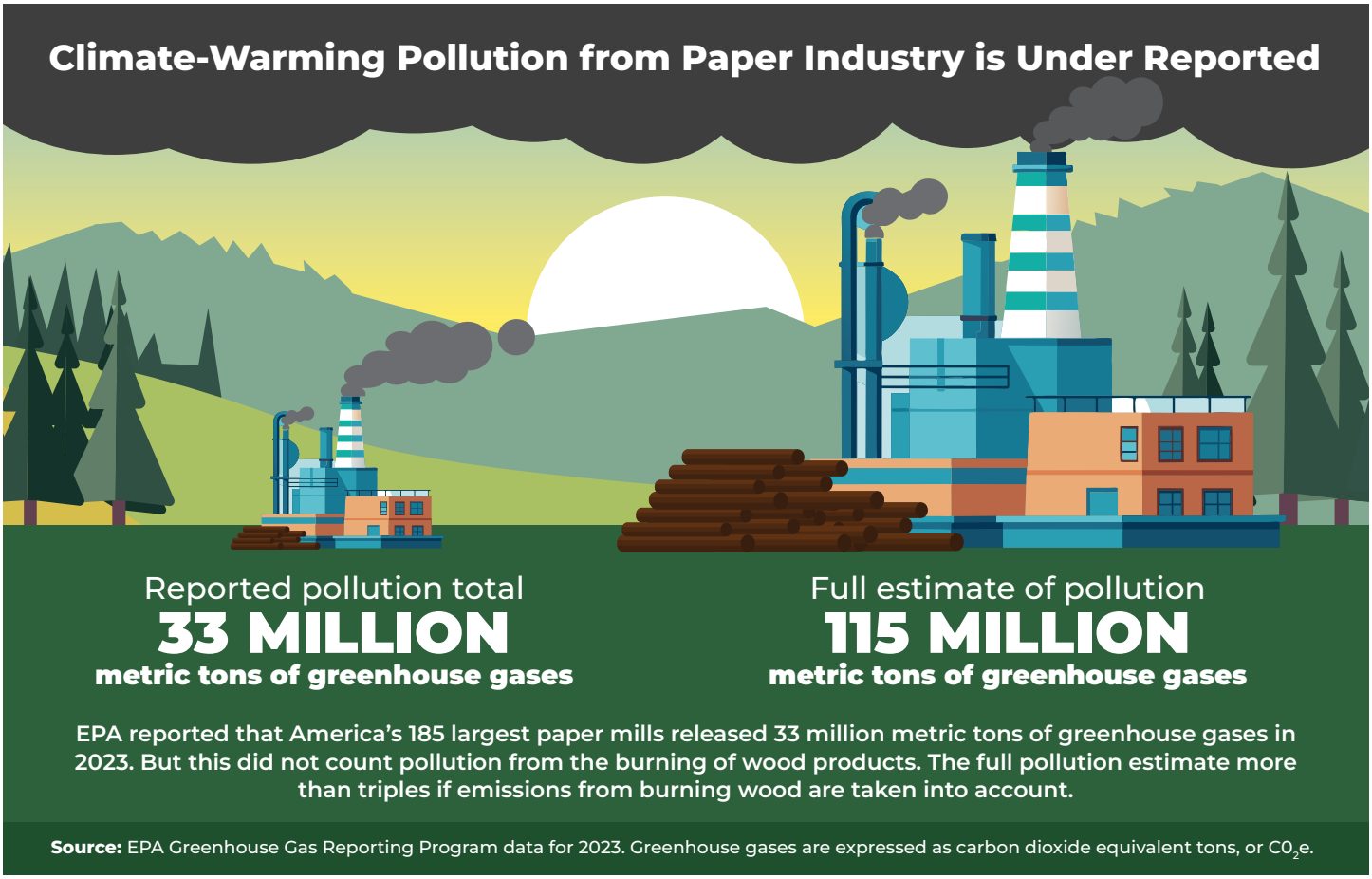
A Paper Trail of Pollution

U.S. Paper Industry Stained by Aging Infrastructure, Dirty Fuels, and Hidden Climate Impact

EXECUTIVE SUMMARY

Paper mills are woven into the fabric of the modern world, manufacturing a wide range of products essential for daily life, ranging from toilet paper to cereal boxes and e-commerce packaging. But despite their low-profile role in the economy, pulp and paper factories are outsized sources of greenhouse gases and air and water pollution across the country. The Environmental Integrity Project (EIP) examined 185 of the largest paper mills in the U.S. and found that the industry's aging infrastructure — including heating units called boilers that in some cases date back to World War II — and the industry's burning of dirty fuels like coal, tires, and a tar-like waste product called "black liquor," are contributing to a heavy environmental footprint. EPA's inaccurate system for reporting greenhouse gases, which allows companies to exclude the carbon dioxide released from burning "black liquor" and other wood products, hides the real climate impact of paper mills and inhibits an industry transition to cleaner production methods. (For a detailed discussion of our methodology, see Appendix A.)

EIP's study of the industry found that 73 percent of large pulp and paper mills (135 of the 185 examined) have outdated boilers. This is a problem because outdated boilers (defined as older than 15 years[1]) tend to be less efficient and are more likely to release higher rates of pollution than newer ones. The average age of a boiler at the mills examined for this report was 41 years. That means the technology dates back to President Reagan's first term, when

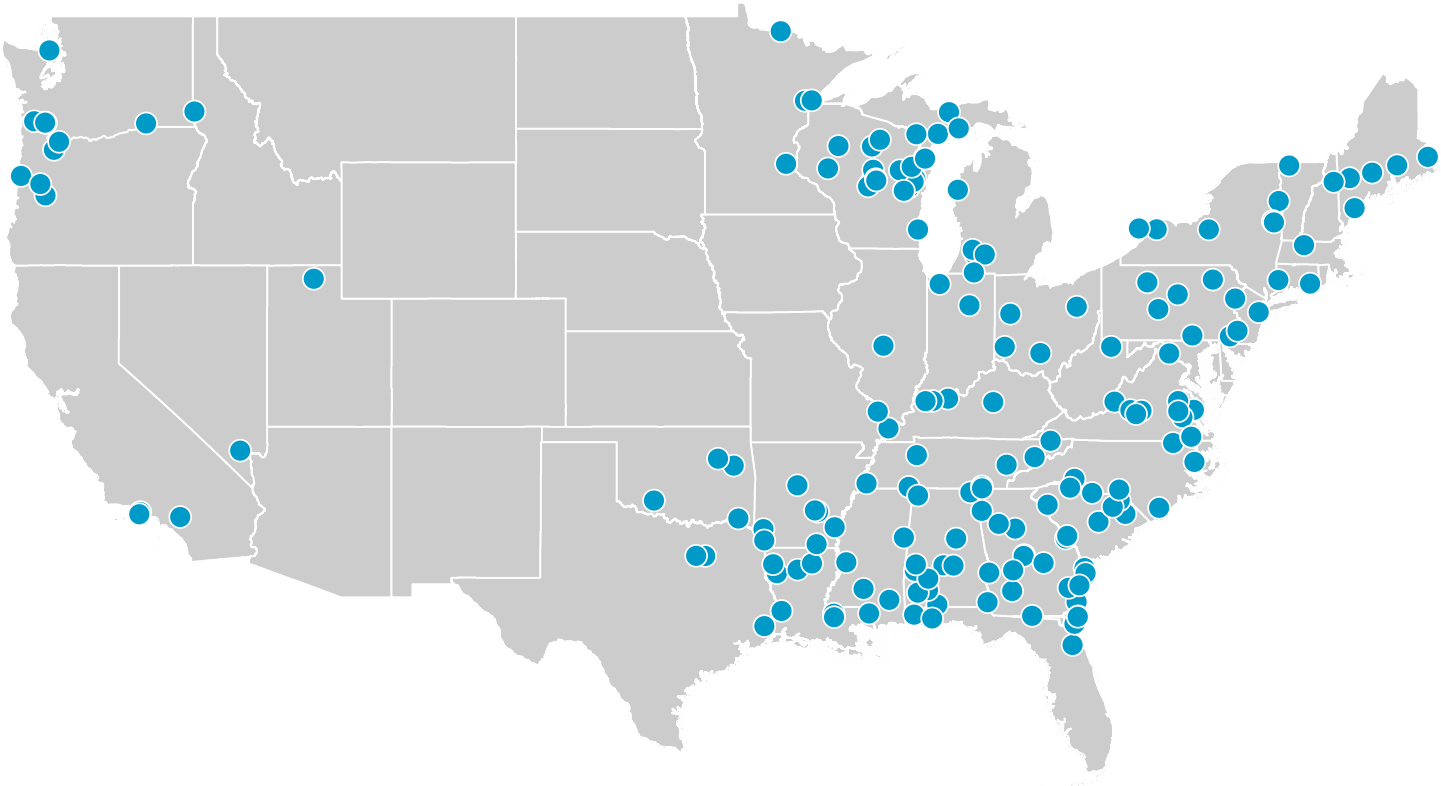


rotary-dial telephones were still a widely-used technology.[2] Over 40 percent of the mills studied (77 out of the 185) had at least one boiler that was a half-century old or more. In order to get air pollution and greenhouse gas emissions under control, outdated industrial boilers like those used in the industry need to be cleaned up. They should be replaced, when possible, by newer technologies like industrial heat pumps, which are more efficient and create no emissions, especially in areas with abundant sources of renewable energy. Where that isn't possible or would result in higher electric demands on grids powered by fossil fuels, mills should switch to cleaner-burning fuels.

The pulp and paper industry uses a large volume of wood to make paper, and it also uses wood as an energy source. About half of the mills examined by EIP burned wood or wood byproducts (also called "biomass") generated during the pulping of trees, including "black liquor," a liquid waste left over after the digestion of wood into pulp. Many mills burn black liquor to create heat to help run their machinery, releasing large amounts of air pollution, including carbon dioxide, sulfur dioxide, particulate matter, nitrogen oxide, and volatile organic compounds (VOCs), all of which can harm both human health and the environment.[3]

Anyone who has driven past a pulp and paper mill will be familiar with the rotten-egg smell of hydrogen sulfide emissions, which are a public nuisance, and in high concentrations, a health hazard. Yet, despite this widespread problem, some mills lack basic pollution control devices — including scrubbers — that can curtail emissions of hydrogen sulfide and other pollutants, including sulfur dioxide. This is just one example of how the installation of modern technology could substantially reduce harmful pollution from the paper industry.

Map A. Locations of the Largest Pulp and Paper Mills in the U.S



Source: EPA's Greenhouse Gas Reporting Program, 2023

For this report, EIP examined thousands of pages of federal and state records on the 185 largest pulp and paper mills in the U.S. and publicly available emission and compliance databases. We reached the following conclusions. (For a detailed list of all the mills and data, see spreadsheet in Appendix B.)

Climate Impact Grossly Underestimated: In 2023, the pulp and paper mills we examined reported a total of 33.2 million metric tons of greenhouse gas emissions to EPA's Greenhouse Gas Reporting Program.[4] However, this amount grossly underestimates the actual greenhouse gases from these plants because EPA allows industry to subtract the amount that came from burning "biogenic" fuels like wood and wood byproducts like black liquor. The questionable rationale for this reporting loophole is that carbon dioxide emissions from burning trees should not count when this pollution is emitted because trees can grow back in the future. If you include the pollution from the burning of wood products, the full estimated emissions from these large pulp and paper mills in 2023 was 115 million metric tons — 350 percent more than was officially reported to the public by EPA.[5]

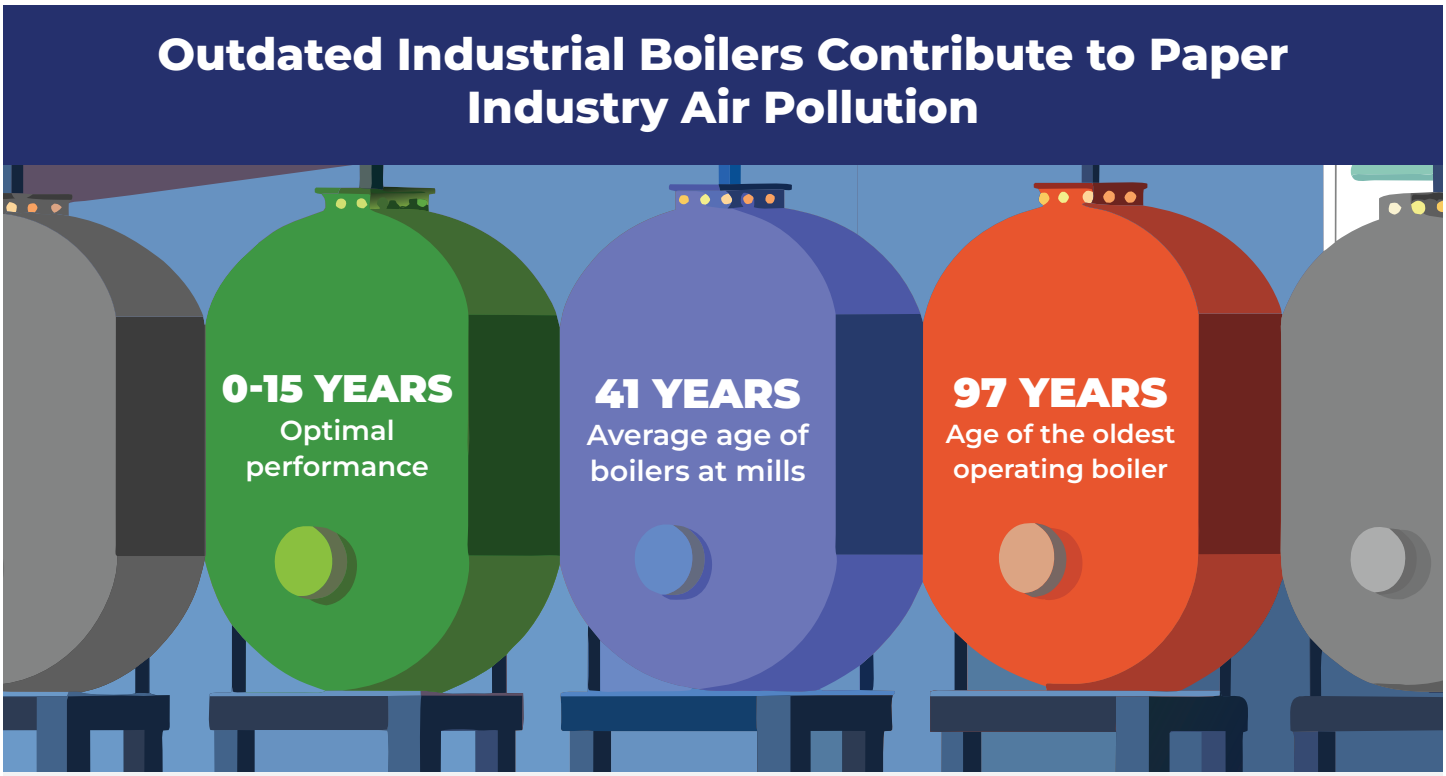
The 10 pulp and paper mills that reported the most greenhouse gases in 2023 were able to lower their reported "total" emissions by anywhere between 61 and 90 percent each because they burned wood products.[6] After taking all emissions into account, the largest paper mills studied for this report each released about as much greenhouse gases as a large oil refinery.

Air Pollution: In 2020, the 185 paper mills EIP examined reported emitting a total of 46,095 tons of sulfur dioxide (SO_2), a pollutant that can contribute to heart and lung damage and premature death; and 110,300 tons of nitrogen oxides, which contribute to smog, asthma attacks, and low-oxygen "dead zones" in waterways.[7] The mills also released a total of about 8 million pounds of hydrogen sulfide in 2023, a pollutant that can irritate the eyes and lungs and trigger headaches and nausea, among other health problems.[8] And they reported releasing that year 3.2 million pounds of acetaldehyde, a probable human carcinogen that can cause respiratory problems.[9]

Pulp and paper manufacturing plants release large amounts sulfur dioxide and hydrogen sulfate air pollution, but some of the plants lack air pollution control devices to control these emissions.

Enforcement and Compliance: A third of the plants examined (63 of the 185) had an air pollution violation in the last three years, according to EPA's Enforcement and Compliance History Online (ECHO) database.[10] State or federal agencies brought 267 air pollution enforcement actions against 95 of the plants in the last five years, including $7.4 million in environmental penalties.

Outdated Boiler Systems: Nearly three quarters of large pulp and paper mills (135 of the 185 examined) have an outdated boiler (meaning more than 15 years old) and almost half have a boiler at least a half-century old. The oldest boiler dates back to 1928, at a paper mill in Longview, Washington. This is a problem because older boilers tend to be less efficient and release more pollution.



Note: 41 years is the average ages of the 509 industrial heating units (boilers) for which information was available at the 185 largest pulp and paper mills in the U.S. **Source:** See Appendix A: Methodology

Reliance on Dirty Fuels, Including 'Black Liquor.' About half of the pulp and paper mills (90 of the 185 studied) burn black liquor and 85 reported burning wood, releasing large amounts of air pollution, including particulate matter, carbon dioxide, and sulfur dioxide. In addition to burning this "biomass," pulp and paper mills rely on a wide array of fossil fuels and waste products. In total, 38 mills reported burning the very dirtiest fuels, including coal, tires, and petroleum coke (a waste product left over from oil refining). Georgia-Pacific's Savannah River mill in Rincon, GA, reported burning all three of these dirty fuels, plus wood waste.

Local Impact

This report provides examples of the local impact of this pollution in three case studies, in Virginia, Washington state, and South Carolina, which can be found on pages 31, 35, and 38.

Virginia: The 126-year-old Smurfit Westrock paper mill in Covington, VA, uses a boiler built in 1940 and has been among the worst polluters in the nation for the industry in recent years — including for releasing the No. 1 most nitrogen oxide (NOx) among large paper mills in 2020 (2,808 tons) and 2,287 tons in 2023.[11] The mill, which inspires numerous pollution complaints from neighbors, was also the No. 1 emitter of methane, a potent greenhouse gas

(releasing 214,755 metric tons) in 2023; and the third biggest emitter of hydrochloric acid (170,000 pounds) among mills nationally that year.[12]

According to the EPA's Greenhouse Gas Reporting Program, the mill released 970,084 metric tons of greenhouse gases in 2023, the most of any U.S. paper mill. But in reality, the mill emitted far more than that — an estimated 2.49 million metric tons, because EPA did not count 1.5 million metric tons from the burning of wood and other "biogenic" material.[13,14] The plant is also a significant source of water pollution, with more than a dozen reports filed over the last five years about the plant fouling the Jackson River, including in one incident on November 12, 2024 that caused a fish kill.

Washington State: The Port Townsend Paper Company's paper mill north of Seattle has been in violation of the Clean Air Act for 12 of the last 12 quarters, including for releasing hazardous air pollutants, soot, and nitrogen oxides, according to EPA's ECHO database.[15] State and federal regulators have hit the plant with five enforcement actions and 23 violation notices over the last five years, but a total of only $63,750 in penalties, according to EPA records.[16]

A federal study in June 2024 found that breathing the sulfur compounds in the air near the Port Townsend mill could contribute to lung disease or irritation.[17] The mill has also been hit with six enforcement actions for water pollution violations with minimal fines ($44,000) over the last five years, according to EPA records.[18]

South Carolina: New-Indy Containerboard, a paper and pulp mill in Catawba, South Carolina, almost an hour south of Charlotte, has an antiquated boiler system that dates back to the Eisenhower Administration. Local residents have filed nearly 50,000 odor complaints about the mill's pollution since it was acquired in 2018 by an investment group led by Robert Kraft, the billionaire owner of the New England Patriots football team, for roughly $300 million.[19]

In 2023, the New-Indy plant was the worst polluter in the nation for mercury and zinc air pollution among the 185 pulp and paper mills we studied.[20] Mercury is a neurotoxin and zinc can cause lung irritation and fever.

The Port Townsend paper mill in Washington State has been hit with five air pollution enforcement actions and 23 violation notices over the last five years, but a total of only $63,750 in penalties.

Recommendations

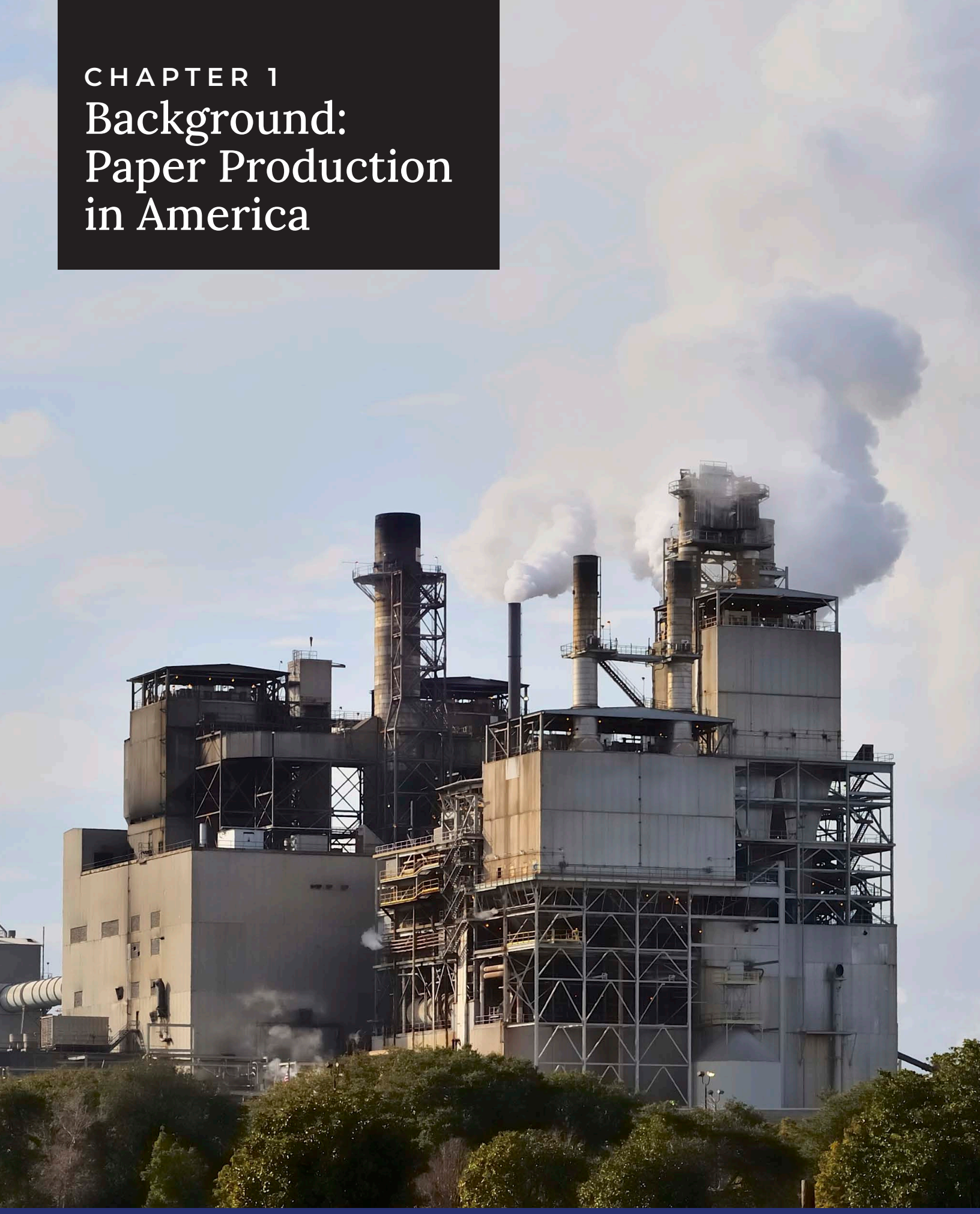
To reduce air and climate-warming pollution from pulp and paper mills across the U.S., this report makes the following recommendations:

1. **Pulp and paper mills should switch to cleaner fuels and replace outdated boilers with zero-emission industrial heat technologies**. The 185 mills in this report often rely on outdated boilers — averaging more than four decades old — and an array of dirty fuels, including coal, tires, petroleum coke, waste oil, fuel oil, natural gas, wood, and black liquor. Where possible, mills should update their equipment, switch to cleaner fuels, and install modern technologies like industrial heat pumps, which efficiently transfer heat rather than create it. These pumps could reduce energy demand and greenhouse gas emissions by about 50 percent, while also cutting health-damaging air pollutants.[21]
2. **Continue the shift toward more recycled paper.** Using virgin wood to make pulp and paper is considerably more damaging to the environment than using recycled paper. Manufacturing a ton of cardboard from recycled paper requires no new wood, about half the energy, 32 percent less water, and creates 10 percent less solid waste and about a quarter of the climate-warming emissions compared to making cardboard from virgin wood.[22] Around 80 percent of U.S. paper mills today already use some recycled paper as an ingredient.
3. **States and EPA should set more stringent pollution limits and vigorously enforce the limits that exist.** By ratcheting down pollution limits, states and the EPA can incentivize paper mills to invest in more efficient, cleaner technologies. Along with safeguarding public health for communities, updated and tightened regulations provide guidelines that ensure the U.S. paper industry will remain on the forefront of technological advancement while also maintaining regulatory certainty. Companies that break the law and violate water and air pollution limits should be required to pay meaningful penalties so that companies have a financial incentive to improve their plants.
4. **The pulp and paper industry should accurately account for emissions from burning wood and black liquor.** Pulp and paper mills are large sources of greenhouse gas emissions. However, their contribution is grossly underestimated because EPA has allowed them to exclude the amount that came from burning "biogenic" fuels like wood and wood byproducts like black liquor. The industry also falsely claims that burning wood and black liquor is clean and sustainable, even though the environmental track record shows otherwise. EPA must improve the accuracy of its federal greenhouse gas reporting program, while also protecting the program from cuts or elimination by the Trump Administration.

Table of Contents

CHAPTER 1

Background: Paper Production in America



Paper mills are major sources of climate-warming greenhouse gas pollution, although their emissions are significantly under reported. Shown here is a paper mill in Georgetown, South Carolina.

Background: Paper Production in America

The first paper mill in America was built in 1690 in Germantown, Pennsylvania, just outside of Philadelphia.[23] In the colonies, papermaking was a specialized trade that used household cotton rags as a raw material and streams to drive waterwheels to provide energy.[24] This meant paper mills had to be located near large urban areas with an ample supply of discarded rags and waterways that could be dammed and harnessed for power.

By 1810, when there were some 185 paper mills in the United States, rags were becoming scarcer and more costly to procure. Papermakers looked for alternative materials as early as the 1790s and experimented with different sources of fiber, including tree bark, sugarcane waste, straw, and cornstalks.[25] After decades of experimentation, wood fiber became a viable alternative thanks in part to the increasing availability of mechanical wood grinders. Paper mills also began to use wood and wood waste byproducts, along with coal and oil, as fuel to create heat for the paper-making process.

By the early 1900s, the United States was the largest paper producer in the world. The rapid expansion of paper mills, first in the northeast and then across the country, contributed to a dramatic loss in forested areas, as the mills required vast amounts of logs to operate. For example, during just one year — in 1907 — the New Hampshire mills owned by the Brown Company cut down 30 to 40 million acres of woodland to fuel their paper-making enterprise.[26]

56% of the paper products manufactured today are for packaging and wrapping, including e-commerce.

Today, the U.S. has about 20 percent more trees than it did half a century ago. The paper industry plants over a billion trees a year to manage forests and regenerate supply.[27] However, many paper mills today still burn high-polluting fuels, including coal, oil, wood, and old tires in outdated equipment that is sometimes almost a century old. And the planting of new trees does not make the burning of wood climate neutral or environmentally friendly, because the combustion releases large amounts of greenhouse gases and health-damaging air pollutants. Replanted trees don't always survive and often take decades or longer to grow back.

Today, the U.S. pulp and paper industry is dominated by a handful of large corporations working mostly in a small cluster of states. Of the 185 plants evaluated in this report, at least 54 were owned by just three companies: Smurfit Westrock, based in Ireland, which owns 22 facilities; International Paper, based in Tennessee, which owns 17; and Georgia-Pacific, based in Atlanta, which owns 18. More than a third of the pulp and paper manufacturing facilities we examined (65 of the 185) are located in five states: Wisconsin, Georgia, Alabama, Maine, and South Carolina.

Paper mills produce a wide variety of products, including writing paper, cardboard boxes, grocery bags, paperboard, envelopes, magazines, sanitary paper, tissues, and fluff used in diapers. But over half (about 56 percent) of the paper products made today are used for packaging and wrapping.

CHAPTER 2

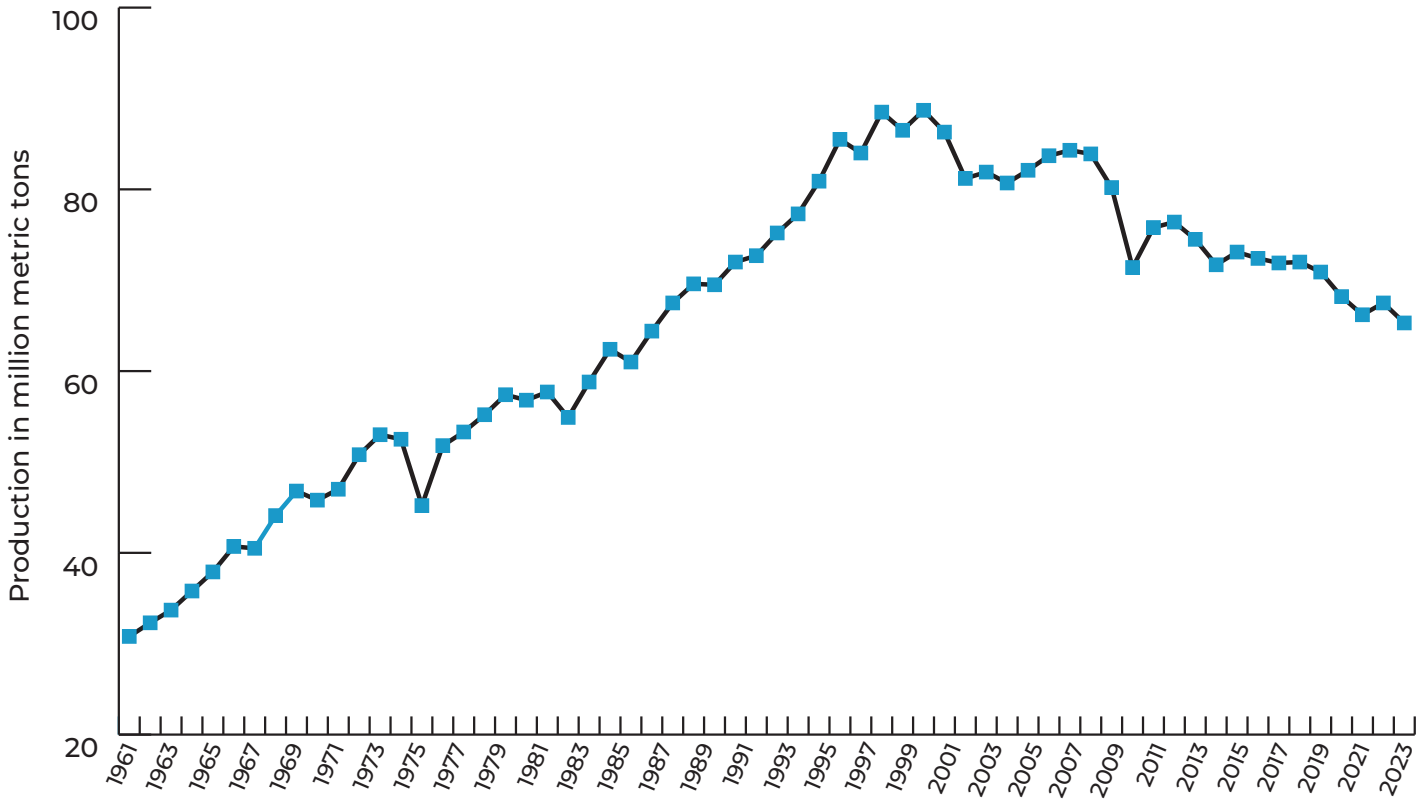
Paper Production Trends in the U.S.

Although global demand for packaging for e-commerce is on the rise, in the U.S. paper production has been in decline since the 1990s because of the rise of electronic documents and the decline of newspapers.

Paper Production Trends in the U.S.

Paper and paperboard production in the U.S. peaked in 1999 at a high of 88.7 million metric tons but has since been in decline as newspapers and other print material have been replaced by digital media. The U.S. remains the second-largest paper and paperboard producer in the world behind China, although China produces twice as much as America.[28]

Graph 1. Production of All Paper Products in the U.S.

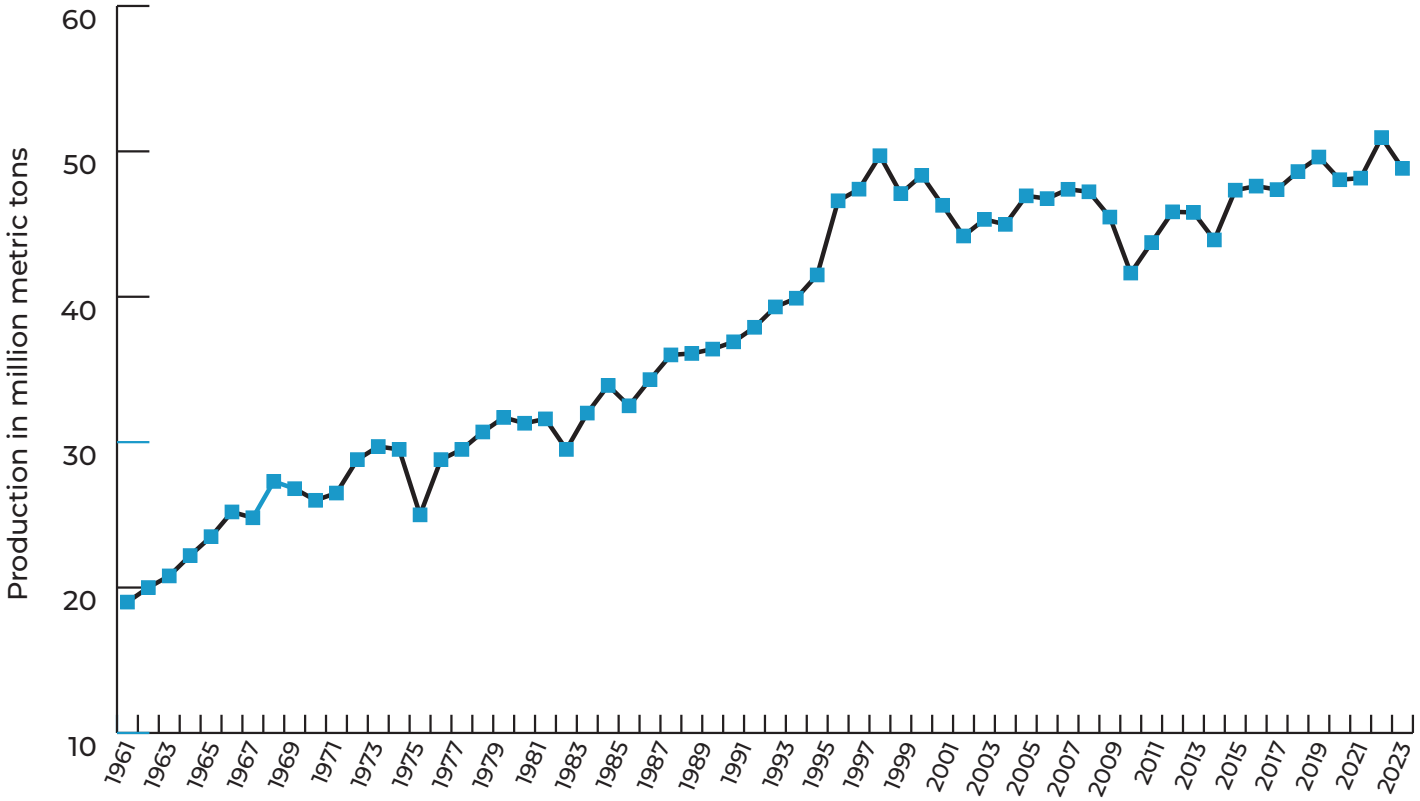


Source: FAO ©Statista 2025

Paper and paperboard manufacturing in the U.S. totaled 61 million metric tons in 2023 — a decrease of around 7 percent from the previous year.[29] The rise of e-commerce, and the accompanying need for more cardboard boxes to ship goods, has not offset the drop in the production of newspaper and other print material in the U.S.[30] Many cardboard boxes are manufactured overseas, close to the factories that make the products that the boxes will contain. China is the largest exporter[31] of goods in the world and also the largest box producer.

Worldwide, because of the popularity of Amazon and other e-commerce platforms, the manufacturing of cardboard and paperboard for boxes is on the rise, growing from 158 million tons in 2015 to about 191 million tons in 2022.[32] But cardboard and paperboard manufacturing in the U.S. has plateaued since the late 1990s, with around 50 million metric tons produced in 1999 as well as in 2019-2021 (the most recent data available).[33]

Graph 2. U.S. Production of Cardboard and Paperboard for Boxes and Packaging



Source: FAO ©Statista 2025

CHAPTER 3

Recycled Paper

A growing number of paper mills use recycled material, which produces less pollution and consumes less water and no trees.

Recycled Paper

Around 80 percent of U.S. paper mills today use some recycled paper as an ingredient. In 2023, the paper recycling rate was 65 to 69 percent, totaling some 46 million tons of paper.[34] Nearly half of recycled paper went into making containerboard, which is used for making cardboard boxes.[35]

Paper products collected from homes and businesses are transported to recovery facilities to be sorted into separate categories. After the paper has been sorted and checked for contaminants, it is baled and sent to a paper mill, where it is loaded into pulpers that resemble giant blenders and break paper down into fibers.

Recycled paper fibers can be reused an estimated five to seven times before they become too short to be usable in new paper products.[36] Recycled paper is used to produce products made entirely of recovered fiber and also blended with virgin fiber. Many mills use both recycled and virgin fiber to make their paper products, with the mix determined by customer demand, environmental awareness, and economics.[37]

Recycling paper is generally better for the environment than making it from virgin wood, and it reduces the amount of trash dumped in landfills or burned in incinerators. Using virgin wood to manufacture one ton of cardboard requires more than four tons of trees and 17,500 gallons of water and releases 8.5 tons of climate-warming greenhouse gases while creating 410 pounds of solid waste.[38] By comparison, making a ton of cardboard from 100 percent recycled paper requires cutting down no trees and uses 32 percent less water (11,900 gallons) while releasing about a quarter of the climate-warming emissions (2.1 tons of greenhouse gases) and 10 percent less solid waste (368 pounds) than paper made from virgin wood.[39] A major reason for the difference in pollution output is the amount of energy required. Creating one ton of cardboard from virgin wood requires 26.2 million British thermal units (MMBtu) of energy, about as much as from the burning of nearly a ton of coal.[40] That is almost twice as much energy as is required to make the same amount of cardboard from recycled material (13.6 MMBtu).

Less Pollution from Recycled Cardboard

Comparing one ton of cardboard made from trees vs. recycled paper

Making cardboard from recycled material consumes about **half the energy** and releases about **one quarter the greenhouse gases** as making it from trees.

Note: Energy measured in million British thermal units (MMBtu) and greenhouse gases as carbon dioxide equivalent (CO_2e) tons. Recycled materials here refers to 100 percent recycled material. **Source**: Environmental Paper Network, "Paper Calculator: Calculate Your Impact."

CHAPTER 4

How Paper Is Made

Paper is rolled and cut in the manufacturing process, shown here. Among the byproducts of pulp and paper mills is "black liquor," which is often burned to produce energy for the mill.

How Paper Is Made

In the U.S., the main ingredient in virgin paper is softwood trees like spruce and pine.[41] Different kinds of mills then convert that wood into pulp — the fibrous, mashed-up wood byproduct that is the raw material in making paper. Some plants make both pulp and final or intermediate paper products. Other mills just make paper or other paper products but don't make their own pulp. Because the pulping process is so energy-intensive and generates toxic byproducts, it is the most polluting part of papermaking and mills that make pulp tend to be the largest polluters in the industry.

Chemical pulping is by far the most common method of making this primary ingredient. In this process, wood chips are digested at high pressure in a mix of chemicals that dissolves lignin — a component of plant cell walls that provides rigidity and structure — allowing it to separate into individual fibers. The most common chemical pulping process in the U.S. (called the kraft process) involves treating wood chips with a heated mixture of water, sodium hydroxide, and sodium sulfide.

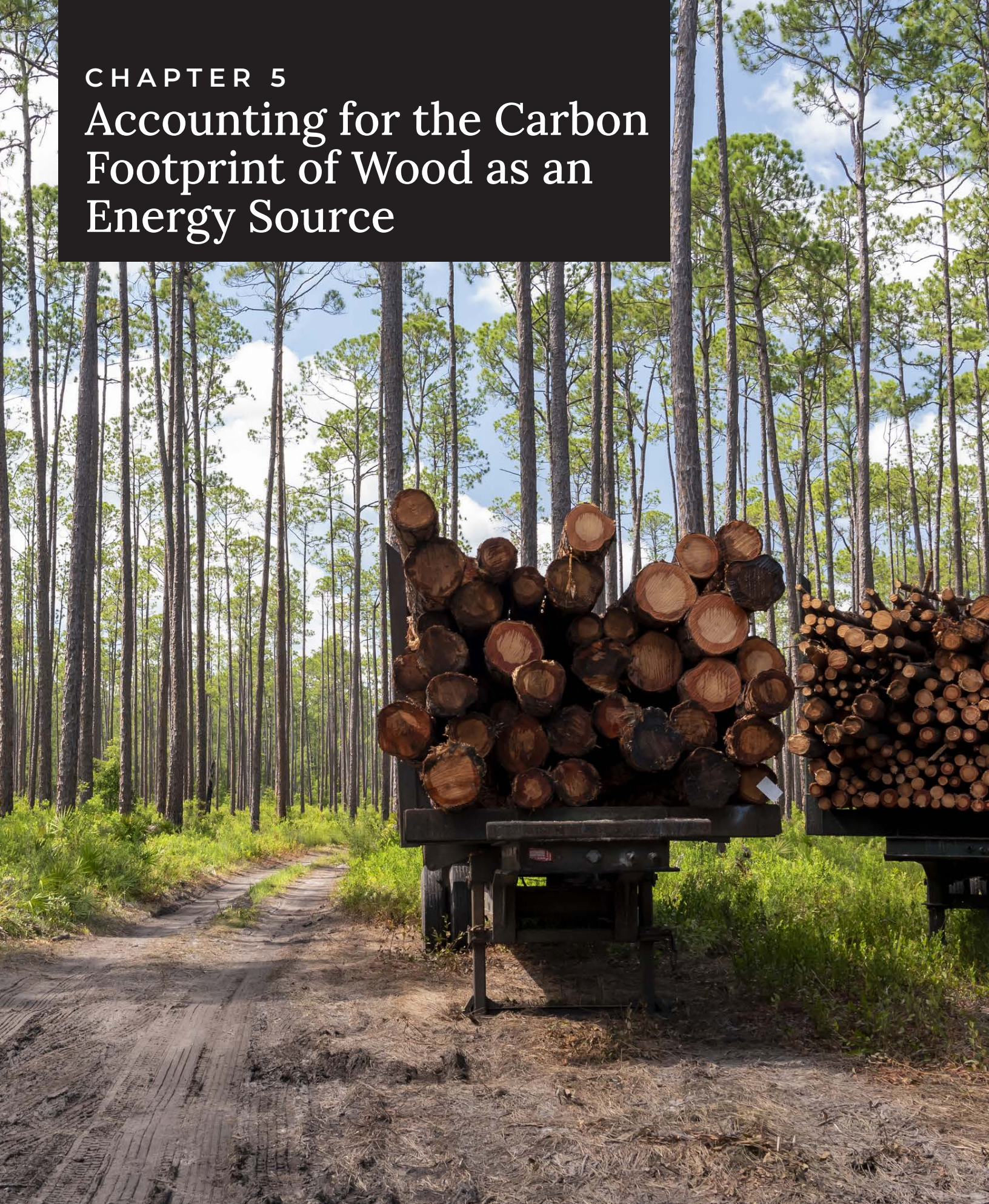
A toxic byproduct of the kraft pulping process is "black liquor," a dark-colored liquid mixture of residues and chemicals that must be washed from the fibers. Until the invention in the early 20th century of boilers that burn black liquor for energy and chemical recovery, black liquor was often simply dumped into waterways.[42] Pulping also generates hazardous gases like hydrogen sulfide, methanol, acetaldehyde, and formaldehyde.[43] Pulping is followed by mechanical, chemical, and drying operations to make paper.

At the largest pulp and paper mills, nearly all of these industrial activities are fueled or powered by large industrial heat sources, called boilers, that provide the heat, steam, and electricity needed to produce paper and paper products. Boilers typically burn fossil fuels, wood, and wood waste products. Many mills also rely on boilers as air pollution control devices to burn and destroy some of the toxic emissions from making pulp.

Pulp, shown here, is the primary ingredient in manufacturing paper.

CHAPTER 5

Accounting for the Carbon Footprint of Wood as an Energy Source



Pulp and paper mills consume vast amounts of wood through the cutting down of trees and burning of wood products. Although this creates large amounts of greenhouse gas pollution, EPA allows companies to not report the emissions from the burning of trees, using the questionable rationale that trees can be replanted and grow back.

Accounting for the Carbon Footprint of Wood as an Energy Source

The pulp and paper industry uses a large volume of wood (also called "biomass") as an energy source as well as an ingredient in making paper. Over half of the fuels used by the paper industry are wood byproducts like bark and black liquor generated during the pulping of trees. Many pulp mills burn black liquor to recover chemicals and create additional heat needed to run the plant. This dirty fuel releases large amounts of air pollution, including carbon dioxide, sulfur dioxide, and soot. Paper mills also burn wood chips and bark. Of the 185 large mills studied for this report, almost half (90) reported burning black liquor in 2023 and nearly as many (85) reported burning wood.[44]

EPA's Greenhouse Gas Reporting Program reported that the 185 paper mills studied for this report released 33.2 million metric tons of greenhouse gases in 2023.[45] However, EPA does not include in this number the carbon dioxide released by the burning of wood and wood byproducts (like black liquor). EPA uses the dubious claim that greenhouse gases created by the burning of wood does not matter to the global climate because trees can be replanted and grow back.[46] However, if the full estimated amount of greenhouse gases released by the industry is taken into account, the total emissions from the 185 paper mills in 2023 was 115 million metric tons — 350 percent more than officially reported to the public by EPA.[47] The discounting of carbon dioxide released through the burning of trees is questionable because it is not clear how many replanted trees will survive — or be cut down again and burned — and because carbon dioxide remains in the atmosphere for hundreds or thousands of years. For these reasons, a full and accurate accounting of the industry's greenhouse gas footprint is essential to tackling the climate crisis.

Most paper mills use wood as a primary fuel and ingredient. Studies have shown that burning wood produces more far more air pollution than burning coal or natural gas.

The table below identifies the 10 pulp and paper mills that EPA reported releasing the most greenhouse gases in 2023 (the most recent available year). EPA adjusted downward their "total" emissions by anywhere between 61 and 90 percent because they burned wood ("biomass.") After taking the full estimated emissions into account, the largest paper mills on this list released about as greenhouse gases as a large U.S. oil refinery.

Table 1. Pulp and Paper Plants that Reported Emitting the Most Greenhouse Gases (2023)

Rank	Facility	Location	Reported greenhouse gas emissions (not counting from the burning of wood)	Full estimated greenhouse gas emissions (including from the burning of wood)	% of emissions not counted because they came from wood	Fuels Burned
1	Georgia-Pacific Alabama River Cellulose, LLC	Perdue Hill, AL	378,850	2,506,948	85%	Wood, gas, black liquor, oil
2	Smurfit Westrock Covington Mill	Covington, VA	970,084	2,493,786	61%	Wood, black liquor, coal, gas
3	Rayonier Advanced Materials (RYAM), Jesup Mill	Jesup, GA	239,187	2,425,021	90%	Wood, black liquor, gas, oil
4	Smurfit Westrock Mahrt Mill	Cottonton, AL	437,315	2,243,528	81%	Wood, black liquor, gas, oil, propane
5	International Paper Mansfield Containerboard Mill	Mansfield, LA	671,632	2,134,519	69%	Wood, black liquor, gas, tires
6	Packaging Corp of America Counce Mill	Counce, TN	291,173	1,982,070	85%	Wood, black liquor, coal, gas, tires
7	Georgia-Pacific Brunswick Cellulose	Brunswick, GA	429,604	1,953,733	78%	Wood, black liquor, gas, oil, tires
8	Smurfit Westrock Evadale Mill	Evadale, TX	477,024	1,939,065	75%	Wood, black liquor, gas, oil
9	Sylvamo Eastover Mill	Eastover, SC	256,795	1,917,906	87%	Wood, black liquor, oil, gas, tires
10	Georgia-Pacific Cedar Springs	Cedar Springs, GA	571,921	1,905,810	70%	Wood, black liquor, coal, gas, oil, propane

Source: EPA's Greenhouse Gas Reporting Program (2023). EIP excluded plants that were no longer operating as of early 2025.

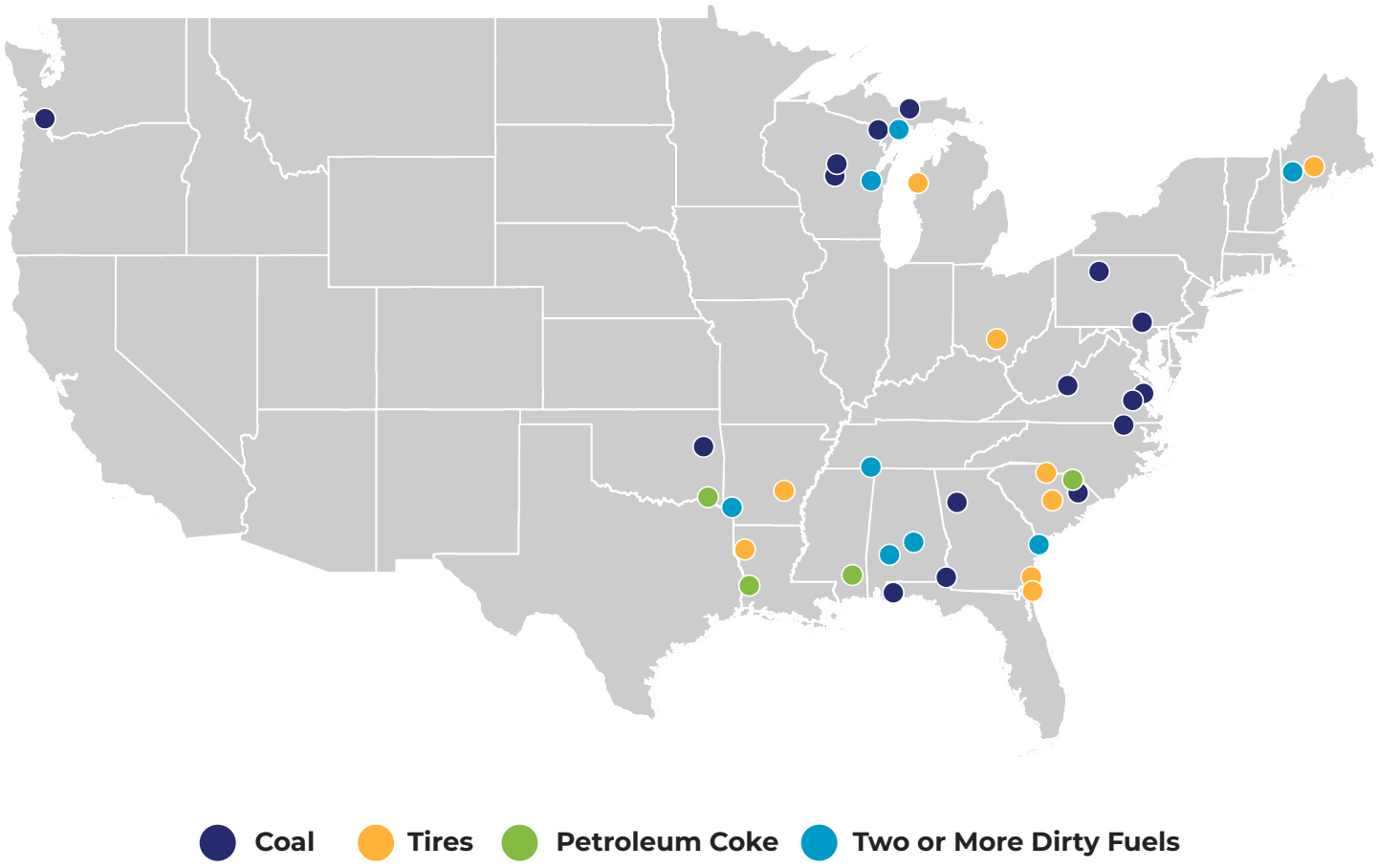
Though the industry is quick to argue that burning wood waste products (including black liquor and bark) is sustainable from a climate-warming perspective, lifecycle analyses have produced a mixed bag of results.[48] Regardless of whether burning biomass for energy is theoretically justifiable, in the real world — measured at the smokestack — it releases large amounts of greenhouse gases and other health-harming air pollutants.

Burning wood can be worse for air quality than burning coal. For example, one study in 2014 found that, per megawatt of energy produced, burning wood products results in 50 percent more carbon dioxide, 150 percent more nitrogen oxides, 600 percent more volatile organic compounds, 190 percent more particulate matter, and 125 percent more carbon monoxide than burning coal. This study also concluded that burning wood also releases about eight times more air pollution than natural gas.[49] Another study, from 2023, estimated that the emissions intensity of burning biomass at power plants was higher than at those that burned fossil fuels. Nitrogen oxides, volatile organic compounds, ammonia, sulfur dioxide, and fine particulate matter were 250 to 900 percent higher at biofuel-fired plants. Similarly, at non-electric generating plants that make steam or heat from biomass, emissions of the same pollutants were between 11 and 89 percent higher than at plants that burn fossil fuels alone.[50]

Other Dirty Fuels Burned by Pulp & Paper Mills

In addition to burning waste wood and other types of biomass, pulp and paper mills rely on a wide array of fossil fuels and other waste products to generate heat and power. These include coal, tires, petroleum refinery waste, oil, and natural gas. In total, 38 of the 185 plants we examined reported burning the dirtiest fuels: coal, tires and a waste product of refineries called petroleum coke or "petcoke." To break these numbers down more specifically: 25 plants burned coal, 15 burned tires, and seven burned petcoke. Georgia-Pacific's Savannah River mill in Rincon, GA, was the only plant that reported burning all three of these dirty fuels (coal, tires, and petcoke) plus wood. The nearly 40-year-old plant has some of the world's largest tissue paper making machines[51] and was among the top emitters of sulfur dioxide pollution in the paper industry in 2020 (third most among the 185 plants we studied), releasing 1,943 tons in 2020 and 1,448 tons in 2023.[52]

Map B. Pulp and Paper Mills that Burned Coal, Tires, and/or Petroleum Coke, 2023



Source: EPA's Greenhouse Gas Reporting Program, 2023

Far more plants reported burning black liquor: 90 of the 185 mills studied for this report burn this tar-like wood byproduct, often in recovery boilers. The burning of black liquor and other dirty fuels for industrial heat releases several potentially dangerous pollutants, which we will discuss in the next section.

Health-Harming Air Pollution

The 185 plants we examined reported releasing substantial amounts of health-damaging air pollution. According to EPA's 2020 National Emissions Inventory, the most recent data available, these large pulp and paper mills are major sources of particulate matter, sulfur dioxide, nitrogen oxides, and volatile organic compounds.

Health impact of these pollutants:

- **Particulate matter (PM)** is a category of microscopic, soot-like particles that can enter the lungs and bloodstream and trigger asthma attacks and premature death in people with heart and lung disease.[53]
- **Sulfur dioxide (SO_2)** can also harm the lungs, as well as contribute to the formation of particulate matter pollution after reacting with other compounds in the atmosphere.[54]
- **Nitrogen oxides (NOx)** damage the respiratory system while contributing to the creation of ground-level ozone (smog) and acid rain.[55]
- **Volatile organic compounds (VOCs)** are chemicals that contribute to smog and can have a variety of health impacts including difficulty breathing and nausea, and damage to the central nervous system, liver, kidneys and other organs. Some VOCs can cause cancer.[56]
- **Acetaldehyde ($CH_3CH=O$)** is a hazardous pollutant and organic chemical compound that can cause respiratory problems and is a probable human carcinogen.
- **Hydrogen sulfides (H2S)** are rotten-egg smelling compounds that can irritate the eyes and lungs and trigger headaches and nausea, among other health problems.

Table 2 below shows the total reported emissions of these pollutants, along with greenhouse gases, by the 185 pulp and paper plants EIP surveyed.

Table 2. Total Emissions Reported by U.S. Pulp and Paper Plants

Greenhouse Gases (metric tons) in 2023	Particulate Matter (PM10, tons) in 2020	Sulfur Dioxide (tons) in 2020	Nitrogen Oxides (tons) in 2020	Volatile Organic Compounds (tons) in 2020	Hydrogen Sulfide (pounds) in 2023	Acetaldehyde (pounds) in 2023
115,344,275	26,921	46,095	110,300	64,665	8,013,093	3,221,784

Source: EPA's 2023 Greenhouse Gas Reporting Program and 2020 National Emissions Inventory. The year reflects the most recent available date for federal data. Greenhouse gases expressed as carbon dioxide equivalent metric tons, or CO_2e.

The pulping process produces gaseous sulfur compounds including hydrogen sulfide that smell like cabbage or rotten eggs. Ninety-two of the 185 plants surveyed reported emitting a total of eight million pounds of hydrogen sulfide in 2023 to EPA's Toxics Release Inventory, with almost half that pollution coming from the top 12 plants.[57]

Hydrogen sulfide can irritate the eyes and lungs and trigger headaches and nausea.[58] At low concentrations, these odors are a nuisance and can degrade the quality of life for local residents, even if they do not pose an immediate health threat.[59] However, at high levels, hydrogen sulfide can exceed health and public safety standards and cause worse health problems. In these cases, community members sometimes take legal action and file class action lawsuits. For example, in 2022 a federal court approved a $1.1 million fine against the New-Indy paper mill in South Carolina, which generated nearly 50,000 odor complaints in less than two years (see case study on page 38).[60]

Pulp and paper mills are among the largest sources of hydrogen sulfide air pollution in the U.S., with six of the 10 largest single industrial emitters of this pollutant reporting to EPA's Toxics Release Inventory in 2023 coming from the paper industry.

Table 3. Total Hydrogen Sulfide Emissions Reported by Pulp and Paper Plants, 2023

Rank	Facility	Location	Hydrogen Sulfide Emissions (lbs)
1	American Kraft Paper Industries LLC	Pine Bluff, AR	523,791
2	Georgia-Pacific Naheola LLC	Pennington, AL	493,000
3	Rayonier Advanced Materials (RYAM), Jesup Mill	Jesup, GA	451,819
4	Smurfit Westrock Roanoke Rapids Mill	Roanoke Rapids, NC	420,252
5	International Paper Pine Hill Containerboard Mill	Pine Hill, AL	326,670
6	International Paper Prattville Containerboard Mill	Prattville, AL	315,654
7	International Paper Rome Linerboard Mill	Rome, GA	296,000
8	Clearwater Paper Corp Augusta	Augusta, GA	246,000
9	Suzano Pine Bluff Plant	Pine Bluff, AR	227,341
10	Georgia-Pacific Monticello	Monticello, MS	223,000

Source: EPA's Toxics Release Inventory (2023).

These plants also produce large amounts of several hazardous air pollutants. These include acetaldehyde (a probable human carcinogen that can cause respiratory problems); formaldehyde (a known carcinogen that can damage the lungs as well); and methanol (which can result in in blurred vision, headache, dizziness, and nausea if inhaled or ingested).[61] In total, the 185 pulp and paper plants we examined reported emitting 3.2 million pounds of

Trees are chipped as the first step of making pulp in the paper manufacturing process. Paper mills with outdated equipment release large amounts of pollution into local communities, including hydrogen sulfide, particulate matter and sawdust.

acetaldehyde; 937,234 pounds of formaldehyde; and 62.7 million pounds of methanol in 2023. For a complete list of specific sources of all these pollutants, see Appendix B.

Nationally, seven of the 10 biggest emitters of acetaldehyde in the U.S. that reported to the EPA were pulp and paper mills, including the top three. Below is a list of the biggest emitters of acetaldehyde among the pulp and paper mills we studied that reported to the EPA's Toxics Release Inventory in 2023.

Table 4. Top Paper Industry Acetaldehyde Polluters (2023)

Rank	Facility	Location	Acetaldehyde Emissions (lbs)
1	International Paper Prattville Containerboard Mill	Prattville, AL	158,132
2	International Paper Bogalusa Mill	Bogalusa, LA	152,169
3	Graphic Packaging International West Monroe	West Monroe, LA	138,600
4	Smurfit Westrock Mahrt Mill	Cottonton, AL	111,221
5	Rayonier Advanced Materials (RYAM), Jesup Mill	Jesup, GA	92,806
6	Green Bay Packaging Inc. Arkansas Kraft Div.	Morrilton, AR	92,651
7	International Paper Riegelwood Mill	Riegelwood, NC	87,763
8	International Paper Rome Linerboard Mill	Rome, GA	84,800
9	Graphic Packaging International Macon	Macon, GA	84,774
10	International Paper Vicksburg Containerboard Mill	Redwood, MS	84,483

Source: EPA's Toxics Release Inventory (2023).

Old and Outdated Boilers

Old and outdated boilers are among the largest sources of greenhouse gases and other air pollutants at pulp and paper mills. Boilers serve multiple functions in the production process, including producing heat and steam. Mills have two main boiler types: power boilers and recovery boilers. Power boilers create steam that drives turbines, which generate electricity for the entire operation. These boilers create almost half of greenhouse gas emissions released by pulp and paper plants — about 40 percent of the total. Power boilers accounted for at least 46 percent of the nitrogen oxide pollution, 57 percent of the sulfur dioxide pollution, and 35 percent of the hazardous air pollution reported by the industry in 2020.

The other type are recovery boilers, which are designed to burn black liquor at pulp mills. At least 88 of the 185 mills evaluated in this report had recovery boilers. Overall, these boilers represent a much smaller slice of total greenhouse gas emissions from the industry, about 2 percent of the total emitted. Recovery boilers accounted for at least 37 percent of the nitrogen oxide pollution, 16 percent of the sulfur dioxide pollution, and 62 percent of the hazardous air pollution reported by the industry in 2020.

Many of the boilers at paper mills are several decades old. Typically, at a well-run mill, managers will consider a boiler for replacement when they are about 15 to 20 years old, because their components begin to break down and their efficiency declines.[62] Climate experts have concluded that for the U.S. to meet a goal of net-zero greenhouse gas emissions by 2050, boilers will need to be replaced with low-emissions or zero emissions technologies on a more aggressive timeline, meaning every 15 years or sooner.[63]

Of the 185 pulp and paper mills examined for this report, 73 percent (135 total) have a boiler that is outdated (more

than 15 years old) and over 40 percent (77 total) have a boiler at least a half century old. Ten are much older and were built in the 1920s and 1940s. Many boilers have been modified over time to fix broken components, add pollution controls, enable fuel switching, and for other reasons. In some cases boilers are completely rebuilt, effectively leaving behind a new boiler. However, the boilers that have not been replaced will still have some aging components that can cause inefficiencies and excessive amounts of pollution.

The table below identifies the 10 pulp and paper plants that had the oldest boilers in 2023 (and were still operating by the time of this report's writing, in early 2025.) EIP determined the age of each boiler by reviewing EPA's detailed Greenhouse Gas Reporting Program data from 2023, permit records and other public documents related to emissions, and a large database that EPA published in 2012 for a national rulemaking pertaining to industrial heaters and boilers.[64]

Table 5. Pulp and Paper Plants with the Oldest Boilers

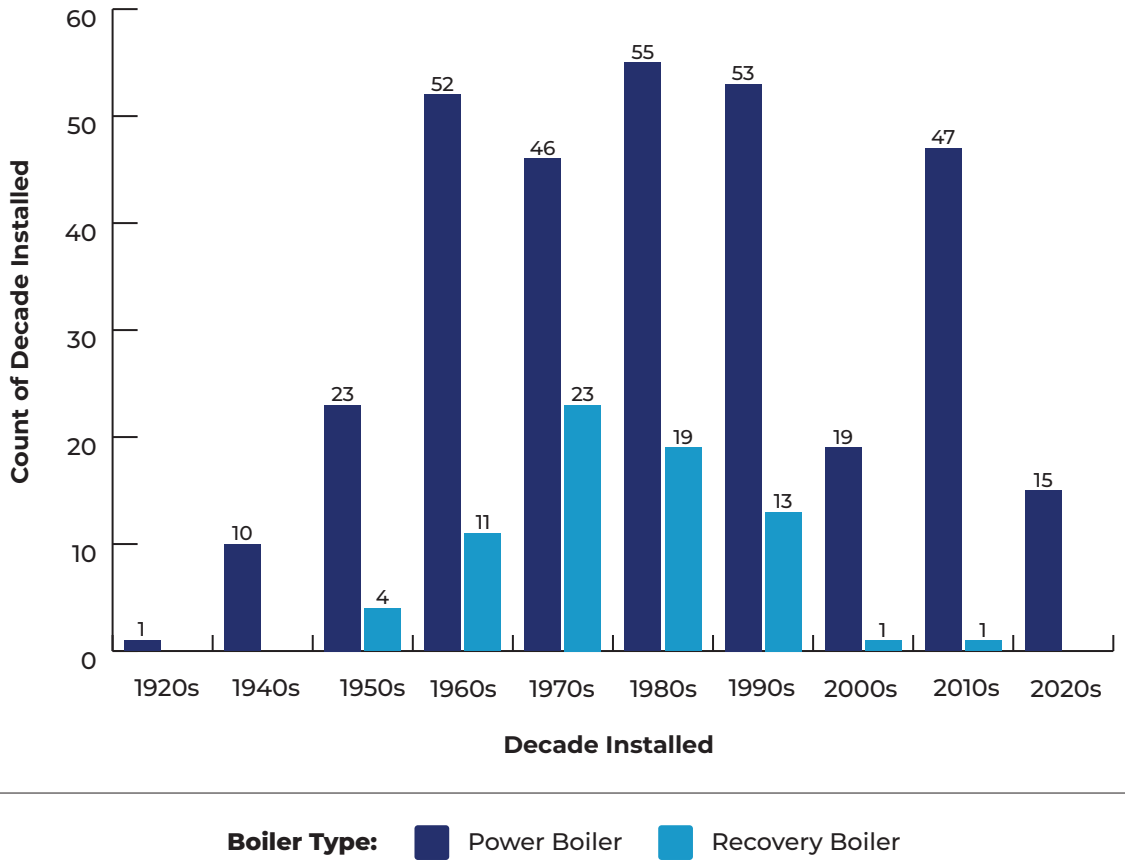
Rank	Facility	Location	Year Oldest Boiler Installed
1	Nippon Dynawave Packaging	Longview, WA	1928
2	Smurfit Westrock Covington Mill	Covington, VA	1940
3	Georgia-Pacific Big Island, LLC	Big Island, VA	1947
4	Billerud Escanaba LLC	Escanaba, MI	1947
5	Graphic Packaging International Macon	Macon, GA	1947
6	Domtar Paper Nekoosa Mill	Nekoosa, WI	1947
7	Smurfit Westrock St. Paul Mill	Saint Paul, MN	1947
8	Ahlstrom Thilmany Mill	Kaukauna, WI	1948
9	Ox Industries White Pigeon Paperboard Mill	White Pigeon, MI	1948
10	Smurfit Westrock Battle Creek Mill	Battle Creek, MI	1948

Source: 2012 Boiler MACT database and/or facility's Title V operating permit reviewed by EIP.

Steam rises from the more than century-old Smurfit Westrock paper mill in Covington, Virginia, forming an odorous backdrop for the community.

The graph below shows the distribution of these boilers' installation years by decade. The 185 paper mills examined for this report had at least 509 total boilers, whose ages (when available) are represented in this table.

Graph 3. Boiler Type by Installation Decade



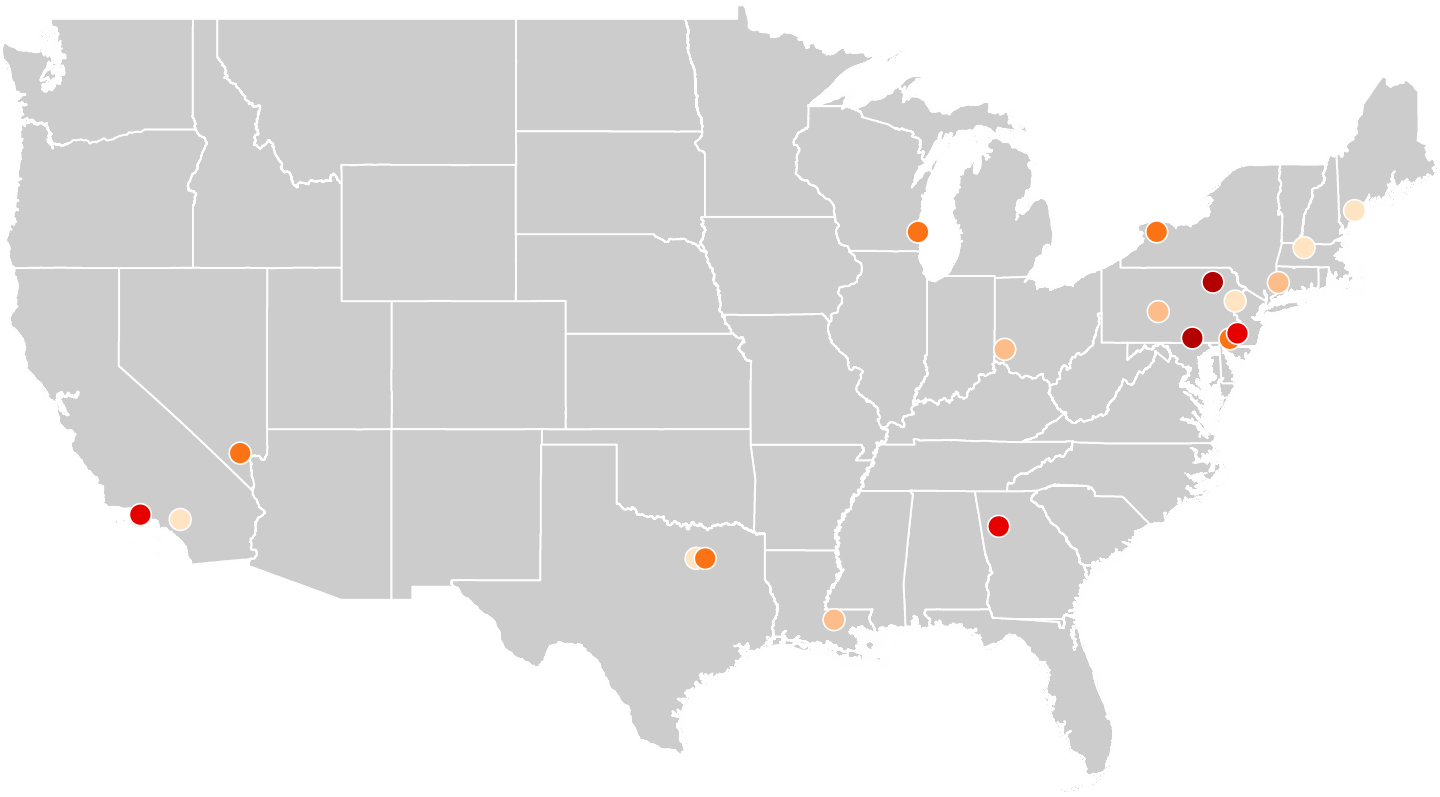
Note: The graph does not include 116 boilers (67 power boilers and 49 recovery boilers) from pulp and paper plants for which EIP was unable to identify installation years. **Source:** 2012 Boiler MACT database and/or facility's Title V operating permit reviewed by EIP.

Pulp and Paper Mills that Contribute to Areas with Bad Air Quality

The Clean Air Act provides additional protections to areas that already have unhealthy levels of certain kinds of air pollution. These regions are called "nonattainment areas" under the federal Clean Air Act. Under the law, emission sources in these zones must comply with more stringent pollution control requirements in order to return air quality to healthy levels. Areas that were previously unhealthy but have improved are called maintenance nonattainment areas because efforts must still be taken to ensure that pollution levels don't rise again.

In total, 23 pulp and paper mills were located in nonattainment areas in 2025, with 21 in areas with unhealthy levels of ground-level ozone, two in areas with unhealthy levels of fine particulate matter (PM2.5), and one in an area with unhealthy levels of sulfur dioxide.[65] Forty-two plants were in areas designated as maintenance nonattainment areas due to historically unhealthy levels of ozone, fine and coarse particulate matter (PM2.5 and PM10), carbon monoxide, or sulfur dioxide.[66] More information about the plants located in nonattainment or maintenance nonattainment areas is available in Appendix B.

Map C: Pulp and Paper Mills in Areas with Unhealthy Levels of Ozone Pollution (Nonattainment Areas)



Nitrogen oxide emissions in tons, 2023

Less than 15 **15 - 30** **30 - 60** **60 - 120** **More than 120**

Source: EPA's Enforcement and Compliance History Online database, most recent state emission inventories (2023).

Twenty one mills emitted nitrogen oxides in areas that already have unhealthy levels of smog (also known as ground-level ozone), which forms when nitrogen oxides and volatile organic compounds react with sunlight. Overall, the plants in these areas reported releasing 2,722 tons of nitrogen oxides in 2020, with 1,199 tons coming from boilers. In 2023, the plants in ozone nonattainment areas reported releasing 2,008 tons of nitrogen oxides, but emissions from individual boilers were not readily available due to differences in readily available state data. These plants primarily burned natural gas, with a few also burning oil or wood and two burning coal in their boilers, according to EPA's Greenhouse Gas Reporting Program.

The largest emitter in an ozone nonattainment area in 2023 was Pixelle Specialty Solutions' Spring Grove Plant in York County, Pennsylvania, located just south of Harrisburg. Pixelle reported emitting 874 tons of nitrogen oxides and 474 tons of volatile organic compounds in 2023, according to state data. This paper mill has a boiler that is 36 years old and the facility burns coal, among other dirty fuels. The Procter & Gamble Paper Products in Mehoopany, north of Scranton, Pennsylvania is also located in an ozone nonattainment area and reported releasing 541 tons of nitrogen oxides and 205 tons of volatile organic compounds in 2023. The remaining 19 mills reported emitting much less — ranging between 6 to 93 tons of nitrogen oxides and 1 to 139 tons of volatile organic compounds.

Clean Air Act Compliance

EIP surveyed EPA's Enforcement and Compliance History Online (ECHO) database for the compliance histories of 185 pulp and paper facilities in the U.S. and identified data from 183 plants. Based on these findings, as of April 2025, 63 plants had a violation reported at the federal, state, or local level in the last three years, and 22 of these had an air pollution "high priority violation" reported in that time. Ten of the plants that reported a high priority violation in the last three years had at least one existing violation that had yet to be addressed. It should be noted that while data from EPA's ECHO database offer a glimpse of the compliance and enforcement history of these plants, the data is not always complete. States — which have primary enforcement responsibilities under the Clean Air Act — do not always update or inform EPA's ECHO database about enforcement actions taken at the state level.

Of the pulp and paper plants with data available, state or federal agencies brought 267 enforcement actions against 95 plants in the last five years. These included $7.4 million in environmental penalties assessed against these facilities over the past five years.

Table 6. Ten Plants with the Most Frequent High Priority Air Pollution Violations (2022 to 2024)

Rank	Facility	Location	Quarters With High Priority Violations (Last 3 years)	Enforcement Actions (Last 5 years)*	Penalties (Last 5 years)
1	Graphic Packaging International Kalamazoo	Kalamazoo, MI	12	5	$228,513
2	Ahlstrom Mosinee Plant	Mosinee, WI	12	5	
3	Georgia-Pacific Toledo LLC	Toledo, OR	12	3	$125,904
4	Port Townsend Paper Corp	Port Townsend, WA	11	28	$63,750
5	Sonoco Products Co Hartsville	Hartsville, SC	11	3	$47,330
6	Billerud Escanaba LLC	Escanaba, MI	10	2	$35,000
7	American Kraft Paper Industries LLC	Pine Bluff, AR	5	3	$7,380
8	Ahlstrom Thilmany Mill	Kaukauna, WI	4	4	$25,000
9	Kimberly-Clark Corp New Milford Mill	New Milford, CT	4	3	
10	Cascades Containerboard Packaging Bear Island	Ashland, VA	4	2	

*Includes formal and informal enforcement actions.

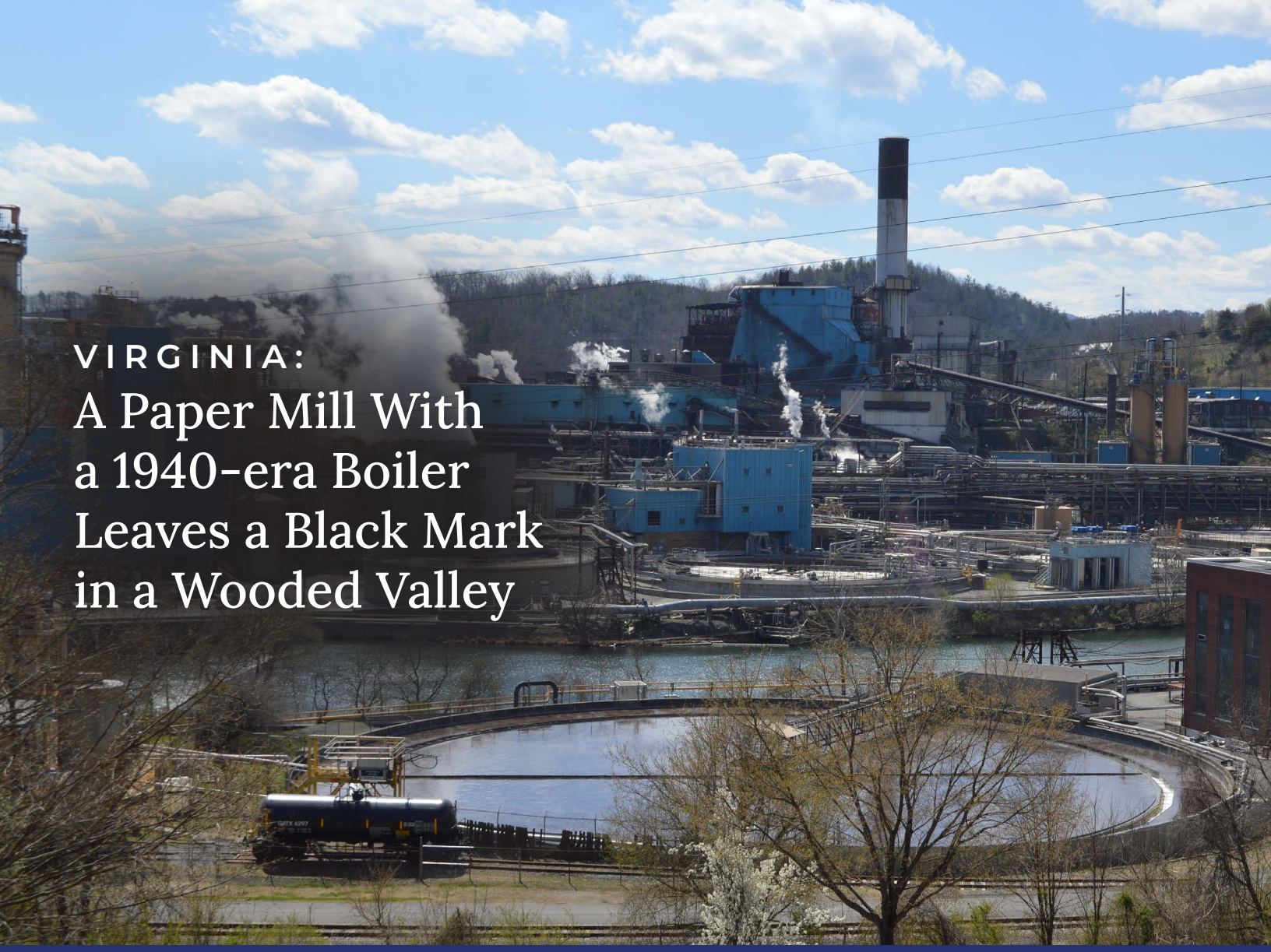
Source: EPA's Enforcement and Compliance Online History (ECHO) database.

Eighteen of the plants that burned either coal, petroleum coke, or tires were flagged by EPA as having a high priority Clean Air Act violation or as having a violation in the past three years. For example, New-Indy's Catawba plant in South Carolina, featured later in this report, violated its sulfur dioxide limits. The Ahlstrom plant in Mosinee, Wisconsin, also violated its permit requirements for sulfur dioxide, particulate matter, and hazardous air pollutants. Nippon Dynawave in Longview, Washington violated permit requirements for dioxins, which are extremely toxic at low levels and bio-accumulate in the environment, as well as for hazardous air pollutants.

CHAPTER 5

Case Studies of Paper Industry Harm

The smokestacks of the Smurfit Westrock paper mill rise over abandoned homes in the small town of Covington, Virginia. The mill provides jobs for some residents of the town, but also harms the local quality of life through air pollution, dust, foul odors and water pollution.



VIRGINIA:

A Paper Mill With a 1940-era Boiler Leaves a Black Mark in a Wooded Valley

The Smurfit Westrock paper mill in Covington, Virginia.

COVINGTON, VIRGINIA – In recent years, the 126-year-old Smurfit Westrock paper mill has been among the worst air polluters in the nation for nitrogen oxide, methane, and greenhouse gas emissions from the paper industry. The mill dominates the quality of life and landscape of this small town nestled in the Allegheny Mountains.

Smokestacks tower over front porches, playgrounds, and abandoned homes in this community of 5,500 people, many of whom work at the mill. All are dusted with soot and sawdust from the mill and its aging boilers, one dating back to 1940.[67]

"The snow is not white here. It's ash, it's nasty, and it's all over the place all of the time," said Robin Brown, a 65-year-old resident who lives near the mill.[68] "And there's that funky odor, like rotten eggs. It's all you can smell."

Upstream from the mill on the Jackson River, the water flows clear in one of western Virginia's most treasured trout-fishing destinations. But downstream, the stream is full of algae and sometimes turns black after what appears to be releases from the plant, according to fishermen who work the river and state records.[69] A fish kill immediately downstream from the mill on November 12, 2024, was linked to a release of tens of thousands of gallons of wastewater from the mill, according to state records.[70]

The Virginia Department of Environmental Quality (DEQ) says it is pursuing a penalty against the mill for that fish kill, according to Julia Raimondi, spokeswoman for the state agency.[71] But she added that the state has no legal authority to force the mill's owners to replace its 85-year-old boiler because the federal Clean Air Act has an exemption that often allows companies to keep operating old and outdated industrial equipment.

"DEQ has no authority to require WestRock to update their units because they are grandfathered under Clean Air Act regulations," Raimondi said. "If and when WestRock modifies those units, the units will then become subject to Clean Air Act regulations and DEQ regulatory authority."

With almost 1,000 employees, the Westrock mill — built in 1899, but purchased in 2023 by a company based in Ireland called Smurfit Kappa[72] — is by far the largest employer in the area. The mill rolls out 950,000 tons per year of paperboard that is used in food containers and other products.[73]

But the plant's antiquated heating systems — which burn coal, oil, and wood — contribute to an environmental footprint that weighs heavily on the lives of local residents.

"The odor gets so bad sometimes, you'll throw up if you come outside. I'll tell you this: It will kill us all some day."

- Donna Thomasson , a nurse who grew up on a hillside overlooking the mill.

Donna Thomasson, 34, a nurse who grew up on a hillside overlooking the mill, said she worries the plant's air pollution is harming the health of her neighbors. "I think it's getting worse," she said.[74] "The odor gets so bad sometimes, you'll throw up if you come outside. I'll tell you this: It will kill us all some day," she said, shaking her head at the reek in the air.

In her neighborhood, several of the homes are empty and have broken windows, and the elementary school is boarded up. Other houses are decorated cheerfully with gnomes, American flags, and easter eggs on a spring day, creating a contrast to the mill — with its hissing, roaring pipes, tanks, and smokestacks, as well as lights that blaze all night, hills of sawdust, and tractor trailers rumbling past loaded high with trees.

According to the EPA's Greenhouse Gas Reporting Program, the mill released 970,084 metric tons of greenhouse gases in 2023, the most of any U.S. paper mill.[75] But the mill released far more than that — an estimated 2.49 million metric tons, because EPA did not count 1.5 million metric tons from the burning of wood and other "biogenic" material, using the questionable claim that CO_2 from trees should not be counted because trees can be replanted.[76] In other words, the total estimated climate impact of this plant is 2.5 times what EPA reports as the plant's total emissions.

"Pollution from industrial factories burning trees is an under-counted source of climate-warming pollution," said Victoria Higgins, Virginia Director of the Chesapeake Climate Action Network.[77] "In order to deliver on the promise of clean air and a stable climate in Virginia, we need to ensure facilities like the more than century-old Westrock mill are moving to cleaner energy sources."

The Smurfit Westrock Covington mill is consistently among the top emitters of smog-forming nitrogen oxide (NOx) and other pollutants among pulp and paper mills, emitting 2,808 tons of NOx in 2020, the most in the industry that

Donna Goff, of Covington, Virginia, shows a visitor soot that she scraped off of her window frames from the Smurfit Westrock paper mill near her home. She said the dust and soot from the mill settles all over the neighborhood, making it hard to live with.

year; and 2,287 tons in 2023.[78] The mill was also the industry's No. 1 emitter of methane, a potent greenhouse gas (releasing 214,755 metric tons) in 2023 and No. 2 biggest emitter of greenhouse gases overall, that year. The plant was also the third biggest emitter of hydrochloric acid (170,000 pounds) among mills nationally in 2023, according to EPA data.

Natalie Moats, 60, has smokestacks looming up over her rooftop. She said she is concerned about the disease rates in the neighborhood.[79] For example, she said she knows 10 people who have had bladder cancer, which she finds suspicious. "The cancer rates here are terrible, and everybody knows it," she said. "People will tell you, 'that's the smell of money,' but I wouldn't mind if it closed"

Sawdust and ash are blown by the wind off the mill's 2,200 acre campus, which has heaps of logs being pulped and mountains of wood chips.

Donna Goff, 59, a local resident, showed a visitor a red plastic cup partially filled with dust that she scraped off her window sills that morning. "I just cleaned my windows, and — oh my goodness — there was so much ash, I had to spoon it out of the bottom of the window frames," Goff said.[80] "It's hard to live with."

State records show violation notices for nitrogen oxide air pollution at the mill, including two in 2021.[81] The state DEQ imposed minimal penalties of only $3,106 for an air pollution violation on April 25, 2023 and $28,788 for another air violation on February 18, 2016.[82]

Discharges from the plant triggered a water pollution violation notice from the state on August 25, 2023, for exceeding toxicity standards and threatening aquatic life.[83] The state also issued three warning letters for water pollution violations on May 10, 2023, October 21, 2022, and January 7, 2022.[84]

On a recent afternoon, Samuel Scott, a 34-year-old professional fishing guide, ventured down to a park to look at the water along the Covington waterfront. He reflected that while the Jackson River upstream from the mill is a great place for trout fishing because of its excellent water quality, downstream from the plant, it has a different nickname, "the Dirty Jackson."[85]

"They dump different substances into the river," said Scott. "Visually what we see is the river downstream from here will turn black, sometimes black as coffee, black as molasses. It'll lap up on the banks and in the vegetation and just stick to all the leaves and the vegetation. And once the water recedes, it's like a black tar that is left."

State records show at least a dozen incidents over the last five years of people reporting the mill dumping black liquor or other dark-colored or murky fluids into the Jackson River.[86] One of those complaints, filed on November 7, 2022, was headlined: "Polluted Water Destroying the Upper James River Fishery." But the complaint was quickly dismissed by the state DEQ with the comment that no action was needed because "the facility is permitted for discharges."[87]

Sam Scott, a professional fishing guide, said the Smurfit Westrock paper mill (shown here) releases pollutants into the Jackson River that will turn the waterway "black as coffee, black as molasses" for miles downstream.

Another report on November 12, 2024, said that 36,808 gallons of wastewater poured into the river from the plant because of an error during maintenance, leading to a fish kill.[88]

A professional fishing guide who has been working the Jackson River for years, Wesley Hodges, 40, said he also has often seen a black liquid from the mill discoloring the river downstream for miles.[89] He said the releases seem to happen most often when the U.S. Army Corps of Engineers releases water into the river from the Gathright Dam on Lake Moomaw, upstream from the paper mill.

"I also see a lot of abnormal algae growth and a drastic decline in the fishing below the paper mill," Hodges said. "I've seen more fish that are sick and have lesions on them downstream from the mill. It looks kind of like staph infections on the fish, swollen, red angry infections. And in the last four years, it's gotten worse."

Hodges said he's reported the mill's pollution to both the state and EPA, but neither of them seem motivated to take action. "The vast majority of families here — you will not see a single soul swimming in that water downstream from the mill," Hodges said. "Upstream it's a pretty clean river. It's beautiful. So one facility is impacting the water quality for the whole community."

WASHINGTON:
Scenic Town Tainted by Paper Plant Odors and Pollution

The Port Townsend Paper Company burns wood, oil, and methane and uses outdated equipment, including a 50-year-old boiler, that produces excessive amounts of air pollution.

PORT TOWNSEND, WASHINGTON – The view from the hillside of this small town two hours north of Seattle near Puget Sound includes snowy mountain peaks, orca-inhabiting waves, towering fir and spruce trees, and a 100-year-old paper mill and its churning smokestacks.

The sulfurous odor from the Port Townsend Paper Company's sprawling waste ponds is easily detected from the main road into town and provides an uninviting welcome to an otherwise picturesque town.

The odor is not the only concern locals have about the pulp and paper mill, which is the largest private employer in Jefferson County. The plant burns wood, oil, and methane and uses outdated equipment, including a 50-year-old boiler,[90] that produces excessive amounts of air pollution.

The paper mill has been identified as having been in violation of the Clean Air Act for 12 of the last 12 quarters, including for releasing hazardous air pollutants and soot, according to EPA's Enforcement and Compliance History Online database.[91] State and federal regulators have hit the plant with five enforcement actions but minimal penalties totaling $63,750 over the last five years, along with 23 air pollution violation notices, according to EPA records.[92]

A June 2024 study by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) determined that breathing

the sulfur compounds in the air near the mill could contribute to lung disease or irritation.[93]

Aaron Young, an environmental health scientist for the agency, said in a public meeting around the study's release that "by measuring the range of sulfur compounds, we have evidence that, yes, multiple of these contaminants can occur at a high level together, and together they can have acute health effects."[94]

The study also noted that "repeated exposure to offensive odors perceived as unpredictable or uncontrollable may also add significantly to individuals' stress levels and affect quality of life. Chronic stress can harm people's health in a variety of ways."

Don Ehnebuske, who has lived in Port Townsend for nearly a decade and has a view of the mill from his house, attended the meeting where Young spoke and left outraged at what he considered its weak recommendations.[95]

"The report was a disappointment in how limp it was," he said. "They recommended things like closing your windows when the odor gets bad. I know the mill has no financial incentive to do anything about the odor as long as it's meeting requirements."

> "**Nobody really knows what's coming out of the pipes from the mill** and what effect the effluent is having on the bay."
>
> **- Alea Waters,** resident in the area for two decades and who has fought for better air pollution standards at the mill in the past.

Atlas Holdings, a private equity firm headquartered in Greenwich, Connecticut, purchased the paper mill in October 2022. Atlas was founded in 2002 with the purchase of a paper mill in Indiana and now owns 25 companies with about 50,000 employees in 350 manufacturing and distribution facilities across the globe.[96]

Ehnebuske worries that Atlas really has only one goal in mind — generating profits. After the federal study of health risks was issued, Ehnebuske put together a group of people interested in working with the mill in a cooperative way to address the pollution issues. He said the mill's management completely rejected them.

While Ehnebuske and his group were mainly concerned about the smell and how to improve the wastewater ponds through better aeration and dredging, others are concerned about the wastewater discharge into the surrounding bay, which feeds into the Puget Sound network of estuaries that supports abundant aquatic life, including orcas.

The Port Townsend Paper Corporation operates a large industrial wastewater treatment plant and a small sanitary wastewater plant that discharge into Port Townsend Bay. It has been in the process of getting a new and updated water pollution control permit[97] because the plant has been operating under an extension since its last permit expired in 2018.

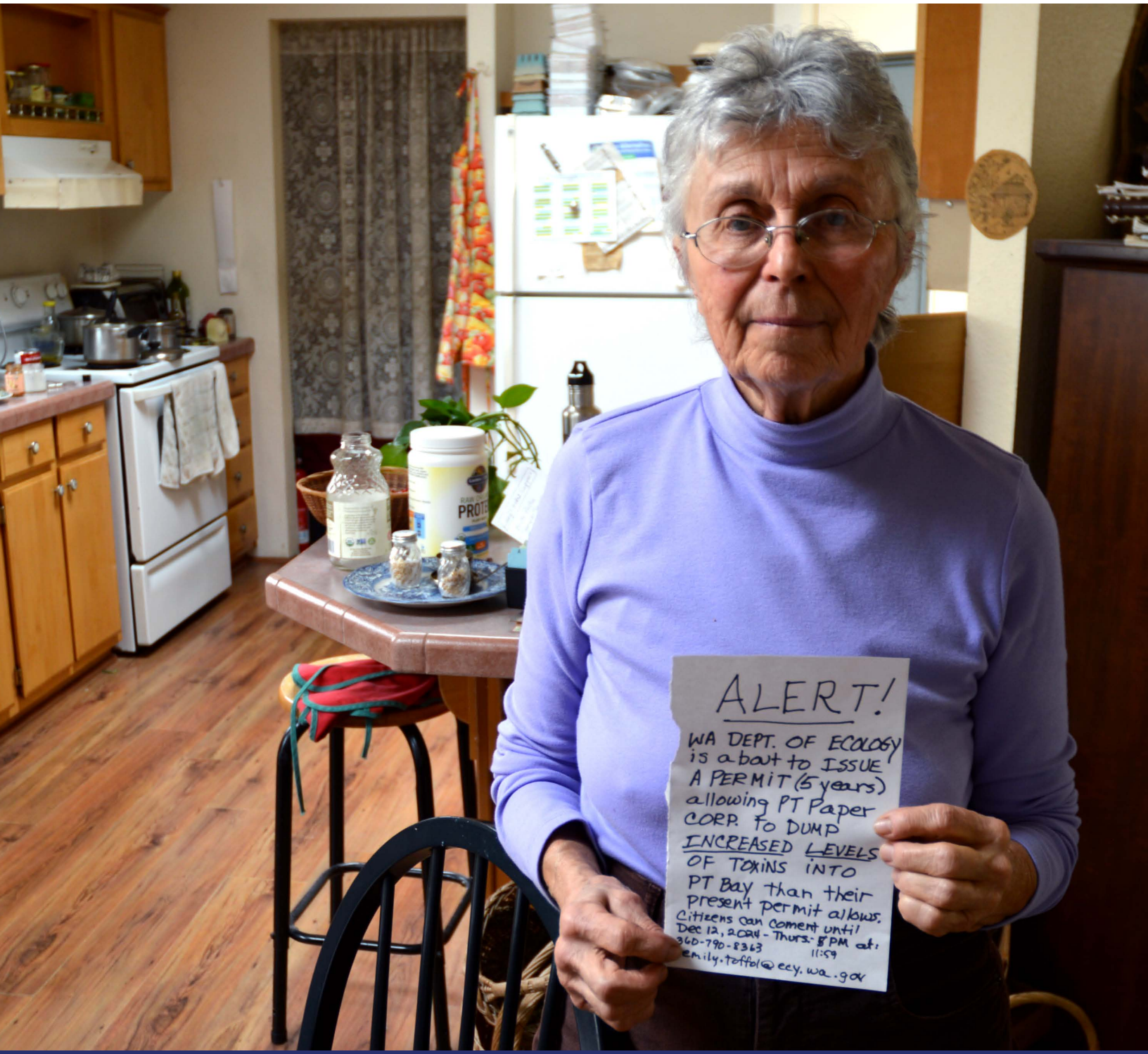
The mill has been hit with six enforcement actions for water pollution violations with minimal fines ($44,000) over the last five years, according to EPA records.[98]

The draft water pollution control permit imposes new effluent limits for some pollutants (including benzo(a) anthracene and chlordane, both probable carcinogens), as well as testing for the discharge of "forever chemicals," or PFAS, and the undertaking of an odor minimization study.[99]

Alea Waters, who has lived in the area for two decades and fought for better air pollution standards at the mill in the past, attended a Dec. 4, 2024, public hearing on the current draft permit for the mill's wastewater. She left the meeting unpersuaded that the permit addressed her concerns.[100]

She said while the permit includes new limits on certain pollutants and calls for increased testing, it also increases certain discharge limits, including for suspended solids, because the mill has increased its production since the approval of its last permit over a decade ago. The mill's capacity has increased from 480 oven-dried tons of pulp per day to 720 tons per day.

"Nobody really knows what's coming out of the pipes from the mill and what effect the effluent is having on the bay," Waters said. "We love the orcas that are going extinct due to several prime factors, one of which is water pollution... We love the octopuses, the star fish, the crabs, and the salmon which are in the same situation."



Alea Waters is concerned about the water pollution from the Port Townsend mill and is pushing the state to impose tighter permit limits to protect marine life. "We love the orcas that are going extinct due to several prime factors, one of which is water pollution."

SOUTH CAROLINA:
A Paper Mill's Long History of Pollution Violations and Lawsuits

The New-Indy paper mill has faced multiple lawsuits, including for alleged water pollution and hazardous waste violations and noxious odors. Photo by Greg Nance, Catawba Riverkeeper

CATAWBA, SOUTH CAROLINA – New-Indy Containerboard, a paper and pulp mill in Catawba, South Carolina, has faced tens of thousands of air quality complaints since being acquired in 2018 by an investment group led by Robert Kraft, the billionaire owner of the New England Patriots football team, for roughly $300 million.[101]

Shortly after the acquisition, the plant shifted from manufacturing bleached paper products to brown containerboard used to make boxes used primarily for e-commerce shipping. Complaints about noxious fumes — smelling of rotten eggs or spoiled cabbage — started pouring in by the thousands during this transition.

In May 2021, local residents filed a class action lawsuit against the mill seeking millions of dollars in compensation, claiming their health had been harmed by the overwhelming odors.[102] The same month, EPA issued an emergency order to reduce the mill's emissions of hydrogen sulfide — which can cause headaches, coughing, and throat irritation — to meet limits as monitored at the fence line.[103]

"The steps taken by EPA today are necessary to address levels of hydrogen sulfide that have impacted residents along the North Carolina and South Carolina border, and Catawba Indian Nation," said EPA Acting Region 4 Administrator John Blevins.

But the mill's pollution problems did not stop there.[104] The plant has an antiquated boiler system that dates back

to the Eisenhower Administration.[105] And in 2023, the New-Indy mill was the worst polluter in the nation for zinc, which can cause lung irritation and fever, and mercury — a potent neurotoxin that can damage the brain and other organs — among the 185 largest paper mills across the U.S. for which information was available. The plant reported releasing 42,116 pounds of zinc air pollution that year and 41 pounds of mercury, according to data from EPA's Toxics Release Inventory (TRI).[106] Those totals made the mill the ninth worst zinc polluter in the nation in 2023 among all industries that report to TRI and the 155th worst mercury polluter out of approximately 1,049 facilities, placing the plant inside the top 1 percent of largest zinc emitters and top 15 percent of mercury polluters.

In July 2022, lawyers for local residents sued the mill again for shutting down a piece of equipment vital to controlling odors — known as a steam stripper — and failing to obtain a required permit[107] as part of the transition process from paper to cardboard production.

Lawyers for area residents said they were looking for "an expeditious end to New-Indy's toxic emissions .... This community deserves better, and we look forward to holding New-Indy fully accountable for the harm it has caused."[108]

In November 2022, a federal court approved an EPA consent decree, including $1.1 million in penalties, resolving allegations that the plant "was causing an imminent and substantial endangerment to public health or welfare or the environment."[109] The agency gave New-Indy until June 2025 to install a new steam stripper to filter out hydrogen sulfide and other contaminants.

In 2023, New-Indy in South Carolina was No. 1 largest emitter of zinc and mercury air pollution among large U.S. paper mills. The mill released:

42,116 lbs of zinc and

41 lbs of mercury.

"This settlement provides significant environmental benefits to the surrounding communities by ensuring they are protected from pollution from this facility through mandatory long-term improvements designed to ensure cleaner air," said Larry Starfield, Acting Assistant Administrator for EPA's Office of Enforcement and Compliance Assurance, of the consent decree.

However, the violations continued. In March 2023, EPA sent New-Indy a letter detailing a slew of nineteen additional violations, namely that the company might not be in compliance with the Clean Air Act regarding chemicals including hydrogen sulfide, nitrous oxide, VOCs, and sulfur dioxide.[110]

On February 13, 2023, local residents filed another lawsuit against the paper mill alleging violations of the Clean Water Act and federal hazardous waste control laws at the New-Indy plant.[111]

"Papermill waste is being stored in large unlined lagoons near the banks of the Catawba River," said Catawba Riverkeeper Brandon Jones. "Our goal is to protect current and future users by requiring the removal of New-Indy's waste from unlined storage near the river."

In May 2024, the paper mill agreed to a $103 million settlement over the odors and wastewater complaints, with the company pledging to make improvements at the plant.[112] The settlement would pay $18 million to about 6,000 homeowners living within a roughly 20-mile radius of the mill.

Included in the settlement, New-Indy would also be required to pay at least $85 million for cleanup activities to resolve three lawsuits accusing the defendants of violating the Clean Water Act and hazardous waste laws and failing to obtain an air pollution control permit.[113] New-Indy would be required to install a new pollution control

device (a steam stripper), restore and modify their existing steam stripper, improve the structural integrity of three waste storage lagoons, cap two lagoons, and make other improvements.[114]

Jones said the Catawba Riverkeeper is pleased the settlement includes some cleanup activities. However, he said the site still has groundwater contamination that is moving towards the river. He looks forward to the state of South Carolina finally updating New-Indy's water pollution control permit, which was last updated in 2014 and has been administratively extended since 2019.

"New-Indy has to take ownership as to what they need to do to correct the issue and that's what the lawsuit is forcing them to do," said Reed Baker, a local resident involved in the class action lawsuit.[115] "They're going to fix the ponds. They're going to put a new stripper in. They are going to be good corporate neighbors."

CHAPTER 6

Solutions Include Cleaner and More Efficient Technologies

Many pulp and paper mills could reduce their pollution by switching from dirty fuels like coal, tires, and wood to cleaner alternatives and by using more modern systems like heat pumps.

Solutions Include Cleaner and More Efficient Technologies

How can pulp and paper mills fix these pollution problems? Despite some recent switches away from coal to natural gas-powered boilers, pulp and paper mills can further reduce greenhouse gas emissions — and cut their health-damaging air pollution — by using cleaner and more efficient alternatives in their industrial processes.

For example, most of the plants examined for this report do not use industrial heat pumps, which have advanced in recent years and can significantly reduce pollution while increasing efficiency. Heat pumps work by moving heat from one area (air, water, or in the ground) and amplifies it to be used at another, rather than generating heat energy themselves.[116] The pulp and paper industry requires much lower heat temperatures compared to other industries, with over 90 percent of heat demand lower than 200 degrees celsius.[117] This leaves a large portion of heating that can be filled by industrial heat pump technologies, which have recently begun to provide heat up to 200 degrees celsius.[118] Industrial heat pump usage could reduce energy demand and greenhouse gas emissions for the industry by about 50 percent.[119]

One complicating factor is that the pulp and paper industry is the largest self-generator of electricity among all U.S. industrial sectors, with 67 percent of the overall energy required by plants being self-generated as of 2015.[120] Additionally, 39 of the pulp and paper plants EIP surveyed also reported selling electricity back to the wholesale market in 2023.[121] Most of the electricity they generated came from burning wood and fossil fuels.

Boilers at pulp mills are also often used as pollution control devices to mitigate emissions of toxic gases from the pulping process and to recover chemicals from black liquor. These wastes will still need to be managed responsibly to protect human health and the environment. One emerging process alternative involves turning black liquor into a gas. Burning this gas could provide electric generation capacity of up to 250-500 MW per mill,[122] enough to provide the electricity and steam needed by many plants.[123] Research has shown that there is a potential for a reduction in greenhouse gases when gasifying black liquor, but this potential is much greater at mills solely manufacturing pulp.[124] Some plants have also installed methane digesters to capture methane from wastewater treatment. However, burning methane and gases produced by gasifying black liquor could also result in climate and health-harming emissions.

To reduce their emissions, pulp and paper mills could pull energy from the grid where electricity grids are dominated by renewable and clean energy sources, like in the Pacific Northwest.[125] They could also install industrial heat pump technologies that reduce overall energy demand while improving heat use efficiency. Toxic gases from the pulping process could be destroyed in other combustion equipment on-site, like thermal oxidizers or lime kilns, rather than in boilers.[126] Other studies have recommended a number of improved operational efficiencies, better maintenance, and use of alternative materials that could further reduce emissions.[127] And at a more basic level, plants should install widely used pollution controls, like scrubbers, and stop burning the dirtiest fuels.

Cleaning up the pulp and paper industry is complex — with details and costs that will vary from site to site — but it could be encouraged through fair and effective enforcement of existing pollution laws and targeted government policies and incentives. Congress and the federal government agreed there is a need to integrate heat pumps into industries such as pulp and paper to reduce greenhouse gas emissions. In 2022, Congress passed the Inflation Reduction Act at President Biden's urging, which included $250 million to boost domestic heat pump manufacturing that was ultimately disbursed to twelve manufacturing projects.[128] These projects should drastically increase industrial heat pump production, reducing purchase costs and improving efficiency further. However, President Trump has threatened to freeze some of the act's funding, so it is not yet clear if these subsidies will survive.

CHAPTER 7

Recommendations

EPA and state regulators should impose and enforce tighter air pollution limits on pulp and paper mills and use more accurate methods of estimating their greenhouse emissions. The industry should replace outdated boilers and continue its shift toward using recycled materials.

Recommendations

The rise of e-commerce and the cardboard boxes needed to ship goods via Amazon and other online businesses has ensured that paper and paperboard demand will remain significant in the years ahead even as newspapers and other printed material continue to decline in demand.

While paper mills have been features of the economy and landscape since colonial times in America, they remain major sources of industrial air and water pollution at dozens of sites across the U.S. and are heavily reliant on outdated boiler systems and dirty fossil fuels.

While environmental regulations have pushed the industry toward cleaner production methods, pollution remains a persistent issue, necessitating further innovation and adoption of more modern industrial systems and cleaner fuel sources.

Boilers at pulp and paper mills, in particular, are large sources of climate-warming greenhouse gases. Overall, the boilers operating at these plants are quite old — averaging 41 years at the 185 largest U.S. paper mills studied by EIP for this report. This is a major problem because older boilers tend to be less efficient and release higher rates of pollution. Of the 185 pulp and paper plants EIP analyzed, 73 percent (135 total) have boilers that are outdated (meaning more than 15 years old) and over 40 percent (77 total) have boilers that were installed at least 50 years ago. In addition to burning wood products — which releases large amounts of air pollution — many pulp and paper mills also use a wide array of fossil fuels and other dirty energy sources, including coal, tires, petroleum coke, and waste oil. In total, 38 plants reported burning the very dirtiest fuels — a practice that must end to protect local public health and the global climate.

The paper industry also grossly underestimates the actual greenhouse gases these plants release because EPA allows the mills to subtract the amount that came from burning "biogenic" fuels like wood and wood byproducts like black liquor. This reduces pressure on the industry to modernize and use cleaner fuels.

The pulp and paper industry can and must significantly reduce greenhouse gas emissions by using more efficient and modern alternatives at facilities — rather than undercounting these emissions with questionable accounting methods.

To address these issues, this report makes the following recommendations:

1. **Pulp and paper mills should switch to cleaner fuels and replace outdated boilers with zero-emission industrial heat technologies**. The 185 mills in this report rely on often outdated boilers — averaging more than four decades old — and an array of dirty fuels, including coal, tires, petroleum coke, waste oil, fuel oil, natural gas, wood, and black liquor. Where possible, mills should update their equipment, switch to cleaner fuels, and install modern technologies like industrial heat pumps, which efficiently transfer heat rather than create it. These pumps could reduce energy demand and greenhouse gas emissions by about 50 percent, while also cutting health-damaging air pollutants.[129]
2. **Continue the shift toward more recycled paper.** Using virgin wood to make pulp and paper is considerably more damaging to the climate and the environment than using recycled paper. Manufacturing a ton of cardboard from 100 percent recycled paper requires no new wood, about half the energy, 32 percent less water, and creates 10 percent less solid waste and about a quarter of the climate-warming emissions compared to making corrugated cardboard from virgin wood.[130] Around 80 percent of U.S. paper mills today already use some recycled paper as an ingredient.

3. **States and EPA should set more stringent pollution limits and vigorously enforce the limits that exist.** By ratcheting down pollution limits, states and the EPA can incentivize paper mills to invest in more efficient, cleaner technologies. Along with safeguarding public health for communities, updated and tightened regulations provide guidelines that ensure the U.S. paper industry will remain on the forefront of technological advancement while also maintaining regulatory certainty. Violations of both water and air pollution limits should be penalized significantly so that companies have a financial incentive to improve their plants.

4. **The pulp and paper industry should accurately account for emissions from burning wood and black liquor.** Pulp and paper mills are large sources of industrial greenhouse gas emissions. However, their contribution is grossly underestimated because EPA has allowed them to exclude the amount that came from burning "biogenic" fuels like wood and wood byproducts like black liquor. The industry also falsely claims that burning wood and black liquor is clean and sustainable, even though their reported pollution and environmental track record demonstrate otherwise. EPA must improve the accuracy of its federal greenhouse gas reporting program, while also protecting the program from cuts or elimination by the Trump Administration.

Appendix A: Methodology

Facility Identification

EIP identified pulp and paper mills that reported to EPA's Greenhouse Gas Reporting Program (GHGRP) 2023. Using a facility's North American Industry Classification System (NAICS) code(s) reported to GHGRP, we removed those that did not report under pulp and paper manufacturing NAICS codes (322110, 322120, 322130). We also excluded facilities that news reports or company websites have identified as closed facilities. EIP also included two mills that reported greenhouse gas emissions in 2022 but stopped reporting in 2023 and are still operating. This narrowed our universe of plants surveyed to 185 plants. We matched the 185 plants with facilities in EPA's Enforcement and Compliance History Online (ECHO) database and EPA's 2020 National Emissions Inventory. A detailed spreadsheet of the plants included in this report is available in Appendix B.

The table below lists the plants that were excluded from this report.

Table A1. Plants Excluded From This Analysis

GHGRP ID	Facility	Location	NAICS Code	Year Plant Closed
1001733	International Paper - Red River Mill	Campti, LA	322120	2025
1004982	Graphic Packaging International Inc	Middletown, OH	322130	2025
1005970	Newark America	Fitchburg, MA	322130	2025
1012019	Caraustar Industries Dba Tama Paperboard	Tama, IA	322130	2025
1000228	International Paper - New Bern Mill	Vanceboro, NC	322110	2024
1005909	International Paper - Orange Mill	Orange, TX	322130	2024
1007912	International Paper - Georgetown Mill	Georgetown, SC	322120	2024
1000230	Blue Ridge Paper Products LLC	Canton, NC	322110	2023
1000345	Foley Cellulose, LLC	Perry, FL	322110	2023
1000426	Westrock Charleston Kraft, LLC	Charleston, SC	322120	2023
1000590	Georgia-Pacific Consumer Operations LLC	Green Bay, WI	322120	2023
1000593	Pixelle Androscoggin LLC	Jay, ME	322120	2023
1000624	Westrock Tacoma Mill	Tacoma, WA	322130	2023
1004961	Sonoco Hutchinson	Hutchinson, KS	322130	2023
1006520	Cascades Tissue Group-Oregon, A Division Of Cascades Holding Us Inc	Saint Helens, OR	322120	2023
1004672	Graphic Packaging International, Inc.	Battle Creek, MI	322130	2022
1005704	Dunn Paper Inc.	Port Huron, MI		2022
1006958	Westrock CP, LLC - Panama City Mill (Formerly Rocktenn)	Panama City, FL	322110	2022
1008999	Cosmopolis Pulp Mill	Cosmopolis, WA	322110	2022
1000311	Resolute Forest Products Calhoun Operation	Calhoun, TN	322120	2021*
1004874	Wisconsin Rapids Paper Mill	Wisconsin Rapids, WI	322120	2020
1002596	Appvion - Appleton PLT	Appleton, WI	322230	N/A

GHGRP ID	Facility	Location	NAICS Code	Year Plant Closed
1004098	Marcal Manufacturing, LLC.	Elmwood Park, NJ	322291	N/A
1004113	Sca Tissue	South Glens Falls, NY	322291	N/A
1011252	KTG (Usa) Inc.	Memphis, TN	322291	N/A
1011427	Huhtamaki, Inc.	Waterville, ME	322299	N/A
1013683	Sofidel America	Circleville, OH	322291	N/A

*Plant stopped pulp and paper manufacturing in 2021, switching to solely tissue paper production.

Identifying Boilers and Installation Years

Facilities that reported to the GHGRP reported the emissions released by individual emission units, including boilers. In certain instances, facilities aggregated multiple units into one reporting unit. EIP disaggregated these units, where possible, in order to match specific unit data from the GHGRP, 2020 National Emissions Inventory and information from permit records and other sources like boiler capacity and installation year. Fuels burned by each emission unit were obtained from the GHGRP.

EIP determined when boilers were installed by reviewing data and records available from several sources. These included EPA's 2012 Boiler MACT database and/or Clean Air Act permit documents. When a range was the only available information for a boiler's installation year, the earlier year was used. In some cases, we were able to determine when a unit began emitting by looking at historical GHGRP emission data. Permit records were sometimes unclear about the distinction between modification and installation dates. EIP checked against Clean Air Act New Source Review permit records where available in order to verify these dates.

EIP determined each facility's initial construction year by reviewing publicly available records and online publications including company websites, news articles, and historical accounts.

Air Pollution Emissions

EIP evaluated emissions from 185 plants that reported to EPA's GHGRP in 2023 and were still operational as of early 2025. Biogenic emissions (from burning biomass) were added to the total reported emissions to determine each plant's actual 2023 emission footprint.

Emissions of toxic pollutants — such as hydrogen sulfide and acetaldehyde — are from EPA's 2023 Toxics Release Inventory and represent the total of fugitive and stack emissions reported by each plant.

Conventional pollutants, like nitrogen oxides, sulfur dioxide, particulate matter (PM10), and volatile organic compounds are from EPA's 2020 National Emissions Inventory (2020 NEI), the most recent national dataset available. EIP also evaluated the most recent state emission inventories in order to obtain more recent emission estimates for select plants. The 2020 emission data may be outdated. For example, four of the largest sources of sulfur dioxide emissions had significantly reduced their emissions by 2023. However, the 2020 NEI is one of the only nationwide datasets that provides unit-level emissions, including from individual boilers.

The emissions data in this report do not reflect the emissions from the entire pulp and paper industry. Not all facilities are required to report. National emissions inventory reporting requirements differ depending on a facility's potential to emit and whether it is located in a nonattainment area.[131] Further, hazardous air pollutant (HAP) emissions are voluntarily collected by state agencies (40 CFR 51.15(a)(4)).[132] Greenhouse gas emission reporting is also

limited to plants that emit more than 25,000 metric tons of CO_2 equivalents per year and are in specific industrial categories.[133]

Identifying Mills in Clean Air Act Nonattainment Areas

EIP determined whether plants were located in nonattainment areas using information available in EPA's Enforcement and Compliance History Online database. The database lists whether plants are in nonattainment or maintenance nonattainment areas, and for which pollutants.

Clean Air Act Compliance and Enforcement

EIP obtained compliance data from EPA's Enforcement and Compliance History Online database on April 10, 2025. The data reflects the past three years of alleged violations (Quarter 2 in 2022 to Quarter 1 in 2025) and the past five years for stack test failures, enforcement actions, and penalties assessed (Quarter 2 in 2020 to Quarter 1 in 2025). The number of enforcement actions in this report are the total of both formal and informal enforcement actions.[134] However, while data from EPA's ECHO database offer a glimpse of the compliance and enforcement history of these plants, the database is not always complete.

Appendix B: Pulp & Paper Mill Database

References and Endnotes

[1] Hellen Chen and Andrew Hoffmeister, "Net-Zero Industry by 2050: A Scenario Analysis of Boiler Replacement with Industrial Heat Pumps," American Council for an Energy-Efficient Economy, page 4, December 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.

[2] The average age of a boiler at the 185 largest paper mills examined by EIP for which data was available was 44 years.

[3] Pulp and paper mills also burn black liquor to recover chemicals.

[4] 2023 is the most recent available year for this data. U.S. EPA, "2023 Data Summary Sheets Direct Point Emitters Total Reported Direct Emissions." Accessed April 10, 2025. Link: https://www.epa.gov/system/files/other-files/2024-10/2023_data_summary_spreadsheets.zip.

[5] U.S. EPA, "2023 Data Summary Sheets Direct Point Emitters Total Reported Direct Emissions and Biogenic CO_2 Emissions." Accessed April 10, 2025. Link: https://www.epa.gov/system/files/other-files/2024-10/2023_data_summary_spreadsheets.zip.

[6] These 10 plants only included facilities still operating as of January 2025.

[7] For criteria pollutants including sulfur dioxide and nitrogen oxides, 2020 is the year with the most recent available federal data. U.S. EPA, "National Emissions Inventory (NEI)." Accessed November 2024. Link: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei.

[8] These are emissions as reported to the U.S. EPA, "Toxics Release Inventory (TRI) Program." Accessed April 2, 2025. Link: https://www.epa.gov/toxics-release-inventory-tri-program.

[9] Ibid.

[10] While data from EPA's ECHO database offer a glimpse of the compliance and enforcement history of these plants, the data are not always complete. For example, in Texas, regulators routinely decline to enforce numerous air pollution violations by industries, allowing companies to argue that many of their pollution releases should be excused because they are allegedly uncontrollable and unexpected and therefore can be shielded by a loophole called the "affirmative defense." States – which have primary enforcement responsibilities under the Clean Air Act – do not always update or inform EPA's ECHO database about enforcement actions taken at the state level. U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Westrock Virginia, LLC." Accessed April 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=VA0000005158000003&sys=AIR.

[11] Virginia Department of Environmental Quality (2024) State Point Source Emission Inventory. The plant reported to the state it released 2,287 tons of NOx in 2023. In 2020, the plant emitted 2,808 tons of nitrogen oxides, according to the U.S. EPA, "National Emissions Inventory (NEI)." Accessed November 20, 2024. Link: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei.

[12] U.S. EPA, "Toxics Release Inventory (TRI) Program." Accessed April 2, 2025. Link: https://www.epa.gov/toxics-release-inventory-tri-program.

[13] U.S. EPA, "Greenhouse Gas Reporting Program (GHGRP)." Accessed March 27, 2025. Link: https://www.epa.gov/ghgreporting.

[14] U.S. EPA, "GHGRP Reported Data." Accessed March 27, 2025. Link: https://www.epa.gov/ghgreporting/ghgrp-reported-data.

[15] U.S. EPA, "Enforcement and Compliance History Online (ECHO)." Accessed March 27, 2025. Link: https://echo.epa.gov/.

[16] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Port Townsend Paper Mill." Accessed March 31, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=110000490326.

[17] U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR), "Exposure Investigation: Outdoor Exposures from the Port Townsend Paper Corporation," June 24, 2024. Link: https://www.atsdr.cdc.gov/HAC/pha/PortTownsendPaperCorp/Port-Townsend-HC-508.pdf.

[18] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Port Townsend Paper Mill." Accessed March 31, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=110000490326

[19] Tim McLaughlin, "Billionaire Kraft's paper mill causes pollution crisis in South Carolina," Reuters, August 17, 2021. Link: https://www.reuters.com/business/environment/billionaire-krafts-paper-mill-causes-pollution-crisis-south-carolina-2021-08-17/.

[20] The plant ranked worst for these pollutants among the 185 largest paper mills across the U.S. we examined, for which information was available. Source: U.S. EPA, "Toxics Release Inventory (TRI) Program." Accessed April 1, 2025. Link: https://www.epa.gov/toxics-release-inventory-tri-program.

[21] European Heat Pump Association, "Saving 50% Energy in Paper Industry Through Heat Pumps," February 6, 2023. Accessed April 1, 2025. Link: https://www.ehpa.org/news-and-resources/news/saving-50-energy-in-paper-industry-through-heat-pumps/

[22] This comparison is between using 100 percent recycled paper and virgin wood. Environmental Paper Network, "Paper Calculator: Calculate Your Impact." Accessed April 1, 2025. Link: https://c.environmentalpaper.org/.

[23] Germantown was incorporated into the city of Philadelphia in 1854.

[24] Georgia Institute of Technology: Robert C. Williams Museum of Papermaking, "Papermaking Moves to the United States." Accessed March 15, 2025. Link: https://paper.gatech.edu/papermaking-united-states-america.

[25] Smithsonian National Postal Museum, "America's Mailing Industry: Forest Products and Paper Manufacturing." Accessed March 16, 2025. Link: https://postalmuseum.si.edu/exhibition/america%E2%80%99s-mailing-industry-industry-segments/forest-products-and-paper-manufacturing.

[26] History of Paper, "Paper Mill History and Facts."Accessed March 16, 2025. Link: https://www.historyofpaper.net/paper-history/history-of-paper-mills/.

[27] American Forest & Paper Association, "How the Paper Industry Champions Sustainable Forestry," August 3, 2023. Link: https://www.afandpa.org/news/2023/how-paper-industry-champions-sustainable-forestry.

[28] Statista, "United States Pulp and Paper Industry – Statistics & Facts," September 19, 2024. Link: https://www.statista.com/topics/5268/us-pulp-and-paper-industry/#topicOverview.
[29] Statista, "Total production of paper and paperboard in the United States from 1961 to 2023," January 14, 2025. Link: https://www.statista.com/statistics/252708/total-us-production-of-paper-and-board-2001-2010/.
[30] Ryan Fox, Corrugated Packaging Market Analyst, Bloomberg Intelligence, interview with the Environmental Integrity Project on January 2, 2025.
[31] The Observatory of Economic Complexity, "Country Profile: China." March 10, 2025. Link: https://oec.world/en/profile/country/chn.
[32] Statista, "Corrugated Board Production Worldwide from 2015 to 2020, with a Forecast to 2022," July 4, 2024. Link: https://www.statista.com/statistics/1295161/production-volume-of-corrugated-board-worldwide/.
[33] Statista, "Total Consumption of Paper and Paperboard in the United States from 2000 to 2023," January 2, 2025. Link: https://www.statista.com/statistics/252710/total-us-consumption-of-paper-and-board-since-2001/.
[34] American Forest & Paper Association, "Does Paper Actually Get Recycled? The Industry Answers," November 14, 2024. Link: https://www.afandpa.org/news/2024/does-paper-actually-get-recycled-industry-answers.
[35] Ibid.
[36] Christopher Witherspoon, "The Paper Recycling Process Explained," Rubicon, March 30, 2023. Link: https://www.rubicon.com/blog/paper-recycling-process/.
[37] U.S. EPA, "Paper Making and Recycling." March 11, 2025. Link: https://archive.epa.gov/wastes/conserve/materials/paper/web/html/papermaking.html.
[38] The figures here are for corrugated cardboard made from 100 percent recycled fibers. Greenhouse gases expressed as carbon dioxide equivalent tons, or "CO_2e." Environmental Paper Network, "Paper Calculator: Calculate Your Impact." Accessed April 1, 2025. Link: https://c.environmentalpaper.org/.
[39] Ibid.
[40] Environmental Paper Network, "Paper Calculator: Calculate Your Impact." Accessed April 1, 2025. Link: https://c.environmentalpaper.org/.
[41] Salim Hiziroglu, "Basics of Paper Manufacturing," Oklahoma State University, July 2016. Link: https://extension.okstate.edu/fact-sheets/basics-of-paper-manufacturing.html.
[42] National Energy Technology Laboratory, "Black Liquor Gasification." Accessed April 8, 2025. Link: https://netl.doe.gov/research/Coal/energy-systems/gasification/gasifipedia/blackliquor.
[43] U.S. EPA, "Pulp and Paper Production (MACT I & III): National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Source Categories." Accessed April 9, 2025. Link: https://www.epa.gov/stationary-sources-air-pollution/pulp-and-paper-production-mact-i-iii-national-emissions-standards#:~:text=In%20these%20actions%2C%20the%20EPA,steam%20stripping%20(kraft%20mills%20only).
[44] U.S. EPA, "Greenhouse Gas Reporting Program: Emissions by Unit and Fuel Type 2011-2023." Accessed April 1, 2025. Link: https://www.epa.gov/system/files/other-files/2024-10/emissions_by_unit_and_fuel_type_c_d_aa.zip.
[45] U.S. EPA, "Greenhouse Gas Reporting Program Facility Level Information on Greenhouse Gases Tool (FLIGHT)." Accessed April 1, 2025. Link: https://ghgdata.epa.gov/ghgp/main.do.
[46] U.S. EPA, "Climate Change: Carbon Dioxide Emissions Associated with Bioenergy and Other Biogenic Sources." Accessed March 24, 2025. Link: https://19january2017snapshot.epa.gov/climatechange/carbon-dioxide-emissions-associated-bioenergy-and-other-biogenic-sources_.html.
[47] U.S. EPA, "Greenhouse Gas Reporting Program (GHGRP)." Accessed April 1, 2025. Link: https://www.epa.gov/ghgreporting.
[48] M. Pathak, R. Slade, P.R. Shukla, J. Skea, R. Pichs-Madruga, D. Ürge-Vorsatz, IPCC SYR report - technical summary, in: P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley (Eds.), Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, NY, USA, 2022, https://doi.org/10.1017/9781009157926.002.
[49] This study used "biomass" as a category of wood and wood products. Mary S. Booth, "Trees, Trash, and Toxics: How Biomass Energy has Become the New Coal," Partnership for Policy Integrity, page 5, April 2, 2014. Link: https://www.pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf.
[50] H. Tran, et al. (2023) "Emissions of wood pelletization and bioenergy use in the United States," *Renewable Energy*. Vol 2, Part 2. P.
[51] Georgia-Pacific, "Savannah River Mill." Accessed March 30, 2025. Link: https://www.gp.com/about-us/mill-sites/savannah-river-mill-rincon-georgia/.
[52] U.S. EPA, "National Emissions Inventory (NEI)." Accessed November 2024. Link: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei.
[53] Particulate matter (PM) is less than 10 micrometers. U.S. EPA, "Health and Environmental Effects of Particulate Matter (PM)." Accessed April 11, 2025. Link: https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm.
[54] U.S. EPA, "Sulfur Dioxide Basics." Accessed April 11, 2025. Link: https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects
[55] U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR), "ToxFAQs™ for Nitrogen Oxides." Accessed April 11, 2025. Link: https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=396&toxid=69.
[56] American Lung Association, "Volatile Organic Compounds." Accessed April 11, 2025. Link: https://www.lung.org/clean-air/indoor-air/indoor-air-pollutants/volatile-organic-compounds.
[57] U.S. EPA, "Toxics Release Inventory (TRI) Program." Accessed April 11, 2025. Link: https://www.epa.gov/toxics-release-inventory-tri-program.

[58] U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR), "Hydrogen Sulfide: Medical Management Guidelines for Hydrogen Sulfide." Accessed April 8, 2024. Link: https://wwwn.cdc.gov/TSP/MMG/MMGDetails.aspx?mmgid=385&toxid=67.

[59] Wisconsin Department of Health Services, "Air: Pulp and Paper Industry Odors." Accessed April 11, 2025. Link: https://www.dhs.wisconsin.gov/air/pulpodors.htm.

[60] Sammy Fretwell, "Federal Court Signs off on $1.1 Million Fine Against Troubled SC Paper Mill," The State, November 21, 2022. Link: https://www.thestate.com/news/local/environment/article268880672.html.

[61] U.S. EPA, "Acetaldehyde," September 2016. Link: https://www.epa.gov/sites/default/files/2016-09/documents/acetaldehyde.pdf; U.S. EPA, "Risk Evaluation for Formaldehyde." Accessed April 11, 2025. Link: https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-formaldehyde; U.S. EPA, "Methanol." September 2016. Link: https://www.epa.gov/sites/default/files/2016-09/documents/methanol.pdf.

[62] Siddika Pasi and Michael R. Muller, "Investigating the Impact of Boiler Aging in Replacement Decision," American Council for an Energy-Efficient Economy and Rutgers University – Center for Advanced Energy Systems, page 4, 2007. Link: https://www.aceee.org/files/proceedings/2007/data/papers/17_2_107.pdf.

[63] Hellen Chen and Andrew Hoffmeister, "Net-Zero Industry by 2050: A Scenario Analysis of Boiler Replacement with Industrial Heat Pumps," American Council for an Energy-Efficient Economy, page 4, December 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.

[64] U.S. EPA, "Boiler Maximum Achievable Control Technologies (MACT) Draft Emissions and Survey Results Database." May 2012. Accessed April 3, 2025. Link: https://www.epa.gov/sites/default/files/2016-09/20120530databases.zip.

[65] One plant was in an area that was out of attainment with both ozone and fine particulate standards. The plants that were located in fine particulate or sulfur dioxide nonattainment areas did not report emitting these pollutants, according to the most recent state emission data. Nonattainment status information is available from EPA's Enforcement and Compliance History Online database, available at https://echo.epa.gov.

[66] Thirteen of the 42 plants were also in non-attainment areas for one or more pollutants.

[67] U.S. EPA, "Boiler Maximum Achievable Control Technologies (MACT) Draft Emissions and Survey Results Database." May 2012. Accessed April 3, 2025. Link: https://www.epa.gov/sites/default/files/2016-09/20120530databases.zip.

[68] Robin Brown, interview with the Environmental Integrity Project on March 25, 2025.

[69] Professional fishing and kayak guides, Jackson River, Virginia, interview with the Environmental Integrity Project in March 2025. Pollution complaints obtained by EIP through a public records request to the Virginia Department of Environmental Quality.

[70] Virginia Department of Environmental Quality, "Pollution Incident Summary Report: IR# 316420," November 12, 2024. Obtained through Freedom of Information Act Request. Link: https://environmentalintegrity.org/wp-content/uploads/2025/09/316420-Incident-Summary-Report.pdf.

[71] Email from Julia Raimondi, Communications Coordinator, Virginia Department of Environmental Quality, to Environmental Integrity Project on April 10, 2021.

[72] Smurfit Westrock, "Press Releases: Smurfit Westrock makes its debut in New York and London," July 8, 2024. Link: https://www.smurfitwestrock.com/newsroom/press-releases/smurfit-westrock-makes-its-debut-in-new-york-and-london.

[73] Allegheny Highlands Economic Development Corporation, "WestRock – Business Spotlight." Accessed March 27, 2025. Link: https://ahedc.com/newsroom/westrock-business-spotlight/#:~:text=WestRock's%20Covington%2C%20Virginia%20mill%20is,50%25%20of%20the%20nation's%20population.

[74] Donna Thommason of Covington, Virginia, interview with the Environmental Integrity Project on March 25, 2025.

[75] U.S. EPA, "Greenhouse Gas Reporting Program (GHGRP)." Accessed March 27, 2025. Link: https://www.epa.gov/ghgreporting.

[76] U.S. EPA, "GHGRP Reported Data." Accessed March 27, 2025. Link: https://www.epa.gov/ghgreporting/ghgrp-reported-data.

[77] Email from Victoria Higgins, Virginia Director of Chesapeake Climate Action Network, to Environmental Integrity Project on March 17, 2025.

[78] Virginia Department of Environmental Quality (2024) State Point Source Emission Inventory. The plant reported to the state it released 2,287 tons of NOx in 2023. In 2020, the plant emitted 2,808 tons of nitrogen oxides, according to the U.S. EPA, "National Emissions Inventory (NEI)." Accessed November 20, 2024. Link: https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei.

[79] Natalie Moats in Covington, Virginia, interview with the Environmental Integrity Project on March 25, 2025.

[80] Donna Goff in Covington, Virginia, interview with the Environmental Integrity Project on March 25, 2025.

[81] Freedom of Information Act filed by the Environmental Integrity Project produced violation notices for nitrogen oxide air pollution on July 2, 2021, June 3, 2021 and May 2-3, 2021.

[82] Ibid.

[83] Notice of violation issued by Virginia Department of Environmental Quality on August 25, 2023, for water discharges exceeding toxicity standards. Obtained by Freedom of Information Act request.

[84] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Westrock Virginia, LLC." Accessed March 27, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=VA0000005158000003&sys=AIR.

[85] Samuel Scott in Covington, Virginia, interview with the Environmental Integrity Project on March 25, 2025.

[86] Freedom of Information Act filed by the Environmental Integrity Project to the Virginia Department of Environmental Quality (VDEQ) produced five years of incident reports at the Smurfit Westrock plant.

[87] Virginia Department of Environmental Quality, "Pollution Incident Summary Report: IR# 307076," November 7, 2022. Obtained through Freedom of Information Act Request. Link: https://environmentalintegrity.org/wp-content/uploads/2025/09/316420-Incident-Summary-Report.

pdf

[88] Virginia Department of Environmental Quality, "Pollution Incident Summary Report: IR# 316420," November 12, 2024. Obtained through Freedom of Information Act Request. Link: https://environmentalintegrity.org/wp-content/uploads/2025/09/316420-Incident-Summary-Report.pdf

[89] Wesley Hodges in Covington, Virginia, interview with the Environmental Integrity Project on March 25, 2025.

[90] U.S. EPA, "Boiler Maximum Achievable Control Technologies (MACT) Draft Emissions and Survey Results Database." May 2012. Accessed April 3, 2025. Link: https://www.epa.gov/sites/default/files/2016-09/20120530databases.zip.

[91] U.S. EPA, "Enforcement and Compliance History Online (ECHO)." Accessed March 27, 2025. Link: https://echo.epa.gov/.

[92] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Port Townsend Paper Mill." Accessed April 10, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=110000490326.

[93] U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry (ATSDR), "Exposure Investigation: Outdoor Exposures from the Port Townsend Paper Corporation," June 24, 2024. Link: https://www.atsdr.cdc.gov/HAC/pha/PortTownsendPaperCorp/Port-Townsend-HC-508.pdf.

[94] Derek Firenze, "New Study Shows Potential Health Risks Related to the Port Townsend Paper Mill," Jefferson County Beacon, July 15, 2024. Link: https://www.jeffcobeacon.com/all-news/new-study-shows-potential-health-risks-related-to-the-port-townsend-paper-mill.

[95] Don Ehnebuske, interview with the Environmental Integrity Project on February 21, 2025.

[96] Port Townsend Paper, "Atlas Holdings Acquires Crown Paper Group," October 22, 2022. Link: https://ptpc.com/atlas-holdings-acquires-crown-paper-group/.

[97] This renewal effort was happening in March of 2025. The water pollution control permit is called a National Pollutant Discharge Elimination System or NPDES permit.

[98] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: Port Townsend Paper Mill." Accessed March 31, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=110000490326.

[99] State of Washington Department of Ecology, "Port Townsend Paper." Accessed March 12, 2025. Link: https://ecology.wa.gov/regulations-permits/permits-certifications/industrial-facilities-permits/port-townsend-paper.

[100] Alea Waters, interview with the Environmental Integrity Project on February 21, 2025.

[101] Tim McLaughlin, "Billionaire Kraft's paper mill causes pollution crisis in South Carolina," Reuters, August 17, 2021. Link: https://www.reuters.com/business/environment/billionaire-krafts-paper-mill-causes-pollution-crisis-south-carolina-2021-08-17/.

[102] Catherine Welch, "South Carolina Paper Mill Sued by Charlotte Resident for 'Rotten Egg' Smell," WFAE Charlotte, May 20, 2021. Link: https://www.wfae.org/energy-environment/2021-05-20/south-carolina-paper-mill-sued-by-charlotte-resident-for-rotten-egg-smell; Sammy Fretwell, "Stinking SC Paper Mill Fights Neighbors in Court. People Complain of Sickening Fumes," The State, June 3, 2022. Link: https://www.thestate.com/article262006130.html.

[103] U.S. EPA, "New releases: EPA Issues Emergency Order and Information Request to New Indy Containerboard Pulp and Paper Mill in Catawba, S.C. and Expands Community Air Monitoring," May 13, 2021. Link: https://www.epa.gov/newsreleases/epa-issues-emergency-order-and-information-request-new-indy-containerboard-pulp-and.

[104] U.S. EPA, "Enforcement and Compliance History Online (ECHO), Detailed Facility Report: New-Indy Catawba LLC." Accessed April 1, 2025. Link: https://echo.epa.gov/detailed-facility-report?fid=SC00024400005&sys=AIR.

[105] The mill's oldest boiler dates to 1959, with other boilers at the plant dating to 1966, 1968, and 1983. U.S. EPA, "Boiler Maximum Achievable Control Technologies (MACT) Draft Emissions and Survey Results Database." May 2012. Accessed April 3, 2025. Link: https://www.epa.gov/sites/default/files/2016-09/20120530databases.zip.

[106] U.S. EPA, "Toxics Release Inventory (TRI) Program." Accessed April 2, 2025. Link: https://www.epa.gov/toxics-release-inventory-tri-program.

[107] The missing permit was a "Prevention of Significant Deterioration" permit, the air pollution control permit needed by major new industries or big industries making major changes to a plant.

[108] Sammy Fretwell, "SC Paper Mill Sued Again Over Stink That Left Thousands Complaining," The State, July 23, 2022. Link: https://www.thestate.com/news/local/environment/article263744828.html.

[109] U.S. EPA, "News Releases: New Indy Agrees to $1.1 Million Penalty and Consent Decree to Resolve Imminent and Substantial Endangerment," November 17, 2022. Link: https://www.epa.gov/newsreleases/new-indy-agrees-11-million-penalty-and-consent-decree-resolve-imminent-and-substantial; Consent Decree available at: https://www.elr.info/sites/default/files/files-pdf/New%20Indy%20Catawba%20LLC.pdf.

[110] Austin Walker, "EPA Says it Found 19 More Potential Violations at New-Indy Plant in South Carolina," WCNC Charlotte, March 9, 2023. Link: https://www.wcnc.com/article/news/special-reports/new-indy/new-indy-epa-letter-3-9-23-health-environment-investigation-local/275-e2a57c04-5492-4a97-85e2-307670e515ab.

[111] Brandon Jones, "Catawba Riverkeeper Files to Join the Clean Water Citizen Suit Against New-Indy mill in Catawba, SC," Catawba Riverkeeper, April 12, 2023. Link: https://www.catawbariverkeeper.org/catawba-riverkeeper-files-to-join-the-clean-water-citizen-suit-against-new-indy-mill-in-catawba-sc.

[112] White v. New-Indy Catawba LLC, 0:21-cv-01480-SAL & 0:21-cv-01704-SAL, (U.S. District Court for the District of South Carolina, 2024). Link: https://www.classaction.org/media/white-v-new-indy-catawba-llc-settlement-agreement.pdf.

[113] New Indy Class Action, "IN RE New Indy Emissions Litigation." Accessed March 22, 2025. Link: https://www.newindyclassaction.com/index.html.

[114] Quinn Wilson, "Robert Kraft-Owned Paper Mill Reaches $103 Million Settlement," Bloomberg Law, May 30, 2024. Link: https://news.bloomberglaw.com/litigation/robert-kraft-owned-paper-mill-reaches-103-million-settlement.

[115] Shaquira Speaks, "South Carolina New-Indy Plant Reaches $103 Million Settlement Over Environmental Concerns," Queen City News, May 31,

2024. Link: https://www.qcnews.com/news/u-s/lancaster-county/south-carolina-new-indy-plant-reaches-103-million-settlement-over-environmental-concerns/.

[116] International Energy Agency, "The Future of Heat Pumps," December 2022. Link: https://iea.blob.core.windows.net/assets/4713780d-c0ae-4686-8c9b-29e782452695/TheFutureofHeatPumps.pdf.

[117] Molly Charles et al., "The Role of the Pulp and Paper Industry in Achieving Net Zero U.S. CO_2 Emissions in 2050," Energy and Climate Change, Vol. 5., p. 2-3. December 2024. Link: https://www.sciencedirect.com/science/article/pii/S2666278724000369?via%3Dihub.

[118] European Heat Pump Association, "Saving 50% Energy in Paper Industry Through Heat Pumps," February 6, 2023. Accessed April 1, 2025. Link: https://www.ehpa.org/news-and-resources/news/saving-50-energy-in-paper-industry-through-heat-pumps/

[119] Ibid.

[120] Molly Charles et al., "The Role of the Pulp and Paper Industry in Achieving Net Zero U.S. CO2 Emissions in 2050," Energy and Climate Change, Vol. 5., December 2024. Link: https://www.sciencedirect.com/science/article/pii/S2666278724000369?via%3Dihub.

[121] U.S. Energy Information Administration, "Form EIA-923 detailed data with previous form data (EIA-906/920), Schedules 6 & 7." Accessed March 31, 2025. Link: https://www.eia.gov/electricity/data/eia923/.

[122] International Energy Agency, "Black Liquor Gasification: Summary and Conclusions from the IEA Bioenergy ExCo54 Workshop," January 2007. Link: https://www.ieabioenergy.com/wp-content/uploads/2013/10/Black-Liquor-Gasification-summary-and-conclusions1.pdf.

[123] Arif Darmawan et al., "Electricity Production from Black Liquor: A Novel Integrated System," Energy Procedia, Vol. 142, 2017. Link: https://www.sciencedirect.com/science/article/pii/S1876610217357326/pdf?md5=dadd8d5c8b0061aac9108aaaf6feed97&pid=1-s2.0-S1876610217357326-main.pdf.

[124] Karin Pettersson and Simon Harvey, "CO_2 emission balances for different black liquor gasification biorefinery concepts for production of electricity or second-generation liquid biofuels," Energy, Vol. 35, February 2010. Link: https://www.sciencedirect.com/science/article/abs/pii/S0360544209002308.

[125] Northwest Power and Conservation Council, "Power Generation Map Overview." Accessed April 24, 2025. Link: https://www.nwcouncil.org/energy/energy-topics/power-supply/power-generation-map-overview/

[126] Katie Hanks and Thomas Holloway, RTI International, memorandum to U.S. EPA on November 16, 2011. Link: https://www.epa.gov/sites/default/files/2015-06/documents/tech_review_memo_subpart_s.pdf.

[127] Dylan D. Furszyfer Del Rio et al., "Decarbonizing the pulp and paper industry: A critical and systematic review of sociotechnical developments and policy options," Renewable and Sustainable Energy Reviews, Vol. 167, October 2022. Link: https://www.sciencedirect.com/science/article/pii/S1364032122005950.

[128] U.S. Department of Energy, "Defense Production Act: Electric Heat Pumps." Accessed April 1, 2025. Link: https://www.energy.gov/mesc/enhanced-use-defense-production-act-1950; U.S. Department of Energy, "Defense Production Act Heat Pump Program Selections." Accessed April 1, 2025. Link: https://www.energy.gov/mesc/defense-production-act-heat-pump-program-selections.

[129] European Heat Pump Association, "Saving 50% Energy in Paper Industry Through Heat Pumps," February 6, 2023. Accessed April 1, 2025. Link: https://www.ehpa.org/news-and-resources/news/saving-50-energy-in-paper-industry-through-heat-pumps/

[130] Environmental Paper Network, "Paper Calculator: Calculate Your Impact." Accessed April 1, 2025. Link: https://c.environmentalpaper.org/.

[131] 40 C.F.R. §51.30; Table 1 to Appendix A of Subpart A—Emission Thresholds by Pollutant for Treatment as Point Source Under. Accessed April 22, 2025. Link: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-51/subpart-A/.

[132] Ibid.

[133] U.S. EPA, "What is the GHGRP?" Accessed April 22, 2025. Link: https://www.epa.gov/ghgreporting/what-ghgrp.

[134] U.S. EPA, "Detailed Facility Report Data Dictionary." Accessed April 22, 2025. Link: https://echo.epa.gov/help/reports/dfr-data-dictionary.