

Industrial Boilers 101

A little-known piece of manufacturing equipment with a big pollution impact.

Despite technological advancements, the industrial sector, while a major driver of economic output and employment, continues to harm frontline communities through facilities using antiquated fossil fuel-fired equipment. These dirty technologies disproportionately impact nearby communities, where residents face elevated health risks from the cumulative burden of industrial facilities, other pollution sources, and existing socioeconomic disadvantages.¹

Fortunately, most facilities can dramatically reduce their air pollution burden by transitioning to **zero-emission technologies like electric boilers, industrial heat pumps, and thermal energy storage** — creating cleaner air, good-paying jobs, and environmental justice.

What are industrial boilers?

Boilers heat water or produce steam for industrial use. Most rely on fossil fuels, particularly methane gas, but zero-emissions electric alternatives are growing.²

In food processing, they support canning, pasteurization, drying, and sterilization. In pulp and paper manufacturing, they support pulping, drying, and pressing. They are also critical in chemicals, pharmaceuticals, textiles, and electronics — anywhere that requires precise application of heat.

¹ American Lung Association, "Clean Heat, Clean Air: Benefits of Zero-Emission Technologies in the Industrial Heating Sector", <https://www.lung.org/clean-air/clean-heat>

² American Council for an Energy-Efficient Economy, "New Map Shows Industrial Electrification Gaining Momentum in U.S.", February 11, 2025, <https://www.aceee.org/blog-post/2025/02/new-map-shows-industrial-electrification-gaining-momentum-us>

Problem with fossil-fueled boilers

Industrial boilers produce a **dizzying array of air pollutants** when they burn fossil fuels to heat water. Most run on methane gas, with oil, biomass, or coal also used.

Burning these fossil fuels produces **carbon dioxide** (CO₂) — the primary driver of climate change — and multiple contaminants that endanger human health. This includes **nitrogen oxides** (NO_x) — a major contributor to ozone — **particulate matter, mercury, and hydrochloric acid**,³ which can cause respiratory illnesses, heart disease, cancer, and premature death.



THE HIDDEN TOLL

- 4 in 10 industrial boilers are in **disadvantaged communities**
 - Boilers in disadvantaged communities **pollute twice as much** as elsewhere
 - Many boilers are located where air is already **unsafe to breathe**⁴

³ Sierra Club and Evergreen Collaborative, "Embracing Clean Heat: Opportunities for Zero-Emission Industrial Boilers", Pg. 9, <https://www.sierraclub.org/sites/default/files/2025-05/embracing-clean-heat-report.pdf>

⁴ Sierra Club and Evergreen Collaborative, "Embracing Clean Heat: Opportunities for Zero-Emission Industrial Boilers", Pg 22, <https://www.sierraclub.org/sites/default/files/2025-05/embracing-clean-heat-report.pdf>

Alternatives to fossil-fueled boilers

Clean, zero-emission alternatives to fossil-fueled boilers already exist, especially for the majority of boilers that operate at low to moderate temperatures (below 200°C / 400°F). These technologies are ready to scale and can meet industrial needs without pollution impacts.⁵

Clean heat alternatives include:

- **Electric boilers:** Simple replacements that generate steam or hot water using electricity instead of fossil fuel combustion.
- **Industrial heat pumps:** Super-efficient systems that transfer heat instead of creating it by burning fuel. Perfect for lower-temperature processes.
- **Thermal energy storage:** Stores heat during off-peak hours, when electricity is often cheaper, and uses it when needed.

These clean heat systems **reduce pollution, improve energy efficiency, cut maintenance costs, and make factories more resilient** as the grid gets cleaner.

Major companies are already making the switch. New Belgium Brewing installed a heat pump in summer 2025,⁶ Bellwether Coffee is pioneering an electric coffee roaster,⁷ and Kraft Heinz plans to install heat pumps at 10 factories by 2030.⁸

⁵ Center for Applied Environmental Law and Policy, "Decarbonizing Industrial Heat: Measuring Economic Potential and Policy Mechanisms", <https://www.caelp.org/reports>

⁶ Bloomberg, "An Iconic Brewery is Installing a Giant Heat Pump to Clean Up Its Emissions", April 22, 2025, <https://www.bloomberg.com/news/features/2025-04-22/new-belgium-brewing-is-installing-a-giant-heat-pump-to-clean-up-its-emissions>

⁷ Berkeley Side, "Berkeley company shakes up coffee industry with new, zero-emission roaster", September 20, 2023, <https://www.berkeleyside.org/2023/09/20/bellwether-coffee-electric-roaster-sustainability>

⁸ Canary, "This map shows where to swap out industrial boilers for heat pumps", March 4, 2025 <https://www.canarymedia.com/articles/heat-pumps/this-map-shows-where-to-swap-out-industrial-boilers-for-heat-pumps>



SECTORS THAT USE INDUSTRIAL BOILERS

- Food and beverage
- Pulp and paper
- Chemicals and plastics
- Pharmaceuticals
- Textiles and garments
- Wood products and lumber mills
- Hospitals and universities



POLLUTION IMPACTS

- **Nitrogen oxides (NOx):** Major contributors to smog and ozone
- **Fine particulate matter (PM2.5):** Tiny particles that damage lungs
- **Carbon dioxide (CO₂):** A leading cause of climate change
- **Mercury and hydrochloric acid:** Hazardous air pollutants that impact the nervous and respiratory systems

HEALTH IMPACTS

- Asthma & respiratory conditions
- Heart disease
- Cancer
- Premature death

Making the switch to clean heat

Replacing dirty boilers with clean alternatives is achievable, but it requires **coordinated action and smart investment from companies** across manufacturing sectors — as well as **stronger regulations from local, regional, and state agencies**. Industrial boilers play a key role in the creation of all kinds of consumer goods, and cleaning up these manufacturing processes will help protect the workers supporting these key pillars of our economy. Here's what it will take:

- **Financial incentives:** Grants, tax credits, and rebates to make electric technologies cost-competitive with fossil fuels.
- **Utility and rate reform:** Manufacturers can access affordable electricity, benefit from off-peak pricing, and save money when they switch.
- **Stronger air pollution rules:** To phase out the oldest, dirtiest boilers and push the industrial sector toward modern, zero-emission systems.
- **Workforce and technical support:** Training and guidance for companies to upgrade equipment and re-skill workers.
- **Justice-first investment:** Focused support for communities hardest hit by industrial pollution, like low-income areas and communities of color.

With the right policies and support, we can **modernize industrial heating, protect public health, and reduce climate pollution**, without slowing down industry.

For more information on industrial boilers, visit sierraclub.org/boilers101 or contact industrialtransformation@sierraclub.org.



CALIFORNIA LEADS THE CHARGE

Local, regional, and state agencies across are leading the charge on clean heat.

In June 2024, California's **South Coast Air Quality Management District (SCAQMD)** passed rule 1146.2 – the nation's first rule to electrify small boilers and water heaters.⁹

In 2025, SCAQMD is working on rules 1146 and 1146.1 for midsize to large industrial boilers. The passage of these rules would follow SCAQMD's goal of reducing air pollution in Southern California, which is designated as one of the nation's most polluted regions.¹⁰

In 2025, advocates are urging the **Bay Area Air Quality Management District (BAAQMD)** to include Rule 9-7, for midsize to large industrial boilers, in its upcoming rulemaking schedule.

⁹ Sierra Club, "SCAQMD Passes Landmark Zero-Emission Rules", June 7, 2024, <https://www.sierraclub.org/press-releases/2024/06/over-100-rally-clean-air-scaqmd-passes-landmark-zero-emission-rules>

¹⁰ American Lung Association, State of the Air Report 2025, <https://www.lung.org/research/sota/city-rankings/msas/los-angeles-long-beach-ca>