





POWER SHIFT

Sustainable Energy Solutions
for the Modern Roastery

By Nani Ferreira-Mathews



ABOVE AND
PRECEDING PAGE

*Photos by Juan José
Sánchez Macías*

MEETING SUSTAINABILITY GOALS IN A coffee roastery often begins with a simple question: Where does your power come from? Roasting is one of the most energy-intensive parts of coffee production, along with many other factors that contribute to a roastery's energy footprint. For roasters looking to grow with sustainability in mind, or to reduce emissions and energy costs, there are now more options than ever for improving your energy efficiency—and shifting to renewable energy sources.

In this article, we'll explore a range of energy solutions for coffee roasteries, from choosing the right roasting equipment to accessing cleaner energy from your utility provider. We'll look at roasting machine innovations that are designed to reduce emissions and fuel consumption, and outline practical steps for evaluating your current energy use. We'll also touch on the regulatory barriers that influence access to greener technologies, and provide real-world insights from manufacturers and roasters navigating these transitions.

While upgrading roasting equipment is often the most visible (and expensive) decision, it's not the only path to reducing your environmental impact. Many cities and utility providers now offer renewable energy programs, green power tariffs and incentives for energy-efficient upgrades. Others are investing

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in on-site solar or renewable energy certificates to offset their grid use. From machine selection to energy sourcing, the choices roasters make today will shape the environmental—and financial—sustainability of their businesses tomorrow.

TRACKING YOUR ROASTERY'S ENERGY USE AND COSTS

Whether you're going for a certification or your coffee roasting business is just trying to save some money on rising energy costs, there are many ways to reach those goals. If you have quantitative goals for your company, you will need to monitor and capture your energy use and costs. These goals might include reducing total energy consumption by a specific percentage year-over-year, lowering greenhouse gas emissions,



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GAS VERSUS ELECTRIC ROASTER

Annual Energy Costs and Emissions



To get a general sense of how different energy sources stack up, we compared a gas roaster and an electric roaster, each operating eight hours per day, 250 days per year. These estimates are based on manufacturer specifications and average U.S. energy rates and emissions factors as of 2025.

The gas roaster consumed approximately 1,260 therms of natural gas and 3,600 kWh of electricity annually, resulting in \$2,799 in utility costs and an estimated 17,694 pounds of CO₂ emissions.

The electric roaster, which uses no gas, consumed 31,800 kWh of electricity, leading to \$4,579 in utility costs and 26,076 pounds of CO₂, based on average U.S. grid emissions.

These figures offer a high-level comparison of these specific machines, not a definitive ranking. Gas consumption is typically measured by runtime, while electric usage often depends on output (i.e., kWh per kilogram roasted), making direct comparisons inherently imprecise. Additionally, actual performance varies by machine design, roast style, utility rates, and your local energy mix.

Still, some broad takeaways emerged from this specific comparison:

- **Annual Cost:** The gas roaster used more energy overall but cost less to operate based on local rates.
- **Emissions:** Despite higher energy use, the gas model produced fewer CO₂ emissions—in this case—assuming average grid emissions
- **Efficiency Factors:** Results will differ widely depending on manufacturer and model; roasting volume; and whether your electricity comes from renewable sources, in which case an electric roaster may ultimately have the smaller footprint.

When choosing between gas and electric, it's essential to look beyond cost and consider grid sourcing, emissions and machine performance in your specific context.

increasing the proportion of renewable energy used in operations, or meeting third-party certification requirements such as B Corp, Carbon Neutral or ISO 14001. Clear, measurable goals not only help businesses align with global sustainability standards but also create accountability and transparency—both of which are increasingly valued by customers, investors and supply chain partners. Tracking this data also provides a baseline for evaluating the impact of equipment upgrades or utility changes over time.

When it comes to roasting machines (or systems) specifically, it can be difficult to isolate their usage and costs on a utility bill—since the total amount also includes lighting, heating and cooling, and other equipment—some research and a few basic calculations can give you a clearer picture.

To estimate your annual energy use and emissions for roasting, start by identifying your roaster's energy consumption specifications. This information is typically available through product documentation or technical support from the manufacturer. Roasting machines are powered by gas or electricity. Gas usage is typically measured in therms (1 therm equals 100,000 British thermal units [BTUs]), while electricity is measured in kilowatt-hours (kWh). These are different units of energy and are billed separately.

Once you've identified your roaster's energy usage, either by hour or by output in pounds or kilograms, multiply it by the number of hours you typically roast in a year or your roastery's annual output. Then, apply your local utility rates to calculate annual costs. For emissions, multiply total gas usage by 11.7 pounds of CO₂ per therm and electricity usage by 0.82 pounds of CO₂ per kWh (or lower if your energy sources include renewables). While not precise, these figures can help you benchmark your roastery's energy performance and guide future equipment decisions.

For a high-level comparison of two 12-kilogram roasting machines, see "Gas versus Electric Roaster: Annual Energy Costs and Emissions" to the left.

Roasting with electricity is sometimes perceived as a cheaper or greener option, but according to Launtia Taylor of Diedrich Roasters, this is not always the case. Factors such as grid mix and operating conditions

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Photo by Juan José Sánchez Macías

should be taken into account, and roasters are encouraged to evaluate actual energy usage and local utility rates before making decisions based solely on fuel type.

WHAT FUELS YOUR ROASTING MACHINE?

Many manufacturers offer roasting machines that use different energy sources. Probat, for example, has models that can run on natural gas, electricity or hydrogen. “I really like this hydrogen roaster, but hydrogen is 10 times more expensive than natural gas per kilowatt,” says Scott Stouffer, chief sales officer of Probat’s coffee division. The company has shipped hydrogen-powered roasters to Laos and Austria, but with no economical way to source hydrogen in the



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U.S., there has been little interest in those models here.

According to the U.S. Department of Energy, “Hydrogen is a clean fuel that, when consumed in a fuel cell, produces only water. Hydrogen can be produced from a variety of domestic resources, such as natural gas, nuclear power, biomass, and renewable power like solar and wind.” However, the infrastructure for hydrogen does not yet exist in the U.S.

Some roaster manufacturers have test facilities where they have natural gas and electric roasters set up side by side. Roasters are invited to come and test the machines before they make a purchase.

“Our calculations do show that gas roasters ... produce less CO₂ emissions than a comparable-sized electric roaster,” says Taylor, referencing Diedrich's internal analysis.

Many cities offer opportunities to purchase “green



power” or renewable energy certificates that allow you to designate that your electricity is coming from a renewable source (wind, water or solar). The same model applies to natural gas providers that offer a renewable energy program, which customers can opt into for an additional cost per therm. It’s worth

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taking a look at your city's power grid to get a better understanding of what renewable energy options are available in your area. The grid is often a mix of resources that includes renewable energy, natural gas, biogas, coal and nuclear.

"In Europe this year, we will actually ship more electric shop roasters than we do gas," says Stouffer. "It's going to be the least environmentally impactful if you can get that electricity from a green source," he adds.

Roaster setup and energy type will vary from country to country, despite many manufacturers' ability to produce equipment. Stouffer explains that the hydrogen roasters in Laos are only possible through a development fund from Japan, something unlikely to happen in most places.

Other manufacturers have introduced equipment designed with energy efficiency in mind. Mill City Roasters, for example, offers models with high-efficiency burners and variable drum and airflow controls, allowing operators to fine-tune fuel usage throughout the roast cycle.

And while many roasting systems rely on traditional drum architecture, fluid-bed roasters—like those developed by Sivetz—use hot air to levitate and roast the coffee, offering extremely rapid roast cycles and direct heat transfer. This design can reduce warm-up and idle energy loss, making it attractive for roasters seeking high-efficiency batch roasting with minimal fuel waste.

A newer player in the energy-conscious roasting space is AirMotion Roasters, whose all-electric, air-based designs emphasize rapid roast capability with a low energy footprint. Their systems feature patented air control technology to ensure consistent bean movement and uniform heat exposure, which reduces roast times and the need for energy-intensive afterburners.

REGULATORY CHALLENGES AND REGIONAL BARRIERS TO INNOVATION

Anne Cooper of Equilibrium Master Roasters, based in Australia, says that compared to other countries

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she's consulted in, Australia has stricter regulations. "[This] can be a hindrance to progress and allowing new innovations in technology for managing energy consumption in the country," she explains.

Bob Austin, president and chief technology officer of Loring Roasters, concurs. "The truth is, there are different regulations, and different safety regulations. Canada and Australia tend to have different safety regulations than the U.S. Europe, of course, is CE [the European standard]. They've got a whole different set of regulations around safety, then there are all the environmental regulations. Germany is very tough, but so is Los Angeles' South Coast Air Quality District [as well as the] Greater Metro Seattle Area."

Austin says Loring sells to 63 different countries, with most of its business occurring outside of the United States. Loring has been producing energy-efficient gas-powered roasting systems for the past 20 years, but moving to an electric model is not possible.

"We have some thoughts about alternative fuels," Austin explains. "... It would be more in the area of hydrogen, because we depend on flames in order to get our system to work correctly, and that has to do with our architecture."

Loring reports that users may experience up to an 80 percent energy reduction compared to similarly sized roasters with an afterburner, based on internal testing and user feedback. While a 12-kilo gas roaster with no afterburner will use less energy, it will release a lot of smoke and particulate matter. To effectively clean the smoke, afterburners must heat up to 1,200 degrees F (about 650 degrees C).

Rob McClure, co-owner of Just Coffee Cooperative in Wisconsin, says his company switched from a different gas roaster to a Loring roaster in 2016. "We had been

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getting about 47.3 pounds of roasted coffee per therm of gas [with the previous machine], and that increased to 58.3 pounds immediately after switching to the Loring,” he says, based on the company’s internal production tracking. After fine-tuning its processes and roast schedules, Just Coffee was able to achieve a 65.4 percent increase in pounds produced per therm used.

“If you compare apples to apples, meaning a clean hot stack, ... the incinerators [afterburners] use four to six times the amount of fuel as does the roaster,” Austin says. “The idea with the Loring roaster is we combine the incinerator with the process heat, and so we use one source of heat to do both, and therefore gain a considerable energy efficiency.”

Cooper shares an example that further proves his point. In her training lab in Australia, her Probat

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P12 using natural gas with an afterburner consumes five times more gas than the Loring with a built-in afterburner.

She says that after 30 years of roasting and consulting in many countries, the introduction of hot air convection systems like Loring, with integrated afterburners and automations systems, has moved the industry toward a new and more energy-efficient standard.

NEW TECHNOLOGIES RESHAPING COFFEE ROASTING

Cooper is excited about a new electric roaster from Typhoon Roasters. The Czech company, founded in 2008, released its first production roasters in 20-kilo and 30-kilo sizes in 2019.



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“Now we have the Typhoon roaster,” Cooper says. “It is fully electric and, because of the unique design of its roasting chamber, every bean is treated with the hot air convection incredibly evenly, like an air fryer, thus allowing for super short roast times that even I still can’t comprehend.”

According to the company’s promotional materials, the system is capable of six-minute roasts. Its patented air convection technology is designed to distribute heat evenly across the bean mass, reducing overall roast time while maintaining consistency. Cooper notes that the short roast duration challenges traditional ideas about profile development and energy use, and she’s still exploring what it might mean for roast quality and approach.

When it comes to emissions, technology to filter smoke, volatile organic compounds and particulate matter with less energy consumption than afterburners can be found from manufacturers like Vortx and Reicat. The Vortx Ecofilter uses a water system to cool hot air released during the roasting process; transform the smoke into droplets that traps the chaff, dust and CO₂; and flush it all out the cyclone through a spillway. Reicat systems reduce smoke, odor and emissions when added to the exhaust system. Reicat operates on natural gas but consumes considerably less energy than traditional afterburners. These stack additions offer an alternative to traditional afterburners, providing lower-emission options for roasters looking

to reduce visible smoke and particulates, especially those in densely populated or residential areas.

On the industrial scale, Probat has explored many energy reduction technologies, including a preheater that uses the hot air from catalyzers. “That air is 750 degrees [F],” Stouffer explains. “You pass that through coffee, essentially where your green coffee charge hopper would be. It’s like a pre-roasting bin. We heat the coffee up to 105 degrees Celsius, which is like 220 Fahrenheit, and then you charge that into the roaster.” According to Probat, this can reduce roast cycle time by 20 percent, and lowers emissions and energy usage by 20 percent. While hundreds of these units have been installed globally, Stouffer notes that only 20 to 30 are currently in use in the United States—but he’s confident that broader adoption is on the horizon.

Cooper likes the concept of a shorter roast but worries that coffee quality could suffer if the systems are strictly designed for energy reduction. “It’s all well and good to shorten a roast, but if it rushes the beans through the key physical events, then we will end up with very dry, sour flavors with low body and sweetness all for the sake of trying to save time,” she says. “[This is] why my brain hurts with the Typhoon, because it challenges any traditional thoughts about roast times or key cooking reactions, but they’ve found a way for it to work.”

Contemplating this new technology and other advances in energy-efficient roasting, Cooper adds, “Just when we think we’ve got it all worked out, something comes along to challenge us—kind of like everything at the moment in the industry!”



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