

California wants farms to capture methane from cow manure. Neighbors say it's killing them

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At a massive dairy farm in the San Joaquin Valley, nearly 14,000 Holstein cows crane their necks through feeding stalls and gnaw leisurely on alfalfa.

Meanwhile, close to their hooves, a sprinkler system activates and flushes the herd's manure into nearby sewer grates. From there, the waste courses through a network of pipes and into an enormous lagoon covered by a thick vinyl tarp.

This enclosed pool, which looks something like a giant whoopee cushion, is known as a digester, and it's the cornerstone of California's bid to reduce [greenhouse gas emissions](#) from its \$7.5-billion [dairy](#) industry.

California—the nation's leading dairy-producing state—is home to 1.7 million milk cows, which belch and excrete copious amounts of methane, a potent greenhouse gas capable of warming the atmosphere 80 times more than carbon dioxide over a 20-year period.

Instead of allowing methane from cattle waste to escape into the atmosphere, digesters harvest the gas from manure so it can be used to fuel heavy-duty trucks, generate electricity or supply gas furnaces and stoves.

It's a strategy California has invested in heavily as [dairy farmers](#) try to meet the world's growing appetite for butter and cheese. But while boosters say the technology has already helped the industry achieve 22% of its needed emission reductions, the facilities are coming under increasing fire from critics, who say they spew lung-damaging pollution in [local communities](#) and seriously undermine the state's net-zero carbon goals.

By providing [financial incentives](#) to capture and burn methane as an energy source, environmentalists argue, California is encouraging the production of, and reliance on, a fuel that still releases planet-warming carbon dioxide and other [air pollutants](#) once it is burned.

"Methane is not some unavoidable waste product that we need to capture

and do something with," said Sara Gersen, a senior attorney with Earthjustice, a San Francisco-based environmental nonprofit. The state's approach, she said, "creates a perverse incentive for people to not only continue emitting methane, but ramp up how much methane is getting generated at their facility."

Massive dairy farms are already among the largest polluters in the San Joaquin Valley, a region that suffers the worst air quality in the nation. Now, residents worry that newly constructed digesters will make it even worse.

They point to research that suggests manure digesters increase the presence of ammonia, a toxic gas present in cow manure and urine. When the captured methane is burned for energy, it also produces other lung-aggravating pollution including nitrogen oxides.

Since 2015, California has funneled hundreds of millions of dollars toward the construction and operation of about 120 digesters—the most of any state in the nation. And state air regulators have unveiled plans that call for building up to 230 more by the end of the decade.

Maria Arevalo, an environmental activist living in California's dairy capital of Tulare County, has vehemently opposed state subsidies for digesters, arguing they reward farms for their pollution.

"They can make a lot of money for methane," said Arevalo, 74, who lives near one of the largest clusters of dairies. "But at what cost? It's our community that's dying. It's our community that's getting sick."

While the climate effects of dairy and beef farms have been well documented, their contribution to air pollution is seldom discussed. Yet the contaminants that manure releases into the air are known to impair lung and heart health.

The primary hazard is lung-irritating ammonia vapor, which binds with vehicle exhaust and smokestack emissions to form an even more dangerous pollutant—fine particulate matter. When inhaled, this microscopic debris travels deep into the lungs and then into the bloodstream, where it causes swelling and scarring.

Persistent exposure to particulates can trigger heart attacks and strokes, in addition to various forms of lung disease.

A 2017 study by the University of Wisconsin examined emissions at dairies with manure digesters and found that when liquid manure is stored inside a digester—often for weeks at a time—ammonia becomes more volatile.

When this stored manure was removed from digesters for use as fertilizer, ammonia emissions grew as much as 81%, according to researchers.

Each year, the San Joaquin Valley, the heart of California's dairy industry, records the nation's highest ammonia concentrations and its greatest particulate pollution. Over half of the valley's fine particulate matter comes from ammonia-based pollution, which primarily comes from livestock waste, according to the local air district.

Clean air advocates say the burden of this pollution falls unfairly on small Latino farming communities such as Pixley, an unincorporated settlement of 4,000 people in Tulare County.

The town has 22 dairies and one feedlot that collectively house more than 118,000 cows, according to reports submitted to the regional water board. These animals produce nearly 2 million tons of manure annually.

Arevalo, a former farm laborer turned community activist, moved there

in 1976, when much of the land surrounding the town was filled with cotton. But, over time, dairy farmers purchased land and built massive open-air barns on the outskirts of town.

The air, Arevalo said, became steeped with rancid odors from cow manure, and clouds of flies regularly descended on the town.

She began to recognize how grave the air pollution had become in the early 2000s, when she volunteered with her church to pray at the bedsides of members who had fallen sick.

Congregants, she said, almost always suffered from some form of respiratory illness or cardiovascular distress, commonly associated with particulate pollution.

Eventually, Arevalo also developed asthma and sleep apnea. She now must sleep with a mask and hose connected to a motorized breathing machine. The device sends pressurized air, as well as medication, to her lungs.

In a community where the median household income is around \$42,000, exposure to poor air is often inescapable. Many residents can't afford air conditioning, which would filter air entering their homes. Instead, they open their windows on hot summer days.

Last year, Arevalo traveled to Sacramento to urge the California Air Resources Board to take steps to reduce dairy pollution. In testimony, she recounted the health effects she attributed to air pollution—nosebleeds, asthma and shortness of breath.

"We're older and our time is coming up," Arevalo said, choking back tears. "But it is sad to think about our children and what future they have. What will their health be like?"

However, the state dairy lobby argues that digesters are the most cost-effective climate solution in California's portfolio, and are essential for reaching the state's goal of net-zero emissions—the point at which human greenhouse gas releases are balanced by their removal from the atmosphere.

"There's going to be trade-offs between one pollutant or another, and if we did identify something, it just means we have to find a way to mitigate it," said Michael Boccadoro, executive director of Dairy Cares. "It doesn't mean we should throw the baby out with the bathwater."

CARB, the state air regulator, has commissioned researchers from Princeton and UC Riverside to measure air pollution and greenhouse gases near dairy digesters, including ammonia and nitrous oxide. The results are expected to be published in the spring.

CARB and the dairy industry argue that even if there is a rise in ammonia, it isn't a significant threat to form more particulate matter. They acknowledged there's an overabundance of ammonia in the Central Valley, but argue that there's not enough tailpipe or smokestack emissions to ultimately boost particulate pollution.

But ammonia, by itself, is an issue. At high concentrations, it has the potential to shroud communities in a corrosive haze. It can foster more bacteria growth in waterways and result in large die-offs of fish. On land, it has the potential to alter soil chemistry and hinder the growth of trees and plants.

There is also the potential for this ammonia to break down into nitrous oxide, a greenhouse gas that is 265 times more effective at trapping heat than CO₂.

Dairy cows are voracious grazers with complex digestive systems. Their

four-chambered stomachs host bacteria that break down plant material and produce copious amounts of methane, causing cows to frequently burp. A single cow can also produce up to 100 pounds of methane-infused manure each day.

More than half of California's methane emissions come from cattle, due in part to how farms treat cattle manure. Dairies use water to flush cattle waste into large uncovered manure lagoons, and the deep, oxygen-free reaches of these ponds are a breeding ground for bacteria that produce methane.

In 2016, the Legislature passed a law to reduce statewide methane emissions by 40% by 2030. It was around this same time that the state Department of Food and Agriculture established a program to fund the construction of dairy digesters.

However, these covered lagoons also breed more bacteria and produce more heat-trapping methane than if manure was simply shoveled outside barns. Some environmental organizations have called on the state to support dairies that don't use water to transport manure, which they say would drastically reduce methane emissions.

"Human agriculture, for millennia, has raised cattle without storing the manure in these wet lagoons to create the unique conditions for methane creation," said Gersen, the Earthjustice attorney. "The methane problem that we have from dairies is a 21st century problem."

Despite such issues, digester advocates say the technology succeeds in preventing large amounts of methane from entering the atmosphere.

Tom Richard, professor of agricultural engineering at Penn State, said that while manure digesters aren't a "perfect solution," they are the most effective climate tool available. Given that methane naturally degrades

into CO₂ in the atmosphere, it would be best to burn it for energy straightaway to prevent unnecessary warming, he said.

"We're taking this high-energy molecule—methane—and we're turning it into CO₂, which would happen in the atmosphere anyway," Richard said. "But we're doing it in a way where we can capture that energy."

State construction grants and clean fuel subsidies have driven a boom in deploying the technology. In 2015, there were about 15 digesters in California. Less than a decade later, about 120 digesters are online, with roughly 100 more in development.

The state Air Resources Board allows for digester operators to be paid for the amount of dairy methane they capture and burn. In 2022, that state program doled out more than \$568 million to dairy- and swine-biogas operations in California and elsewhere, according to Aaron Smith, a professor of agricultural economics at UC Davis.

Some critics believe this financial incentive sends a dangerous signal to farmers.

"You can imagine this dystopian situation we're arriving at where people start to keep farms just for the sake of creating methane and animals turn into basically power plants," said Sasan Saadat, a senior research and policy analyst for Earthjustice.

Some policymakers agree. At a state meeting earlier this year, CARB board member Gideon Kracov said relying on methane long term undermines California's commitment to transition away from combustible fuels, which contribute pollution and greenhouse gases.

"These are bridge fuels that we do not want in the transportation sector after 2040," Kracov said. "These are cleaner than diesel, and there has to

be an appropriate return on investment. But we also need to signal to industry that the credit and subsidy has to end. Otherwise, I do believe we imperil our zero-emission future."

CARB staff recently recommended that the state end the financial incentives to capture and burn dairy methane by 2040. But the board will vote on the future of this program early next year.

Environmental groups also complain that the California Air Resources Board has erroneously deemed dairy methane to be a cleaner energy source than electric vehicles and other zero-emission technology.

Although burning dairy methane undoubtedly produces CO₂, the Air Resources Board considers it a carbon-negative fuel—a designation typically reserved for an activity that removes more heat-trapping gases from the atmosphere than it emits.

On average, dairy methane earns a score of about minus-300. For comparison, gasoline and diesel are scored around 100, while an electric vehicle that is powered by solar energy would hypothetically be scored zero.

Critics say this calculation portrays dairy methane as California's most climate-friendly fuel, when in fact it produces a tremendous amount of CO₂ and other pollutants. They also have expressed frustration that CARB refuses to release CO₂ or nitrogen oxide emissions data for the digesters it funds.

State officials defended the carbon-negative designation.

"Because methane is a more powerful greenhouse gas than CO₂, avoiding an emission of that molecule does more to avoid climate change than simply using a zero-emission vehicle," said Lys Mendez, a

spokesperson for CARB.

Environmentalists have criticized CARB for failing to adopt new rules to limit greenhouse gas emissions from farms rather than providing incentives. Starting in 2024, California law gives CARB the authority to regulate [methane](#) emissions from dairy and livestock operations.

State air regulators contend they are following the Legislature's wishes by starting with incentives. They say also that stiff rules could drive dairies to other states with more lenient environmental laws.

Liane Randolph, chair of the state Air Resources Board, visited Pixley in the fall to talk with valley residents and environmental groups about concerns they had with dairy pollution.

Leslie Martinez, a community activist with the environmental nonprofit Leadership Counsel for Justice & Accountability, said she hoped the visit changed the way Randolph sees the massive dairies the agency is funneling money toward.

When Martinez sees dairy products sitting on refrigerated shelves, she can't help but ponder the environmental toll it takes to produce them: the odor, truckloads of manure and the haze that obscures the mountains.

"I like cheese. I love ice cream," Martinez said. "I'm not saying that we have to get rid of the dairy industry as a whole. But we have to think about ways to make it sustainable. ... There is no ice cream that is good enough to justify what is happening in Pixley."

As Arevalo, the Pixley resident, continues to call for change, her own health hangs in the balance. Her doctors have told her the only way to truly alleviate her respiratory issues is to move.

It's advice Arevalo refuses to take.

"Our community was here before all these cows," she said. "We live a humble life—we're farmworkers. We don't make a lot of money. We barely eat with what we get paid. And for those of us that have a poor little house, we worked very hard to get that poor little house. And for someone to think that we can just sell it and buy a new one, it's just not true."

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