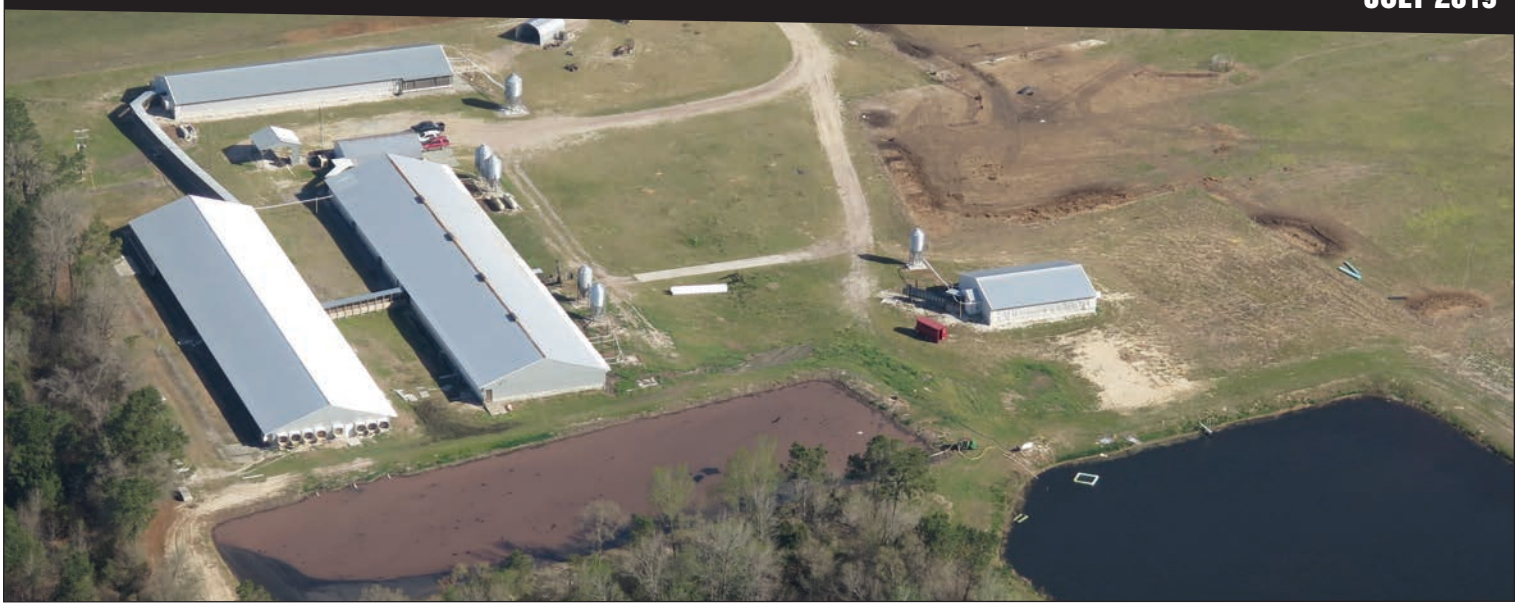


Biogas From Factory Farm Waste Has No Place in a Clean Energy Future

As the threats of global climate change and fossil fuel dependence are increasingly being felt worldwide, countries are turning to biogas as a part of a transition to renewable energy. Biogas is being boasted as a "renewable" energy solution, designed to help mitigate climate change. The process of anaerobic digestion converts organic material into biogas, which can be used to produce electricity on-site, for heating, or as vehicle fuel.[1]

Despite claims of environmental benefits, biogas is primarily made up of methane, a potent greenhouse gas. And the focus on the supposedly renewable nature of biogas ignores the many environmental and health threats posed by a major source of this gas: manure from massive factory farms. Biogas has no place in the world's clean energy future.

Proponents are promoting biogas as a means to abate the environmental consequences associated with large-scale livestock operations, often referred to as factory farms or concentrated animal feeding operations (CAFOs). These facilities raise large numbers of animals in intensive confinement, concentrating the animals and their manure.

Biogas digesters are among the new wave of "green" manure management solutions being used on livestock operations all over the world. But these digesters simply prop up factory farms that threaten human health, contribute to global warming and put workers, communities and farmers at risk.

Biogas Is Dirty Energy

Despite claims that digesters reduce greenhouse gas emissions[7], burning biogas actually releases carbon dioxide and other pollutants including smog-forming nitrogen oxides, ammonia and hydrogen sulfide[8], potentially offsetting other

What Is Biogas?

Biogas is a mixture of gases that are produced after plant and animal material are broken down by microorganisms in a process called anaerobic digestion.[2] Anaerobic digestion — which occurs in a closed, oxygen-free space called a digester — takes substances like manure from factory farms, sewage sludge or food waste and "eats" the material, leaving mostly methane and carbon dioxide, among other gases. The material left over is called digestate.[3]

Biogas can be converted into biomethane through the removal of hydrogen sulfide, carbon dioxide and moisture.[4] It also can be treated and made into compressed natural gas (CNG) or liquefied natural gas (LNG)[5], with the removal of siloxanes and hydrogen sulfide[6], to be used to generate power or distributed through pipelines to homes and businesses.

greenhouse gas reductions. Additionally, biogas is composed of roughly 50-70 percent methane, 30-45 percent carbon dioxide and trace amounts of other gases.[9] Biomethane typically contains more than 95 percent methane.[10] Methane is a potent greenhouse gas, nearly 90 times more powerful than carbon dioxide over a 20-year time period.[11]

Data have shown that biogas digesters are responsible for both systemic and accidental methane emissions.[12] Plants that store digestate — the byproduct of anaerobic digestion — in open tanks emit a steady flow of methane. Accidental leaks can occur in over-pressured digesters, which can lead to explosions.[13] In a review of several studies, researchers estimated that the leakage from "renewable" methane production is actually similar to that of fossil fuel gas production.[14] On top of this, the transport of biogas and materials to and from digesters still uses massive amounts of toxic diesel fuel.[15]

Releases of harmful contaminants are also associated with biogas plant operation and infrastructure such as pipelines, the end use of the gas and digestate management.[16] These releases can destroy the Earth's protective ozone layer, warming the atmosphere and changing the global climate.[17] Biogas purification technology exists to reduce methane leakage, but it is costly and faces major challenges in terms of efficiency and energy consumption.[18]

The high costs of factory farm manure

Worldwide, factory farms produce millions of tons of manure a day. Many pig and dairy cow factory farms flush untreated waste into large cesspools called lagoons, where it is stored until it is applied as fertilizer on fields. However, waste from lagoons is routinely overapplied to crop land as fertilizer, leading to runoff into surface waters and leaching into groundwater, which impacts human health and nearby communities. And unlike human sewage, which is treated at wastewater treatment plants, such treatment facilities for livestock waste are nonexistent.[19]

Because they produce so much waste, large-scale factory farms are also dangerous sources of methane. Methane emissions from agriculture in the United States have gradually risen by 14 percent in the past few decades and steadily continue to rise.[20] From 1990 to 2017, manure management was the largest cause of the increase in methane emissions in the U.S. agricultural sector.[21] The majority of this observed increase was predominately from pig and dairy cattle manure, with emissions increasing 29 percent and 134 percent, respectively.[22]

Studies have claimed that the use of biogas technology offers a way to avoid the negative impacts of methane emissions and toxic gases from manure.[23] The multinational meat giant Smithfield Foods not only plans to push the U.S. factory farms that raise their animals to construct digesters, but also intends on building new factory farms specifically to tap into the potential to generate biogas.[24]

Biogas digesters are a false solution that do nothing to actually mitigate emissions from agriculture. On-farm digesters can cost anywhere from an estimated $400,000 to $5 million to construct depending on the size, design and features.[25] The money being funneled into digesters is wasted capital that should instead be invested in zero-emission renewable energy sources, like solar and wind.

And the looming spread of factory farms — driven in part by the promotion of biogas digesters — can be dangerous, compounding the already existing threats to farmers, workers and local residents.

Biogas in the United States

The energy crisis in the 1970s propelled the United States to consider the feasibility of biogas as an alternative energy source.[26] Once fully developed as usable technology, digesters were put on larger livestock operations. But this first generation of biogas digesters suffered from high capital costs and substantial operational hurdles.[27] By the 1980s, 85 percent of existing digester facilities were shut down, due in part to poor technological designs, bad management and a lack of knowledge needed to operate them.[28]

In actuality, some farmers were finding that the costs to run biogas operations were exceeding the money earned from generating electricity.[29] A drastic decline in electricity prices in the past decade has made selling the electricity to the grid less profitable.[30] This, coupled with the changing landscape of environmental regulations and legal challenges from neighboring communities, has resulted in the expansion of methane digesters used to produce "renewable" natural gas (RNG).[31] RNG production has created an incentive for constructing even more digesters — and the pipeline infrastructure needed to move the gas — across the country.[32]

According to the U.S. Environmental Protection Agency (EPA), as of January 2019 at least 282 anaerobic digesters were in construction or currently operating on livestock farms in the United States.[33] The EPA estimates that biogas technology can be employed on at least 8,000 additional large dairy and pig operations.[34] So far, the U.S. Department of Agriculture has invested more than $10 million in biogas research and use.[35] State governments also incentivize digesters by promoting biogas as renewable energy in their Renewable Portfolio Standard policies.[36]

Environmental injustices stemming from digesters

Across the country, the presence of factory farms and increased promotion of biogas are threatening low-income communities and communities of color. In the Central Valley of California, biogas digesters could impose disparate health impacts on already vulnerable populations. Pig farms in eastern North Carolina are disproportion-

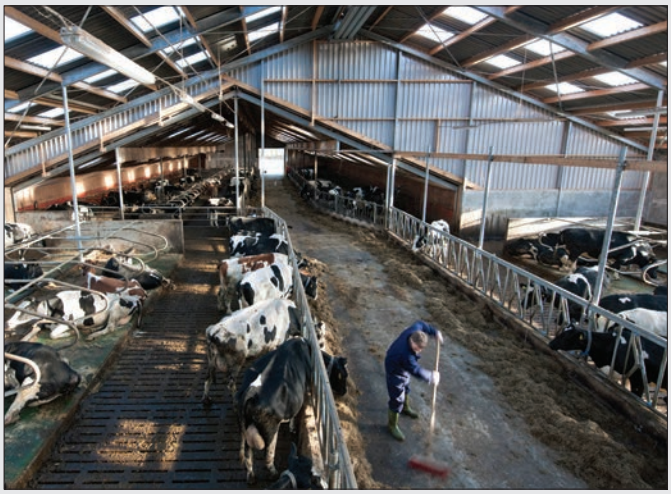
The Case of Smithfield Foods

Rural communities across the United States are being targeted for new digesters. In late 2018, Smithfield Foods announced its plans to build "manure-to-energy" projects at 90 percent of the facilities raising its pigs — in Missouri, Utah and North Carolina — with the goal of achieving greenhouse gas emission reductions.[37] This $250 million joint venture with Dominion Energy will convert existing anaerobic lagoons into covered digesters, which will capture biogas that will then be transported to processing facilities around the country to be turned into natural gas.[38]

The partnership claims "to promote cleaner energy, sustainable family farms, and a brighter future for rural communities."[39] But the creation of even more dirty natural gas through anaerobic digestion at large factory farms will do nothing for independent family-scale farms because digesters require such large quantities of manure. This amount of manure can only be produced on farms that confine thousands of animals.

On top of this, Smithfield's greenwashing attempts are not surprising given the company's egregious track record in North Carolina. In 2018, Smithfield lost three lawsuits filed by a group of North Carolinians who live near its pig farms. The plaintiffs were awarded nearly $550 million after testifying about terrible odors, adverse health impacts and property destruction. After Hurricane Florence, conditions worsened as pig waste lagoons around the state overflowed — some breaching entirely — resulting in the release of millions of gallons of untreated pig manure into floodwater and people's homes.[40]

Smithfield's newfound interest in biogas digesters comes right on the heels of these lawsuits, which emphasized just how dangerous pig manure lagoons and sprayfield systems have been for nearby communities.[41] But this plan does nothing to solve the problem of Smithfield's polluting factory farms — instead, Smithfield will not only maintain its factory farms, but also employ dirty biogas infrastructure under the guise of being "renewable."



The Case of California's Central Valley

Before 2002 in the Central Valley of California, there were less than five dairies that operated manure digesters.[42] By 2015, five dairy factory farms had been awarded millions of dollars in grants to build new biogas digesters that would be located in disadvantaged communities in the Central Valley. The California Department of Food and Agriculture claims that these digesters will mitigate global warming by cutting methane emissions through the production of renewable energy.[43]

But the Central Valley is a region already plagued by pollution and terrible environmental conditions, and digesters may only make things worse. The increased presence of factory farms to promote biogas, the use of diesel trucks to cart manure to and from digesters, and the invasive construction of pipelines to move biogas across the country pose major risks to an already polluted Central Valley.

The valley is surrounded by mountains that trap air pollutants, resulting in poor air quality. Already, the concentrations of ozone and particulate matter often exceed the state and federal standards.[44] Groundwater has also been degraded partly because of land use and agriculture practices.[45]

The San Joaquin Valley, which makes up two-thirds of the Central Valley, is home to a population that is 54 percent people of color.[46] This area is agriculturally rich but economically poor, ranking among the nation's poorest regions. These communities lack the political agency and resources needed to advocate for themselves, and often go unnoticed by state officials.[47]

ately located in communities of color where bacteria from manure is found in water.[48]

Moreover, air pollutants from these operations disrupt daily living — of predominately Black, Hispanic and Indigenous residents — contributing to stress and anxiety, mucous membrane irritation, respiratory conditions, reduced lung function and blood pressure elevation.[49] And while a good portion of emissions are present before digestion takes place, biogas construction and production will bring its own pollutants and emissions — from the exhaust generated from the use of heavy equipment and vehicles, to the potential odors that will come with the transport of manure and other material used for digestion.[50]

The placement of digesters in already disadvantaged communities will only exacerbate the existing environmental degradation facing vulnerable populations around the country.

Biogas Domination in Europe

Europe is far more familiar with biogas operations than the United States, with more than 17,000 digesters located around the continent. Seventy percent of these plants operate on agricultural materials,[51] which includes animal waste, other waste associated with food production, and energy crops — crops grown specifically for anaerobic digestion.[52]

The increase in biogas production can be attributed, in part, to renewable energy policies backed by the European Union, which boasts that biogas is economically and environmentally beneficial.[53] More than £200 million (roughly $273 million) of taxpayer money is used annually to fund digesters in the United Kingdom (UK) alone.[54] Germany has more than 8,000 digesters as a result of a law that guarantees renewable energy producers above-market rates for their power.[55]

Contrary to claims of new energy production, the power from digesters cannot actually be harnessed in the ways that the fracking and natural gas industries promote. In a report on the feasibility of renewable biogas, researchers note that there are significant economic constraints in achieving substantial volumes of "renewable" methane from manure in Europe.[56] Even when incentivized, the high costs of transporting "renewable" methane to the grid for heating and transportation becomes increasingly difficult.[57]

Safety issues on the rise

These operations have proven time and time again to be extremely dangerous. And accidents are increasing. One

farm in the UK has been the site of two separate digester spills, which spewed toxic black sludge onto acres of farmland — killing more than 50 farm animals — and into a nearby stream.[58] The sludge even reached neighboring farms. Damages from the two spills cost around £114,000, roughly $145,000.

A study of biogas accidents around Europe found that increased digester development has led to a higher number of operational accidents. The study examined more than 200 accidents and found that explosions and leaks resulted in a number of worker injuries on biogas plants. In more extreme instances, hazardous conditions at plants have led to worker deaths.[59] Researchers from the study had a database of only 208 accidents to examine, but concluded that the number of accidents at plants probably exceeds what is recorded.

The Urgent Need to Shift to Renewables

Because biogas has the potential to be turned into natural gas, it appeals to industries that want to expand natural gas infrastructure development around the world. The cost of a single biogas digester can reach $5 million. The expansion of natural gas infrastructure to handle new biogas production will also come at a high price. By 2016, the costs for constructing U.S. pipelines rose to a whopping $2.4 million per mile above 2015 costs, bringing total costs to $7.65 million per mile (roughly £5.86 million).[60] Rather than investing this huge amount of capital in dirty energy, it would be better spent on actual renewable energy efforts.

We must reject biogas as renewable energy

This worldwide promotion of biogas as "renewable" by agribusinesses and the fracking and natural gas industries is misleading and harmful. Dirty biogas releases greenhouse gas emissions and other pollutants, puts workers and farmers in danger, and harms nearby communities, all while failing to provide reliable power. Investing in natural gas infrastructure and factory farm-linked technology forestalls meaningful reductions in emissions and delays a true shift to renewable energy. It is time to invest in a just transition to a 100 percent, zero-emission, clean energy future, not factory farm biogas.

Endnotes

1 Scarlat, Nicolae et al. "Biogas: Developments and perspectives in Europe." *Renewable Energy.* Vol. 129, Part A. December 2018 at 458.

2 Environmental and Energy Study Institute (EESI). "Biogas: Converting Waste to Energy." October 2017 at 1; U.S. Environmental Protection Agency (EPA). "How does AD work?" Available at https://www.epa.gov/anaerobic-digestion/basic-information-about-anaerobic-digestion-ad. Accessed April 2019.

3 *Ibid*.

4 California Environmental Protection Agency (CalEPA). "Central Valley Dairy and Co-digester PEIR — Notice of Preparation/Initial Study." ESA/209481. March 2010 at 6.

5 EESI (2017) at 4.

6 Murray, Brian C. et al. Nicholas Institute for Environmental Policy Solutions, Duke University. "Biogas in the United States: An Assessment of Market Potential in a Carbon-Constrained Future." NI R 14-02. February 2014 at 7.

7 Smithfield Foods. [Press release]. "Smithfield Foods announces landmark investment to reduce greenhouse gas emissions." October 25, 2018; Ouzts, Elizabeth. "Using biogas to clear the air near hog farms." *Environmental Health News*. November 16, 2017.

8 Kuo, Jeff. California State University, Fullerton. "Air Quality Issues Related to Using Biogas From Anaerobic Digestion of Food Waste." Prepared for California Energy Commission. CEC-500-2015-037. March 2015 at 2, 9 and 10.

9 U.S. Department of Agriculture (USDA) et al. "Biogas Opportunities Roadmap." August 2014 at 6; Jørgensen, Peter Jacob. (2009). *Biogas — Green Energy*. Denmark: Faculty of Agricultural Sciences, Aarhus University at 4.

10 CalEPA (2010) at 6; Kuo (2015) at 9.

11 Jackson, Robert B. et al. "Natural gas pipeline leaks across Washington, DC." *Environmental Science & Technology*. Vol. 48, No. 3. 2014 at 2051.

12 Baldino, Chelsea et al. The International Council on Clean Transportation. "The Potential for Low-Carbon Renewable Methane in Heating, Power, and Transport in the European Union." Working Paper 2017-26. October 2018 at 9.

13 Clemens, J. et al. "Leakage control of biogas plants." bonalytic GmbH. 2012 at 1.

14 Baldino et al. (2018) at 9.

15 CalEPA (2010) at 13.

16 Paolini, Valerio et al. "Environmental impact of biogas: A short review of current knowledge." *Journal of Environmental Science and Health, Part A*. Vol. 53, No. 10. 2018 at 899 to 900.

17 Papadias, Dennis and Shabbir Ahmed. Argonne National Laboratory. "Biogas Impurities and Cleanup for Fuel Cells." Presented at the Biogas and Fuel Cells Workshop. Golden, Colorado. June 11-13, 2012 at 5; Minnesota Pollution Control Agency. "Chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs)." Available at https://www.pca.state.mn.us/air/chlorofluorocarbons-cfcs-and-hydrofluorocarbons-hfcs. Accessed March 2019; Jørgensen (2009) at 6.

18 Ullah Khan, Imran et al. "Biogas as a renewable energy fuel — A review of biogas upgrading, utilisation and storage." *Energy Conversion and Management.* Vol. 15. October 2017 at 291.

19 Hribar, Carrie. National Association of Local Boards of Health. "Understanding Concentrated Animal Feeding Operations and Their Impact on Communities." 2010 at 2.

20 EPA. "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017." 430-R-19-001. April 11, 2019 at 2-18.

21 *Ibid*. at 2-18 to 2-19.

22 *Ibid*. at 2-19.

23 Mathias, João Felippe Cury Marinho. "Manure as a resource: Livestock waste management from anaerobic digestion, opportunities and challenges for Brazil." *International Food and Agribusiness Management Review.* Vol. 17, Iss. 4. 2014 at 88.

24 Smithfield Foods (2018).

25 Montana State University Extension. "E3A: Anaerobic Digester Applications for the Farm or Ranch." E3A-AD.3. October 2011 at 1.

26 Lusk, P. Resource Development Associates. "Methane Recovery From Animal Manures: The Current Opportunities Casebook." Prepared for National Renewable Energy Laboratory. NREL/SR-580-25145. September 1998 at 2-6; Bond, Tom and Michael R. Templeton. "History and future of domestic biogas plants in the developing world." *Energy for Sustainable Development*. Vol. 15, Iss. 4. December 2011 at 348; Klinkner, Blake Anthony. "Anaerobic digestion as a renewable energy source and waste management technology: What must be done for this technology to realize success in the United States?" *UMass Law Review.* 2014 at 82 to 83.

27 Lusk (1998) at 2-6.

28 Klinkner (2014) at 84 to 85.

29 Yu, Alan. "Waste not, want not: Why aren't more farms putting poop to good use?" NPR. April 23, 2017.

30 Clayton, Chris. "Livestock: methane digesters — New growth for renewable energy in agriculture." AgFax. November 1, 2018.

31 *Ibid*.

32 *Ibid*.

33 EPA. "AgSTAR Livestock anaerobic digester database." January 2019. Available at https://www.epa.gov/agstar/livestock-anaerobic-digester-database. Accessed April 2019.

34 *Ibid*.

35 USDA et al. (2014) at 4 and 21.

36 Food & Water Watch. "Cleanwashing: How States Count Polluting Energy Sources as Renewable." July 2018 at 8.

37 Smithfield Foods (2018).

38 Dominion Energy. [Press release]. "Dominion Energy and Smithfield Foods partner to transform the future of sustainable energy." November 27, 2018; Willets, Sarah and Leigh Tauss. "Smithfield Foods says it will cover its lagoons. Critics say that's just lipstick on a pig." *Indy Week*. October 31, 2018.

39 Dominion Energy (2018).

40 Krissy Kasserman. Food & Water Watch. "Smithfield Foods is in the HOGhouse." November 8, 2018.

41 Willets and Tauss (2018).

42 CalEPA. "History: Anaerobic digesters at dairies in California." Available at https://calepa.ca.gov/digester/history/. Accessed March 2019.

43 "Five new Central Valley dairy digesters to capture methane, generate renewable energy." *Dairy Cares Newsletter*. July 2015.

44 CalEPA (2010) at 7.

45 *Ibid*. at 7.

46 Flegal, Chione et al. PolicyLink. "California Unincorporated: Mapping Disadvantaged Communities in the San Joaquin Valley." 2013 at 7.

47 *Ibid*.

48 Wing, Steve and Jill Johnston. The University of North Carolina at Chapel Hill. Department of Epidemiology. "Industrial Hog Operations in North Carolina Disproportionately Impact African-Americans, Hispanics and American Indians." August 29, 2014 at 2 and 7.

49 *Ibid*. at 1.

50 CalEPA (2010) at 12 and 13.

51 European Biogas Association. "EBA Statistical Report 2017." Available at http://european-biogas.eu/2017/12/14/eba-statistical-report-2017-published-soon/. Accessed March 2019.

52 Steffen, R. et al. Institute for Agrobiotechnology Tulln. University of Agricultural Sciences Vienna. "Feedstocks for Anaerobic Digestion." September 30, 1998 at 9 to 11.

53 Scarlat et al. (2018) at 457.

54 Rose, David. "The great green guzzler con: Monster digesters are meant to guzzle up waste and churn out eco-friendly energy... but they are fed with CROPS, produce pitiful levels of power, cost YOU £216 m in subsidies and HARM the environment." *Daily Mail*. December 31, 2016.

55 Kesmodel, David. "Energy prices steer farmers away from manure power." *Wall Street Journal*. February 18, 2016.

56 Baldino et al. (2018) at 5 and 6.

57 *Ibid.* at 6.

58 Rose (2016).

59 Trávníček, Petr et al. "Quantitative analyses of biogas plant accidents in Europe." *Renewable Energy.* Vol 122. 2018 at 89 and 92.

60 Smith, Christopher E. "Natural gas pipeline profits, construction both up." *Oil & Gas Journal*. September 5, 2016.