Factory Farms, Fracking, and the Methane Emergency

With every day that the status quo continues, the chance of keeping global temperature rise below the 1.5 degree Celsius (°C) tipping point slips further and further away.[1] Much focus remains on cutting carbon dioxide (CO_2) emissions, the largest source of greenhouse gas emissions and warming.[2] But reducing its more insidious counterpart, methane, is even more essential in stabilizing global climate and reducing short-term warming.

Food & Water Watch found that U.S. factory farms released significant amounts of methane in 2022. This includes up to:

- 2.5 million metric tons from the 7 million dairy cows living on factory farms;
- 533,000 metric tons from the 12 million factory feedlot beef cattle; and
- 107,700 metric tons from the 72.2 million hogs living on factory farms.

Additionally, fracking released an estimated 26.4 million metric tons of methane.

Global fossil fuel methane emissions remained near record highs in 2023,[3] while continuing meat and dairy production and consumption as-is threatens to blow the planet past 1.5°C of warming.[4] Ending the largest sources of methane emissions — factory farms and fracking — is the quickest and only way to secure our future.

Methane's Potency

Since the Industrial Revolution, greenhouse gas emissions have skyrocketed, filling the air with an overabundance of gases and amplifying the Earth's natural warming effect.[5] Methane is responsible for a third of total warming since then,[6] with a warming effect 86 times stronger than CO_2 on a 20-year timescale (See Fig. 1).[7] In 2021, atmospheric methane hit new highs, marking the largest annual increase in the National Oceanic and Atmospheric Administration's (NOAA) 38-year record.[8] The year 2022 did not fare much better — NOAA recorded the fourth largest increase in methane, reaching a total of 1,911 parts per billion.[9]

Methane stays in the atmosphere for only around 12 years, compared to potentially thousands of years for CO_2. Despite this shorter lifespan, methane traps significantly more atmospheric heat than CO_2 and contributes to the formation of other greenhouse gases, giving it a higher global warming potential than CO_2.[10] This means that reducing the rate of methane emissions is essential to stabilizing long-term temperature rises,[11] while providing more immediate climate-cooling effects.[12]

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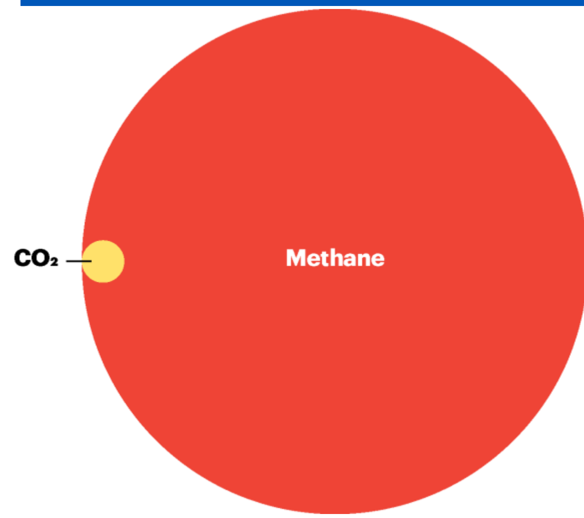
More than 60 percent of atmospheric methane is anthropogenic, stemming from fossil fuels, factory farms, landfills, and sewage treatment.[13] Globally, two industries are largely at fault for this: industrial animal agriculture and fossil fuel production.[14] Within the U.S., estimates from the Environmental Protection Agency (EPA) show that emissions from animal agriculture have increased over the past few decades,[15] while a recent International Energy Agency analysis found that the U.S. is the largest global emitter of methane in the oil and gas sector.[16]

FIG. 1: Warming Impact of CO_2 vs. Methane (20 years)



Source: Ravishankara et al. and U.S. EPA

Impacts of Animal Agriculture

According to EPA estimates, emissions from animal agriculture have risen since 1990, contributing significantly to methane emissions.[17] Food & Water Watch (FWW) estimates that emissions from hogs, beef cattle, and dairy cows living on U.S. factory farms[a] total up to 3.2 million metric tons of methane every year (see Methodology). This is equivalent to 65.3 million cars being driven for a year, or driving around the Equator over 28 million times (see Fig. 2).

Most on-farm livestock emissions come from enteric fermentation, a natural process within the digestive system of ruminants.[18] With gas produced as a byproduct, the animal loses up to 12 percent of its energy intake as methane.[19] Emissions from enteric fermentation have grown over the past three decades, attributed to increasing cattle populations.[20] FWW estimates that mega-dairies dominate these emissions, with nearly 7 million cows together producing 1.06 million metric tons of methane every year. The 11 to 12 million beef cattle on factory farms produce 507,000 metric tons of methane annually.

The other major source of on-farm emissions is manure production and management. The EPA estimates that methane increased a staggering 69 percent between 1990 and 2021, largely attributable to swine and dairy factory farms.[21] As animal agriculture has become increasingly corporatized and industrialized, emissions from manure management have grown.[22] Liquid storage is more common on factory farms and encourages the release of methane.

Annual methane emissions from manure management in dairy cattle more than doubled from 1990 to 2020, despite the total number of dairy cows remaining relatively steady.[23] For example, anaerobic lagoons, used by factory farms in an attempt to stifle the smell,[24] produce more than three times as much methane as the cattle on these farms release through enteric fermentation.[25] Another estimate found that one ton of manure from large dairy farms produces more than twice as many heat-trapping emissions as one ton of manure from small dairy farms.[26]

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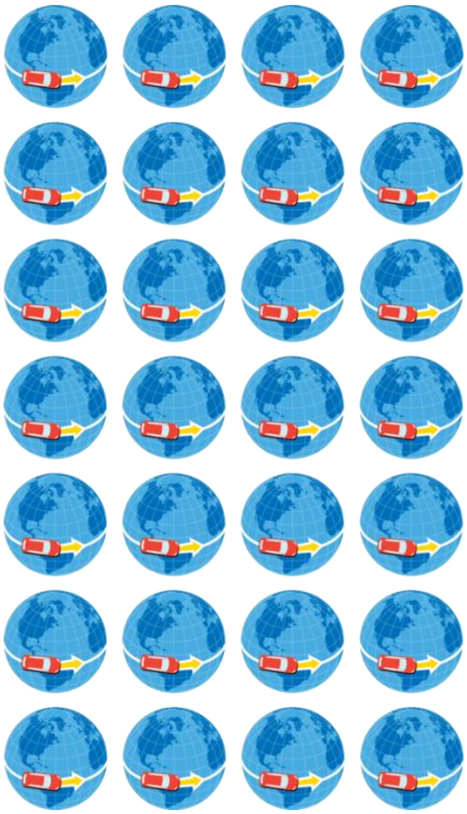
[a] *In this analysis, factory farms refer to dairy operations with 500+ cows, beef feedlots with 1,000+ head, hog operations with 1,000 head, and broiler operations with 500,000+ sales annually. See Methodology for more information.*

FIG. 2: Emissions from Factory Farms Equal 28 Million Trips Around the Equator



One car equals one million trips around equator.
Source: FWW analysis of U.S. EPA

FWW estimates that emissions from manure management of mega-dairy cows total up to 1.49 million metric tons of methane every single year. This is equivalent to 14 billion gallons of gasoline burned, or 30.5 million cars driven for a year. FWW estimates that beef cattle on factory farms emit up to 26,200 metric tons of methane annually, equivalent to 247 million gallons of gasoline consumed. Dairy manure emissions vary by state, with mega-dairies in big dairy states like California and Texas each emitting up to 370,000 and 167,000 metric tons annually respectively. In a status quo scenario, research shows that emissions from the largest individual meat and dairy companies may exceed emissions by fossil fuel companies.[27]

Thanks in no small part to lobbying by Big Ag, regulations are lackluster at best when it comes to curbing methane emissions. At the 2021 United Nations Climate Change Conference (COP 26) in Glasgow, Scotland, President Joe Biden pledged a 30 percent reduction in U.S. emissions by 2030, but he encouraged only voluntary changes for agricultural producers, thrilling industry groups. The National Cattlemen's Beef Association rejoiced at coming out of negotiations "relatively unscathed."[28] Whistleblowers from the Food and Agriculture Organization of the United Nations claim that research on livestock methane was sidelined for years following pressure from agricultural lobbying groups, impacting the veracity of reporting.[29]

Within the U.S., Big Ag lobbyists have worked just as hard, spending $2.5 billion on lobbying between 1998 and 2019.[30] This has involved defeating federal legislation intended to address emissions and creating a "climate change countermovement" in the process.[31] Even simple reporting measures face backlash, with the American Farm Bureau Federation calling weak mandatory reporting provisions "elaborate and burdensome." Big Ag operates in fear, worrying that reporting will lead to regulation, thereby hurting its profits.[32]

These efforts come as billions of dollars pour into industry scams like anaerobic digesters, which will only worsen the industry's methane crisis and stall a transition to renewable energy.[33] Despite all the industry's talk about what a transformative opportunity biogas is,[34] digesters do not address any emissions from enteric fermentation.[35] They leak methane at higher rates than oil and gas supply chains,[36] and produce the same pollutants as fossil fuels when burned as an end-use.[37] Biden's Methane Reduction Plan, in its few references to agriculture, focuses largely on incentivizing digesters and fails to require any significant change in the industry.[38]

Impacts of Fossil Fuels

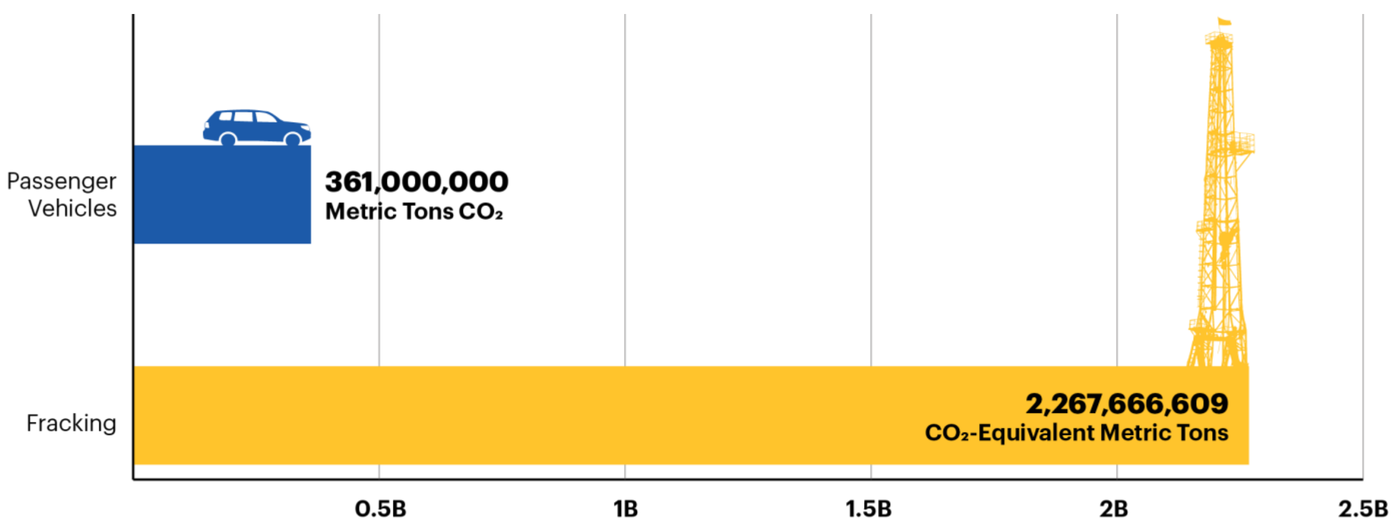
According to United Nations (UN) estimates, fossil fuels account for 35 percent of anthropogenic methane globally.[39] And while EPA estimates show declining emissions from the fossil fuel sector, peer-reviewed research has shown that the EPA consistently underestimates this crisis.[40] FWW estimates that in 2022, fracking across the U.S. released lifecycle emissions of over 26.4 million metric tons of methane (see Fig. 3). This includes emissions from well sites, processing, and distribution, but excludes combustion.[41] This is equivalent to over 500 million cars driven for a year, or 255 billion gallons of gasoline burned. Again, this varies by state, with Pennsylvania surpassing 500 million metric tons of CO_2-equivalent emissions.

While the UN escalates pleas for faster emissions reductions,[42] the U.S. continues to plow ahead with oil and gas exploration. Oil and natural gas production both increased in 2022,[43] and the U.S. rose to become the top exporter of liquefied natural gas (LNG) in 2023.[44] The consequences of this are dire. Natural gas comprises mostly methane, emitting the pollutant during production and as an end-use.[45] Per unit of heat energy, methane emissions exceed those of oil or coal.[46]

Fracking has likely caused 40 percent of the total increase in atmospheric methane in the twenty-first century.[47] Increasing atmospheric methane closely corresponds to the fracking boom. Satellite analysis found that U.S. methane emissions increased 30 percent between 2002 and 2014.[48] At the same time, U.S. oil and gas production increased 20 percent on the back of a ninefold increase in shale gas production.[49] Multiple analyses have also associated the 2007 to 2014 methane reversal with similar changes in atmospheric levels of ethane, a pollutant largely emitted by oil and gas production.[50]

Methane leaks occur throughout the natural gas chain, starting with the production phase. Fugitive methane emissions in U.S. oil and gas fields are among the highest worldwide.[51] Substantial emissions occur when producers drill through small gas deposits.[52] Broken, corroded, and leaky well casings can provide pathways for methane to leak directly into the atmosphere.[53] Recent studies found that gas leaks through fractures and to the surface through old wells.[54] Even after production stops, methane can escape from faulty equipment, such as loose fittings on aging joints,

FIG. 3: Methane Emissions from Fracking Exceed Carbon Emissions from U.S. Passenger Vehicles



Source: FWW analysis of U.S. EPA and Howarth (2019) rusted piping at the wellhead base, malfunctioning pressure regulators, and condensate on produced water tank batteries.[55]

The EPA's greenhouse gas reporting estimates of methane emissions have been exclusively bottom-up estimates, which are generated from estimating each likely source of emissions and summing them. Generally, these tend to underestimate the impact, as researchers may be unable to gain full access to the facilities in question.[56] Another reason for these underestimates are super-emitters, or sources that emit far beyond expected due to "abnormal" operating conditions.[57] Such conditions — which include gas venting, over-pressured separators, and routine flaring — have become typical in the industry, contributing about a third of all emissions at natural gas sites.[58] Top-down estimates determine these emissions more accurately, using flyovers or satellite imagery to observe emissions. One such investigation found readings of as high as 1,100 pounds of methane emitted in a single hour.[59] A recent EPA rule begins to address these gaps, incorporating top-down monitoring for large release events and expanding reporting requirements.[60]

Similar to Big Ag lobbyists, Big Oil lobbyists have pushed back against methane regulations, with a *New York Times* investigation finding the very same super-emitting companies opposing regulation.[61] The Independent Petroleum Association of America (IPAA) lobbyists circulated materials meant to rebut scientific studies of fugitive emissions, claiming that the data "create[s] the illusion" of major issues stemming from super-emitters. Trade organizations representing bigger firms like BP, ExxonMobil, Chevron, and Shell have similarly fought against regulation.[62]

The EPA recently finalized a rule to reduce methane emissions from the oil and gas sector, which phases out routine flaring, requires routine monitoring of equipment, and addresses super-emitters.[63] Further proposed regulations under the Inflation Reduction Act would charge polluters for excess emissions.[64] While these efforts are a good first step, they do not end drilling or cease the fossil fuel operations at the heart of climate change. Nonetheless, industry groups have challenged EPA's rule to reduce methane emissions and called the new regulations "unfair, unworkable, and uneconomic."[65] IPAA and other groups have moved to stay the methane rule in court, claiming that such "onerous" requirements will lead to "billions of dollars of costs" for the industry.[66] While industry tries to stop and stall regulations, a new study estimates the annual cost of climate change at $38 trillion by 2050.[67]

Benefits of Reducing Methane

Reducing methane emissions benefits human and climate systems alike. Methane emissions contribute to the formation of ground-level ozone, an unhealthy pollutant that poses respiratory and circulatory mortality risks.[68] Even just a few hours of exposure increase a person's risk of worsening illness, hospital admission, or death.[69] Anthropogenic methane causes half a million deaths globally every single year.[70] But every million tons of methane reduced prevents over 1,400 deaths and 4,000 emergency visits.[71]

For our climate system, methane reductions are a matter of emergency. Many climate feedback loops that exacerbate climate change and warming — such as sea-level rise and glacial melt — depend on cumulative increases in atmospheric heat, for which methane plays a massive role.[72] Slashing methane would slow amplifying processes like the snow-albedo feedback — by which ice melt reduces light reflection, thereby increasing warming — and permafrost melt. Slowing these in turn slows Earth's warming, increasing our probability of staying below crucial tipping points.[73] Reducing methane is thus one of the most significant actions we can take immediately.

Immediate reductions in anthropogenic methane also accommodate natural production of methane. Permafrost, for example, releases long-trapped methane as it melts. This leads to another positive feedback loop, with the release of methane further warming the planet, and in turn further melting permafrost.[74] Eliminating anthropogenic emissions is essential to mitigating how much methane is released into the atmosphere and to ensuring a livable future.

Conclusion

The Biden administration recently paused all permits for LNG exports, threatening planned projects along the U.S. Gulf Coast that would release massive emissions.[75] While this is an essential and important first step, the administration must go beyond this and end fracking and fossil fuel production across the industry. Federal officials must also move forward with preventing agricultural methane from continuing, by ending new factory farm construction and refusing to succumb to industry schemes like biogas.

Food & Water Watch recommends:

- Banning new factory farms and the expansion of existing ones;
- Ending federal subsidies and support for factory farm gas and digesters;
- Banning fracking; and
- Ending the approval of new oil and gas drilling, fracking, and gas infrastructure.

Methodology

Livestock Emissions

FWW totaled monthly beef inventories for 2022 from the U.S. Department of Agriculture's (USDA) Cattle on Feed reports,[76] which include estimates for beef cattle on 1,000+ head feedlots — falling under the EPA's criteria for large concentration animal feeding operations (CAFOs).[77] We estimated dairy cow and hog inventories by summing monthly estimates in 2022 from the USDA's Milk Production[78] and Hogs and Pigs[79] reports, then multiplying by the ratio of livestock on 500+ dairy or 1,000+ hog operations in each state, respectively, as estimated using 2022 Census of Agriculture data. For dairy manure emissions, annual population estimates were used with the same head count restrictions, pulled from the 2022 Census of Agriculture. These size categories fall under the EPA's inventory criteria for medium CAFOs.[80] We estimated Maryland broiler inventories using the 2022 Census of Agriculture, dividing the total sales of operations with 500,000+ sales annually by 5.5 (the average annual flock turnover rate).[81]

We used the EPA's Annexes to the Inventory of U.S. Greenhouse Gas Emissions and Sinks to derive methodologies for enteric fermentation and manure management emissions.[82] The EPA's Annexes provide standard enteric fermentation emission factors for each livestock type, which could then be applied to each animal population. For manure management calculations, we used USDA Agricultural Resource Management Survey data contained in a 2016 USDA-contracted report to determine proportions of waste management systems used on large farms.[83] Because total categories were over 100%, each percentage of manure system was divided by the total percentage and categorized into EPA parameters. State percentages were then determined by USDA Production Regions as they were in 2005.[84] The remaining variables (like volatile solid production rate and methane conversion factors) used EPA data. For the national manure management estimate, state estimates were totaled.

Our estimates for manure management exclude estimated reductions from anaerobic manure digesters, given the uncertainties surrounding the efficacy of digester technology and leakage rates.[85] Even with these assumptions, our EPA-based, bottom-up estimates may be conservative, given outside top-down research suggesting that the EPA's estimates of animal agricultural may be up to 90 percent underestimated.[86] Significant uncertainty gaps exist in many methane assessments, including estimates from the EPA and the Intergovernmental Panel on Climate Change (IPCC).[87]

We calculated the carbon dioxide equivalency (CO_2e) of emissions from enteric fermentation and manure management using the EPA's Greenhouse Gas Equivalencies Calculator.[88]

Fracking Emissions

For national and state estimates, we used the U.S. Energy Information Administration's Natural Gas Withdrawals dataset to pull monthly shale well production numbers.[89] We assumed a 4 percent shale gas leakage rate, taken from Howarth (2019),[90] which is a middle-ground estimate based on a literature review conducted in our 2020 report, Fracking's Bridge to Climate Chaos. A global warming potential (20-year) for methane of 86 is used throughout the calculations. We calculated the CO_2e of fracking emissions using the EPA's Greenhouse Gas Equivalencies Calculator.[91]

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