FACT SHEET

The End of the Hydrogen Rainbow: Subsidies for Coal and Factory Farms

The Internal Revenue Service is currently developing rules for hydrogen tax credit 45V under the Inflation Reduction Act (IRA), which could allow companies to produce hydrogen from dirty energy.[1] By counting "fugitive" methane sources like coal mine methane and biogas as clean feedstocks for hydrogen production, these rules are a gift to corporations lobbying to channel IRA subsidies to dirty industries.[2] This would create a massive loophole enabling hydrogen producers that rely mainly on fracked gas to completely "offset" their emissions by using a small percentage of "fugitive" methane.[3]

Hydrogen Subsidies Carry Significant Risks

Even efforts to subsidize hydrogen produced from renewable electricity must be pursued carefully to avoid negative climate outcomes. Hydrogen is a potent greenhouse gas with 33 times the global warming potential of carbon dioxide (CO_2) over 20 years.[4] Hydrogen is the smallest element, and if it is transported in pipelines designed to carry natural gas, it is very likely to leak from them.[5] Hydrogen leaks at a rate around three to five times that of methane, depending on the pipeline's material type and construction.[6]

Research has highlighted how hydrogen produced via electrolysis (using electricity to separate hydrogen from water) can result in more emissions than conventionally produced hydrogen (producing hydrogen from methane) — if the electrolysis is powered by electricity from the grid, rather than by time-matched, new renewable electricity in the same region.[7]

Additionally, subsidizing hydrogen carries environmental risks associated with hydrogen use. The leading uses of hydrogen are for oil refining (68 percent) and for producing nitrogen fertilizers (21 percent).[8] Subsidizing hydrogen inputs for these industries can happen either directly by allowing petrochemical facilities to tap a cheaper source of hydrogen or indirectly, by diverting additional hydrogen that would otherwise be used for energy storage and decarbonization measures.[9]

Oil refiners buy massive quantities of hydrogen and are likely to be first in line for new, cost-competitive sources of hydrogen.[10] Changing the economics of oil refining through the use of lower-cost hydrogen has the potential to encourage continued use of internal combustion engine vehicles (which burn fossil fuels directly) over electric vehicles (which can be powered using renewable electricity).[11]

info@fwwatch.org
202.683.2500 (DC)
510.922.0720 (CA)
foodandwaterwatch.org

SEPTEMBER 2024

Meanwhile, the overproduction and use of nitrogen fertilizers has serious environmental consequences, ranging from the contamination of drinking water to eutrophication and mass ecosystem die-offs.[12] Around two-thirds of the life-cycle greenhouse gas emissions from nitrogen fertilizers occur during their use phase, not production, as changes in the soil chemistry after application lead to the release of CO_2 and nitrous oxide (N_2O).[13]

Utilities are also proposing dangerous plans to supply hydrogen through local gas distribution systems and burn it at natural gas fired power plants.[14] These old and leaky pipes are not equipped to safely carry methane, much less hydrogen.[15] Using hydrogen in infrastructure designed for a different purpose carries safety risks that include leaks, fires, and explosions. Additionally, it could exacerbate nitrogen oxide (NO_x) emissions while providing little to no greenhouse gas reductions.[16]

Transporting and using methane has unavoidable climate consequences

Transporting methane to hydrogen production facilities will create significant methane emissions. A recent study found that natural gas gathering, transportation, and compression facilities in oil and gas basins leaked between 0.53 percent and 1.68 percent of the methane they carried on average — much higher than official U.S. Environmental Protection Agency (EPA) estimates.[17]

It is unlikely that limiting the distance that the gas is carried will reduce these methane emissions. For example, older studies suggest that the leakage occurs primarily before the methane is added to high-pressure, long-distance transmission pipelines (these pipelines were found to have a leak rate of 0.35 percent, although actual leakage could be much higher).[18] Emissions also occur from natural events that break pipelines, such as erosion from rain, landslides, and sinkholes.[19] Transmission pipeline companies self-report significant or serious accidents once per 3,000 miles annually (reporting only covers a limited portion of events).[20]

Using Coal Mine Methane Does Not Reduce Greenhouse Gas Emissions

The EPA draws a distinction between coalbed methane (methane extracted directly from coal seams) and coal mine methane (methane released through mining activities).[21] In both cases, the methane is released as a result of human activity. Coal mine methane is released mainly through drainage and ventilation systems designed to reduce methane levels in mines for improved safety. Methane also escapes from abandoned mines through vents, pipes, and boreholes, which would not be present if not for coal mining.[22]

Distinguishing “avoided” coal mine methane emissions from coalbed methane is often impossible. In many cases, local pressure and geological conditions hold methane underground in coal mines until recovery operations change these conditions.[23] In most cases, methane recovery extracts more methane than would ever have been released to the atmosphere, had the geology been left alone.[24] Rather than simply waiting for methane to leak from mines, coal mine methane operations frequently use well stimulation techniques like hydraulic fracturing to increase gas production from coal mines.[25]

Methane emissions from coal mines are preventable without utilization

The International Energy Agency says that flooding of mines is the best way to reduce methane emissions from abandoned coal mines, and recommends a combination of concrete, gravel, and hydrostatic pressure to keep the methane in place. Shutting down the ventilation network in abandoned mines also reduces methane emissions.[26] A study of abandoned coalbed methane projects in Wyoming found that hydrogeological conditions were very effective at reducing methane emissions from coal.[27] Other techniques, such as using foam as a sealant, have also been shown to reduce methane emissions and explosion risk from abandoned mines.[28]

In contrast, capturing the methane for use is technologically feasible only at a small portion of abandoned coal mines.[29] Most underground coal mines emit methane that is highly diluted.[30] Processing this diluted gas into pure, usable methane relies on technologies that are still in the demonstration stage.[31] Low-concentration gas (between 5 and 16 percent methane) also poses high explosion risks, and many countries either do not allow the use of coal mine methane below 25 percent by volume, or require complex explosion suppression technologies.[32] Many methane enrichment technologies have safety risks as well as high energy requirements, which should be included in emission calculations.[33]

Offsets for coal mine methane are a subsidy to coal

Allowing coal mine methane to receive emission credits as a hydrogen feedstock under new 45V tax rules may provide additional subsidies to projects that would have occurred otherwise, essentially funneling money to coal mines.[34] Advocates of coal mine methane note that this additional revenue stream can contribute positively to the financial stability of coal mines.[35]

Establishing an emissions impact of coal mine methane requires setting a baseline counterfactual case (that is, what would happen without the 45V tax credit), which the Internal Revenue Service recognizes is potentially vulnerable to gaming and abuse.[36] The proposed tax credit rules specify that hydrogen production must be the “first productive use” of any fugitive methane, in an attempt to prevent existing projects from counting toward emission reductions.[37] In practice, enforcing these provisions is nearly impossible. Determining whether a methane capture project “would have occurred” (known as additionality) without the tax credits requires commissioning detailed speculative market analysis studies.[38] Maintaining an accurate assessment of project-level additionality, common practice, and baseline emissions will likely strain administrative and regulatory capacity, resulting in reliance on under-verified information from industry actors that have a perverse incentive to distort baselines.[39]

Methane emissions vary widely among coal mines.[40] Allowing operators to determine parameters and to report data for their own baselines greatly increases the risk of over-crediting.[41] Even if the tax credits go only to new projects, they may provide a perverse incentive to increase overall methane production from coal mines, or to shift coal mining to “gassier” mines; this would result in an overall increase in emissions relative to conventionally sourced methane.[42]

In California, efforts to generate offsets from coal mine methane have faced numerous problems, which are likely to undermine federal tax credits. Establishing site-specific baseline conditions for the capture of coal mine methane is necessary, as gassy mines are disproportionately likely to already engage in some form of methane capture.[43] These baselines are also necessary to show that the extracted methane would otherwise have been released to the atmosphere. One study found that the methane emissions from abandoned coalbed methane wells in the Powder River Basin in Montana and Wyoming were systematically overestimated.[44]

Mandatory management of coal mine methane is at odds with its use for offsets

Coal mine methane and other fugitive sources of fossil fuel methane are legally distinct from agriculturally sourced methane. This is because the U.S. Clean Air Act grants authority to the EPA to regulate and thus eliminate emissions from fossil fuel sources.[45] Including fossil fuel methane emissions in the IRS rules could delay or interfere with the EPA's attempts to regulate these emissions.[46] In contrast, reductions in agricultural methane emissions are voluntary.[47]

The EPA encourages the capture and use of coal mine methane. The Infrastructure Investment and Jobs Act has allocated $11.3 billion to mine reclamation and filling, which is intended to reduce methane emissions without extraction and combustion.[48] The emission reductions required by law are by definition "non-additional"; setting up offsets as voluntary but lucrative creates a strong incentive to delay and not implement future binding regulations.[49] For example, an analysis of the U.S. Bureau of Land Management's efforts to regulate methane emissions from fossil fuels on federal lands may have excluded coal methane because of its inclusion in California's offset scheme.[50]

Factory farms cash in on weak IRA provisions

The Internal Revenue Service is also considering allowing factory farm gas (biogas) — methane captured from anaerobic digesters at factory farms — to count as offsets or lower-emission feedstock for hydrogen under the 45V tax credit.[51] This tax credit, among others outlined in the IRA, has set off a biogas gold rush. With the implementation of the IRA, the American Biogas Council envisions 8,600 new digesters on factory dairy, hog, and poultry farms.[52] Rather than meaningfully reducing methane emissions, these incentives instead reward methane-intensive methods of manure management and factory farming.

Such public investment is creating perverse incentives, where animal agriculture could become more about maximizing manure production than supplying animal products.[53] To remain financially viable, the system depends on the generation of emissions, which does nothing to reduce emissions from the source.[54] By locking in existing herd sizes and even incentivizing livestock expansion, an increase in biogas investment risks a parallel increase in greenhouse gas emissions.[55]

U.S. methane emissions are worsening, not improving. Since the Obama administration's endorsement of dairy digesters in 2009, the dairy industry's methane emissions have risen by over 15 percent. This is partly the result of growing herd sizes,[56] a trend that will only worsen as continued biogas subsidies incentivize industry growth.[57] Factory farms are developing new projects or expanding existing herd sizes alongside the development of digesters, creating new sources of methane that did not exist before.[58]

Unlike factory farms, pasture-based beef or dairy systems do not produce significant emissions from manure, as livestock manure dries on pasture and produces negligible methane.[59] Hog manure also produces barely any methane at smaller farms that typically use dry-range, pasture, and paddock manure disposal systems.[60] Adequately aerating hog manure ensures that aerobic decomposition occurs, avoiding the anaerobic conditions that produce methane.[61]

For poultry digester systems, the situation is even more damning. Annual U.S. methane emissions from poultry manure are just 6 percent of those generated from cow and hog manure combined. Poultry litter — a combination of feathers, bedding, and manure[62] — produces minimal methane emissions to begin with, making it unsuited for digestion.[63] So for most poultry digesters, when the system leaks or the biogas is later burned, it generates new methane emissions that would not have existed without digesters.

Digester systems are also riddled with leaks. Research shows that methane emissions along the supply chain are greatly underestimated — as much as double what was assumed in previous estimates.[64] Just like in traditional oil and gas supply chains, “super-emitters” are a major, persistent problem, with the highest 5 percent of methane emitters contributing over 60 percent of cumulative emissions.[65] But unlike traditional oil and gas systems, factory farm gas has much higher loss rates.[66] Methane leaks could be as high as a 15 percent loss rate, with the potential to release significant amounts of methane annually. Due to this, factory farm gas cannot be a zero-greenhouse gas emission fuel, let alone a negative emission fuel.[67]

Conclusion

Offset schemes cannot distract from the fact that hydrogen should never be produced from methane. Adding complicated methane offset schemes, such as those proposed under tax credit 45V, will only worsen the emissions associated with supplying methane for hydrogen production and create a backdoor for lucrative subsidies to factory farms and fossil fuels. While there are potential roles for hydrogen in a green economy, the climate risks inherent in the technology require extreme caution. It is essential that hydrogen is always produced from renewable electricity, not methane, and is only used when better alternatives are not available.

Endnotes

1 88 Fed. Reg. 89225 and 89238. December 26, 2023.

2 *Ibid.*

3 88 Fed. Reg. 89238 to 89240. December 26, 2023.

4 Warwick, Nicola et al. University of Cambridge and University of Reading. "Atmospheric Implications of Increased Hydrogen Use." April 2022 at 54.

5 Chediak, Mark. "Hydrogen is every U.S. gas utility's favorite Hail Mary pass." *Bloomberg*. May 2, 2022.

6 Melaina, M. W. et al. National Renewable Energy Laboratory. "Blending Hydrogen Into Natural Gas Pipeline Networks: A Review of Key Issues." NREL/TP-5600-51995. March 2013 at x; Raju, Arun et al. University of California, Riverside. Prepared for California Public Utilities Commission. "Hydrogen Blending Impacts Study." July 2022 at 13.

7 Ricks, Wilson et al. "Minimizing emissions from grid-based hydrogen production in the United States." *Environmental Research Letters.* Vol. 18. January 2023 at abstract.

8 Energy Information Administration (EIA). "U.S. refiners and chemical manufacturers lead hydrogen production and consumption." April 8, 2024.

9 Azadnia, Amir Hossein et al. "Green hydrogen supply chain risk analysis: A European hard-to-abate sectors perspective." *Renewable and Sustainable Energy Reviews*. Vol. 182. May 2023 at 3.

10 EIA (2024).

11 Rapson, David S. and Erich Muehlegger. University of California, Davis. "The Economics of Electric Vehicles." National Bureau of Economic Research Working Paper No. 29093. July 2022 at 3 and 4.

12 Liu, Lei et al. "Modeling global oceanic nitrogen deposition from food systems and its mitigation potential by reducing overuse of fertilizers." *PNAS.* Vol. 120, No. 17. April 2023 at 1 and 7.

13 Gao, Yunhu and André Cabrera Serrenho. "Greenhouse gas emissions from nitrogen fertilizers could be reduced by up to one-fifth of current levels by 2050 with combined interventions." *Nature Food*. Vol. 4. February 2023 at abstract and 171.

14 For more on this plan and its dangers see: Food & Water Watch (FWW). "Hydrogen in Our Homes: A Dangerous Pipe Dream." April 2023; Penrod, Emma. "As momentum for hydrogen builds, electric utilities chart multiple paths forward." *Utility Dive.* August 18, 2021; Chediak (2022).

15 Weller, Zachary D. et al. "A national estimate of methane leakage from pipeline mains in natural gas local distribution systems." *Environmental Science & Technology.* Vol. 54, Iss. 14. June 2020 at 8961 and 8963; FWW analysis of U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA). "Gas Distribution Services by Decade Installed." January 10, 2023. Accessed January 2023; Raju, Arun et al. (2022) at 4 and 107.

16 Van Renssen, Sonja. "The hydrogen solution?" *Nature Climate Change. Vol*. 10. September 2020 at 799 and 801; Wright, Madeleine L. and Alastair C. Lewis. "Emissions of NOx from blending of hydrogen and natural gas in space heating boilers." *Elementa: Science of the Anthropocene*. Vol. 10, Iss. 1. May 21, 2022 at abstract; Najjar, Yousef. "Hydrogen safety: The road toward green technology." *International Journal of Hydrogen Energy*. Vol. 38. July 2013 at 10723.

17 Sherwin, Evan D. et al. "US oil and gas system emissions from nearly one million aerial site measurements." *Nature*. Vol. 627. March 2024 at 328.

18 Zimmerle, Daniel J. et al. "Methane emissions from the natural gas transmission and storage system in the United States." *Environmental Science & Technology*. Vol. 49. July 21, 2015 at 9375 and 9378.

19 Soraghan, Mike. "Pipeline blast in Ohio linked to earth movement." *E&E News.* April 3, 2019.

20 Congressional Research Service (CRS). "DOT's Federal Pipeline Safety Program: Background and Key Issues for Congress." R44201. March 29, 2019 at 1 to 3; FWW analysis of Pipeline and Hazardous Materials Safety Administration. Gas Transmission & Gathering Annual Data — 2010 to present. Updated April 17, 2019. Available at https://www.phmsa.dot.gov. Accessed May 2019.

21 Environmental Protection Agency (EPA). "About Coal Mine Methane." Available at https://www.epa.gov/cmop/about-coal-mine-methane. Accessed August 2024.

22 *Ibid.*

23 Nivitanont, Jeffrey et al. "Characterizing methane emissions from orphaned coalbed methane wells in the Powder River Basin." *Environmental Research Communications.* Vol. 5. May 2023 at 3 and 4.

24 Haya, Barbara et al. "Managing uncertainty in carbon offsets: Insights from California's standardized approach." *Climate Policy.* Vol. 20, Iss. 9. June 2020 at 6.

25 Karacan, C. Özgen et al. "Coal mine methane: A review of capture and utilization practices with benefits to mining safety and to greenhouse gas reduction." *International Journal of Coal Geology.* Vol. 86, Iss. 2-3. May 2011 at 134.

26 International Energy Agency. "Driving Down Coal Mine Methane Emissions." February 2023 at 12, 19, and 36.

27 Nivitanont et al. (2023) at 7.

28 Tian, Zhaojun et al. "Application of inorganic solidified foam to control the coexistence of unusual methane emission and spontaneous combustion of coal in the Luwa Coal Mine, China." *Combustion Science and Technology*. Vol. 192, Iss. 4. March 2019 at abstract.

29 Haya et al. (2020) at abstract.

30 Su, Shi et al. "An assessment of mine methane mitigation and utilisation technologies." *Progress in Energy and Combustion Science*. Vol. 31. March 2005 at 123; Wang, Xinxin et al. "Overview and outlook on utilization technologies of low- concentration coal mine methane." *Energy & Fuels.* Vol. 35. September 2021 at 15398; Pacific Northwest National Laboratory. [Press Release.] "Methane emissions from coal mines are higher than previously thought." January 27, 2021.

31 Wang et al. (2021) at 15400.

32 *Ibid.*

33 *Ibid.* at 15400 and 15402.

34 Haya et al. (2020) at 2 and 7.

35 Virginia Department of Energy. "Virginia Department of Energy Evaluation of Policy Options to Encourage the Capture and Beneficial Use of Coal Mine Methane." November 15, 2023 at 2.

36 88 Fed. Reg. 89240. December 26, 2023.

37 88 Fed. Reg. 89239. December 26, 2023.

38 Haya et al. (2020) at 2 and 6.

39 *Ibid.* at 11.

40 EPA. "Abandoned Coal Mine Methane Opportunities Database." July 2017 at 8 to 22.

41 Haya et al. (2020) at 6.

42 *Ibid.* at 2 and 7.

43 *Ibid.* at 5.

44 Nivitanont et al. (2023) at abstract.

45 CRS. "The Legal Framework for Federal Methane Regulation." August 7, 2023 at 1.

46 Haya et al. (2020) at 2.

47 CRS (2023) at 1.

48 *Ibid.* at 2.

49 Haya et al. (2020) at 8.

50 *Ibid.* at 8.

51 88 Fed. Reg. 89238 to 89240. December 26, 2023.

52 Schneider, Keith. "A push to turn farm waste into fuel." *New York Times*. April 4, 2023.

53 Smith, Aaron. University of California, Davis. "What's worth more: A cow's milk or its poop?" February 3, 2021; Kelloway, Claire. "Big Ag and Big Oil eye biogas profits, Shell buys Nature Energy." *Food & Power Net.* December 7, 2022.

54 Lazenby, Ruthie. "Rethinking Manure Biogas: Policy Considerations to Promote Equity and Protect the Climate and Environment." Vermont Law & Graduate School, Center for Agriculture and Food Systems. August 2022 at 24.

55 *Ibid.*; Kelloway (2022).

56 Douglas, Leah and Nichola Groom. "Biden spending bill ignites debate over dairy methane pollution." *Reuters*. January 11, 2022.

57 Kelloway (2022).

58 Held, Lisa. "Are biogas subsidies benefiting the largest industrial animal farms?" *Civil Eats*. September 20, 2021.

59 Lee, Hyunok and Daniel A. Sumner. "Dependence on policy revenue poses risks for investments in dairy digesters." *California Agriculture*. Vol. 72, No. 4. December 17, 2018.

60 EPA. "Annexes to the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022." April 2024 at A-313 to A-314 and A-332.

61 Ge, Jinyi et al. "Particle-scale modeling of methane emission during pig manure / wheat straw aerobic composting." *Environmental Science & Technology.* Vol. 50, April 2016 at 4374 and 4375.

62 MacDonald, James M. U.S. Department of Agriculture. Economic Research Service. "Technology, Organization, and Financial Performance in U.S. Broiler Production." Economic Information Bulletin Number 126. June 2014 at 1 and 23.

63 EPA. "Anaerobic digestion on poultry farms." EPA 430 F 22 004. 2024

64 Bakkaloglu, Semra et al. "Methane emissions along biomethane and biogas supply chains are underestimated." *One Earth*. Vol. 5. June 17, 2022 at abstract.

65 *Ibid.* at abstract and 727.

66 *Ibid.* at 727 and 731.

67 Grubert, Emily. "At scale, renewable natural gas systems could be climate intensive: The influence of methane feedstock and leakage rates." *Environmental Research Letters*. Vol. 15. August 11, 2020 at abstract and 7.