Environmental Defense Fund

June 12th, 2023

New Jersey Board of Public Utilities
Submitted electronically to Docket Nos. QO23040235 and QO23040236

RE: CLEAN ENERGY PROGRAMS AND BUDGET FOR THE FISCAL YEAR 2024

Environmental Defense Fund (EDF) appreciates the opportunity to provide comments on BPU's FY '24 Comprehensive Energy Efficiency & Renewable Energy Resource Analysis (CRA). The Environmental Defense Fund ("EDF") is a membership organization with more than 110,000 New Jersey members and activists; our mission is to preserve the natural systems on which all life depends. Guided by expertise in science, economics, law, and business partnerships, EDF seeks practical and lasting solutions to address environmental problems.

The FY '24 CRA proposes to "conduct a study of the potential use of renewable natural gas and/or green hydrogen as a means to reduce greenhouse gas emissions, and for additional new clean energy technology initiatives that may arise" (page 18). EDF conducts extensive research around the environmental, climate, and social implications of biomethane and hydrogen deployment and engages regularly with industry and governments in the United States and around the world to advise on sustainable hydrogen strategies, and we appreciate the opportunity to offer our comments on this matter.

While some stakeholders argue that low-carbon fuels should significantly contribute to replacing fossil gas in the clean energy transition, the BPU should carefully assess the potential and limitations of each fuel. It is particularly important to identify the best application of low-carbon fuels that could facilitate decarbonization of New Jersey's energy system and most effectively drive greenhouse gas emission reductions while ensuring historically overburdened communities suffer no additional harm and, in fact, benefit. Hydrogen and biomethane (also referred to as renewable natural gas or RNG) could be valuable to decarbonizing the energy sector in certain, tailored applications. However, a rigorous study must include an analysis of climate, economic and safety impacts and risks as well as economic comparisons to other existing available technologies, like those used in building electrification.

We would be glad to clarify, elaborate, or provide further details on any of the points made in the comments below. If there are any questions, BPU staff should contact Mary Barber (mbarber@edf.org), State Director, New York and New Jersey, and Karla Sosa (ksosa@edf.org), Project Manager, New Jersey.

1. Biomethane

Not all biomethane is carbon neutral, and it is important to distinguish between different sources and their corresponding greenhouse gas emissions profiles. Biogenic methane is typically emitted from sources such as landfills, lagoons, and animal-feeding operations, and capturing and using such currently emitted biogas can be beneficial because it can yield a net reduction in methane emissions, even if there is some leakage. But if new biomethane were generated from sources not already producing it—for example, wood product wastes or purpose-grown crops—subsequent leakage of that new biogenic methane would increase overall atmospheric methane concentrations and be counterproductive to addressing climate change.[1]

For a biomethane source to provide genuine climate benefit, the fuel must result in a net reduction in methane emissions. To demonstrate that benefit, biomethane production and use must not result in new or excess methane emissions relative to current waste management practices.[2] This is an unlikely hurdle for biomethane to achieve, however, due to leakage issues throughout the supply chain.[3] Gasifying organic sources of biomethane would likely result in more net climate pollution due to methane leakage during production, processing, and end-use applications. A study from Lawrence Livermore Laboratory found that organic sources such as forest biomass and agricultural residue are not viable source materials for biomethane because they would not yield a net reduction in climate pollution.[4]

Furthermore, biomethane combustion releases carbon dioxide (CO_2) and local pollution at the same rates as natural gas, since both are comprised primarily of methane. CO_2 from biomethane does not increase the atmospheric CO_2 levels as it is derived from pre-existing CO_2 via photosynthesis, unlike fossil natural gas sources. However, local emissions of air pollution (such as NOx) from biomethane combustion are equivalent to natural gas combustion and contribute to negative health effects—which could be eliminated by converting homes from gas combustion to electrification.

2. Hydrogen

EDF believes clean hydrogen has the potential to greatly aid decarbonization efforts in 'hard-to-abate' sectors. These include industrial processes (such as cement and steel

---

[1] Joe Rudek & Stefan Schwietzke, *Not all biogas is created equal*, EDF Energy Exchange (Apr. 15, 2019), *available at* https://blogs.edf.org/energyexchange/2019/04/15/not-all-biogas-is-created-equal/

[2] Mark Omara & Joe Rudek, *Careful accounting is critical to assessing the climate benefits of biomethane*, EDF Energy Exchange (Mar. 24, 2021), *available at* https://blogs.edf.org/energyexchange/2021/03/24/careful-accounting-is-critical-to-assessing-the-climate-benefits-of-biomethane/

[3] *See, e.g.,* Alvarez et al., *Assessment of methane emissions from the U.S. oil and gas supply chain*, Science Vol. 361, Issue 6398, 186-188 (2018), *available at* https://www.science.org/doi/10.1126/science.aar7204

[4] S. Baker et al., *Getting to Neutral: Options for Negative Carbon Emissions in California* at Fig. 15, Lawrence Livermore National Laboratory, LLNL-TR-796100 (Jan. 2020), *available at* https://www.osti.gov/biblio/1597217

production) and some transportation sectors such as shipping and aviation (on which EDF has developed extensive guidance[5].) EDF also believes sectors that have clear electric alternatives that are feasible and cost effective—like building electrification and medium duty and some heavy-duty trucks—should not be the focus of clean hydrogen research and demonstration projects[6]. The primary reason for this is the relative energy intensity of hydrogen: EDF calculations[7] suggest that replacing fossil fuels with green hydrogen for home heating and road transportation takes 3-7 times more energy than direct electrification. Moreover, hydrogen's powerful warming effect along with its high leak-prone nature add increased risks to hydrogen.

In order to ensure that any green hydrogen generated is truly clean, it is critical that the BPU and other relevant New Jersey state agencies implement a rigorous lifecycle emissions accounting framework with a wide system boundary. This should include upstream processes (e.g. electricity generation; feedstock extraction or production, treatment and delivery; fugitive emissions), hydrogen production itself (e.g. fuel combustion, fugitive emissions, and process emissions), and downstream processes associated with CO_2 transport and sequestration. It should also include management of other fugitive emissions like hydrogen throughout the value chain, as well as emissions associated with liquefaction, compression, storage, transport, delivery, and distribution.

The inclusion of upstream Scope 2 emissions in the accounting framework is particularly important. Overlooking these emissions would incentivize hydrogen resources that pose serious climate risks—including steam methane reformers that source gas linked to high methane leakage, as well as electrolyzers powered by fossil fuel-based electricity generation.

In addition to carbon dioxide and methane emissions, lifecycle assessments must also account for hydrogen emissions in both production and downstream processes. Hydrogen is a short-lived, indirect greenhouse gas that causes warming by increasing the concentration of other greenhouse gases in the atmosphere. It is also a small and slippery molecule that can easily escape from all parts of the value chain. Recent studies found hydrogen's warming power is over 30 times larger than CO_2 pound for pound over the 20 years after it is emitted, and about 10 times larger over 100 years—values that are 2-6 times higher than previously thought[8]. EDF research shows that if the hydrogen emission rate is high across the value chain, it can severely undermine the intended benefits of clean hydrogen[9].

[5] https://blogs.edf.org/climate411/2022/08/22/cleaner-skies-edf-new-high-integrity-sustainable-aviation-fuels-saf-handbook/

[6] https://www.edf.org/media/study-emissions-hydrogen-could-undermine-its-climate-benefits-warming-effects-are-two-six

[7] https://blogs.edf.org/energyexchange/2023/01/30/rule-1-of-deploying-hydrogen-electrify-first/

[8] Ocko, Ilissa and Hamburg, Steve (2022). "Climate consequences of hydrogen leakage." Atmospheric Chemistry and Physics. Vol. 22, Issue 14. https://acp.copernicus.org/articles/22/9349/2022/; and Warwick et al., (2022). "Atmospheric Implications of Increased Hydrogen Use". Department for Business, Energy & Industrial Strategy. https://www.gov.uk/government/publications/atmospheric-implications-of-increased-hydrogen-use

[9] Ocko, Ilissa and Hamburg, Steve (2022). "Climate consequences of hydrogen leakage." Atmospheric Chemistry and Physics. Vol. 22, Issue 14. https://acp.copernicus.org/articles/22/9349/2022/

Currently, estimates of hydrogen leakage rates range considerably due to a lack of empirical data on leakage from specific infrastructure such as electrolyzers, pipelines, and storage[10]. Studies on hydrogen leakage often rely on natural gas supply chain leakage as a proxy, and there is a high degree of uncertainty in existing methane emission estimates. Moreover, the patterns of hydrogen leakage can be different from that of methane, with fluid dynamics theory suggesting that hydrogen can leak 1.3 to 3 times faster than methane, and experimental studies suggest different leak rates for different leak regimes. Current estimates of leakage rates for the full hydrogen value chain, including production, processing, storage and delivery, range from 0.3% to 20%[11].

3. Conclusion

While biomethane and hydrogen may play a role in New Jersey's energy system decarbonization efforts, the BPU should exercise caution when considering the appropriate role of these fuels—with particular caution given to blending hydrogen into natural gas pipelines due to the heightened risks to safety, climate and cost. We look forward to collaborating with BPU Staff to provide further comment as details for the study of these low-carbon fuels develop.

[10] Hydrogen emissions associated with production include both unintended leakage and intentional purging/venting (which can be controlled by incorporating technology that recombines purged and vented hydrogen back into the production process). Overall, estimates of emissions associated with electrolytic hydrogen production currently range from 0.1% to 9.2%. Blue hydrogen production is estimated to have less than 1.5% hydrogen emissions, since waste gas is likely to be flared or used for process heat. Hydrogen also has the potential to leak from various delivery segments of the value chain, including compression, liquefaction, storage, and transportation via pipelines or trucks. Overall, current estimates of leakage rates for the full hydrogen value chain, including production, processing, storage and delivery, range up to 20%. Estimates include Cooper et al., (2022). "Hydrogen emissions from the hydrogen value chain-emissions profile and impact to global warming". Science of the Total Environment. Vol. 830. https://linkinghub.elsevier.com/retrieve/pii/S004896972201717X ; Frazer-Nash Consultancy (2022). "Fugitive Hydrogen Emissions in a Future Hydrogen Economy". https://www.gov.uk/government/publications/fugitive-hydrogen-emissions-in-a-future-hydrogen-economy ; Arrigoni, A. and Bravo Diaz, L. (2022). "Hydrogen emissions from a hydrogen economy and their potential global warming impact". Publications Office of the European Union, Luxembourg. doi:10.2760/065589, JRC130362; and Schultz et al., (2003). "Air Pollution and Climate-Forcing Impacts of a Global Hydrogen Economy". Science, Vol. 302. https://www.science.org/doi/10.1126/science.1089527

[11] The low-end estimated full value chain leakage is from van Ruijven et al., (2011). "Emission scenarios for a global hydrogen economy and the consequences for global air pollution". Global Environment Change, Vol. 21, Issue 3. https://www.sciencedirect.com/science/article/pii/S0959378011000409 The upper end estimated leakage for the full value is from Schultz et al., (2003). "Air Pollution and Climate-Forcing Impacts of a Global Hydrogen Economy". Science, Vol. 302. https://www.science.org/doi/10.1126/science.1089527