Memo of stakeholder input to the DOE Clean Hydrogen Standard Process

From:
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Re: Submission to the consultation on the Clean Hydrogen Production Standard

My name is Dr Chris Bataille, and I am an Adjunct Research Fellow at the Columbia University Center for Global Energy Policy and a Lead Author for the IPCC AR6 Chapter 11 on Industry as well as the Summary for Policymakers. I am submitting this stakeholder input as an individual expert on clean hydrogen production and industrial decarbonization – any errors or attribution are to be to me only.

My key concern with the proposed 4kg CO_2/kg H_2 clean hydrogen standard is that while <=2 kg CO_2/kg H_2 is specified in the Bipartisan Infrastructure Law (BIL)[1], the proposed 4 kg standard does not provide a structural long-term "aim point" consistent with mid-century net-zero emissions for long-lived (i.e., 20-30 year) hydrogen production investments.

Based on Bauer et al. (2022), blue hydrogen producers (i.e., reformation of methane followed by sequestration of the carbon dioxide) should aim for >=90% capture when produced fed by fossil methane with an upstream fugitive rate of <0.5%, and ideally towards 0.2%. At these maximum GHG intensity points, the emissions per kg hydrogen are approximately 1.5 kg CO_2e from well to end-use. If we take this 1.5 kg CO_2e figure as a benchmark and an electrolyzer efficiency of 70% is assumed, green hydrogen (33.6 kWh/kg) should be made from electricity with a GHG intensity of less than or equal to 30 grams CO_2 per kWh in operation. Other forms of hydrogen production would also logically be held to this 1.5 kg CO_2 per kg hydrogen standard as applicable, consistent with the initial guidance provided for the BIL. These benchmarks are technologically and commercially feasible with a few years lead-time, and in the context of the existing IRA subsidies.

There is a higher-order question if these benchmarks are actually consistent with scenarios for net-zero-emissions by mid-century the US. If we use final end-use energy intensity in grams CO_2 per kWh as the common link, the IPCC AR6 1.5-2°C scenarios[2] are in the range of 35-55 grams CO_2/kWh globally in 2050, albeit with substantial offsetting carbon dioxide removal (~0.5 tonnes per person per year). Williams et al. (2021) found that CO_2 intensities for electricity from 0-16 grams CO_2/kWh are required for net-zero CO_2 by 2050 in the US, while the 2021 White House Long Term Strategy for the United States' goal was 100% carbon-free electricity by 2035. Hydrogen is arguably not a direct substitute for electricity, however, and will likely only be used where hydrogen is already used (e.g., fertilizer and chemical production, upgrading) and where direct electrification is challenging or very expensive, e.g., iron-ore reduction, heavy freight, more than 150°C process heat and seasonal energy storage (Bataille et al., 2021). For all these reasons,

[1] https://www.hydrogen.energy.gov/pdfs/clean-hydrogen-production-standard.pdf
[2] Chapter 6, Figure 6.22 Panels A & D (IPCC, 2022)

while net-zero carbon hydrogen is a good aspiration, it is more important that it's ultra-low emitting instead, at the current practical engineering and commercial limits of blue and green hydrogen. A 60% reduction from standard grey methane-based production[3], as the 4 kg standard implies, is not sufficient, however without a clear signal that emissions must drop below 2 kg during the life of the facility.

Thank you for your attention, and I would be happy to engage in future conversations if of interest.

Sincerely,

Chris Bataille

References

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[3] https://www.nrdc.org/experts/rachel-fakhry/ira-hydrogen-incentives-climate-hit-or-miss-tbd