DEPARTMENT OF MECHANICAL ENGINEERING
THE UNIVERSITY OF TEXAS AT AUSTIN

204 E. Dean Keeton St., C2200 • Austin, TX 78712 • 512 475 6867 • FAX 512 471 8727
http://webberenergygroup.com/ • webber@mail.utexas.edu

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Submitted by:

Mia Moore, Emily Beagle, PhD, Michael E. Webber, PhD
Webber Energy Group
Department of Mechanical Engineering
University of Texas at Austin
Austin, TX

Thank you for the opportunity to comment on the Department of Energy's (DOE) initial proposal for a Clean Hydrogen Production Standard (CHPS) to be used to meet the requirements of the Infrastructure Investment and Jobs Act of 2021, also known as the Bipartisan Infrastructure Law (BIL), Section 40315. In this proposal, the DOE proposes that the CHPS establish an initial target for life cycle greenhouse gas emissions of 4.0 kg CO_{2e}/kg H_2. This proposed standard is different from that given in the passed legislation of 2.0 kg CO_{2e}/kg H_2 at the point of production.[1] Both the proposed life cycle emissions analysis framework and target of 4.0 kg CO_{2e}/kg H_2 are suitable because they align well with other US hydrogen policy standards and current international definitions and standards of clean hydrogen.

We are highly supportive specifically of the change in the proposed standard from consideration of emissions only at the point of production to life cycle emissions of hydrogen production. Significant emissions occur outside of the point of production for a number of different hydrogen production pathways, including upstream methane emissions for fossil-based production and electricity generation emissions for electrolysis-based production. For example, electrolysis-based hydrogen would have ~0 kg CO_{2e}/kg H_2 if only point of production emissions were considered but the same hydrogen could have upwards of 20 kg CO_{2e}/kg H_2 if life cycle emissions are considered, depending on the emission intensity of the electricity used. Meeting the program goal of mitigating emissions across the supply chain to the greatest extent possible is only achievable if full life cycle emissions are included for hydrogen production. If only the point-of-production emissions are considered, then it is possible that this standard would incentivize electrolysis with unmitigated coal-fired electricity generation, which would be counter to the CHPS' aims.

In response to question 2-a under Stakeholder Feedback, we maintain that using the ISO frameworks as recommended in the IPHE HPTF Working Paper in support of the CHPS will prepare projects funded under the BIL to demonstrate the fulfillment of similar international hydrogen standards' requirements.

We also recommend that the standards not be used to narrowly incentivize older production pathways such as electrolysis or methane reformation. There are many nascent hydrogen production pathways, such as pyrolysis, photolysis, radiolysis, thermochemical methods,

[1] Infrastructure Investment and Jobs Act of 2021, Section 40315 (Clean Hydrogen Production Qualifications), https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf

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biological mechanisms, redox reactions, and geological production and reserves in the subsurface. Designing a standard that either fails to anticipate these novel pathways or directly excludes them would have the net effect of inhibiting innovation. Thus, the standard should be as open as possible while treating the various pathways on a level playing field by looking at their life cycle impacts.

Section 2. Methodology

a. The IPHE HPTF Working Paper (https://www.iphe.net/iphe-working-papermethodology-doc-oct-2021) identifies various generally accepted ISO frameworks for LCA (14067, 14040, 14044, 14064, and 14064) and recommends inclusion of Scope 1, Scope 2 and partial Scope 3 emissions for GHG accounting of lifecycle emissions. What are the benefits and drawbacks to using these recommended frameworks in support of the CHPS? What other frameworks or accounting methods may prove useful?

We investigated several global clean hydrogen standards and certification schemes and found that common threads among all of them were a basis on the International Organization for Standardization (ISO) emissions life cycle analysis frameworks and their agreement that the production of clean hydrogen should emit some value less than 5.0 kg CO_{2e}/kg H_2 over its life cycle. By setting a life cycle emissions target in alignment with international standards, the DOE will receive more project bids that are designed to meet this life cycle emissions target and will be better able to send funding to projects that will be well-positioned to participate in the global hydrogen market.

The following are four certification schemes/standards that base their emissions analyses on ISO frameworks that US hydrogen exporters may have to interact with in order to compete globally:

- CertifHy, a European consortium formed to develop hydrogen certification schemes across Europe to support hydrogen's market growth, defines "Low Carbon Hydrogen" as hydrogen that emits less than 4.4 kg CO_{2e}/kg H_2, from well to gate. CertifHy references ISO 14044 and 14067 when defining the boundaries and methodologies used in their analyses of production pathways.[2]
- The Standard and Evaluation of Low-Carbon Hydrogen, developed in China, defines "Clean Hydrogen" as hydrogen produced while emitting less than 4.9 kg CO_{2e}/kg H_2 over its life cycle. This document also references ISO 14067 in its emission analysis framework.[3]
- TUV Rheinland is an organization that provides certification services, including certification of carbon-neutral hydrogen. Their requirements are that a hydrogen product produce 0 kg CO_{2e}/kg H_2 over the lifetime analyzed, but they allow for flexibility in

[2] CertifHy (n.d.). *Certification Schemes*. Retrieved November 14, 2022, from https://www.certifhy.eu/go-labels/
[3] China Industry-University-Research Institute Collaboration Association (2020, December). *Standard and Evaluation of Low-carbon Hydrogen, Clean Hydrogen and Renewable Hydrogen.* Fuel Cell China. http://www.fuelcellchina.com/cnt_143.html

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selecting the system boundary depending on the producers' needs and allow for the use of credits and other mechanisms to meet this threshold. Their methods reference ISO 14067, 14040, 14044, and 14064.[4]

- The Green Hydrogen Organization is a non-profit organization under Swiss law that has produced its own green hydrogen standard for use globally. This standard has the strictest requirements of those we investigated, granting a certificate of origin only to hydrogen produced using renewable fuel and emitting less than 1.0 kg CO_{2e}/kg H_2, while meeting other requirements. The life cycle analysis for this standard follows the International Partnership for Hydrogen in the Economy's (IPHE) methodology, which is based on ISO frameworks.[5]

Based on our recent examination of currently published international standards and certification schemes, the original definition for the CHPS as specified in the legislative text (<2 kgCO_{2e}/kgH_2 at point of production) is the only standard that considers point of production emissions, and not some form of life cycle emissions, when defining "clean hydrogen". All other standards/ certification schemes use life cycle analysis based on ISO methodologies. In particular, ISO 14067 is referenced in three international certification schemes and in China's Standard and Evaluation for Low-Carbon Hydrogen. ISO 14067 provides the criteria for calculating the carbon footprint of a product based on life cycle analysis, including different life cycle boundaries.

One of the primary benefits of adopting one of the recommended ISO frameworks for the CHPS would be synchronicity with international standards. Building clean hydrogen hubs that meet international clean hydrogen criteria would allow these producers to participate in the international clean hydrogen market, enabling these hubs to achieve the program goal of being commercially viable after expiration of the DOE funding, which would be a boon for American competitiveness. Additionally, this updated standard and emission assessment methodology brings the CHPS into alignment with the clean hydrogen production tax credit passed in the Inflation Reduction Act.[6] This will similarly reduce administrative burden on projects for emission accounting and verification and enable projects and hubs to more easily take advantage of both avenues of financial support.

[4] TÜV Rheinland (n.d.).*Green hydrogen certification.* Retrieved November 14, 2022, from https://www.tuv.com/landingpage/en/hydrogen-technology/main-navigation/certification-%E2%80%9Cgreen-hydrogen%E2%80%9D/

[5] Green Hydrogen Organization (2022). *The Green Hydrogen Standard.* *https://gh2.org/sites/default/files/2022-05/GH2_Standard_2022_A5_11%20May%202022_FINAL_REF%20ONLY%20%281%29.pdf*

[6] Inflation Reduction Act of 2020, Sec. 13204, https://www.congress.gov/bill/117th-congress/house-bill/5376/text