U.S. Department of Energy Clean Hydrogen Production Standard (CHPS) Draft Guidance

November 14, 2022

Response Submitted By:

Siemens Energy, Inc.
4400 Alafaya Trail
Orlando, Florida 32826-2399

Business Contact: Hilda Varshochi
Phone: 1 (321) 230-4681
Email: hilda.varshochi@siemens-energy.com

1) Data and Values for Carbon Intensity

a) Many parameters that can influence the lifecycle emissions of hydrogen production may vary in real-world deployments. Assumptions that were made regarding key parameters with high variability have been described in footnotes in this document and are also itemized in the attached spreadsheet "Hydrogen Production Pathway Assumptions." Given your experience, please use the attached spreadsheet to provide your estimates for values these parameters could achieve in the next 5-10 years, along with justification.

Parameter	Assumptions made in analysis supporting proposed targets within draft CHPS	Respondent feedback		
		Regional or national average values achievable within next 5 years (i.e. by 2027)	Regional or national average values achievable in future years, and respective timescale	Rationale for estimates and any additional comments
Share of clean energy within electricity consumption	Use of predominantly clean energy (i.e. ≥85% clean energy, ≤ 15% U.S. grid mix) in electrolysis is expected to enable achievement of the lifecycle target proposed in this draft guidance. In columns C-E, please provide feedback on the technical and economic feasibility of electrolyzers accessing this share of clean energy.	The limit can be met in US- central and southern Plains mix, with about 30% of energy provided from the grid. However, using the US-mix distributed electricity's CI of 410.1/MWh, the CO2e limit for H2 production at 3MPa can be met using maximum 14.5% grid electricity. For H2 at atmospheric, the limit can be met with 15.5% grid electricity.	As electrolysis equipment degrades and consumes more energy, the GHG goals set by the standard will not be met using 15% of grid electricity unless US-mix renewables percentage increases over time.	Numbers are based on commercially available electrolysis equipment
Other (e.g. pressure and purity conditions at output of hydrogen production facilities)	In analysis to inform the CHPS, systems were modeled to achieve hydrogen production with 99% purity and 3 MPa at the outlet.	H2 purity: 99% is acceptable. Pressure: multiple applications and processes require hydrogen at different pressures.	Purity may be subject to extreme variation based on technology chosen, therefore it is our recommendation to use mass-based hydrogen production as reference condition for future cases	It is recommended to use atmospheric pressure and H2 mass flow as standard reference, for technology agnostic evaluation

b) Lifecycle analysis to develop the targets in this draft CHPS were developed using GREET. GREET contains default estimates of carbon intensity for parameters that are not likely to vary widely by deployments in the same region of the country (e.g., carbon intensity of regional grids, net emissions for biomass growth and production, avoided emissions from the use of waste-stream materials). In your experience, how accurate are these estimates, what are other reasonable values for these estimates and what is your justification, and/or what are the uncertainty ranges associated with these estimates?

The GREET model is acceptable, and the regional averages in the grid are reasonably accurate.

f) How should the lifecycle standard within the CHPS be adapted to accommodate systems that utilize CO2, such as synthetic fuels or other uses?

It is recommended keeping the focus on hydrogen production rather than involving other processes that involve CO2 in the process, which can possibly lead to a falsely low lifecycle CI calculation.

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?

The scope definition in the IPHE HPTF Working Paper is acceptable. Ideally the entire Scope 1, Scope 2, and Scope 3 would be included in the evaluation, but it is currently impractical to evaluate. Any alternative method that includes all processes "inside the fence" of the hydrogen production facility would be acceptable as well.

c) How should GHG emissions be allocated to co-products from the hydrogen production process? For example, if a hydrogen producer valorizes steam, electricity, elemental carbon, or oxygen co-produced alongside hydrogen, how should emissions be allocated to the co-products (e.g., system expansion, energy-based approach, mass-based approach), and what is the basis for your recommendation?

The effect of co-products should be evaluated on a case-by-case basis with a full analysis of the CI of all products and inputs across the system boundary. As a global process, it needs to be a net CI-decreasing system over a period of time.

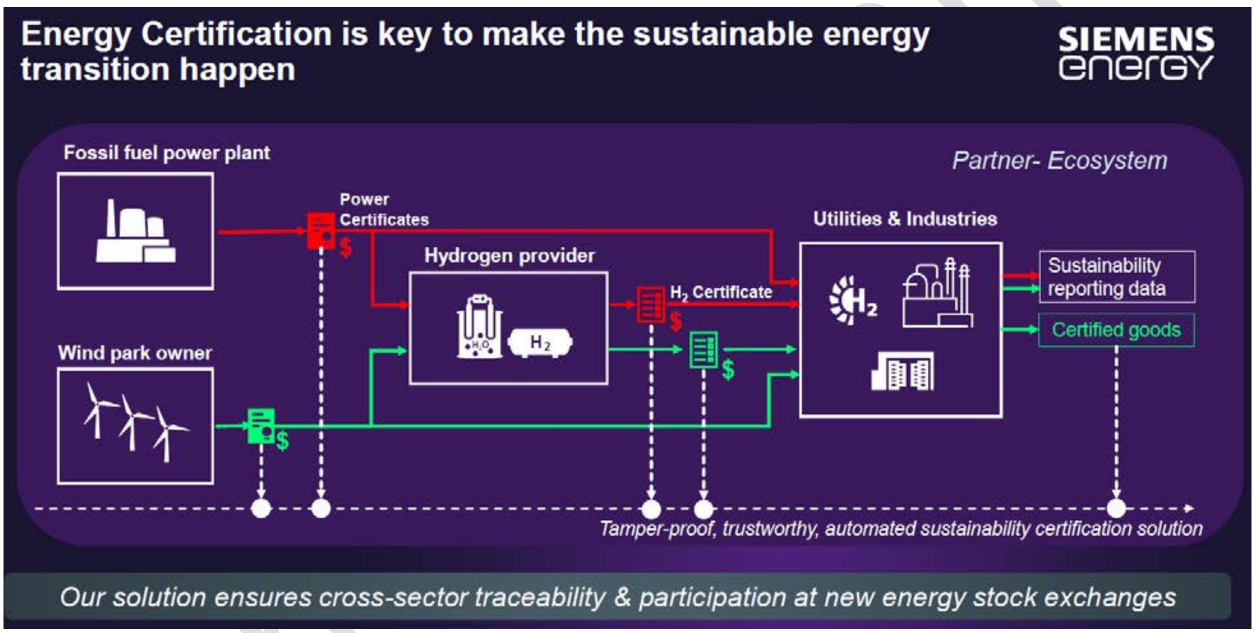
d) How should GHG emissions be allocated to hydrogen that is a by-product, such as in chlor-alkali production, petrochemical cracking, or other industrial processes? How is byproduct hydrogen from these processes typically handled (e.g., venting, flaring, burning onsite for heat and power)?

The effect of co-products should be evaluated on a case-by-case basis. Since the main purpose of such processes is not hydrogen production, the additional development needed to handle, harness, and purify the produced hydrogen can be considered as a separate boundary and GHG evaluation.

3) Implementation

a) How should the GHG emissions of hydrogen commercial-scale deployments be verified in practice? What data and/or analysis tools should be used to assess whether a deployment demonstrably aids achievement of the CHPS?

Clean Energy Certification system blockchain-agent should be utilized as it can be managed and audited by responsible authorities and prevent "green-washing" across the value chain.



c) Should renewable energy credits, power purchase agreements, or other market structures be allowable in characterizing the intensity of electricity emissions for hydrogen production? Should any requirements be placed on these instruments if they are allowed to be accounted for as a source of clean electricity (e.g. restrictions on time of generation, time of use, or regional considerations)? What are the pros and cons of allowing different schemes? How should these instruments be structured (e.g. time of generation, time of use, or regional considerations) if they are allowed for use?

The production of clean hydrogen under both implementation configurations is acceptable, with and without RECs. However, hydrogen production facilities that can work reliably and flexibly upon availability of renewable energy sources are ideal.

d) What is the economic impact on current hydrogen production operations to meet the proposed standard (4.0 $kgCO_2e/kgH_2$)?

Some technologies will be affected and required to invest in additional technology such as CCS. For those plants currently operating, the IRA production tax credit can help to lower levelized cost of hydrogen (LCoH).