May 15th, 2024

Dear Convener, Secretary and members of TC 197/SC 1/WG 1,

We are a group of environmental organizations and participants in the development of the hydrogen sector writing to you to offer feedback on the process of developing the new standard ISO/AWI 19870-1, based on the Technical Specification 19870:2023. We urge the Secretariat and relevant committees to consider this feedback as the new standard is developed.

We acknowledge the need for global cooperation on assessing the climate impacts of hydrogen, in order to facilitate a market for truly clean, low-carbon hydrogen and hydrogen derivatives. We are grateful for the work that has gone into this document and acknowledge several positive aspects: We share the aim expressed in the Technical Specification to capture the full lifecycle impact of hydrogen production with appropriate system boundaries. We also are pleased to see the inclusion of important considerations such as transmission line losses, and a provision to require the time period of the lifecycle evaluation to be justified and representative of intra- and inter-annual variability in order to avoid gaming.

However, cooperation on standards is only positive for the climate if those standards are robust and accurately capture the emissions impacts of hydrogen production. We find several areas of concern in the Technical Specification that must be addressed as the Technical Specification is developed into ISO standards if the standards are to be credible. We offer recommendations to address these concerns that will contribute to the interoperability of global standards, fostering the development of a durable industry that is not tainted by underreported climate impacts.

A summary of our recommendations is below:

1. The limitations of the standard as a methodology for calculating lifecycle emissions, but not a definition of what counts as clean hydrogen, must be transparently communicated.
2. Examples should be given of the differences between consequential and attributional approaches, alongside guidance for when to use each.
3. Methane leakage must be reported with more accuracy and granularity and not rely on underreported national averages.

4. A robust and uniform process is essential for verifying the full climate impacts of fossil-based production pathways. Carbon capture and storage (CCS) must be monitored to verify actual capture rates and to ensure the permanence of sequestration.
5. Electricity accounting must credibly account for induced grid emissions due to hydrogen production. If claiming lower-than-grid-emissions or zero emissions for electricity inputs, then credible proof must be demonstrated in three areas:
    a. Incrementality
    b. Hourly matching
    c. Deliverability
6. Due to the warming impacts of hydrogen itself, hydrogen emissions must be addressed in the standard. Once accurate measurement equipment is commercially available, hydrogen's warming impact must be included in the lifecycle assessment.
7. Lifecycle assessments should be reported on both 100-year and 20-year timescales due to the potency of some short-lived climate pollutants, like methane.
8. Data sources should be consistent where possible.
9. Stakeholder input should be improved, for example by making published documents available to civil society stakeholders working on these issues free of charge.

1. Transparently communicating the limitations of an ISO standard

The ISO standard will be a calculation methodology for hydrogen greenhouse gas (GHG) emissions, but defining what should count as clean hydrogen is beyond its scope. As the ISO standard will not set an emissions threshold or definition for clean hydrogen, ISO should clearly articulate that its hydrogen standard does not serve that function. Otherwise, there is a risk of hydrogen producers dishonestly marketing what ISO compliance will really mean.

Complying with the envisioned ISO standard is not the same as complying with existing thresholds and regulatory frameworks around the world. It will mean only that the ISO methodology has been followed to calculate emissions. As ISO standards are voluntary tools used by the industry, legislation could establish other calculation methodologies, which will have precedence. Therefore, ISO compliance should not be misrepresented as a silver bullet for promoting clean hydrogen. Any misunderstanding on that point could undermine global cooperation on climate action.

In developing its methodology, the ISO working group should consider other existing calculation methodologies related to hydrogen emissions and acknowledge the limitations of voluntary standards, which should support—but not replace—mandatory standards.

2. Consequential and Attributional Approaches

The Technical Specification describes parallel attributional and consequential approaches to assessing the lifecycle emissions of hydrogen but does not identify the circumstances in which each approach would be most suitable. Worked examples comparing the outcomes for each approach for the same hydrogen systems would be instructive, as would guidelines for when each should be used.

3. Methane leakage must be reported with more accuracy and granularity

Methane emissions are one of the largest contributors to lifecycle GHG emissions in hydrogen systems that rely on fossil fuel feedstocks. Studies show that high methane leakage rates, coupled with hydrogen leakage, can make these hydrogen applications worse for the climate in the near-term in terms of aggregate GHG emissions than fossil fuel alternatives.[1] Thus, robust accounting for upstream methane emissions is a critical component of a credible standard. TS19870 offers multiple pathways to estimate the emissions factor of natural gas (section 4.3.2.5.4), including the option to use national average emissions intensities. However, national averages are often based on underreported emissions. Data from recent satellite-based studies show that global methane emissions from oil and gas production are 30% higher than the total reported by countries to the UNFCCC.[2] Additionally, relying on single national averages obscures the significant geographic variation that can occur between basins. Rather than emission factor-based estimates, the standard should instead require the use of observed (measured) emissions data, ideally at the site- and source- level utilizing internationally recognized monitoring, reporting and verification standards, verified by a technically competent and authorized third party. The ISO standard could reference level 4 and level 5 reporting under the Oil and Gas Methane Partnership (OGMP) 2.0 framework. With newly available satellite data, including through the UN Environment Programme's International Methane Emissions Observatory (IMEO), the barriers to using empirical emissions data have been greatly reduced.

4. Carbon capture and sequestration must be permanent, demonstrable and verified.

The carbon intensity of fossil fuel-derived hydrogen cannot be fully assessed without appropriate monitoring, reporting, and verification of both the capture and permanent sequestration of captured carbon. For capture, actual capture rates are essential -- given that facilities often capture at rates lower than their nameplate efficiencies, don't run their CCS technologies constantly, and/or don't control emissions from all processes at a facility. Similarly, in developing an ISO standard for hydrogen, the best available, most rigorous standards for ensuring, demonstrating, and verifying secure storage – from site characterization through termination – should be incorporated. This should include, at a minimum, incorporation of existing ISO standards for geologic storage of CO2 (ISO 27916:2019 and ISO 27914:2017), any updates necessary following the finalization of the ongoing update to ISO 27914, and any modifications deemed appropriate to ensure the best monitoring, reporting, and verification framework for carbon sequestration as it relates particularly to fossil-fuel derived hydrogen technologies.

In addition, ISO should explicitly require demonstrable emissions reductions and storage on a well-to-wheel basis for fossil-based hydrogen production to claim lower emissions than unabated fossil-based production. The Technical Specification states that "Outcomes from carbon offsetting actions or GHG emissions trading (e.g. under the European Union Emissions Trading System (EU ETS)) shall not be taken into account for quantification and reporting of GHG emissions from transport operations." ISO should clarify that the prohibition on offsetting applies at *any* step of the hydrogen production and distribution process, not only transportation. This includes offsets relating to avoided methane leakage, biomethane, or tree planting.

5. Accounting for upstream electricity emissions must be rigorous for all approaches.

Accurate measurement of the GHG intensity of the electricity used to produce hydrogen is of utmost importance to the overall lifecycle assessment (LCA). Hydrogen produced by electrolysis in particular presents electricity emissions accounting concerns, due to the large load that electrolysis can present to the electricity system.

---

[1] Ocko, I. B. and Hamburg, S. P.: Climate consequences of hydrogen emissions, Atmos. Chem. Phys., 22, 9349–9368, https://doi.org/10.5194/acp-22-9349-2022, 2022.
[2] Shen, L., Jacob, D.J., Gautam, R. et al. National quantifications of methane emissions from fuel exploitation using high resolution inversions of satellite observations. Nat Commun 14, 4948, https://doi.org/10.1038/s41467-023-40671-6, 2023.

The electricity used to produce hydrogen must be assumed to have the same carbon intensity as the grid average unless there is credible proof that zero-carbon power has been procured that meets three requirements: incrementality, deliverability, and hourly matching. ISO standards should not treat electricity used for hydrogen production as zero-carbon unless these three requirements are satisfied. Both consequential and attributional approaches should include these three requirements to ensure that when hydrogen producers claim to procure electricity with zero consequential greenhouse gas emissions, that is truly the case. The following sections describe the importance of each of these requirements.

a. Additionality or Incrementality: Avoiding the emissions implications of resource shuffling

The Technical Specification currently states that "Following the product system boundaries, direct emissions from electricity use may be considered to be zero when on-site renewable electricity produced from hydro, photovoltaic or wind is used." However, this is not the case if the energy used from these renewable sources is not new and/or incremental. If an electrolyzer uses power from an existing renewable generator, and that power would otherwise have been delivered to the grid, fossil fuel electricity production will likely increase to replace at least a portion of the diverted energy, leading to emissions increases linked to hydrogen production. When existing renewable energy resources are used, emissions are induced regardless of whether the existing source is on-site or off. This can result in electrolytic hydrogen production in the U.S. that is two or more times worse for the climate than today's incumbent hydrogen.[3] This problem is even more significant in more coal-heavy grids.[4] Therefore, unless incremental resources are used, hydrogen production should be assumed to be powered by the average grid – with its emissions intensity determined accordingly—as opposed to a zero-carbon resource.[5]

b. Hourly matching is necessary to accurately determine emissions resulting from hydrogen production

There is a substantial body of evidence that only hourly matching of electricity generation and electricity consumption for hydrogen production can accurately capture its emissions impacts.[6] Indeed, with a looser timescale, such as annual matching, there will likely be a major mismatch between times of hydrogen production and those of clean energy availability that risks driving increases in fossil fuel generation with a commensurate increase in emissions. Therefore, a grid average emissions intensity must be used with respect to grid-connected hydrogen production unless hourly (or shorter) temporal matching with clean energy resources is demonstrated. With markets for hourly Environmental Attribute Certificates (EACs) already available or in development in much of the world, hourly matching is both feasible and necessary for accurate LCA of hydrogen production. While the statements requiring justification of the time range of the evaluation of the LCA are encouraging, certainty around electricity attributes in particular requires that the standard explicitly call for hourly matching. The manner in which hourly matching will be

---

[3] Ricks, W., Xu, Q., & Jenkins, J. D. (2023). Minimizing emissions from grid-based hydrogen production in the United States. *Environmental Research Letters*, *18*(1), 014025. https://doi.org/10.1088/1748-9326/acacb5
Blanford, G., & Bistline, J. (2023). Impacts of IRA's 45V Clean Hydrogen Production Tax Credit. EPRI. Retrieved January 29, 2024, from https://www.epri.com/research/products/000000003002028407
Energy Innovation. (2023). Smart Design Of 45V Hydrogen Production Tax Credit Will Reduce Emissions And Grow the Industry https://energyinnovation.org/publication/smart-design-of-45v-hydrogen-production-tax-credit-will-reduce-emissions-and-grow-the-industry/
[4] Ibid.
[5] Incremental resources potentially could include otherwise-curtailed resources. However, robust criteria must be in place to avoid risks of gaming (for example, self-scheduling) and to ensure that those resources actually would be curtailed, in the same location and during the same hours the electrolyzer is producing hydrogen, *but for* powering that hydrogen production.
[6] Ricks, (2023); Zeyen, E., Riepin, I., & Brown, T. (2022). Hourly versus annually matched renewable supply for electrolytic hydrogen. Zenodo. https://doi.org/10.5281/zenodo.7457441

achieved may be geographically dependent. For example, while hourly certification systems will be a widespread tool in Europe and the U.S., developing countries may need to use other methods for hourly matching such as behind the meter configurations or bilateral PPAs based on hourly delivery. ISO has in fact already endorsed hourly accounting in its 50010 standard[7] for net zero carbon.[8]

c. Deliverability: Accounting for the impact of transmission constraints

Specific deliverability requirements are needed to ensure that the zero-carbon energy hydrogen producers claim to use can actually be delivered to the grid where the electrolyzer is located. For behind the meter or directly connected sources of zero-carbon energy, deliverability is already satisfied. For other sources, ISO must require that the producer demonstrates that there is no major transmission bottleneck hindering delivery of zero-carbon energy to the hydrogen project. The Technical Specification references Annex E of ISO14064-1:2018[9], "Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals," which contains language relating to quality criteria for energy attribute certificates (EACs) used to claim procurement of electricity. It states that electricity consumers may use the "market based" approach of contractual instruments with EACs if the electricity "is produced within the country, or within the market boundaries where consumption occurs if the grid is interconnected." This language does not ensure that electricity is physically deliverable and not behind some transmission bottleneck or constraint. The Technical Specification should add a stronger deliverability requirement to address this potential emissions loophole. If this requirement is not met, the grid average emissions intensity must be used.

6. Hydrogen emissions need to be measured

Any credible LCA must also factor in the warming impact of hydrogen itself. At least 15 scientific publications released over the past two decades, including two Intergovernmental Panel on Climate Change (IPCC) assessment reports, have cautioned about the warming effects of hydrogen emissions.[10] In 2001, the IPCC reported the first Global Warming Potential (GWP) value for hydrogen, based on the quantification of hydrogen's lower-atmosphere warming potency. Most recently, advancements in chemistry-climate modelling have led to quantification of hydrogen's full atmospheric warming effects—which are double earlier estimates: Hydrogen emissions are now known to be 30-40 times more powerful at trapping heat over the following 20 years than carbon dioxide for equal mass, and 8-12 times more powerful over a 100-year period.[11] A recent multi-model assessment – developed by six teams of scientists across the US and Europe – found high confidence in the quantification of hydrogen's warming effects and explicitly stated that the science is robust enough to be included in policy decisions and tools.[12]

---

[7] https://www.iso.org/standard/51873.html

[8] Goldstein, D. (2023). Net Zero Carbon to Stop Climate Change: ISO Standard 50010. https://www.nrdc.org/bio/david-b-goldstein/net-zero-carbon-stop-climate-change-iso-standard-50010

[9] https://www.iso.org/obp/ui/#iso:std:iso:14064:-1:ed-2:v1:en

[10] Warwick et al. (2023); Sand et al. (2023); Derwent et al. (2023); Hauglustaine et al. (2022); Bertagni et al. (2022); Ocko and Hamburg (2022); European Commission JRC (2022); Paulot et al. (2021); Field and Derwent (2021); Derwent et al. (2020); Wuebbles et al. (2010); IPCC AR4 (2007); Derwent et al. (2006); Colella et al. (2005); Warwick et al. (2004); Prather (2003); Schultz et al. (2003); IPCC TAR (2001), Derwent et al. (2001)

[11] Warwick et al. (2023); Sand et al. (2023); Derwent et al. (2023); Hauglustaine et al. (2022)

[12] Sand, M., Skeie, R. B., Sandstad, M., Krishnan, S., Myhre, G., Bryant, H., Derwent, R., Hauglustaine, D., Paulot, F., Prather, M., & Stevenson, D. (2023). A multi-model assessment of the Global Warming Potential of hydrogen. Communications Earth & Environment, 4(1), 1–12. https://doi.org/10.1038/s43247-023-00857-8

There has been some confusion about whether an indirect greenhouse gas like hydrogen can or should be included in LCA methodologies. However, indirect effects are already factored into IPCC-approved GWP metrics. Methane is both a direct and indirect greenhouse gas in that it absorbs infrared radiation but also affects atmospheric chemistry in ways that increase other greenhouse gases (primarily tropospheric ozone and stratospheric water vapor). Approximately 70% of methane's warming impacts comes from its direct absorption of infrared radiation, and the other 30% is from it increasing the amounts of other greenhouse gases. Both methane's direct and indirect warming effects are included in its GWP values.[13]

The final ISO standard can fill this gap in the TS19870 lifecycle methodology by establishing a phased approach. Initially, producers can report hydrogen emissions separately, outside of their primary LCA calculations, using estimated loss rates, which can be either drawn from the literature[14] or derived using mass-balance calculations. Once site-specific measurements are feasible, as higher-sensitivity emission detection sensors become more readily available, the standard should be updated to include these emissions within the LCA system boundary.

7. Warming timescales

Given the short-lived nature of the warming impacts of both hydrogen emissions and methane emissions, both of which are potentially significant components of the greenhouse gas footprint of many hydrogen production pathways, the use of GWP100 – the warming impact over 100 years – understates the impacts of hydrogen production. Currently the Technical Specification says that other time horizons besides GWP100 may be reported separately, but does not require it. Acknowledging the need to reduce emissions by 45% relative to 2010 by 2030 and reach global net zero by 2050, acknowledged in the Technical Specification introduction, hydrogen producers should be required to report both GWP100 and GWP20 – the warming impact over 20 years.

8. Data sources should be consistent where possible.

To make this standard meaningful, any secondary data used for the LCA should always come from the same source. The current ISO text requires producers to identify the secondary data they have used for their calculation but does not provide guidelines on which database is appropriate to use, which could lead to comparability issues. The results of the calculations would have to be interpreted by interested parties, requiring additional research and verification even though the calculations were made following the same methodology. Using consistent secondary data, when possible, will increase the credibility of the calculation methodology and will create more trust when this information is consumer-facing.

9. Stakeholder input

The process of developing these standards could be improved by greater participation from civil society organizations in the ISO/TC 197/SC 1. There should be more transparency on the proposals under discussion, and we suggest that the documents, once published, should be made freely available without a paywall to civil society stakeholders that are working on these issues.

We hope that these concerns are received constructively and that we can work together on the next iteration of this methodology and its implementation into a set of standards with high integrity that underpins the safe and climate-aligned production of hydrogen and hydrogen derivatives.

---

[13] IPCC 2021 Chapter 7

[14] Esquivel-Elizondo S, Hormaza Mejia A, Sun T, Shrestha E, Hamburg SP and Ocko IB (2023) Wide range in estimates of hydrogen emissions from infrastructure. *Front. Energy Res.* 11:1207208. doi: 10.3389/fenrg.2023.1207208

Yours sincerely,

Bellona

CWP global

Earthjustice

EnergyTag

Environmental Defense Fund

Future Clean Architects

Hy Stor Energy LP

Natural Resources Defense Council

Union of Concerned Scientists