November 14, 2022

To: The Honorable Jennifer M. Granholm, Secretary
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585C
Cleanh2standard@ee.doe.gov

Re: American Chemistry Council Comments on the Draft Clean Hydrogen Production Standard

Dear Secretary Granholm:

Thank you for the opportunity to provide preliminary feedback in response to your Request for Comment (RFC) on the Department's draft Clean Hydrogen Production Standard (CHPS). ACC and its members applaud Congress' and the Department's commitment to building a clean hydrogen economy and see the U.S. chemical industry as an essential partner. Our members are eager to work with policymakers to realize these important policy goals.

ACC represents a diverse set of companies engaged in the business of chemistry, an innovative, $486 billion enterprise.[1] ACC members work to solve some of the biggest challenges facing our nation and our world, driving innovation through investments in research and development (R&D) that exceed $10 billion annually. They supply the chemical products, polymers, and materials underpinning the energy sector's industrial base and the energy efficiency, clean energy, and clean energy-enabling technologies needed for a low-carbon economy. Products of chemistry will be important enablers of developing hydrogen technologies, and critical elements of the hydrogen and fuel cell supply chain.

The chemical industry is uniquely positioned to tap into and grow the emerging hydrogen economy through its process expertise, existing assets and innovation capabilities, and its growing demand for lower-emissions fuels and feedstocks. U.S. chemical and petrochemical manufacturers have a history of leadership in hydrogen production and utilization, accounting for roughly a third of the 10 million-ton U.S. hydrogen market in 2020 - one of the largest markets for hydrogen globally. Beyond serving as a valuable commodity in contemporary chemical manufacturing processes, hydrogen offers tremendous promise as a building block for a more competitive, lower emissions chemical sector and national economy in the future. In a 21st century clean

[1] ACC's mission is to deliver value to our members through advocacy, using best-in-class member engagement, political advocacy, communications, and scientific research to foster progress in our economy, environment, and society.

hydrogen economy, chemical manufacturers are hydrogen producers and suppliers, hydrogen technology enablers, clean hydrogen users, and market creators.[2]

The innovation, infrastructure, and production incentives authorized under the Bipartisan Infrastructure Law and Inflation Reduction Act have tremendous potential to advance and accelerate clean hydrogen's deployment across the economy. To maximize the impact of the various hydrogen incentives, DOE, the Treasury, and other implementing agencies should interpret, define, and execute these programs in a manner that retains the nation's current hydrogen productive capacity and competitive position while promoting a smooth transition to cleaner hydrogen sourcing, production, and use. ACC urges the Administration to adhere to the following principles as it develops its clean hydrogen policies.

1. Recognize current hydrogen production technologies, infrastructure, and markets as building blocks rather than impediments in the clean hydrogen transition.

2. Recognize the need for rapid federal action to incentivize, site, and permit the energy and transportation infrastructure needed to leverage IRA's resources and within the timeframes assessed.

3. Make realistic assessments of current technology readiness levels of candidate hydrogen technologies; the level of infrastructure investment, siting, construction, and permitting needed to deploy each technology at a national, commercial scale, and the timing required for such deployment.

4. Consider the current readiness-level of clean energy and H2 manufacturing infrastructure against status quo and incorporate transition time into guidance implementation.

5. Develop definitions, metrics, and implementation guidance for clean hydrogen production that reward both early adoption of currently technologically and economically feasible lower-emissions hydrogen production technologies and continued investment into emerging solutions.

6. Adopt realistic, performance-based, technology-neutral definitions and standards for clean hydrogen production and program eligibility, and reject

[2] For more discussion of the chemical industry's current and future potential as a supplier, enabler, and consumer of clean hydrogen, a copy of DOE's response to DOE Request for Information # DE-FOA-0002698 (Clean Hydrogen Manufacturing, Recycling, and Electrolysis) is attached as exhibit 1.

technology or feedstock restrictions or preferences (*e.g*., grey, blue, green hydrogen, etc.).

These principles are consistent with the text of the BIL[3] and the draft CHPS standard and support the Department's goal of "reducing the carbon intensity of hydrogen production from diverse feedstocks over time."[4] Consistent with these principles, ACC provides the following preliminary responses to the topics raised in the RFI.

I. Proposed Terms and Definitions

A. System Boundary for Lifecycle Target:

ACC supports draft CHPS proposal to set lifecycle boundaries in accordance with the boundaries established under the clean hydrogen production tax credit provision in the Inflation Reduction Act.[5] Consistent with the discretion granted under that provision, ACC believes that carbon or other GHGs captured during the production process should be omitted from the lifecycle boundary where geologically sequestered or utilized as a feedstock in the production or manufacture of a new product.

The CHPS should allow for flexibility to pursue project specific carbon reduction methods across the value chain, which will spur innovation and reduce the cost of meaningful carbon reduction. The standard should give consideration to verifiable, robust certified low-emissions feedstocks (including natural gas) and avoid default regional scores where actual data is available. It should also allow for the use of non-physical instruments such as PPAs, RECs, and book-and-claim market mechanisms.

B. Eligibility Standard for DOE-Funding Programs.

As a general principle, DOE should strive to maximize the range of projects, products, and product components eligible for funding – particularly early in the implementation process, focusing on the nexus to emission reduction rather than artificial technical or process distinctions.

[3] 42 U.S.C. §16166(b) and *id*. §16154(e)(2) (directing the initial standard to "support the production of clean hydrogen from diverse energy sources" including, in addition to an enumerated list of examples, "any other methods the Secretary determines to be appropriate;" …and "take into consideration technological and economic feasibility."

[4] Draft CHPS Guidance at 2 ("under the statute, the definition of clean hydrogen is a component of the CHPS but is not the sole component of the CHPS.").

[5] *Id*.

ACC supports DOE's proposal to allow consideration of projects with emissions exceeding the initial CHPS standard under DOE funding programs if the selected projects "demonstrably aid the achievement" of the CHPS or any technology cost goals oriented toward achieving the CHPS.[6] This includes projects that may utilize, in part, components of existing more emissions intensive hydrogen production processes and infrastructure.

ACC and its members see tremendous opportunity to develop a comprehensive low-carbon hydrogen value chain, but that will require development of the supply chains, technologies, infrastructure, distribution chains, and end markets. In the near term, the bulk of clean hydrogen demand will come from existing natural gas industries converting from more emissions intensive processes to lower ones.

II. Responses to Issues Raised for Comment

A. Data and Values for Carbon Intensity

1. Is it technically and economically feasible to expect hydrogen produced through electrolysis to use >85% clean energy (CCUS, nuclear, renewables) and < 15% U.S. grid mix now or in the next 5-10 years?

ACC defers to its specific members with respect to the site-specific conditions that may determine the feasibility of various production standards across the chemical sector. More generally, in considering the technical and economic feasibility of its ambitious renewable scenario, DOE should give careful consideration to the significant prerequisite gating steps required for deployment and the likely variability in cost and feasibility of renewable integration across regions, industries, and product manufacturing systems.

The technical feasibility of the assumptions DOE makes with its initial proposed HCPS technology pathways will differ significantly based on the location of the producer, the reliability and robustness of its value chain and the critical energy, transportation, and low carbon manufacturing infrastructure available to it, and other increasingly important variables like community acceptance, state and local permitting requirements, etc.

Industrial manufacturing, including hydrogen production, is extremely energy intensive, involving both electric and heat energy. In some areas, producers may have little to no direct access to renewable power or the transport and storage infrastructure

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[6] *Id.* at 6.

needed for CCS. (This is one of the reasons it is so important to recognize carbon utilization as an equal, if not preferable, approach to carbon management than sequestration).

To illustrate the challenge with rapid transition to renewable industrial power deployment, the Energy Information Administration (EIA) has projected that the U.S. electrical grid will reach 55% renewable generation by 2040 under a business-as-usual approach. In this context, chloro-alkali producers would have to utilize power purchase agreements (PPA's) for investment in nuclear and renewables as they are limited on quantity of renewable energy production availability as well as return on investment of renewables as it relates to commodity chemicals.

With respect to economic feasibility, cogeneration heat and power mirrored with carbon offsetting technology (DAC, CCUS) would be a large capital investment and additional permitting, making feasibility from a low-carbon technology and financial return very challenging in the short term. Both are technology levers that would require support under IRA-type programs to make the financials work. While IRA offers the potential to expedite the pathway to renewable energy integration at the national scale, it remains unclear whether DOE, EPA, and Administration policies regarding grant allocation and permit review and approval will be implemented in a manner and timeframe to make the incentive programs realistically feasible in the limited time provided by Congress. If the Administration is not able to leverage the funding to promote broadscale investment, the proposed standard may prove economically infeasible for sectors eager to make investments.

2. GREET Model: Comments on the accuracy of estimates in the GREET model, and alternatives to this tool

Based on consultation with our members, the default estimates contained in GREET appear to vary in reliability and representativeness, and are likely to vary dramatically for individual projects, based on the GHG intensity of upstream feedstock supply chains. This variability is not easy to reflect in a model, but it could have a significant impact on lifecycle GHG emissions.

It is not clear whether or how users could adjust for these variables. In the absence of some adjustment method, the model could generate divergent or erroneous results from different LCA practitioners making submissions to CHPS. To achieve a high degree of accuracy for the CI of a given H2 production project, CHPS should allow for the representation of project specific parameters in GREET, including but not necessarily limited to:

- Well-to-gate GHG intensity of feedstock natural gas

- Imported power GHG intensity (currently GREET has grid power factors available for 10 sub-national regions, but greater regional specificity (e.g., state level) would be more accurate)

- Imported steam quantity and quality

- Other utility or material inputs (e.g. process water, cooling water, nitrogen, instrument air, oxygen)

- Quantity and quality of co-produced steam, power, solid carbon, oxygen, or other co-products

- Direct emissions or flue gas quantity and composition

- The use of non-physical instruments to reduce GHG emissions including PPAs, RECs, and book-and-claim.

Furthermore, DOE should provide guidance on exactly which parameters (tab and cell locations) may be edited to reflect specific projects, as well as the evidence required to deviate from a default assumption, parameter value or emission factor. This would provide clarity for the submission process and help generate more consistent results under the CHPS program.

DOE should also utilize a model that can accurately represent the various technology line-ups for producing low carbon hydrogen a producer may use. At present, not all technology pathways for hydrogen production are included in the tool, which will discourage innovation and slow hydrogen deployment.

Finally, in addition to assessing the net emissions intensity of the hydrogen produced under a funded project, DOE should also consider the potential impact a project may have in developing or demonstrating lower emissions production technologies or techniques that could be readily deployed more broadly to rapidly increase market access to affordable, lower-intensity hydrogen supplies and facilitate an incremental step toward more significant GHG reductions.

3. Boundary: Are any key emission sources missing from the system boundary DOE proposes

The current CHPS system boundary accounts for the sequestration of carbon captured during the production process but not for the capture and subsequent utilization of CO_2 in the manufacture of new chemistries, materials, and products, including fuels where the captured CO_2 reduces the need for other fossil-fuel inputs. Such utilization pathways should be recognized within the system boundary.

Developing robust utilization technologies and markets for captured CO_2 not only diverts process CO_2 from the environment, it can help reduce the cost associated with carbon capture and clean-hydrogen manufacturing, advancing the goals of the CHPS program while creating carbon abatement technologies applicable across the broader economy.

In working with ACC's members on the RFI, we also received questions regarding DOE's intent in the framing of certain provisions. Specifically:

a. *What was the motivation behind looking only at emissions during a single step of the lifecycle (production step)? If at all, lifecycle-wide emissions are more relevant to the topic of global warming*

b. *How are boundaries drawn around the production step:*
   i. *Is captured carbon treated as captured (not-emitted), even if it is transported out of the site boundary?*
   ii. *Are emissions from electricity produced off-site included or excluded? What if electricity is produced on-site?*

4. **Systems to improve characterization and management of hydrogen's impact**

Current H_2 sensors have limitations. Has DOE considered development of a hydrogen monitoring and reporting system analogous to the OGMP2.0 framework used for methane, and address current limitations in suitable H_2 sensors?

5. **Synthetic fuels: How should the lifecycle standard within the CHPS be adapted to accommodate systems that utilize CO_2, such as synthetic fuels or other uses?**

As discussed above, where CO_2 generated during the hydrogen production process is captured and used productively in a new chemical, material, product, or synthetic fuel that would otherwise have required a fossil-derived input, the GHGs avoided from the use of that alternative fossil-derived input should be considered in the LCA.

B. Methodology

1. **ISO Frameworks: What are the benefits and drawbacks to using various generally accepted ISO frameworks (14067, 14040, 14044, 14064, and 14064) for LCA and including Scope 1, Scope 2**

and partial Scope3 emissions for GHG accounting of lifecycle emissions?

The ISO standards cited above are the gold standard and foundation for all subsequent LCA methodologies, so we strongly support the use of ISO as the basis for CHPS. In many cases, however, they lack the specificity to ensure fully consistent application of LCA and emissions accounting.

6. **Biogenic Resources: What frameworks, analytic tools, or data sources can be used to quantify emissions and sequestration associated with biogenic resources in hydrogen production, including waste products that would otherwise have been disposed of (e.g., municipal solid waste, animal waste)?**

DOE's question is an important one, since avoided emissions from use of biogenic resources could, in many cases, be so significant as to dominate the overall life cycle results. As such, it will be important to reflect project-specific parameters in calculating the LCA of the H_2 product whenever possible. Otherwise, there may be a significant discrepancy in LCA results reflecting a general case and the conditions of a specific feedstock source.

The Guidance could use the default data/pathways in GREET as a starting point**,** supplemented with use of the EPA WARM model for MSW feedstocks, or GREET or CA-GREET pathways for renewable natural gas (RNG) from landfills or animal manure. RNG-derived hydrogen pathways from different feedstocks should be included as an option in the GREET model. There may be other carbon accounting software packages that could verify upstream scope 3 carbon intensity of the RNG or biogenic sources. DOE should be open, however, to more refined analyses supported by valid data where producers can provide it.

Members have expressed the need for guidance from DOE on how emissions and avoided emissions would be addressed in projects that potentially combine biogenic resources with carbon capture and sequestration, resulting in permanent storage of biogenic CO_2 and, in some cases, a negative emissions profile. That clarity would be helpful for project evaluation – both for applicants and reviewers.

7. **Co-products: 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?

DOE could consider mass balance as aligned with ISO 14040 LCA standard. Whether it stoichiometrically or mass ratio from cracker, mass balance is the preferred method of allocating carbon.

ISO stipulates that system expansion should be used whenever possible in order to avoid allocation. Following this logic, system expansion should be used whenever possible. However, this is difficult in practice because there needs to be clarity around what is being displaced from the market and its associated GHG footprint. In order to avoid diverging results for similar systems, DOE should provide specific guidance on the GHG credit values tied to certain co-products when system expansion is used (this is similar to the approach CARB uses in CA-GREET).

In other instances, particularly when it is difficult to determine the product displaced from the market, or the co-products are energy carriers (e.g., electricity), it could be more meaningful to use energy allocation. Mass allocation rarely results in a meaningful comparison given the utility of different products, so should only be used if system expansion is impractical and energy allocation is not meaningful for the relative utility of the products.

8. **By-products: 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)?**

Where hydrogen is developed as a byproduct of another primary production process, the LCA GHG emissions attributed to hydrogen should be limited to those directly resulting from the diversion, storage, and processing for use as a product, as well as any additional consumption of fossil energy required to make up for the diversion of hydrogen from the primary process. These impacts, in turn, should be omitted from the LCA for the primary product to avoid double counting.

C. Implementation

1. Use of Standard

We would like to seek the following clarifications for the proposed Clean Hydrogen standard, especially the 2.0 kg/kg threshold for emissions at the production step. For which purposes will this threshold be used (for tax credit purposes, the IRA provides for a threshold of 4.0 kg/kg lifecycle emissions. What is the intent behind the 2.0 kg/kg threshold and how will DOE determine which would apply?

2. **Verification Requirement: How should the GHG emissions of hydrogen commercial-scale deployments be verified in practice?**

ACC supports periodic auditing and verification against a clear but flexible standard. The audit process should allow for consistent, practicable reviews and results by developers and 3rd Parties.

3. **Verification Method: What data and/or analysis tools should be used to assess whether a deployment demonstrably aids achievement of the CHPS?**

Because this area of technology is still evolving, ACC would urge DOE not to mandate a single data metric or analytical methodology for demonstrating the benefit of a potential deployment. It is too early to understand how different projects along the value chain can impact net emissions and a flexible policy would encourage development of innovative new approaches and analyses.

There are, however, some available tools that DOE should review and consider as potential verification tools. One potential model is the Low Carbon Fuel Standard (LCFS) verification program operated by the California Air Resources Board (CARB).

4. **Upstream Nat Gas Emissions: How can developers access information regarding the sources of natural gas being utilized in their deployments, to ascertain fugitive emission rates specific to their commercial-scale deployment?**

DOE should provide developers with flexibility to use the most robust data reasonably available, while recognizing that such data may not always be available – particularly early in the implementation process. Where natural gas suppliers are willing to provide actual data, that data will provide both developers and DOE a better understanding of their project metrics and parameters. Where such data is not available from their natural gas supplier, either the midstream pipeline operator, or integrated company who both produces and delivers the NG, DOE should allow developers use generic data (from DOE studies and others) which reflect average emissions in a given NG supply network, or even national level data (such as is in GREET) if regional data is unavailable.

5. **Low Carbon Accounting Instruments: Should renewable energy credits, power purchase agreements, or other market structures be allowable in characterizing the intensity of electricity emissions for hydrogen production? If yes, what conditions should apply?**

ACC strongly supports allowing hydrogen producers to use clean hydrogen market instruments to demonstrate the use of low or zero emissions electricity when doing so yields a net reduction of emissions intensity associated with low-carbon hydrogen production. Without allowing producers to participate in the national market for clean energy, the relative scarcity of industrial-scale renewable electricity supply at the grid level, combined with the often disproportionate cost associated with investing in domestic clean energy onsite generation, would preclude many investors and competing in the clean hydrogen market place, slowing the transition to lower emissions manufacturing and reducing the demand for new investment in clean electricity generation and supply. Clean energy financial instruments should be subject to robust third-party certification and verification requirements.

These instruments are important mechanisms for sending a strong market signal for lower GHG intensity power generation, enabling accelerated investments in renewable capacity, and leveraging the economies of scale, and load balancing of grid-connected power generation. The availability of industrial-scale renewable power is still limited to certain regions and grids, and these pockets of lower-emissions power do not necessarily overlap with sources for hydrogen generation. DOE should provide applicants with flexibility to use market tools and other commercial agreements to advance both Hydrogen and renewable power generation and markets.

In doing so, ACC recognizes the need for safeguards to prevent double counting. ACC would welcome the opportunity to talk further about potential methodologies that may address some of these issues and how they could be implemented effectively in the industrial sector.

6. **Economic Impact of Compliance: What is the economic impact on current hydrogen production operations to meet the proposed standard (4.0 kgCO2e/kgH2)?**

The economic and compliance burden of any CHPS design will differ based on the size, nature, and complexity of proposed projects, their value chains, and their access to critical infrastructure. For existing hydrogen production operations seeking to transition, however, some producers will have to make significant changes to their operations, requiring long-term capital expenditures for new equipment, land, etc., and sustained elevated operating expenditures (staffing, alternative feedstocks, processing chemicals, increased energy demands, etc.) to meet the current standards. In some cases, we expect these increased costs are likely to increase production costs and ultimately the market price of hydrogen as well as commodity chemical products, particularly in the early hears of implementation. One critical determinant of the impact of the standard will be its integration into the existing hydrogen production economy. The more flexibility the standard provides to allow producers to leverage available technology, feedstocks, and infrastructure in their emissions reduction efforts, the lower the impact will be – and the quicker the U.S. can scale up its hydrogen economy.

The American Rescue Plan, BIL, and IRA, provide unprecedented opportunities for the nation to advance its climate, economic, and societal goals through investment in 21st century technologies and infrastructure that can build more sustainable and productive work forces, businesses, and communities. In seizing this opportunity, all stakeholders will have to face and overcome the significant implementation challenges associated with technology gaps, limited infrastructure, and the time constraints imposed on federal funding. Many of the recent Federal investment programs have windows of between 4-10 year for appropriations of funding. The time required for permitting, engineering, design, final investment decision, procurement, construction, permitting, and commissioning new technologies, will be an immense challenge.

D. Other elements of a robust process

1. Facilitate Partnerships

Effective deployment of the full clean hydrogen value chain will require collaboration of many entities at different phases in the clean hydrogen value chain. DOE policies should encourage collaboration and partnerships within the value chain.

2. Continue to Support Innovation

On the production side, it is critical to understand current limitations in hydrogen production technology relying on renewable energy such as water electrolysis and identify key solution to improve energy efficiency. Innovation which can bring the cost of hydrogen in line with incumbent technology is essential.

For storage, more work is needed to identify and refine new technologies for hydrogen storage such as chemical storage that allows safe and energy efficient storage. Safety is of paramount concern, but options which co-locate stored hydrogen near end-use applications enable optimal reliability and lower cost.

For end-use Applications, existing assets must be upgraded or replaced to accommodate the use of hydrogen. Demonstration of large-scale hybrid systems must be proven. New end-use applications must be developed and validated to integrate with existing systems.

3. Safety Standards

Establish clear safety standards for the generation, use, transport, and storage of hydrogen to ensure confidence in the commercial viability of hydrogen-based technologies.

III. Conclusion

We look forward to working with the Hydrogen Office and its sister Offices to build on this public private dialogue to help the U.S. chemical industry continue its role as a solution provider and market. Please feel free to reach out to me directly at (202) 297-4420 or charles_franklin@americanchemistry.com if you would like to discuss ACC's comments further.

Sincerely,

Charles Franklin, Senior Director
Energy, Climate, and Environment