November 14, 2022

VIA ELECTRONIC MAIL (Cleanh2standard@ee.doe.gov)

Sunita Satyapal
Director
Hydrogen and Fuel Cell Technologies Office
Energy Efficiency & Renewable Energy
U.S. Department of Energy
Washington, DC 20585

Re: U.S. Department of Energy Clean Hydrogen Production Standard (CHPS) Draft Guidance

Dear Director Satyapal:

The Coalition for Renewable Natural Gas ("RNG Coalition") represents the renewable natural gas ("RNG") industry in North America. We are a non-profit association of companies and organizations dedicated to the advancement of RNG as a clean, green, alternative, and domestic energy and fuel resource. Our membership includes companies throughout the value chain of waste feedstock conversion to end uses, including transportation fuel. RNG Coalition appreciates the opportunity to submit comments on the U.S. Department of Energy's ("DOE") Clean Hydrogen Production Standard ("CHPS") Draft Guidance.[1]

RNG is biogas-derived fuel that has been captured from organic waste streams—including agricultural wastes, municipal wastewater, and municipal solid waste in landfills—and upgraded to achieve quality standards necessary to blend with or substitute for geologic natural gas. Every community in America produces organic waste. As that waste breaks down, it emits methane, which is a naturally occurring, but potent and harmful greenhouse gas ("GHG"). RNG projects capture this methane from existing food waste, animal manure, wastewater sludge and garbage, and redirect the methane away from the environment, repurposing it as a clean, green energy source.

[1] On October 18, 2022, DOE issued a press release that it had extended the deadline to submit stakeholder feedback on the draft guidance from October 20, 2022 to November 14, 2022. *See* DOE Hydrogen and Fuel Cell Technologies Office, *Extended Deadline to Submit Feedback on the Clean Hydrogen Production Standard*, Oct. 18, 2022, https://www.energy.gov/eere/fuelcells/articles/extended-deadline-submit-feedback-clean-hydrogen-production-standard.

RNG can be used in the same applications as conventional natural gas, including in transportation, industrial, and heating/electricity applications. RNG is currently sold in the transportation fuel market as renewable compressed natural gas ("CNG") and renewable liquefied natural gas ("LNG"), and RNG makes up over 95% of our nation's cellulosic biofuel production under the Renewable Fuel Standard ("RFS") program. During power outages, RNG can also be tapped to provide reliable, sustainable energy. This dependability is also why it is already being used to power essential services for food storage, airports, universities, hospitals, and other important facilities.

RNG also can be used to produce renewable hydrogen.[2] Renewable hydrogen at scale could significantly reduce carbon emissions from various applications. This is especially true for those sectors that may be hard to decarbonize and where electrification is difficult or impossible, such as in the heavy-duty transportation sector. When renewable hydrogen production is paired with carbon capture and sequestration ("CCS"), the RNG process is ultimately carbon negative. Therefore, the material used for RNG today can be deployed as renewable hydrogen, providing another avenue for zero-carbon and carbon-negative renewable gas in the energy, transportation, and industrial sectors.

In the CHPS Draft Guidance, DOE correctly recognizes that it should support "clean hydrogen from diverse fuel sources." CHPS Draft Guidance at 1. It specifically cites reforming of RNG as a biomass-based system for production of "clean hydrogen." *Id.* at 3. The target proposed by DOE is lifecycle GHG emissions of 4.0 $kgCO_2e/kgH_2$. *Id.* This proposal is aligned with the recent tax credits established under the Inflation Reduction Act for "qualified clean hydrogen." *Id.* at 2. DOE references the GREET Model for lifecycle analysis of GHG emissions in support of its proposal. *Id.* at 3, 5. DOE indicates that this proposal provides stakeholders with flexibility regarding how the lifecycle target could be achieved. *Id.* at 4. RNG Coalition generally supports DOE's proposed initial target and use of a lifecycle analysis and agrees that RNG as a feedstock for hydrogen production should meet this target.

As RNG Coalition previously explained to DOE, it is critical to quantify and track the carbon intensity of hydrogen pathways based on onsite and upstream production emissions.[3] This accounting approach includes emissions associated with feedstock production, feedstock transportation, losses, flaring, hydrogen production, and carbon capture and storage (if applicable). A lifecycle analysis accounts for the climate impacts associated with hydrogen production pathways. It also helps reduce market misrepresentations and facilitates the development of a credible clean hydrogen market.

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[2] *See, e.g.,* European Commission, Questions and answers: A Hydrogen Strategy for a climate neutral Europe (2020), https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1257 ("Renewable hydrogen may also be produced through the reforming of biogas (instead of natural gas) or biochemical conversion of biomass, if in compliance with sustainability requirements.").

[3] *See* RNG Coalition, Response to Request for Information # DE-FOA-0002664.0002, dated Mar. 21, 2022.

The lifecycle target here, however, corresponds to a "system boundary that terminates at the point at which hydrogen is delivered for end use," excluding post-hydrogen production steps such as potential liquification, compression, dispensing into vehicles, etc. CHPS Draft Guidance at 5 n.11. We are concerned that this reference in a footnote to the CHPS Draft Guidance could be misinterpreted to refer to hydrogen transportation, storage and/or distribution occurring downstream of the hydrogen point of production. RNG Coalition does not support such inclusion and requests that this be clarified in final guidance.[4]

In sum, the proposal to use a target based on lifecycle emissions would help ensure the diverse fuel sources sought by Congress, including organic waste-based hydrogen. RNG is key to decarbonization efforts, as it avoids methane emissions, converting it to energy. Methane has a significantly higher global warming potential than carbon dioxide, and this Administration has committed to reducing methane emissions in the United States. While the cited documents generally refer to landfill gas, it is important to note that RNG projects capture this methane from food waste, animal manure, wastewater sludge and garbage. RNG projects that use biogas from landfill, food waste/source-separated organics, wastewater, and agricultural waste have low carbon intensity and can even have net negative carbon intensity scores, resulting in significantly higher avoided emissions as compared to diesel fuel.[5]

RNG Coalition provides additional information in response to the specific questions in the CHPS Draft Guidance in the appendix to this letter.

Please reach out with any questions.

Respectfully Submitted,

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[4] RNG Coalition supports a well-to-gate approach for identifying hydrogen production emissions for purposes of identifying "clean hydrogen," but notes that a different approach is needed when comparing the different end uses for hydrogen, which is where downstream emissions may be more appropriate for consideration.

[5] *See, e.g.,* M.J. Bradley & Associates, *The Role of Renewable Biofuels in a Low Carbon Economy*, at 10 (2020), *available at* https://www.mjbradley.com/sites/default/files/MJBA_Role-of-Renewable-Biofuels-in-a-Low-Carbon-Economy.pdf.

Responses to CHPS Draft Guidance Questions

RNG Coalition provides the following responses to DOE's questions as listed below. We would be pleased to provide additional information as DOE may request.

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.*

Response: The attached spreadsheet includes assumptions for fugitive methane emissions, rate of carbon capture, share of clean energy within electricity consumption (for electrolyzers), CO_2 leak rate from carbon capture and sequestration ("CCS"), and other (e.g., pressure and purity conditions at output of hydrogen production facilities). We provide the following considerations on methane leakage and CCS leakage.

On fugitive methane emissions, ~1% of methane throughput between the point of natural gas drilling to the point of use is assumed to be released through fugitive emissions (e.g., during drilling process, transmission pipelines). This assumption is believed to reflect average fugitive methane emissions between natural gas plays across the U.S. and current steam methane reformers. The referenced citation appears to relate to geologic natural gas, although RNG can utilize the same distribution systems as geologic natural gas. It is important to note, however, that RNG comes from society's waste and the methane would have otherwise escaped into the atmosphere were it not being captured. Nonetheless, RNG Coalition is actively studying this question with respect to RNG projects and is committed to continually improving technology and infrastructure to remove any-and-all leaks. RNG projects lose money as a result of leakages and thus have the financial incentive to detect and eliminate leaks.

On CCS, leak rates of <1% from CO_2 sequestration sites are assumed to be feasible today and expected to enable achievement of the proposed targets in this draft guidance. Facilities using RNG are also looking at the feasibility of incorporating CCS, which, as noted above, would provide carbon negative emissions. One study has noted that the "relatively pure stream of CO_2 from the biogas upgrading process presents an opportunity for low-cost CO_2 capture."[6] There has been substantial experience with CCS projects, which similarly have all incentives to protect against leaks. In addition, CCS projects are highly regulated and can require both state and federal permitting after extensive review and analysis.

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[6] Jun Wong, et al., *Market Potential for CO_2 Removal and Sequestration from Renewable Natural Gas Production in California*, Environ. Sci. Technol. 2022, 56, 4305, 4307, *available at* https://pubs.acs.org/doi/pdf/10.1021/acs.est.1c02894.

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?*

Response: We support use of the GREET Model, which is publicly available and well known. GREET has been used by the U.S. Environmental Protection Agency ("EPA") in its assessments under the Renewable Fuel Standard ("RFS") Program. California uses a modified form of GREET in its assessments under the Low Carbon Fuel Standard to account for regional differences related to the California specific program.

We generally support the methods used to generate regional parameters in GREET. The avoided emissions associated from use of waste-stream materials are a critical factor with respect to demonstrating the carbon intensity benefits of RNG-derived hydrogen. Regional differences in the electric grid can have an impact on assessing GHG emissions, but default values could be sufficient for purposes of the CHPS. To the extent a facility takes actions to improve their electricity use, however, that should be allowed (though not required) to be considered to show their improved emissions profile.

c) *Are any key emission sources missing from Figure 1? If so, what are those sources? What are the carbon intensities for those sources? Please provide any available data, uncertainty estimates, and how data/measurements were taken or calculated.*

Response: Figure 1 (copied below) appears to include the major steps associated with a lifecycle analysis of hydrogen production. The phrasing "extraction of feedstock" seems a little targeted to fossil fuel sources. We would suggest clarifying where organic waste biomass feedstocks would fall. In particular, we recommend that the reference to "Net GHG emissions associated with production of biomass feedstocks" should be clarified to ensure that this step includes both avoided emissions benefits from organic waste to RNG for all GHGs (e.g., methane) as well as sinks of CO_2 as biogenic material (that eventually becomes the organic waste) is grown.

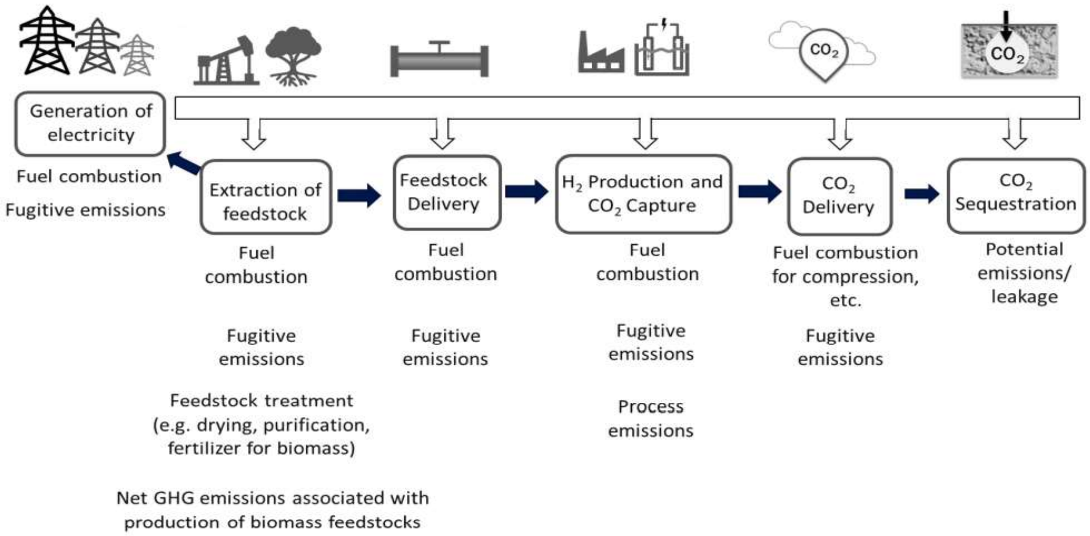

Figure 1: A lifecycle system boundary enables consistent and comprehensive evaluation of diverse hydrogen production systems. Examples of key emission sources within each step typically considered in the boundary are shown above.[11]

d) *Mitigating emissions downstream of the site of hydrogen production will require close monitoring of potential CO_2 leakage. What are best practices and technological gaps associated with long-term monitoring of CO_2 emissions from pipelines and storage facilities? What are the economic impacts of closer monitoring?*

Response: It is unclear what downstream CO_2 leakage is being referenced by this question, particularly where the CHPS Draft Guidance proposes to set the system boundary at the gate of hydrogen production. If this is referencing potential CO_2 leakage from CCS, as noted above, CCS projects may be regulated by both federal and state authorities. Such regulations likely include monitoring requirements.

e) *Atmospheric modeling simulations have estimated hydrogen's indirect climate warming impact (for example, see Paulot 2021). The estimating methods used are still in development, and efforts to improve data collection and better characterize leaks, releases, and mitigation options are ongoing. What types of data, modeling or verification methods could be employed to improve effective management of this indirect impact?*

Response: RNG Coalition supports efforts to identify leakage mitigation measures and best practices as part of any infrastructure buildout for hydrogen production. Although concerns have been raised regarding the ability of current methods to measure extremely low levels of hydrogen leakage that may have short-term impacts, studies have indicated that new hydrogen production facilities likely will be designed to work with hydrogen from the outset and will be well sealed.[7] "Welded joints will be used as much as possible with flanged joints only where necessary. Similar to the leakage from electrolysis, this is likely to be negligible for new, purpose-built plant."[8]

Leakage downstream from production may occur. Pipelines have demonstrated a low risk of leakage.[9] The life-cycle loss of hydrogen from integrated transportation/storage systems has been estimated to be 2%.[10] The Pacific Northwest National Laboratory with funding from the DOE Office of Energy Efficiency and Renewable Energy's Hydrogen and Fuel Cell Technologies Office has provided some tools to assist in leak detection at https://h2tools.org/.

As part of the process for identifying and funding Hydrogen Hubs, DOE can consider where and how to effectively deploy hydrogen – such as through co-located production and end-use applications. This is separate, however, from determining whether the hydrogen production process, itself, meets the CHPS.

f) How should the lifecycle standard within the CHPS be adapted to accommodate systems that utilize CO_2, such as synthetic fuels or other uses?

Response: There are some efforts at determining the feasibility of producing RNG from CO_2 and Hydrogen. However, we continue to consider this issue and how it may interact with incentives for downstream production of fuels using Hydrogen. It is unclear if this would be reflected in the CHPS or as part of the analysis for the downstream fuel. DOE can, nonetheless, consider these end uses as it considers implementation of Hydrogen Hubs or consideration of funding of particular projects.

2) Methodology

a) The IPHE HPTF Working Paper (https://www.iphe.net/iphe-working-paper-methodology-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?

Response: As noted above, we support the use of the GREET Model for estimating lifecycle GHG emissions from hydrogen production. We also would refer DOE to California's

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[7] Frazer-Nash Consultancy, *Fugitive Hydrogen Emissions in a Future Hydrogen Economy*, at 21 (2022), *available at* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067137/fugitive-hydrogen-emissions-future-hydrogen-economy.pdf.
[8] *Id.*
[9] Zhiyuan Fan et al., *Hydrogen Leakage: A Potential Risk for the Hydrogen Economy, Columbia Center on Global Energy Policy*, July 5, 2022, https://www.energypolicy.columbia.edu/research/commentary/hydrogen-leakage-potential-risk-hydrogen-economy.
[10] *Id.*

Low Carbon Fuel Standard, which many RNG producers already comply and, as such, are familiar with the process of calculating and verifying GHG emissions used by the California Air Resources Board. We would not support any method that attempts to use scope choice to exclude key benefits of RNG creation (e.g., ignores avoided methane benefits, biogenic CO_2 sinks, etc.).

b) Use of some biogenic resources in hydrogen production, including waste products that would otherwise have been disposed of (e.g., municipal solid waste, animal waste), may under certain circumstances be calculated as having net zero or negative CO_2 emissions, especially given scenarios wherein biogenic waste stream-derived materials and/or processes would have likely resulted in large GHG emissions if not used for hydrogen production. What frameworks, analytic tools, or data sources can be used to quantify emissions and sequestration associated with these resources in a way that is consistent with the lifecycle definition in the IRA?

Response: A "well to gate" analysis should include an assessment of avoided emissions.

Alternative to using a "well to gate" analysis, a question that must be considered is how to account for "biogenic" emissions at the "site of production." In the case of waste-derived feedstocks like biogas, emissions would occur as part of the natural decay of the waste, with some of the carbon likely transformed to methane. Based on this carbon cycle, biogenic CO_2 emissions associated with RNG are considered carbon neutral. Even if a lifecycle analysis is not utilized, DOE should treat "biogenic" CO_2 emissions associated with production using organic wastes as carbon neutral and, therefore, not accountable against the 2 kilograms standard. In this way, DOE is still achieving the emissions reductions sought, while ensuring inclusion of more renewable sources of hydrogen.

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?

Response: System expansion, energy, and mass-based allocation are all valid LCA co-product methods that can be employed properly in the hands of trained LCA experts. However, if all are allowed, we recommend clear reporting on which method was used.

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 by-product hydrogen from these processes typically handled (e.g., venting, flaring, burning onsite for heat and power)?

Response: N/A

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?

Response: Federal and state government agencies may require reporting of GHG emissions, which may include verification measures. DOE should allow facilities to rely on these reporting requirements to report their direct emissions. For example, a fuel pathway approved by the EPA, the California Air Resources Board, or similar agency and subject to third party verification/quality assurance methods in the RFS or Low Carbon Fuel Standard ("LCFS") programs should also be an acceptable method of demonstrating GHG emissions performance in this process. Otherwise, DOE should be able to rely on the GREET Modelling to determine upstream emissions.

b) DOE-funded analyses routinely estimate regional fugitive emission rates from natural gas recovery and delivery. However, to utilize regional data, stakeholders would need to know the source of natural gas (i.e., region of the country) being used for each specific commercial-scale deployment. 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?

Response: N/A

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?

Response: DOE should allow the use of market-based instruments for both clean electricity procured via the grid and RNG from commercial pipelines to be used as a feedstock source for hydrogen. Renewable Thermal Credits ("RTC")—analogous to renewable electricity credits ("REC") in the electricity market—are the primary means of accounting for renewable gas use in the U.S., and DOE can look at the book-and-claim process used by the EPA under the RFS program as a known and well-functioning system.

Most RNG projects are connected to a natural gas pipeline system. Market-based instruments are important for their ability to allow the widespread, distributed buildout of renewable resources utilizing common energy delivery infrastructure which already exists. The need for market-based instruments may be eliminated as clean energy throughput on the electric and gas systems increase over time, however, building out clean hydrogen and these feedstock resources in the meantime is reliant on the use of market-based instruments so that first-movers can successfully purchase clean energy without physical limitations.

Disallowing the use of RTCs and RECs under the CHPS will limit the amount of clean hydrogen which can be produced using renewable energy feedstocks. This may lead to inefficient use of existing grid infrastructure (e.g., non-optimal citing for renewable power) and gas infrastructure (e.g., the buildout of dedicated RNG pipelines where usable common infrastructure exists). In some cases, this can lead to additional GHG emissions (e.g., trucking of RNG vs. use of common infrastructure to reach hydrogen production facilities).

Market-based accounting is used in nearly all renewable gas procurement programs—in the RFS; LCFS programs in California, Oregon, and British Columbia, and Canada on the federal level; state-level renewable gas standard and clean heat standard programs; and voluntary renewable energy procurement frameworks from Climate Disclosure Project,[11] and The Climate Registry.[12] For transactions in both compliance markets and the voluntary renewable energy procurement space, the primary RNG tracking systems in use are M-RETS[13] for North America and ERGaR[14] in Europe; the latter supported by national registries such as GreenGas UK.[15] These tracking systems issue a unique, traceable, digital certificate guaranteeing the origin of RNG from projects across jurisdictions, which ensures that RTC and REC procurement methodologies are robust and reliable.

d) What is the economic impact on current hydrogen production operations to meet the proposed standard (4.0 kgCO_2e/kgH2)?

Response: One likely method of meeting the proposed standard at current hydrogen production facilities would be to switch to renewable feedstocks, such as RNG. RNG comes at a premium relative to fossil gas feedstocks. However, quantifying that premium, and thus the economic impact on current hydrogen production operations, is a non-trivial exercise that varies based on the specific source of RNG.

Variables related to the cost and market value of RNG (and other clean energy resources) depend on where the energy is sold. For example, the RFS and LCFS programs and associated credit prices currently govern a large portion of the U.S. RNG supply used in the transportation sector. Due to fluctuations in credit price, this structure can cause significant uncertainty for RNG buyers—in this case where RNG is procured as a hydrogen feedstock to be used within an LCFS program. Furthermore, the high value of RNG in transportation decarbonization programs raises

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[11] CDP, *CDP Technical Note: Accounting for Scope 2 Emissions*, at 27-28 (2022), *available at* https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/000/415/original/CDP-Accounting-of-Scope-2-Emissions.pdf?1617880167.
[12] The Climate Registry, *Advanced Methods for Quantifying Emissions*, at D-7 https://www.theclimateregistry.org/protocols/GRP-V3-Advanced-Methods.pdf#page=7 (last visited Nov. 7, 2022).
[13] https://www.mrets.org/
[14] https://www.ergar.org/
[15] https://www.greengas.org.uk/certificates

the cost of RNG for non-transportation end-uses—including as a hydrogen feedstock more generally.

For hydrogen produced via thermochemical conversion of biological waste, additional uncertainties such as feedstock (e.g., forestry waste) availability and cost of collection and transport apply. Furthermore, the cost and efficiency of carbon capture and sequestration systems, which can be used to make waste-derived hydrogen carbon negative on a lifecycle basis, can also contribute to this uncertainty for all resources, including hydrogen produced using RNG.

The forthcoming IRA tax credits are expected to reduce costs and add certainty for producers and consumers, ultimately providing a cost-effective pathway for RNG and other waste-derived hydrogen production methods to achieve their potential GHG reductions and other environmental benefits. The ability to produce hydrogen with drop-in renewable feedstocks is a significant opportunity based on near-term scalability and overall environmental impact, however, the aforementioned variables underscore that adjusting current hydrogen production operations to achieve the standard will be a significant undertaking which is currently hard to quantify.

4) Additional Information

a) Please provide any other information that DOE should consider related to this BIL provision if not already covered above.

Response: "RNG is a cost-competitive option" to achieving this Administration's climate change goals.[16] One means for doing so is to support hydrogen production from RNG. RNG Coalition appreciates DOE's efforts to promote hydrogen and generally supports the proposed CHPS.

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RNG Coalition thanks DOE for its consideration of the information provided above. We urge DOE to consider ensuring incentives to utilize RNG in the production of hydrogen, which will help move this country toward decarbonization and this Administration toward meeting its climate change goals.

We would be happy to provide more information to DOE as may be needed.

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[16] ICF Resources, *Study on the Use of Biofuels (Renewable Natural Gas) in the Greater Washington, D.C. Metropolitan Area*, at 3-4 (2020), *available at* https://www.worldbiogasassociation.org/wp-content/uploads/2020/03/200316-WGL-RNG-Report-FINAL-1.pdf.