www.theicct.org
communications@theicct.org
twitter @theicct

THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION
1500 K STREET NW | SUITE 650 | WASHINGTON DC 20005

International Council on Clean Transportation comments on REG–117631–23: Proposed regulations relating to the credit for production of clean hydrogen (45V)

February 23, 2024

These comments are submitted by the International Council on Clean Transportation (ICCT). ICCT welcomes the opportunity to comment on the proposed regulations relating to the credit for production of clean hydrogen and the energy credit, as established and amended by the Inflation Reduction Act of 2022. The ICCT is an independent non-profit research organization founded to provide first-rate research, technical and scientific analysis to environmental regulators. Our mission is to improve the environmental performance and energy efficiency of road, marine, and air transportation, in order to benefit public health and mitigate climate change. We promote best practices and comprehensive solutions to increase the sustainability of alternative fuels such as hydrogen, increase vehicle efficiency, reduce pollution from the in-use fleet, and curtail emissions of local air pollutants and greenhouse gases (GHG) from international goods movement.

This proposed rulemaking builds upon the impressive steps the Treasury, in consultation with the Department of Energy and Environmental Protection Agency, has undertaken to promote low-GHG hydrogen in the U.S with the implementation of the Inflation Reduction Act. The comments below offer a number of observations for the Treasury to consider while finalizing the rulemaking to maximize its benefits in mitigating the risks of climate change. Staff may contact Nikita Pavlenko (n.pavlenko@theicct.org) or Stephanie Searle (stephanie@theicct.org) with any questions.

Stephanie Searle, PhD
Acting Deputy Director

Summary of Policy Recommendations

We commend the requirements the Treasury has already proposed to ensure that the 45V tax credit advances clean hydrogen technology while also being stringent enough to prevent dangerous levels of induced emissions. At the same time, it is imperative that fossil and biomethane-derived hydrogen pathways are held to similarly strict eligibility requirements as electrolysis hydrogen. Otherwise, the 45V tax credit will not serve its purpose and business-as-usual fossil hydrogen production could receive tax-payer funds without contributing to the development of advanced clean energy technology or long-term decarbonization of the U.S. economy. Here, we provide a summary of our comments on the proposed regulations relating to the credit for production of clean hydrogen:

1. ***Ensure rigorous attribution of Energy Attribute Certificates (EACs) for electrolysis-based hydrogen pathways***

   We strongly support the proposed implementation of incrementality, temporal matching, and deliverability rules for electrolysis hydrogen produced from zero-emission electricity sources. We particularly commend Treasury's proposal for an hourly-matching requirement for energy attribute certificates (EACs) after January 1^{st}, 2028. For hourly matching requirements to be most effective, we recommend they apply consistently to all electrolysis hydrogen producers without grandfathering once implemented.

   For determining if older electricity generators may satisfy the incrementality requirement, we are concerned that a broad formulaic approach could lead to significant induced GHG emissions. Instead, we recommend that the Treasury implement separate procedures for allowance of EACs from individual older producers depending on the specific basis for the allowance, i.e. avoided-retirement, curtailed renewables, or production occurring on an electricity grid with a high percentage of renewables.

   Finally, 45V support for hydrogen produced from fossil electricity carbon capture and storage (CCS) may constitute a perverse incentive. If this pathway were to be deemed 45V eligible, we recommend that the 45V electricity suppliers not be allowed to receive 45Q incentives, that the CCS equipment installation not result in a more recent commercial operations date (COD) for the electricity generator, and that the CCS operations undergo stringent verification.

2. ***Consider guardrails for hydrogen production from renewable natural gas (RNG) and fugitive methane***

   Without clear guidance there is a danger that producers claiming the use of renewable natural gas (RNG) or fugitive methane as a feedstock for hydrogen production could receive significant 45V subsidies without necessarily deploying new technologies or meaningfully reducing overall GHG emissions. To avoid this outcome, we recommend the following guidelines:

1) Hydrogen facilities employing steam methane reforming (SMR) or autothermal reforming (ATR) be required to demonstrate a direct connection to a qualifying source of RNG to be eligible for 45V credits. This is especially important for business-as-usual hydrogen production facilities, which would not employ any carbon capture and storage technologies to achieve GHG reductions and would rely on the RNG to receive the tax credit.
2) Assume the use of methane flaring as a counterfactual rather than methane venting for the purposes of calculating hydrogen lifecycle GHG emissions for all pathways that use the captured methane as a feedstock, including both fossil and RNG.
3) A prohibition on the blending of feedstocks for the purposes of lifecycle GHG emission calculations.
4) For the purposes of calculating life-cycle emissions, fugitive fossil methane used as a hydrogen feedstock be treated consistently with conventional natural gas.
5) In any cases where a direct connection to an RNG facility is not required, require a demonstration of RNG deliverability similar to the deliverability rules for EACs in electrolysis hydrogen production.
6) RNG eligibility as a 45V feedstock only if hydrogen production is its "first productive use".

3. Implement rigorous life-cycle GHG emissions accounting for natural gas + Carbon Capture and Storage (CCS) hydrogen pathways

We recommend that Treasury take steps to accurately account for upstream methane leakage and the rate and permanency of carbon capture and storage, as these two factors have a major impact on the GHG emissions from fossil hydrogen pathways. We suggest the Treasury:

1) Adjust the default background upstream methane loss rates in 45VH2 GREET to reflect real-world emissions, and make this a fixed value**.** Alternatively, if the Treasury prefers that hydrogen producers be allowed to apply for an upstream methane loss rate that is lower than the default: a) Require Oil and Gas Methane Partnership 2.0 Level 5 reporting, and b) Increase the default upstream methane loss rate in GREET to an even more conservative value than the average real-world emissions reported in the literature, to account for the fact that hydrogen producers purchasing natural gas with emissions higher than average will choose the default.

2) Implement clear requirements for the verification of CO_2 capture rates and the permanence of CO_2 sequestration, as rigorous as those of the California Air Resource Board's (CARB) Carbon Capture and Sequestration Protocol for the Low Carbon Fuel Standard (LCFS).

We expand upon these recommendations and provide specific examples and analysis in the discussion below.

Ensure rigorous attribution of Energy Attribute Certificates (EACs) for electrolysis-based hydrogen pathways

We strongly support the proposed implementation of incrementality, temporal matching, and deliverability rules for electrolysis hydrogen produced from zero-emission electricity sources. These sensible provisions are the only way to guarantee that the clean electricity generation required to support 45V eligible clean hydrogen projects is constructed in line with demand. In absence of such criteria, electrolysis hydrogen production could create a strain on the electricity grid, potentially forcing more fossil electricity production online to compensate. This would mean hydrogen and its derivatives produced via electrolysis could have grid GHG emissions higher than fossil fuels. For example, even when considering significant renewable energy deployment in the EU by 2030, we found that hydrogen produced via electrolysis using grid-average electricity in the EU would have GHG emissions nearly as high as natural gas.[1] The proposed regulations will also ensure that clean hydrogen production does not divert clean electricity from supplying the power sector, which is necessary to decarbonize a rapidly growing fleet of electric vehicles.

We commend Treasury's proposal for an hourly-matching requirement for EACs after January 1st 2028. As stated in previous ICCT comments[2], temporal correlation on an hourly basis is critical for ensuring that electrolysis hydrogen production does not strain the electricity grid, forcing more fossil electricity online during times of high demand. **For hourly matching requirements to be most effective, we recommend they apply consistently to all electrolysis hydrogen producers, i.e. with no grandfathering allowed, once implemented**. Annual matching has been found to have no impact on reducing induced fossil GHG emissions[3] and separate standards for older facilities could lead to substantial cumulative emissions[4]. In Europe, the transition

[1] Stephanie Searle and Yuanrong Zhou, "Don't let the industry greenwash green hydrogen (blog)," (Washington, D.C.: International Council on Clean Transportation, September 24, 2021), https://theicct.org/dont-let-the-industry-greenwash-green-hydrogen/

[2] "ICCT Comments on Notice 2022-58 V2," December 2, 2022, https://www.regulations.gov/comment/IRS-2022-0029-0085.

[3] Wilson Ricks, Qingyu Xu, and Jesse D. Jenkins, "Minimizing Emissions from Grid-Based Hydrogen Production in the United States," *Environmental Research Letters* 18, no. 1 (January 2023): 014025, https://doi.org/10.1088/1748-9326/acacb5.

[4] Ben King et al., "How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit Guidance" (Rhodium Group, January 4, 2024), https://rhg.com/research/clean-hydrogen-45v-tax-guidance/.

period to hourly matching requires monthly matching, which the Treasury could also consider for a period of time prior to 2028.[5]

Regarding alternative approaches to establishing incrementality for minimal-emissions electricity generators that have a commercial operations date (COD) outside 36 months prior to the beginning of hydrogen production, **a formulaic "one size fits all" approach such as a 5% hourly generation allowance could lead to significant induced emissions[6] since this allowance would not be targeted to specific cases where the indirect emissions risk of not complying with incrementality is lower**. Thus, we recommend that the Treasury instead implement separate procedures for allowance of EACs from older producers depending on the basis for the allowance (i.e. avoided-retirement, curtailed renewables or being located in a grid with a high percentage of renewable electricity) as described below. Similar frameworks are being implemented in the EU and UK suggesting that this is a workable approach that may also facilitate the eventual global trade of clean hydrogen under a harmonized set of standards.

1) **Avoided Retirements:** We recommend that the Treasury implement some version of the application-based "avoided retirements approach" which requires older renewable electricity, or other energy generators with comparable GHG emissions, to apply for 45V EAC eligibility based on financial statements which include both a demonstration of financial loss and projections indicating that the sale of EACs could restore financial viability. For an example of a test that could be used to demonstrate these factors, the Treasury can refer to the United Nations Framework Convention on Climate Change (UNFCC) Clean Development Mechanism "Tool for the Development and Assessment of Additionality"[7] and the associated methodological tool covering investment analysis.[8] We further recommend that facilities seeking a COD exemption under this provisions be required to first pursue more targeted funding opportunities such as the Bipartisan Infrastructure Law's Civil Nuclear Credit[9] program as well as any state-specific support mechanism.

2) **Curtailed Renewables:** Renewable electricity can be curtailed when local renewable generation exceeds the sum of local demand and the capacity of transmission infrastructure to redirect electricity to other demand sources. Allowing older renewable generators to satisfy the proposed incrementality

---

[5] European Commission, "Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 Supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by Establishing a Union Methodology Setting out Detailed Rules for the Production of Renewable Liquid and Gaseous Transport Fuels of Non-Biological Origin," 157 OJ L § (2023), http://data.europa.eu/eli/reg_del/2023/1184/oj/eng.

[6] Dan Esposito, Eric Gimon, and Michael O'Boyle, "45V Exemptions Need Strong Guardrails To Protect Climate, Grow Hydrogen Industry" (Energy Innovation, February 22, 2024), https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/.

[7] UNFCCC/CCNUCC CDM – Executive Board, "'Tool for the Demonstration and Assessment of Additionality' (Version 05.2)," n.d., https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf.

[8] UNFCCC CDM, "TOOL27 Methodological Tool: Investment Analysis (Version 06.0).," n.d., https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v1.pdf.

[9] "Civil Nuclear Credit Program," n.d., https://www.energy.gov/gdo/civil-nuclear-credit-program.

requirement during times of curtailment is reasonable but requires verification that there are no transmission constraints between the electricity provider and the hydrogen production facility that would prevent the hydrogen producer from using the otherwise curtailed electricity.

To establish 45V EAC eligibility for older producers based on curtailment we recommend a market-based approach similar to that being implemented in the European Rules,[10] whereby eligible electricity "*is consumed during an imbalance settlement period during which the fuel producer can demonstrate, based on evidence from the national transmission system operator, that: (a) power-generating installations using renewable energy sources were redispatched downwards* …(*b) the electricity consumed for the production of [electrolysis hydrogen] reduced the need for re-dispatching by a corresponding amount.*"

Given the differences in operating procedures between regional markets in the United States we recommend that Treasury consult Energy Innovation's analysis of this issue[11] as well as regional Independent System Operators (ISOs) for details on how this approach could be implemented while ensuring that avoided-curtailment renewable electricity is deliverable to the hydrogen producer and not blocked by transmission constraints.

3) **100% clean-electricity grid:** The Treasury could consider provisions similar to those adopted by the EU[4], which establish that older clean electricity generators can contribute to clean hydrogen production provided that the emissions from the electricity grid to which a hydrogen producer is connected falls below a certain threshold. The EU regulation requires that when a grid reaches a maximum of 18 gCO_2e/MJ in the previous calendar year, COD requirements are lifted. It could be reasonable to allow older generators to supply 45V eligible EACs if similar conditions were met; as in the EU, clean hydrogen producers would still need to provide proof that they are meeting deliverability and temporal matching requirements, and that the EACs are retired and not double-counted towards other policies.

The Treasury also requested comments on pathways where CCS-equipped fossil electricity generation is used as the electricity source for hydrogen production. We caution that using electricity produced with natural gas to generate hydrogen via electrolysis is extremely inefficient compared to direct conversion of natural gas to hydrogen via steam methane reforming, meaning 45V support for this configuration may constitute a perverse incentive. Natural gas power plants typically generate electricity

[10] European Commission, Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023 supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin.
[11] Esposito, Gimon, and O'Boyle, "45V Exemptions Need Strong Guardrails To Protect Climate, Grow Hydrogen Industry."

with a maximum efficiency of around 60%[12] while electrolyzers have an electricity to hydrogen efficiency of around 70%[13] leading to a combined 42% efficiency, while conventional steam methane reforming (SMR) has an efficiency of 66%[14]. Further, capturing CO_2 from power generation is also less efficient and more expensive than capturing CO_2 at an SMR hydrogen production facility due to lower CO_2 concentrations in power plant flue gases[15]. Consequently, from both an economic and environmental point of view a SMR-CCS facility is superior to the use of fossil-CCS electricity in combination with hydrogen production via electrolysis. To minimize the risk that the incentives for CCS-electricity pathways exceed environmental benefits we recommend the following:

1) Exclude hydrogen producers claiming 45V credits from using electricity generated in facilities claiming 45Q carbon sequestration credits. This would align electrolysis pathways with the statutory prohibition on the coordination of these credits at a single facility.
2) Ensure that calculations of GHG emissions for pathways incorporating fossil-CCS electricity generation use facility-level verified carbon capture rates for electricity producers and take into account all emissions associated with fuel supply to the electricity production facility and loss of power generation due to redirection of power to CCS equipment. We discuss CCS verification in more detail in the last section of these comments.
3) Prevent fossil generators installing CCS equipment from receiving a later COD based on this installation. This will also prevent the redirection of electricity from these facilities from spurring further fossil generation to meet existing demand.

Implement guardrails for hydrogen pathways using renewable and fugitive natural gas feedstocks

The Treasury indicated an intention to provide rules addressing hydrogen production pathways using Renewable Natural Gas (RNG) or fugitive sources of methane as a feedstock. We note that for these pathways estimated life-cycle emissions are acutely sensitive to assumptions of counterfactual behavior leading to a risk that without clear rules, significant subsidies may be available for what is essentially conventional hydrogen production from fossil natural gas without the capture of CO_2 emissions. There is also a risk that 45V credits may also be used to support emissions mitigation efforts that are already likely to occur through other less costly mechanisms. To avoid these outcomes we recommend implementing the following guardrails:

---

[12] National Renewable Energy Laboratory, "2018 Annual Technology Baseline," 2018, https://atb-archive.nrel.gov/electricity/2018/index.html?t=cg.

[13] Yuanrong Zhou et al., "Current and Future Cost of E-kerosene in the United States and Europe," (Washington, D.C.: International Council on Clean Transportation, March 1, 2022), https://theicct.org/publication/fuels-us-eu-cost-ekerosene-mar22/

[14] P. L. Spath and M. K. Mann, "Life Cycle Assessment of Hydrogen Production via Natural Gas Steam Reforming" (National Renewable Energy Lab. (NREL), Golden, CO (United States), September 28, 2000), https://doi.org/10.2172/764485.

[15] National Petroleum Council, "Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage," 2019, https://dualchallenge.npc.org/.

1) **Require that the exclusive use of RNG as a feedstock in hydrogen facilities be demonstrated by a direct connection.**

As described in the Section IX of the proposed regulations, a direct connection between the supplier of RNG and hydrogen production facility “can reduce the uncertainty of pipeline leakage, tracking, and verification” relative to a book-and-claim system. Under a book and claim system, a hydrogen production facility would purchase credits for RNG from a biomethane producer that is injecting their biomethane into the grid, but there is no direct, exclusive pipeline connection between the RNG producer and the facility.

We are concerned that a further disadvantage of book-and-claim RNG accounting is a mismatch between the support offered by 45V and the clean hydrogen-specific investment required of producers using a book-and-claim system. Gas-grid connected SMR and ATR facilities that are not directly connected to an RNG supplier would not include “all components that function interdependently to produce qualified clean hydrogen” as outlined in the proposed §1.45V–1(a)(7)(i). Thus, one could argue they should not qualify as “clean hydrogen production facilities” for the purposes of 45V eligibility. Allowing 45V credits for new or recently constructed SMR or ATR facilities claiming production of qualifying hydrogen solely on the basis of RNG certificates despite no meaningful change in operations compared to current “business as usual” practice would not contribute to the development of new clean hydrogen technology and is contrary to the intention of the IRA.

Furthermore, as currently written, there is no mechanism to prevent such facilities from immediately switching to conventional production using a natural gas feedstock at the end of the 10-year credit period. Of course, tax credits will also expire after ten years for hydrogen produced via electrolysis, but 100% decarbonization of US electricity production is both realistic[16] and a stated policy goal[17]. Further, the new, additional renewable electricity supply constructed for the hydrogen production should have a lifetime well beyond the 10 year lifetime of the credit. For this reason it is reasonable to expect that electrolysis facilities supported by 45V credits will continue to use zero or low-carbon electricity once their 10-year credit window expires. In contrast, there is no credible possibility of converting the US natural gas grid to anything approaching 100% RNG, with industry supported research finding a total national potential of 4.7 Trillion Cubic

---

[16] Paul Denholm et al., “Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035,” September 6, 2022, https://doi.org/10.2172/1885591.

[17] United States Department of State and the United States Executive Office of the President, “The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050,” November 2021, https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf.

Feet per Year (TCF/Y) of RNG[18] compared to an annual national consumption of 32.3 TCF/Y of natural gas in 2022[19]. For this reason, we recommend that all conventional gas-grid connected SMR or ATR facilities that claim to use RNG be required to demonstrate direct connection to RNG, or at least those without CCS.

2) **Prohibit the use of methane venting as a counterfactual assumption for the purposes of calculating hydrogen GHG intensity for both fossil and RNG pathways, and assume flaring instead.**

   Although venting of methane currently occurs in some circumstances, there is ample evidence that pre-IRA policies already support the capture of vented methane where possible, for both RNG and fossil gas, and that remaining methane emissions are likely to be mitigated even in the absence of 45V supported hydrogen projects. For example, according to United States Department of Agriculture (USDA) data the number of anaerobic digesters operating on U.S. farms increased 12-fold since 2000, with 50 digesters commencing operation in 2021, just prior to the passage of the IRA[20]. Steady growth has also occurred for landfill gas capture to RNG production, with 65 projects coming online between 2005 and 2021.[21] 92% of all municipal solid waste going into landfills covered by gas capture systems,[22] which are mandatory under Environmental Protection Agency (EPA) regulations for landfills above a certain size[23]. Fossil methane leakage has also decreased, with steady declines in the oil and gas sector[24], and the EPA's Coalbed Methane Outreach program resulting in 8.63 MMTCO_2e of avoided emissions in 2021,[25] with a further $11 billion appropriated to eligible states and tribes for abandoned coal mine reclamation in the Bipartisan Infrastructure Law[26]. The EPA has also recently

---

[18] American Gas Foundation, "Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment," Prepared by ICF, December 2019, https://gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf.

[19] U.S. Energy Information Administration, "U.S. Natural Gas Total Consumption," January 31, 2024, https://www.eia.gov/dnav/ng/hist/n9140us2A.htm.

[20] USDA, "Number of On-Farm Anaerobic Digesters Systems Used to Decompose Organic Waste Has Increased over Time," March 2023, https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=106096.

[21] US EPA, "Landfill and Agriculture RNG Projects in the United States (2005-2022)," February 12, 2024, https://www.epa.gov/lmop/renewable-natural-gas.

[22] Resource Recycling Systems, "Data Corner: Digging into Landfill Methane Recovery," July 20, 2021, https://resource-recycling.com/recycling/2021/07/20/data-corner-digging-into-landfill-methane-recovery/.

[23] US Environmental Protection Agency, "86 FR 27756 - Federal Plan Requirements for Municipal Solid Waste Landfills That Commenced Construction On or Before July 17, 2014, and Have Not Been Modified or Reconstructed Since July 17, 2014," *Federal Register Volume 86, Issue 97*, May 21, 2021, https://www.govinfo.gov/app/details/FR-2021-05-21/2021-10109.

[24] Xiao Lu et al., "Observation-Derived 2010-2019 Trends in Methane Emissions and Intensities from US Oil and Gas Fields Tied to Activity Metrics," *Proceedings of the National Academy of Sciences* 120, no. 17 (April 25, 2023): e2217900120, https://doi.org/10.1073/pnas.2217900120.

[25] US EPA Coalbed Methaen Outreach Program, "CMOP Annual Methane Emission Reductions," May 25, 2023, https://www.epa.gov/cmop/coalbed-methane-outreach-program-accomplishments.

[26] The White House, "Accelerating Progress: Delivering on the U.S. Methane Emissions Reduction Action Plan," December 2023, https://www.whitehouse.gov/wp-content/uploads/2021/11/US-Methane-Emissions-Reduction-Action-Plan-1.pdf.

issued regulations to further reduce methane leakage in the oil and gas sector[27], and although non-binding, the U.S. participation in the Global Methane Pledge[28] is a further indication that continuous unmitigated venting of methane should not be taken as a "business as usual" counterfactual.

Due to the fact that methane has a global warming potential 27.9 times that of CO_2 on a GWP100 basis, the allowance of venting as a counterfactual for the purposes of calculating net hydrogen carbon intensity would incentivize hydrogen producers to claim counterfactual offsets against real emissions from production and upstream methane leakage in order to establish eligibility for the most generous tier of 45V credits. In the oil and gas sector the use of fugitive methane venting as a counterfactual in life-cycle calculations may also create a perverse incentive to adjust operations to maximize 45V credit values, undermining any other methane regulation. Following the precedent set by the Clean Development Mechanism, which treats even vented methane as flared for the purpose of calculating emissions credits,[29] would avoid these issues.

Finally, the allowance of methane venting as a counterfactual will also undermine IRA support for truly innovative clean hydrogen technologies. Given that conventional hydrogen production costs generally fall between $1-3 per kg depending on the price of natural gas, the $3 per kg maximum 45V tax credits for hydrogen with a GHG intensity less 0.45 kg CO_2e per kg H_2 are clearly intended to help nascent clean hydrogen technologies compete with conventional natural gas production pathways. If the use of avoided methane certificates resulted in $3 per kg 45V subsidies to conventional hydrogen producers this could instead undermine the market for these technologies. **Requiring that flaring be used as the baseline condition for all pathways including RNG is a simple way to prevent crediting of pathways that offset real-world emissions with GHG reductions based on unrealistic counterfactual scenarios**.

3) **Limit 45V eligible pathways to a single feedstock for the purposes of determining life-cycle GHG emissions for that pathway.** Because of the perverse incentives and implementation complexity associated with blending, it is common practice for LCA based policies such as the Federal RFS and California Low Carbon Fuel Standard to prohibit feedstock blending for the purposes of LCA calculations. Blending fossil and RNG feedstocks allows producers to maximize the use of cheaper fossil natural gas while still achieving a CI score consistent with a particular 45V CI threshold. If blending is allowed, for example, a producer obtaining a CI score of 2.6 kg CO_2e per kg H_2 on the basis of a 100%

---

[27] US EPA, "40 CFR Part 60 Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review," November 30, 2023, https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-operations/epas-final-rule-oil-and-natural-gas.

[28] "Global Methane Pledge," n.d., https://www.globalmethanepledge.org/resources/global-methane-pledge.

[29] CDM Executive Board, "Approved Baseline and Monitoring Methodology AM0009 'Recovery and Utilization of Gas from Oil Wells That Would Otherwise Be Flared or Vented,'" n.d., https://cdm.unfccc.int/UserManagement/FileStorage/MXEUS2WIK1NQ36DFLBZC9G70YJRAPT.

RNG feedstock would be incentivized to blend fossil natural gas up to the point of reaching the 4 kg CO_2e per kg H_2 threshold. This issue would be compounded by life-cycle accounting for avoided methane emissions, such that a blend of highly-negative CI RNG could be blended at low volumes with high quantities of fossil natural gas in order to seek a favorable CI score. Notably, hydrogen produced from 100% fossil natural gas in a conventional SMR facility offset with RNG certificates covering only 30% of the gas input is already being promoted by one company as "carbon neutral" and "IRA eligible" on the basis of using venting as a counterfactual.[30] This clearly illustrates the danger of both venting as a counterfactual and CI calculations based on blended feedstocks.

4) **For the purposes of calculating life-cycle emissions, treat fugitive fossil methane used as a hydrogen feedstock consistently with conventional natural gas.** In contrast to the biogenic origin of RNG, fugitive fossil methane is a fossil fuel. As described above, the abatement of methane emissions is already supported under programs and policies aligned with the U.S. Methane Emissions Reduction Action Plan[31]. This comprehensive plan does not include the use of fugitive methane as hydrogen feedstock. In fact, the use of 45V credits to support the construction of hydrogen production facilities reliant on fugitive fossil methane would lock in further fossil CO_2 emissions over the 30 plus year life of the newly constructed facility. This is clearly contrary to the intended purpose of 45V credits and should be avoided.

5) **Set stringent deliverability requirements if RNG or fugitive methane certificates are allowed for the purposes of calculating hydrogen carbon intensity**. If Treasury opts to include these pathways, despite the risks described above, there are other safeguards that could mitigate some of the risks. These measures would align the 45V treatment of RNG or fugitive methane emissions with the sensible measures proposed for renewable electricity. Without such measures, the Treasury risks requiring stricter rules for matching renewable electricity with hydrogen production that do not align with the book and claim approach for RNG or fugitive methane emissions requirements in natural gas hydrogen production.

   We therefore recommend that any RNG fed into the gas grid to be utilized by hydrogen producers (for example in a SMR-CCS facility) must be fed into the same local gas distribution system where the clean hydrogen facility operates to fulfill the deliverability requirement. Such a measure could help ensure that GHG emissions from transport of the RNG or fugitive methane feedstock to the hydrogen production facility can be accounted for with some degree of certainty. If these conditions are met, RNG use claimed by hydrogen producers would

---

[30] BayoTech, "Decarbonizing Hydrogen with Renewable Natural Gas (RNG)," May 23, 2023, https://blog.bayotech.us/hydrogen-production-from-rng.

[31] The White House, "Accelerating Progress: Delivering on the U.S. Methane Emissions Reduction Action Plan."

better reflect real operations, not just "on paper" accounting, and would also facilitate more reliable calculations of GHG intensity based on a local operating conditions.

6) **We support the proposed requirement that any hydrogen derived from RNG and fugitive emissions is the "first productive use" of this source.** As written in Section IX, the Treasury suggests that the "producer of that gas first begins using or selling it for productive use in the same taxable year as (or after) the relevant hydrogen production facility was placed in service." This would both be a) consistent with the COD requirement for electrolysis production and b) help prevent RNG from being diverted from current productive uses towards hydrogen production. RNG has many possible alternative uses[32], some of which are not easily decarbonized except through the use of RNG. For example, RNG can be used to produce high temperature heat in industrial processes, generate electricity at gas peaker plants during times of high electricity demand, used in legacy natural gas-heating equipment, and serve as a chemical feedstock. If RNG were diverted from these uses, it would likely be backfilled with natural gas. Furthermore, in each of the above cases the direct use of RNG rather than conversion to hydrogen is more efficient from an energy perspective, and in the absence of subsidies such as tax credits would be a more economic use of this resource.

   Likewise, we recommend RNG producers generating credits for the Low Carbon Fuel Standard, Renewable Fuel Standard (RFS), or any other program should be excluded from 45V eligibility. This is because the 45V tax credit will not support additional GHG reductions from those producers, since production would have taken place even in absence of the 45V tax credits. For example, under the RFS, most RNG qualifies for D3 Renewable Identification Numbers (RIN), the highest incentive in this system.[33]

Ensure the accuracy of lifecycle GHG emission calculations for fossil-derived hydrogen pathways

The life-cycle emissions of hydrogen pathways using a natural gas feedstock and carbon-capture technology are very sensitive to both upstream methane loss rates and the percentage of CO_2 emissions that are permanently sequestered.[34] These findings are backed by recent work from the Department of Energy's National Technology Lab

[32] IEA, "Outlook for Biogas and Biomethane," 2020, https://iea.blob.core.windows.net/assets/03aeb10c-c38c-4d10-bcec-de92e9ab815f/Outlook_for_biogas_and_biomethane.pdf; McKinsey & Company, "Renewable Natural Gas: A Swiss Army Knife for US Decarbonization?," November 2023, https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/renewable-natural-gas-a-swiss-army-knife-for-us-decarbonization#/.

[33] U.S EPA, "Renewable Natural Gas from Agricultural-Based AD/Biogas Systems," https://www.epa.gov/agstar/renewable-natural-gas-agricultural-based-adbiogas-systems

[34] Yuanrong Zhou et al., "Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union" (Washington, D.C.: International Council on Clean Transportation, October 10, 2021), https://theicct.org/publication/life-cycle-greenhouse-gas-emissions-of-biomethane-and-hydrogen-pathways-in-the-european-union/.

(NETL) which found that lifecycle emissions from SMR hydrogen producers with CCS will likely exceed the 4 kg CO_2e/kg H_2 45V eligibility threshold and could reach higher than 8 kg CO_2e/kg if natural gas, grid electricity, and CO_2 management emissions all exceed baseline values[35]. Given these findings we recommend that Treasury implement the following safeguards to ensure that CI scores determined in 45VH2 GREET for the purposes of determining 45V credit values accurately reflect real-world emissions:

1) **Adjust the default "background" upstream methane loss rate in 45VH2 GREET to reflect real-world emissions and make this a fixed value**

Due to the potent warming effects of methane, the lifecycle GHG emissions of fossil-CCS hydrogen pathways are strongly influenced by upstream methane leakage during the production, processing, and transport of natural gas. Figure 1a illustrates that if methane leakage rates are higher than the 45VH2 GREET "default" value, then the GHG emissions associated with CCS hydrogen production could be much higher.

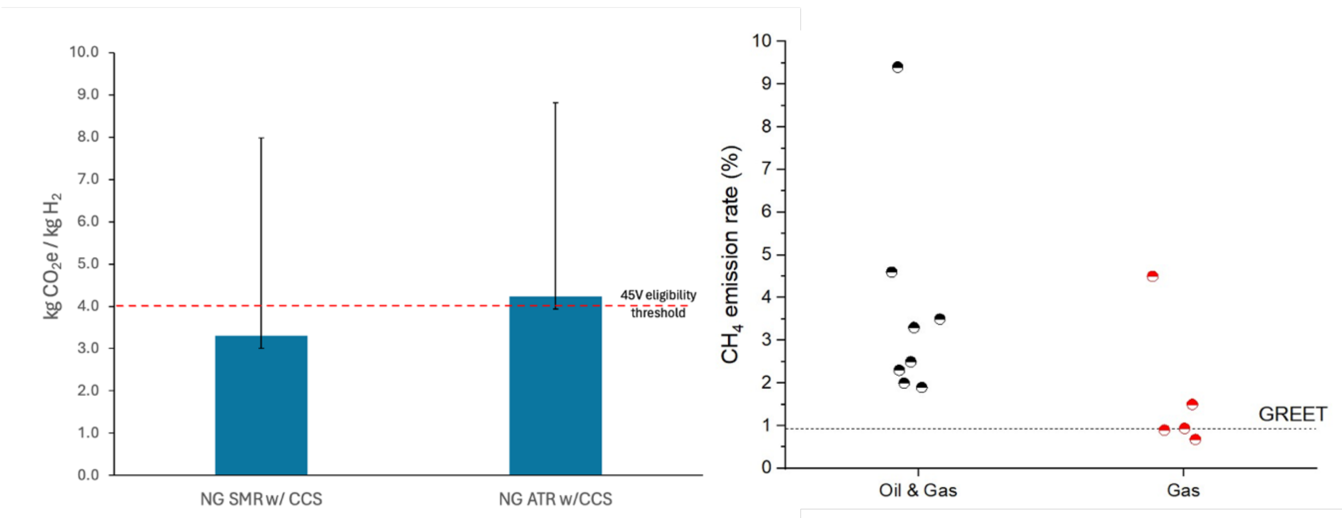

Figure 1. a) Sensitivity of fossil hydrogen carbon intensity to methane leakage rate. Columns illustrate the emissions from hydrogen production, using steam methane reforming on the left and autothermal reforming on the right, when all factors are set to the default values in GREET 2023, which is linked to 45VH2 GREET. Error bars show the CI intensity range, where the minimum corresponds to EPA's methane leakage estimation of 0.68%, and maximum values are obtained when methane leakage was set to 9.1%, b) Methane emission rates from combined oil and gas production, as well as only natural gas production, from literature[36].

---

[35] Shannon McNaul et al., "Hydrogen Shot Technology Assessment: Thermal Conversion Approaches," December 5, 2023, https://doi.org/10.2172/2228279.

[36] Lu Shen et al., "Satellite Quantification of Oil and Natural Gas Methane Emissions in the US and Canada Including Contributions from Individual Basins," *Atmospheric Chemistry and Physics* 22, no. 17 (September 2, 2022): 11203–15, https://doi.org/10.5194/acp-22-11203-2022; Xiaoyi He et al., "Life-Cycle Greenhouse Gas Emission Benefits of Natural Gas

As shown in Figure 1b, the “background” natural gas leakage rate specified in 45VH2 GREET may significantly underestimate real-world emissions, so we suggest it be amended to reflect the higher values in the literature. 45VH2 GREET “background values” are a scaled version of the EPA greenhouse gas inventory (GHGI) methane emission rates, using a hybrid bottom-up and top-down approach. The EPA’s GHGI uses a bottom-up methodology, which has been criticized[37] as accounting insufficiently for super-emitters, which are unusually large sources of methane emissions. Despite being slightly higher than EPA estimates, the 45VH2 GREET loss rates are still much lower than rates found in most peer-reviewed studies. For example, a recent paper in the Proceedings of the National Academy of Sciences found that despite an overall trend of declining methane leakage, the mean methane intensity from oil and gas industry in the U.S. in 2019 was ~2.5%[38], more than double the 45VH2 GREET “background” value. Furthermore, average values mask a wide distribution of emission rates, with high emitting sites contributing to an outsized share of total methane loss[39]. **We therefore recommend that this rate be adjusted to a higher, more conservative value and that the Treasury fix this background value so that producers cannot apply for a lower upstream methane emissions rate**. This would account for both the real-world loss rate measurements cited above and the possibility that methane leakage from the specific natural gas infrastructure used to supply the hydrogen production facility is higher than the overall national average. Further, fixing the value would avoid a perverse incentive where producers “cherry pick” natural gas producers in basins with lower-than-average emissions. This would have no net climate benefit, since natural gas from high-emitting basins would shift to unregulated industries, which have no incentive to purchase natural gas with lower upstream emissions.

Alternatively**, if the Treasury prefers to provide an option for producers to submit a site-specific methane loss rate, we suggest they require it comply with the Oil and Gas Methane Partnership 2.0 Level 5 reporting.[40] Likewise, it is imperative that**

Vehicles,” *ACS Sustainable Chemistry & Engineering* 9, no. 23 (June 14, 2021): 7813–23, https://doi.org/10.1021/acssuschemeng.1c01324; Mark Omara et al., “Methane Emissions from Natural Gas Production Sites in the United States: Data Synthesis and National Estimate,” *Environmental Science & Technology* 52, no. 21 (November 6, 2018): 12915–25, https://doi.org/10.1021/acs.est.8b03535; Lu et al., “Observation-Derived 2010-2019 Trends in Methane Emissions and Intensities from US Oil and Gas Fields Tied to Activity Metrics”; David R. Lyon et al., “Concurrent Variation in Oil and Gas Methane Emissions and Oil Price during the COVID-19 Pandemic,” *Atmospheric Chemistry and Physics* 21, no. 9 (May 3, 2021): 6605–26, https://doi.org/10.5194/acp-21-6605-2021; J. Peischl et al., “Quantifying Atmospheric Methane Emissions from the Haynesville, Fayetteville, and Northeastern Marcellus Shale Gas Production Regions,” *Journal of Geophysical Research: Atmospheres* 120, no. 5 (March 16, 2015): 2119–39, https://doi.org/10.1002/2014JD022697.

[37] Jeffrey S. Rutherford et al., “Closing the Methane Gap in US Oil and Natural Gas Production Emissions Inventories,” *Nature Communications* 12, no. 1 (August 5, 2021): 4715, https://doi.org/10.1038/s41467-021-25017-4; Ramón A. Alvarez et al., “Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain,” *Science* 361, no. 6398 (July 13, 2018): 186–88, https://doi.org/10.1126/science.aar7204; Lu et al., “Observation-Derived 2010-2019 Trends in Methane Emissions and Intensities from US Oil and Gas Fields Tied to Activity Metrics”; He et al., “Life-Cycle Greenhouse Gas Emission Benefits of Natural Gas Vehicles.”

[38] Lu et al., “Observation-Derived 2010-2019 Trends in Methane Emissions and Intensities from US Oil and Gas Fields Tied to Activity Metrics.”

[39] Daniel Zavala-Araiza et al., “Toward a Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites,” *Environmental Science & Technology* 49, no. 13 (July 1, 2015): 8167–74, https://doi.org/10.1021/acs.est.5b00133.

[40] Yuanrong Zhou and Chelsea Baldino, “Recommendations for a stringent ISO standard on the GHG emissions from blue hydrogen production,” (Washington, D.C.: International Council on Clean Transportation, June 23, 2023), https://theicct.org/wp-content/uploads/2023/07/ISO_blue_hydrogen_GHG_ICCT_DNV.pdf

any default background methane leakage rate for producers who do not receive site-specific verification be adjusted to a much higher value than currently in 45VH2 GREET, even higher than the literature values provided in the previous paragraph. This is because in this circumstance, producers relying on infrastructure with above-average methane loss rates will surely choose the “background” value. Recognizing this effect, the European Union’s Renewable Energy Directive, for example, specifies that “*default values shall be conservative* [i.e. higher] *compared to normal production processes.”*[41]

2) **Implement clear and stringent verification requirements to verify the CO_2 capture rate and ensure the permanence of CO_2 sequestration**

In calculating hydrogen CI for CCS pathways using 45VH2 GREET a key input is the quantity of carbon captured as reported to U.S. Environmental Protection Agency’s (EPA’s) Greenhouse Gas Reporting Program (GHGRP). Under the proposed 45V regulation §1.45V–5 (d)(1) this value must be independently verified, but there is no reference to specific verification standards. This is concerning because in some cases CCS equipped facilities have struggled to achieve designed rates of carbon capture,[42] a fact highlighted by a recent NETL report which documents planned capture rates of 88-99% at hydrogen CCS facilities “under development” despite the fact that capture rates at operational hydrogen facilities have yet to exceed 60%[43]. Furthermore, of the three primary carbon waste streams from hydrogen production via SMR, hydrogen producers generally only capture carbon from one of these streams, thus capturing only around 50% of the carbon[44]. As shown in Figure 2, when realistic CO_2 capture rates are used to calculate GHG intensity via the 45VH2 GREET tool, the resulting carbon intensities are above the 4 kg CO_2e/kg H_2 45V cut off, creating a strong incentive to report capture rates in-line with the designed capacity rather than actual operations.

---

[41] European Parliament and Council of the European Union, “Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources” (European Union, 2018), http://data.europa.eu/eli/dir/2018/2001/oj.

[42] Bruce Robertson and Milad Mousavian, “The Carbon Capture Crux” (Institute for Energy Economics and Financial Analysis, September 2022), https://ieefa.org/sites/default/files/2022-09/The%20Carbon%20Capture%20Crux.pdf.

[43] McNaul et al., “Hydrogen Shot Technology Assessment.”

[44] Zhou et al., “Life-Cycle Greenhouse Gas Emissions of Biomethane and Hydrogen Pathways in the European Union.”

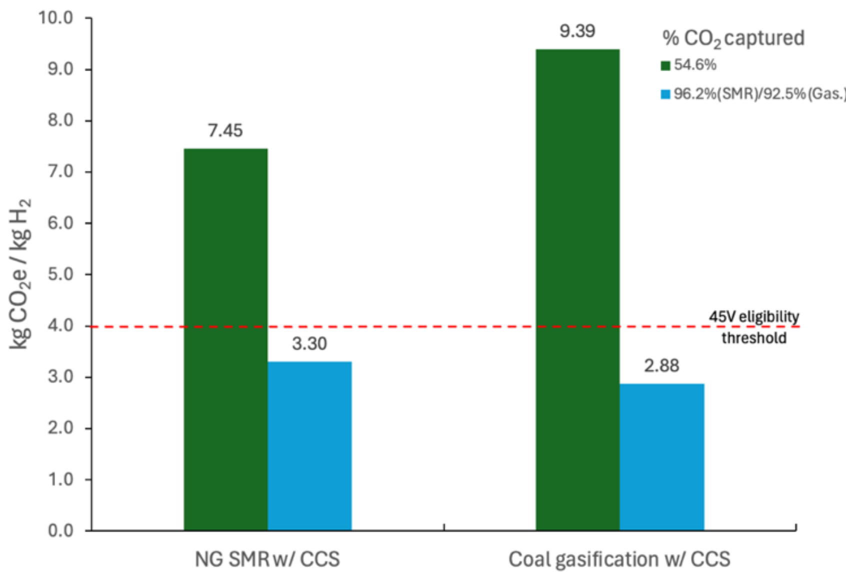

Figure 2. Sensitivity of hydrogen GHG intensity, produced from either natural gas or coal plus CCS, to the carbon capture rate. A capture rate of 54.6% represents typical industrial practice at SMR facilities today, while a 96.2% and 92.5% capture rate for NG+SMR and Coal gasification represent 45VH2 GREET defaults.[45]

We are concerned that the absence of specific standards may make room for ambiguous monitoring reporting and verification (MRV) plans which do not fully guarantee long term sequestration of captured carbon[46]. To avoid the possibility that CO_2 reported as sequestered is not truly secure, we recommend that Treasury add reference to specific requirements for verification and monitoring as robust as the Carbon Capture and Sequestration Protocol[47] developed by the California Air Resource Board (CARB) for the Low Carbon Fuel Standard (LCFS). This protocol has explicit requirements for permanence certification of CCS projects including third-party review and site-based risk assessment of CO_2 leakage over 100 years after the injection with an emergency and remediation plan. Importantly, the protocol also specifies the techniques for CO_2 monitoring.

[45] Ibid.

[46] Yuanrong Zhou, "Carbon Capture and Storage: A Lot of Eggs in a Potentially Leaky Basket," *ICCT Staff Blog* (blog), January 17, 2020, https://theicct.org/carbon-capture-and-storage-a-lot-of-eggs-in-a-potentially-leaky-basket/.

[47] California Air Resources Board, "Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard," 2018, https://ww2.arb.ca.gov/resources/documents/carbon-capture-and-sequestration-protocol-under-low-carbon-fuel-standard.