EPRI Comments on the U.S. Department of the Treasury and Internal Revenue Service Proposed Rule "Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election to Treat Clean Hydrogen Production Facilities as Energy Property"

IRS REG–117631–23

February 26, 2024

EPRI submits the enclosed comments to the U.S. Department of the Treasury and Internal Revenue Service (IRS) in response to the proposed rule. EPRI thanks the Treasury and IRS for the opportunity to comment.

EPRI is an independent, nonprofit organization for public-interest energy and environmental research. Founded in 1972, EPRI brings together member organizations, EPRI's scientists and engineers, and other leading experts and stakeholders to work collaboratively on solutions to the challenges of electric power and broader energy systems. This collaborative research, development, and deployment spans nearly every area in the generation, delivery, and use of electricity, including reliability, efficiency, health, safety, and the environment.

Specifically related to these proposed rules, EPRI leads decarbonization-related research, with technology assessment, development, and innovation central to its mission. EPRI jointly leads the Low-Carbon Resources Initiative, a global collaborative of more than 60 organizations working together to advance the development and adoption of low-carbon energy carriers, including hydrogen, for the benefit of society.

EPRI's comments were developed from its research expertise and are technical. They are not legal in nature. In assembling these comments, EPRI drew upon decades of experience and expertise in wide-ranging research efforts associated with:

- Low-carbon electric generation technologies and energy carriers such as clean hydrogen, bioenergy, and renewable natural gas
- Modeling the electric power sector, energy systems, and linkages to the broader economy
- Air quality models, measurements, and health effects
- Climate impacts and the social costs of carbon and other greenhouse gases
- Energy storage technology development and deployment

EPRI's comments are organized by:

- Comments on requested topics related to methods for evaluating and using energy attribute certificates (EACs) to inform accounting of hydrogen production from grid-connected electricity facilities, biomass-powered electricity generation, fugitive methane emissions, and renewable natural gas (RNG).
- Suggestions for the Treasury to provide further clarification and comments on the eligibility of electric generators to receive qualifying EACs and the ability of a taxpayer to claim both 45V and 45Q credits for synthesis of molecules.

Summary of EPRI Comments

1. EPRI believes the use of modeling can inform the accounting of hydrogen production emissions and grid impacts associated with electricity inputs to hydrogen production. EPRI's experience has shown that modeling to determine emissions impacts from the use of grid-connected electricity facilities should incorporate structural investment effects, which can dominate short-run dispatch effects under a range of sensitivities.

2. EPRI recognizes that EACs can be used as a proxy for quantifying grid-induced emissions. However, significant gaps remain in the institutional capacity to implement the EAC mechanism described in the Treasury guidance for 45V.

3. EPRI recognizes that clarifying the treatment of energy storage is an important gap in the proposed 45V implementation rules. Use of EACs to track hourly alignment between generation, storage, and hydrogen production is theoretically possible but not supported by current EAC systems.

4. EPRI is providing comments and references on emissions associated with biomass-powered electricity generation used for hydrogen production (as requested under *Supplementary Information* section "V. Procedures for Determining Lifecycle Greenhouse Gas Emissions Rates for Qualified Clean Hydrogen…2. Eligible Energy Attribute Certificate Requirements").

5. EPRI is providing comments on Treasury's requests for information on the use of fugitive methane emissions and RNG for hydrogen production (as requested *Explanation of Provisions* section *IX. Renewable Natural Gas and Fugitive Sources of Methane*).

6. EPRI suggests clarification of the eligibility of electric generators outside the region where electrolytic hydrogen is produced to receive qualifying EACs.

7. EPRI suggests clarification of the ability for a taxpayer to claim both 45V and 45Q credits at a single facility for the purpose of creating synthetic molecules.

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1. **EPRI believes the use of modeling can inform accounting of hydrogen production emissions and grid impacts associated with electricity inputs to hydrogen production. EPRI's experience has shown that modeling to determine emissions impacts from the use of grid-connected electricity facilities should incorporate structural investment effects, which can dominate short-run dispatch effects under a range of sensitivities.**

   "The Treasury Department and the IRS seek comments on whether to provide an opportunity to demonstrate zero or minimal induced grid emissions through modeling or other evidence under specific circumstances… (iv) best practices for making such demonstrations, including for ensuring the impartiality and replicability of calculation approaches…"
   (*Explanation of Provisions* section V.C.2.a.ii *Zero or Minimal Induced Grid Emissions Through Modeling or Other Evidence*, page 89231).

   EPRI has published multiple reports that suggest best practices and considerations for quantifying induced emissions and grid impacts from electrolysis, electrification, and other system changes. One key finding supported by EPRI research is that the use of short-run marginal emissions rates may not accurately capture consequential emissions changes.

   Linked power sector capacity planning and systems operations modeling can capture both short-run operational changes and structural effects that can alter investment and retirement decisions. For instance, an EPRI-led study in Nature Communications (Bistline, et al., 2022)[1] illustrates how short-run marginal emissions approaches can underestimate carbon dioxide (CO_2) reductions from electrification by 32% to 91%. Another EPRI study evaluates induced emissions changes from battery storage deployment, accounting for both long-run investment and dispatch effects simultaneously across regions in the U.S. (Bistline and Young, 2020).[2] Modeling results indicate that structural investment effects dominate short-run dispatch effects under a range of sensitivities. In general, this research suggests that long-run marginal emissions rates may be better proxies of these changes, though they entail scenario- and context-specific assumptions (Gagnon, et al., 2022).[3]

2. **EPRI recognizes that energy attribute certificates (EACs) can be used as a proxy for quantifying grid-induced emissions. However, significant gaps remain in the institutional capacity to implement the EAC mechanism described in the Treasury guidance for 45V.**

   "… EACs with attributes that meet certain criteria [can serve] as a reasonable methodological proxy for quantifying certain indirect emissions associated with electricity for purposes for the 45V credit" (*Explanation of Provisions* section V.C. *Use of Energy Attribute Certificates*, page 89227).

   Existing EAC programs are not sufficiently developed across the U.S. to create eligible EACs as defined in section 1.45V-4(d)(iii).

   - Most existing EAC programs in the U.S. do not have the ability to track all types of electricity generation, but rather focus on renewable and other sources of non-emitting

[1] Bistline, et al. (2022). Economy-Wide Evaluation of CO_2 and Air Quality Impacts of Electrification in the United States. Nature Communications, 13: 6693.
[2] Bistline and Young (2020). Emissions Impacts of Future Battery Storage Deployment on Regional Power Systems. Applied Energy, 264: 114678.
[3] Gagnon, et al. (2022). Short-Run Marginal Emissions Rates Omit Important Impacts of Electric-Sector Interventions. Proceedings of the National Academy of Sciences, 119(49): E2211624119.

generation. Examples include issuing, tracking, and retiring renewable energy credits (RECs) and similar tradable instruments.

- Of the nine "qualified" EAC registries identified in the proposed rule, EPRI is only aware of two – the PJM-GATS and NYGATS registries – that operate an "all generation" tracking system that comprehensively tracks generation attributes for all power generation within PJM or imported into the region.
- Other tracking systems, such as M-RETS, currently do not track all regional generation sources and currently only track, issue, and retire RECs for renewable electricity resources (e.g., wind and solar) and other sources of energy.
- Existing EAC registries do not have the capability today to identify generation "uprates" that may qualify as incremental generation under the proposed rule. It will be important for the EACs to develop this capability to support implementation of the proposed rule.
- The proposed rule would create tradable EACs associated with power generation resources that *emit* CO_2. To our knowledge, no existing tradable EACs exist today for CO_2 emitting resources. Existing EAC registries capabilities will need to be enhanced to issue, track, and retire EACs from CO_2-emitting generation resources.

3. EPRI recognizes that clarifying the treatment of energy storage is an important gap in the proposed 45V implementation rules. Use of EACs to track hourly alignment between generation, storage, and hydrogen production is theoretically possible but not supported by current systems.

"Among the issues that require resolution as EAC [energy attribute certificate] tracking systems move to hourly resolution is the treatment of electricity storage."
(*Explanation of Provisions* section V.C.2.b. *Temporal Matching*, page 89233).

EPRI modeling indicates that including energy storage in system configurations with generation and electrolysis could be economically advantageous in some regional systems for 45V-qualified electrolysis to better align carbon-free electricity output and electrolyzer demand (EPRI, 2023).[4]

Grid-connected energy storage systems (ESS) may be charged using non-emitting generation, such as wind and solar generation and other carbon-free resources (e.g., nuclear), but also may be charged using fossil-fired power generation (EPRI, 2020)[5], (EPRI, 2021)[6]. In order for electricity discharged by ESSs to be used to produce hydrogen that may be eligible for the 45V tax credit, it will be necessary for producers to be able to determine the greenhouse gas (GHG) content of the power generation sources that have been used to charge the ESS prior to its discharge to a production facility.

When EACs used to claim the 45V subsidy must coincide temporally with production of qualified resources, as in the proposed Treasury guidance, grid-connected energy storage systems (ESS) could potentially be eligible to receive (and sell forward to hydrogen producers) qualifying EACs coinciding temporally with storage discharge, but this would likely require that storage operators purchase and retire separate EACs from qualifying generation temporally aligned with electricity use

[4] EPRI (2023). Impacts of IRA's 45V Clean Hydrogen Production Tax Credit. Report 3002028407 (EPRI, Palo Alto, CA).
[5] EPRI (2020). Overview of Emissions Impacts from Grid-Connected Battery Energy Storage. Report 3002020074 (EPRI, Palo Alto, CA).
[6] EPRI (2021). Modeling Greenhouse Gas Emissions in Energy Storage and Distributed Energy Resource Decision-Making Frameworks. Report 3002021604 (EPRI, Palo Alto, CA).

for charging (including a charging penalty). Moreover, the storage operator would likely also be required to demonstrate that the time stamp of the EAC associated with charging energy occurred before the time stamp of the issued EAC associated with discharge, possibly including an additional stipulation around the physical operation of the storage balance. While such an arrangement is theoretically possible, existing EAC programs do not provide this functionality or capability. EPRI is not aware of any existing EAC program in the U.S. that issues, tracks and retires EACs associated with the charging and discharging of ESS, especially with the added complication of separate time stamps.

Furthermore, the ability of ESS to shift the temporal nature of the power used to charge the ESS and the power discharged from the ESS exacerbates the challenge of incorporating ESS into an EAC registry and using EACs to demonstrate the temporal matching requirement envisioned in this proposed rule. Because there is no existing mechanism to either convert an EAC used to *charge* an ESS into an EAC associated with ESS *discharge*, there is no existing institutional mechanism for an ESS or an EAC program to convert the hourly time stamp on an EAC used to *charge* an ESS system to a new and possibly different hourly time stamp for a corresponding EAC transferred to an H_2 producer when the ESS is *discharged*.

4. **EPRI is providing comments and references on emissions associated with biomass-powered electricity generation used for hydrogen production (as requested under *Supplementary Information* section V.C.2. *Eligible Energy Attribute Certificate Requirements*").**

"The Treasury Department and the IRS also request comment on specific lifecycle GHG emissions considerations, including the use of counterfactual scenarios, that should be considered in evaluating direct and indirect emissions associated with specific types of biomass and its consumption." (*Explanation of Provisions* section V.C.2. *Eligible Energy Attribute Certificate Requirements*, page 89229).

When evaluating the GHG implications of supplying biomass for energy, it has been shown to be important to consider landscape, long-run, and cross-market carbon stock and emissions effects for agriculture and forestry cellulosic biomass feedstocks. Modeling that does so has found carbon neutral or better (i.e., net carbon gains and climate beneficial) net GHG biomass use, including potential net negative emissions[7, 8, 9, 10, 11, 12, 13].

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[7] Field, J. L. et al., 2020. Robust paths to net greenhouse gas mitigation and negative emissions via advanced biofuels. *Proceedings of the National Academy of Sciences,* Volume 117, pp. 21968-21977.
[8] Mignone, B. K. et al., 2022. Changes in global land use and CO2 emissions from US bioethanol production: What drives differences in estimates between corn and cellulosic ethanol?. *Climate Change Economics,* 13(4).
[9] Dwivedi, P. et al., 2015. Cost of Abating Greenhouse Gas Emissions with Cellulosic Ethanol. *Environmental Science & Technology,* Volume 49, pp. 2512-2522.
[10] Rose, S. K. et al., 2022. Global biomass supply modeling for long-run management of the climate system. *Climatic Change,* 172(3).
[11] Baker, J.S., C.M. Wade, B.L. Sohngen, S. Ohrel, A.A. Fawcett, 2019. Potential complementarity between forest carbon sequestration incentives and biomass energy expansion, Energy Policy, Volume 126: 391-401, ISSN 0301-4215, https://doi.org/10.1016/j.enpol.2018.10.009.
[12] Favero, A., A. Daigneault, B Sohngen, 2020. Forests: Carbon sequestration, biomass energy, or both? Science Advances, 6(13). DOI:10.1126/sciadv.aay6792.
[13] Khanna, M, R Abt, M Barlaz, M Buford, M Harmon, J Hill, J Reilly, C Rice, S Rose, D Schrag, R Sedjo, K Skog, T West, P Woodbury, 2017. *SAB Review of EPA's Framework for Assessing Biogenic CO2 Emissions from Stationary*

Also, such modeling approaches provide average effect results that can be used for emissions factors, which could be calculated as average change from reference or via a series of marginal calculations to estimate marginal emission factors for incrementally larger feedstock supplies.

5. **EPRI is providing comments on Treasury's requests for information on the use of fugitive methane emissions and RNG for hydrogen production (as requested under *Explanation of Provisions* section *IX. Renewable Natural Gas and Fugitive Sources of Methane*).**

"(1) What data sources and peer reviewed studies provide information on RNG production systems (including biogas production and reforming systems), markets, monitoring, reporting, and verification processes, and GHG emissions associated with these production systems and markets?"

"(2) What conditions for the use of biogas and RNG would ensure that emissions accounting for purposes of the section 45V credit reflects and reduces the risk of indirect emissions effects from hydrogen production using biogas and RNG? How can taxpayers verify that they have met these requirements?"

"(11) What counterfactual assumptions and data should be used to assess the lifecycle GHG emissions of hydrogen production pathways that rely on RNG? Is venting an appropriate counterfactual assumption for some pathways? If not, what other factors should be considered?" (*Explanation of Provisions* section *IX. Renewable Natural Gas and Fugitive Sources of Methane*, pages 89239-89240).

A. EPRI has several resources that could be helpful in addressing questions 1, 2, and 11 under section "*IX. Renewable Natural Gas and Fugitive Sources of Methane*":
   i. Estimated U.S. state-level RNG supplies from fugitive methane and food waste: https://www.epri.com/research/products/000000003002027970. This EPRI study estimates future U.S. state level economic supplies of RNG (volume and price) to 2050, as well as the corresponding GHG mitigation associated with the RNG, for fugitive methane emissions from landfills, livestock manure, industrial wastewater, and municipal wastewater, and food waste. This is a useful resource with information regarding potential RNG production systems and RNG supply volumes, as well as the estimated GHG reductions.
   ii. Estimated RNG supplies from agriculture and forestry biomass: https://www.epri.com/research/products/000000003002024993. This EPRI study uses an integrated energy system model to evaluate economy-wide decarbonization. Among other things, the analysis captures competition for agriculture and forestry cellulosic biomass feedstocks across bioenergy applications in the full economy, which include the possibility of producing RNG from the gasification of cellulosic agriculture and forestry biomass feedstocks.
   iii. Estimates of mitigation supplies for coal methane fugitive emissions: https://www.epri.com/research/products/000000003002009609. This EPRI study assesses U.S. regional GHG mitigation supplies for fugitive methane from coal mines, as well as non-CO_2 GHGs from oil and gas operations, landfills, and adipic and nitric acid production. These results provide mitigated and unmitigated coal emissions projections estimates that could be helpful to characterizing fugitive methane supplies—

Sources (2014), Draft Report, June 2, 2017, https://yosemite.epa.gov/sab/sabproduct.nsf/LookupWebProjectsCurrentBOARD/6CC0C0FA87B00F72852581860059A5EB/$File/BiogenicCarbon-06-02-17.pdf.

counterfactuals and mitigated. For landfill fugitive methane emissions, we suggest using the study cited in EPRI report 3002027970 as noted above, which has more recent estimates.

iv. RNG production systems: https://www.epri.com/research/products/000000003002027972. This EPRI study is a survey of existing and potential biofuel conversion technologies, including RNG from gasification and methanation (with and without carbon capture and sequestration), as well as RNG from anaerobic digestion.

v. EPRI's research noted in points *i* and *ii* above provide counterfactual and biogas and RNG supply estimates that would be helpful for assessing "first productive use" effects. Note also that a flaring counterfactual for fugitive methane RNG, such as from landfills, would imply no additional emissions from the RNG application since the methane is being combusted in both outcomes.

(6) How can the section 45V regulations reflect and mitigate indirect emissions effects from the diversion of biogas or RNG or fugitive methane from potential future productive uses? What other new uses of biogas or RNG or fugitive methane could be affected in the future if more gas from new capture and productive use of methane from these sources is used in the hydrogen production process?

(7) How can the potential for the generation of additional emissions from the production of additional waste, waste diversion from lower-emitting disposal methods, and changes in waste management practices be limited through emissions accounting or rules for biogas and RNG use established for purposes of the section 45V credit?

(8) To limit the additional production of waste, should the final regulations limit eligibility to methane sources that existed as of a certain date or waste or waste streams that were produced before a certain date, such as the date that the IRA was enacted? If so, how can that be documented or verified? How should any changes in volumes of waste and waste capacity at existing methane sources be documented and treated for purposes of the section 45V credit? How should additional capture of existing waste or waste streams be documented and treated? (*Explanation of Provisions* section IX. *Renewable Natural Gas and Fugitive Sources of Methane*, pages 89239-89240).

B. Related to questions (6), (7), and (8), analysis of potential indirect emissions, waste production, and waste diversion due to 45V is needed. It is important to keep in mind that transitioning from today to future hydrogen markets may entail some "leakage," but in the long run the benefits could outweigh the transition losses. For instance, see Rose and Sohngen (2011)[14], who estimate that forest carbon transition leakage is likely with more realistic global forestry carbon mitigation policy transitions; however, large net carbon sequestration and climate benefits are estimated in the long run. Thus, it is important to evaluate the opportunity for a climate net-positive transition that may include some leakage along the way. Imposing no leakage requirements is potentially unrealistic and could preclude consideration of potential net climate beneficial strategies.

[14] Rose, S.K. and B. Sohngen, (2011). Global Forest Carbon Sequestration and Climate Policy Design, *Environment and Development Economics* 16: 429-454.

6. **EPRI suggests clarification of the eligibility of electric generators outside the region where electrolytic hydrogen is produced to receive qualifying EACs.**

   "The deliverability requirement in proposed § 1.45V– 4(d)(3)(iii) would require qualifying EACs to represent electricity that was produced by an electricity generating facility that is in the same region as the relevant hydrogen production facility." (pg. 89228)
   (*Supplementary Information* section V.C.2. *Eligible Energy Attribute Certificate Requirements*, page 89228).

   "Proposed § 1.45V–4(d)(2)(vi) would define the term "region" to mean a United States region derived from the National Transmission Needs Study (DOE Needs Study) that was released by the DOE on October 30, 2023."
   (*Supplementary Information* section V.C.1. *Definitions Related To Use of Energy Attribute Certificates*, page 89228)

   "The Treasury Department and the IRS request comments on whether there are additional ways to establish deliverability, such as circumstances indicating that electricity is actually deliverable from an electricity generating facility to a hydrogen production facility, even if the two are not located in the same region or if the clean electricity generator is located outside of the United States."
   (*Supplementary Information* section V.C.2.c. *Deliverability*, page 89233).

   The regions outlined in the guidance are in some cases electrically connected to areas outside of the U.S., such as the participation of the Canadian province of Manitoba in MISO. In such cases, national boundary between the U.S. and Canada is essentially arbitrary, and it may be reasonable to extend the definition of "deliverable" to include these inter-connected regions. Additionally, in some cases within the U.S., significant electrical connections exist across the regional borders defined in the guidance. In general, electricity generation from outside the region in which the electrolytic hydrogen production occurs, whether within or outside the U.S., could potentially be established as "deliverable" if the hydrogen producer contracts directly with the generator, for example under a physical power purchase agreement (PPA). This situation would be analogous to the purchase of bundled renewable energy certificates (RECs), where both the power and attribute are sold together. Some states require bundling of RECs for compliance with renewable portfolio standards to ensure deliverability.

7. **EPRI suggests clarification of the ability for a taxpayer to claim both 45V and 45Q credits at a single facility for the purpose of creating synthetic molecules.**

   "Section 45V(d)(2) provides that no section 45V credit is allowed with respect to any qualified clean hydrogen produced at a facility that includes carbon capture equipment for which a credit is allowed to any taxpayer as determined under section 45Q (section 45Q credit) for the taxable year or any prior taxable year." (Supplementary Information section I.A.3.b. *Coordination With Section 45Q*, page 89222 and *§ 1.45V–2 Special rules*).

   EPRI suggests that the Treasury provide comments on the ability for a taxpayer to claim credits from both 45V and 45Q for the purpose of using hydrogen and CO_2 for synthesis of other molecules (e.g., methane, ammonia, methanol). The proposed ruling states claiming both 45V and 45Q credits is not allowed for hydrogen production but is silent on combining both for synthesis of other molecules.

EPRI research evaluated the feasibility of producing synthetic methane from hydrogen and CO_2 with economic assumptions that allow the use of both 45V and 45Q credits. (EPRI 2023)[15].

[15] EPRI (2023). Feasibility Assessment of U.S. E-gas Exports to Japan. Report 3002028027 (EPRI, Palo Alto, CA).