Submitted February 26, 2024

AES Clean Energy Comments on IRS Notice of Proposed Rulemaking on REG–117631–23

AES commends the Treasury Department and the IRS on their well-considered proposed regulations relating to Internal Revenue Code Section 45V (Credit for Production of Clean Hydrogen). AES submits the following comments with the objective of supporting the twin goals of decarbonization and industry liftoff that we understand have been cornerstones of the efforts of the Treasury Department and the IRS in drafting the proposed regulations. In our review of the Proposed Rules, we determined that several important changes could be made, within the framework of the "three pillars", that could result in more efficient support for the achievement of the United States' decarbonization goals while accounting for the complexity of building a sustainable clean hydrogen market.

Part 1: Introduction to AES

The AES Corporation ("AES") is a Fortune 500 global energy company accelerating the future of energy. Together with our many stakeholders, we improve lives—and our planet—by delivering greener, smarter energy solutions to businesses and organizations, cities and nations, and entire industries. AES is an industry leader in developing and operating the solutions that will enable the transition to zero- and low-carbon sources of energy and achievement of the Paris Agreement's goal of net-zero emissions by 2050.

In addition to being a top U.S. solar, wind, and storage developer, AES has quickly become a trailblazer in the clean hydrogen industry, and we are leveraging our market-leading innovation, development, and project execution capabilities to drive the market forward. We believe green hydrogen is essential to achieving global net-zero goals, and we are leveraging existing capabilities and insight-based innovation to increase efficiency and drive substantial cost reduction of green hydrogen production. We recently announced the largest green hydrogen project[1] in the United States, are a participant in two Regional Clean Hydrogen Hubs[2] awarded by the U.S. Department of Energy and are actively developing a diverse portfolio of electrolytic hydrogen projects around the country. Our active participation in the green hydrogen space over the last two years has allowed AES to build key relationships with leading industry stakeholders, including customers, suppliers, OEMs, customers, and lenders.

Part 2: AES Comments

2.1 Hydrogen volume to input into H2GREET Model

AES Comment: AES requests that the regulations allow a facility the discretion to input into the H2GREET model the volume of hydrogen for which it is requesting section 45V production tax credits ("PTCs") during the taxable year (the "Requested Hydrogen Volume"), rather than needing to input into H2GREET the total hydrogen production during the taxable year (the "Total Hydrogen Volume"). The Requested

[1] AES Corporation, December 2022, "*Air Products and AES Announce Plans to Invest Approximately $4 Billion to Build First Mega-scale Green Hydrogen Production Facility in Texas*" Available at: https://www.aes.com/press-release/air-products-and-aes-announce-plans-invest-approximately-4-billion-build-first-mega

[2] AES Corporation, October 2023, "*AES Participating in Two Clean Hydrogen Hubs Awarded Funding by US Department of Energy*" Available at: https://www.prnewswire.com/news-releases/aes-participating-in-two-clean-hydrogen-hubs-awarded-funding-by-us-department-of-energy-301956018.html

Hydrogen Volume would equal the summation of the quantity of qualified clean hydrogen across all 8760 hours of the year for which the taxpayer is requesting PTCs.

Specifically, AES suggests the following modifications A, B, and C to the draft regulations:

A. Modify § 1-45V-1(a)(8)(iii) as indicated by the red text:

> (iii) *Emissions through the point of production (well-to-gate).* The term *emissions through the point of production (well-to-gate)* means the aggregate lifecycle GHG emissions related to specified quantities of hydrogen for which the taxpayer is requesting credit produced at a hydrogen production facility during the taxable year through the point of production. It includes emissions associated with feedstock growth, gathering, extraction, processing, and delivery to a hydrogen production facility. It also includes the emissions associated with the specified quantity's hydrogen production process, inclusive of the electricity used by the hydrogen production facility during the hours of the quantity's production and any capture and sequestration of carbon dioxide generated by the hydrogen production facility.

B. Modify § 1.45V–4(a) as indicated by the red text:

> § 1.45V–4(a) *In general.* The amount of the section 45V credit is determined under section 45V(a) of the Code and § 1.45V-1(b) according to the lifecycle GHG emissions rate of ~~all~~ the specified quantity of hydrogen produced at a hydrogen production facility during the taxable year for which the taxpayer is requesting credit.

C. Modify § 1.45V–4(b) as indicated by the red text:

> § 1.45V–4(b) *Use of the most recent GREET model.* […] This determination is made following the close of each such taxable year and must include ~~all~~ hydrogen production for which the taxpayer is requesting credit during the taxable year. […]"

Explanation: AES views clarity around this methodology as critical to enabling projects to secure hydrogen PTC and to the successful liftoff of the overall clean hydrogen sector. If taxpayers are required to aggregate a facility's Total Hydrogen Volume over the entire year for input into H2GREET, they face the risk of inadvertent and punitive non-qualification of significant portions of hydrogen production even during hours when the facility was powered by qualified EACs meeting the proposed deliverability, incrementality, and temporal matching criteria, putting the project's financial viability at risk.

Consider the example facility and the two scenarios described below:

> **Example facility:**
>
> A 100 MW electrolysis facility which operates with an efficiency of 50 kWh/kg of hydrogen. During one hour on a given day, it operated at 40% capacity and consumed 40 MWh of electricity to produce 800 kg of hydrogen.
>
> During this same hour, the facility secured (through a power purchase agreement with a solar farm) 25 MWh of renewable electricity, evidenced by 25 energy attribute credits ("EACs") for renewable energy produced during that same hour.
>
> Assume that all 25 EACs meet the deliverability, incrementality, and temporal matching criteria of the proposed 45V regulations.
>
> Assume that (per H2GREET) the carbon intensity of a MWh of grid power where the facility is located is 330 kg CO2e per MWh.

- **Under a "Total Hydrogen Volume" approach:**
    - **Zero kg of the production volume would qualify for PTC**: If the taxpayer is required to input into H2GREET the total hydrogen production during this hour (800 kg), and thus to account for the carbon intensity (CI) of the entire 40 MWh, then the power supply for the 800 kg will be deemed to come from 25 MWh of renewable energy (evidenced by EACs) with carbon emissions of 0 kg CO2e and 15 MWh from the grid with carbon emissions of 4950 kg CO2 (330 * 15). Taking the weighted average across the 40 MWh, H2GREET would calculate an average carbon intensity for the 800 kg as 6.2 kg CO2e/kg hydrogen, which is above the PTC qualifying threshold for qualified clean hydrogen, and thus *none* of the hydrogen produced by the facility during this hour would qualify for PTC. Not only would this methodology and outcome seem contrary to the purpose of the 45V tax credit (to incentivize the use of carbon free energy in the production of hydrogen), but it would render uneconomic nearly all electrolytic hydrogen projects in development today.
    - **Overly steep PTC cliff:** Consider another version of this example, whereby the taxpayer procures 38 EACs out of the total 40 MWh used. Despite the total quantity of hydrogen produced being 95% matched, compared to a 100% matched quantity, the overall PTC would reduce by 67% from $3 per kilogram to $1 per kilogram [(330 * 2) + (0 * 38)]/800kg = 0.82], a significant cliff.

- **Under a "Requested Hydrogen Volume" approach:**
    - **500 kg of zero carbon hydrogen would qualify for PTC:** If the taxpayer is permitted to input into H2GREET only the volume of hydrogen that it seeks to earn PTCs on, the taxpayer can determine that the 25 EACs it purchased produced 500 kg of zero carbon hydrogen (25 MWh * 1000 KWh/1 MWh * 1kg / 50 KWh = 500 kg) and can input 500 kg into the H2GREET model. Once the third-party verifier verifies the 25 EACs used to produce the 500 kg, the taxpayer would qualify for $1500 in PTC (500 kg * $3). The remaining 300 kg of hydrogen produced during that hour would not qualify for PTC, and thus the taxpayer would exclude it from its requested quantity.

There are several reasons why the example described above is likely to be quite common:

- **Variable renewable generation**: While a taxpayer might make every effort to plan its production in accordance with expected variable renewable generation (and will be incentivized to do so to maximize PTC), it is very likely that facilities will not be able to perfectly match renewable energy generated on an hourly basis over long periods of time. There will be misses and margins of error due to challenges predicting wind and solar generation at a particular moment (e.g., when a cloud passes over a solar farm, or the wind suddenly dies down). Considering such potential risks, the Requested Hydrogen Volume approach ensures that the taxpayer receives PTC for the qualified clean hydrogen that it does produce and doesn't risk unintentional or unpredictable misses costing large volumes of PTC, potentially rendering the project uneconomic.
- **Offtake requirements**: While electrolyzers will eventually have ramping capabilities to follow intermittent renewable generation sources like wind and solar, many of the highest potential use cases of clean hydrogen (including green ammonia, e-methanol, and green steel) have downstream process facilities that require a steady and consistent stream of hydrogen. Even

hydrogen liquefaction facilities – which are needed to serve most mobility customers – have much more limited ramping capabilities. If the electrolytic hydrogen facility is directly connected to these types of offtakers, then it would need to produce and supply a relatively consistent hourly volume of hydrogen. If the hydrogen facilities are powered by wind and solar (which are the predominant forms of incremental carbon free generation available today), then it should be expected that at times the facility will need to utilize grid power to meet the offtaker's hourly supply requirements for safe and stable operations. The taxpayer applying for PTC should be allowed to input into H2GREET the volumes that it can verify with EACs, not the total hydrogen produced. Without this methodology, we would expect nearly all green hydrogen projects supplying green ammonia, e-methanol, liquefaction facilities, and other such use cases to be uneconomic, and thus never be built.

- **Technical limitations**: Today, many electrolyzer technologies are not capable of operating at lower capacity utilizations. Consider an electrolyzer with a minimum operating load of 40%. Using such equipment, a facility would be required to produce hydrogen at this minimum load even when EACs are not available, meaning that the facility would need to power the electrolyzer with grid electricity to fill the gap between EACs and the minimum operating load, risking disqualification from PTC as demonstrated in the example above. Once again, in this scenario, the taxpayer should be able to input into H2GREET the Requested Hydrogen Volume for which it can directly match EACs, and not be forced to include the non-compliant production volume due to technical limitations.

In the above scenarios, financial support could abruptly and significantly reduce or be eliminated. This creates significant challenges in raising financing for an infrastructure project like green hydrogen for several reasons:

- **Increased risk perception by lenders and investors:** Lenders and investors seek stable and predictable returns and may seek a higher risk premium to compensate for potentially reduced or zero PTC. This risk is particularly acute since the margin for error is only ~2% of hydrogen volume for a relatively new technology class. Additional negative impacts include higher interest rates and general reluctance to invest.
- **Difficulty in forecasting cash flows:** For infrastructure projects, financial viability is often heavily dependent on predictable cash flows. A steep PTC cliff makes it difficult to forecast long-term cash flows accurately, as it introduces a potential drastic reduction in revenue. This uncertainty can make it challenging to create a robust business case that can be financed.
- **Impact on credit ratings:** Credit rating agencies might view the steep PTC cliff as credit negative, as it can materially impact the project's ability to meet its debt obligations, especially if the operational metrics are not met. This translates into higher borrowing costs, further exacerbating the financing challenge and increasing the levelized cost of hydrogen.

Allowing a Requested Hydrogen Volume Approach would permit taxpayers to smooth the PTC cliff, eliminating binary risks to taxpayers and their financiers.

2.2 Include sub-regional grid power as a feedstock option eligible for DOE Emissions Rate and H2GREET Provisional Emissions Rate ("PER").

AES Comment: The current version of H2GREET provides carbon intensity values for nine regional grids[3] across the United States and eight hydrogen production pathways.[4] For any *feedstock* or *technology* production pathway not included in the most recent H2GREET model, the proposed regulations allow taxpayers to apply for a DOE emissions value and PER. AES requests that grid power from a sub-regional grid (defined as a subset of one of the nine regional grids identified in the DOE Transmission Needs Study) be included as a potential "feedstock" for which a taxpayer may request a PER. To this end, AES suggests the following revisions:

A. Add the red text to modify § 1.45V–4(c)(2)(i):

> (2) *Rate not determined* —(i) *In general.* […] A lifecycle GHG emissions rate has not been determined under the most recent GREET model with respect to hydrogen produced by the taxpayer at a hydrogen production facility if either the feedstock used by such facility or the facility's hydrogen production technology is not included in the most recent GREET model. A facility's hydrogen production pathway is not included in the most recent GREET model if the feedstock used by such facility or the facility's hydrogen production technology is not included in the most recent GREET model. A taxpayer may file a petition for a PER if it is proposing a feedstock or technology that is more specific than one already included in the GREET model (for instance, while GREET already includes the feedstock emission rate of grid power from the nine regional grids, a taxpayer may request a PER for feedstock power drawn from a sub-region of one of those grids). [...]

B. Add the red text to modify § 1.45V–5:

> (5) *Department of Energy (DOE) emissions value request process.* […] The DOE may decline to review applications that are not responsive, including those applications that use a hydrogen production technology and feedstock already in 45VH2–GREET or applications that are incomplete. Applications for feedstocks or technologies that are more specific than those already in 45VH2-GREET (for example, power from a sub-regional grid as a feedstock) shall not be deemed to be already covered in 45VH2-GREET). […]

Explanation: There are certain subsets of regional grids that have much lower carbon intensity than the overall regional grid, and hydrogen facilities that locate in those areas should be able to utilize and account for that lower carbon intensity power when requesting PTC. For example, ERCOT's aggregate renewable penetration is an estimated 40%, but ERCOT's West Load Zone has experienced renewable penetration above 80% with significant evidence of renewable generation curtailment. To further improve granularity of grid carbon intensity calculations, AES requests clarification that the types of feedstocks that taxpayers can request and utilize a PER for can include grid power drawn from sub-regional grids with high penetration of zero or minimal emission generation sources. Establishing a PER for power drawn from such sub-regional grids would allow hydrogen facilities located in those sub-regions to complement their EACs with additional low CI grid power, thus increasing their capacity

[3] Alaska, Hawaii, California, Mountain, Southwest, Texas, Plains, Northwest, Midwest, Delta, Southeast, Florida, Mid-Atlantic, New York, and New England. As illustrated in the October 2023 DOE Transmission Needs Study, available at: https://www.energy.gov/sites/default/files/2023-12/National%20Transmission%20Needs%20Study%20-%20Final_2023.12.1.pdf

[4] (1) Steam methane reforming (SMR) of natural gas, with potential carbon capture and sequestration (CCS); (2) Autothermal reforming (ATR) of natural gas, with potential CCS; (3) SMR of landfill gas with potential CCS; (4) ATR of landfill gas with potential CCS; (5) Coal gasification with potential CCS; (6) Biomass gasification with corn stover and logging residue with no significant market value with potential CCS; (7) Low-temperature water electrolysis using electricity; and (8) High-temperature water electrolysis using electricity and potential heat from nuclear power plants, as listed in Section V.A. GREET MODEL in the Explanation of Provisions.

utilization with limited to negligible induced carbon emissions. This would improve the economic viability of many potential projects and incentivize hydrogen producers to locate in sub-regional grids that have made very significant progress in decarbonizing and thus have lower induced emissions.

To establish a PER for sub-regional grid power as a new feedstock, the taxpayer would follow the same process already established in § 1.45V–4(c)(3) *Process for filing a PER petition*, and § 1.45V–4(c)(5) *Department of Energy (DOE) emissions value request process*. To support the process and avoid gerrymandering, when the DOE specifies procedures to request and obtain an emissions value, it may specify certain parameters for which applications it will accept, including for example that the proposed sub-regional grid meet the following suggested criteria:

- Is located within one of the nine grids identified in the National Transmission Needs Study but is not already modeled by H2GREET in the exact boundary configuration proposed by the taxpayer.
- Meets certain minimum size criteria.
- Is consistent with an already recognized sub-region within the grid (e.g., a power trading hub, a transmission zone, an area with identifiable transmission export/import constraints, etc.), for which reliable data already exists.
- Has had at least 75% of its annual energy generated by zero emission sources in at least one of the previous three years.
- Demonstrates evidence of curtailment of zero emission generation, whether through reports of physical curtailment or instances of negative power pricing.

Importantly, other jurisdictions attempting to characterize the carbon intensity of hydrogen produced from grid electricity have recognized similar pathways to this one. For instance, European Union (EU) regulations qualify hydrogen produced using grid power in grids where 90% of the generation comes from zero emission sources as "renewable liquid and gaseous transport fuels of non-biological origin".[5] Once that 90% threshold is reached within a calendar year, the additionality and hourly matching requirements are waived for the subsequent five calendar years.[6] While the majority of EU bidding zones follow national borders, Italy, Norway, and Sweden include smaller zones within their national borders.[7] By virtue of the proposed feedstock pathway, a similar concept could be adopted in the US, where some regional grids experience very different carbon intensities within their sub-regions.

2.3 Provide taxpayers with flexibility to allow the use of the H2GREET version used at the project's beginning of construction for the entirety of the project's lifetime.

AES Comment: AES requests that the regulations allow a taxpayer to use the version of H2GREET available as of the project's beginning of construction date for the duration of the project. This modification would require revising the text used to describe the appropriate GREET model from "most

[5] European Union, February 2023, "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," Article 4 "General rules for counting electricity taken from the grid as fully renewable", Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1184&qid=1704969010792

[6] European Union, February 2023, "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," Article 4 "General rules for counting electricity taken from the grid as fully renewable", Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R1184&qid=1704969010792

[7] Ofgem, July 2014, "Bidding Zones Literature Review", Available at: https://www.ofgem.gov.uk/sites/default/files/docs/2014/10/fta_bidding_zone_configuration_literature_review_1.pdf

recent GREET model" to the "applicable GREET model". This would also require the replacement of all 41 occurrences of text reading "most recent GREET model" with "applicable GREET model" throughout the regulations inclusive of its use in the Supplementary Information and Explanation of Provisions.

Suggested modifications (in red) to the draft regulations would begin with (but not be limited to):

§ 1.45V-1(a)(8)(ii):

> (ii) ~~*Most recent*~~ *Applicable GREET model.* Unless otherwise specified in the section 45V regulations, for purposes of the section 45V credit, the term ~~*most recent*~~ *applicable GREET model* means either (A) the latest version of 45VH2–GREET developed by Argonne National Laboratory that is publicly available, as provided in the instructions to the latest version of Form 7210, *Clean Hydrogen Production Credit,* or any successor form(s), on the first day of the taxable year during which the qualified clean hydrogen for which the taxpayer is claiming the section 45V credit was produced; or (B) the most recent version of 45VH2-GREET available, as provided in the instructions to the latest version of Form 7210, *Clean Hydrogen Production Credit,* or any successor form(s), on the date on which the facility's construction began. If a version of 45VH2–GREET becomes publicly available after the first day of the taxable year of production (but still within such taxable year), then the taxpayer may, in its discretion, treat such later version of 45VH2–GREET as the ~~most recent~~ applicable GREET model.

Explanation: AES appreciates that the draft regulations provide the taxpayer with the flexibility and discretion to choose between two H2GREET versions: (1) the H2GREET model that is available on the first day of the taxable year and (2) any updated H2GREET model that is made available after the first day of (but still within) the taxable year. AES generally believes that future versions of H2GREET will likely reflect an ever-greening grid. However, to allow the predictability that will be necessary for project financing, AES requests the addition of a third option: (3) the H2GREET model that was available as of the date on which construction of the qualified hydrogen facility began.

This additional option would provide a "baseline" H2GREET output that can be relied upon by project sponsors, investors, and lenders for the duration of the PTC term, at the time that the sponsors are making project investment decisions. If, for example, a newer version of H2GREET requires that a technology assume a higher carbon intensity than used in a previous H2GREET, this could result in a lower PTC than anticipated at financial close for the project, even if operating metrics are consistent with financing assumptions. This uncertainty may cause hesitancy among project investors and result in expensive and less efficient financing, impacting these projects' economic viability.

2.4 Do not subtract transmission and distribution line losses from the electricity represented by an EAC.

AES Comment: In response to the Treasury Department and the IRS' request for comment in V.C. Use of Energy Attribute Certificates in the Explanation of Provisions, AES agrees with the example used to describe a "qualifying EAC" as "one megawatt-hour of electricity used to produce hydrogen would need to be matched with one megawatt-hour of qualifying EACs". AES strongly opposes any treatment to adjust this 1:1 ratio for potential transmission and distribution (T&D) line losses.

Explanation: Estimating T&D losses is a highly complicated and dynamic exercise that involves a significant amount of modeling, assumptions, and calculation. It would be nearly impossible to make this both simple and accurate, as every project will have different T&D losses depending on the location of the hydrogen production facility relative to the source of EACs as well as the time of day. As such, it would add significant complexity, uncertainty, and administrative burden to an accounting and

verification process that is already much more complicated than what legacy PTC systems are used to – all for nearly negligible value. This additional layer of complexity may also create uncertainty for facility operators in their real-time operational decision-making process and increase the overall project costs due to risk-pricing in the financing process.

Part 3: Conclusion

AES reiterates our appreciation for the opportunity to comment on these proposed regulations. Our comments reflect our commitment to advancing the clean energy transition in a just, equitable, and affordable way. We welcome the opportunity to engage with the Treasury Department and the IRS to provide additional information or clarification on our comments.