Institute for Policy Integrity
NEW YORK UNIVERSITY SCHOOL OF LAW

February 26, 2024

**To:** Department of Treasury & Internal Revenue Service

**Subject:** Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property

The Institute for Policy Integrity at New York University School of Law[1] (Policy Integrity) respectfully submits this comment letter responding to the Department of Treasury and the Internal Revenue Service's (together, Treasury) notice of proposed rulemaking *Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property* (Proposed Rule).[2] Policy Integrity is a nonpartisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy.

Policy Integrity commends Treasury for its attention to the emissions of grid-connected electrolyzers for purposes of the 45V credit for clean hydrogen production,[3] as these emissions were the focus of our supplemental comments to Treasury in December 2022.[4] In this new round of comments, we support Treasury's proposal to allow grid-connected electrolyzers to establish the emissions intensity of their hydrogen by purchasing energy attribute certificates (EACs) that are incremental, time-matched, and geographically matched.[5] We also respond to specific questions posed by Treasury and offer additional recommendations for how to improve and better support the Proposed Rule.

**Incrementality:**

- Without the proposed incrementality requirement, an electrolyzer could induce substantial grid emissions by (1) adding load, (2) diverting existing non-emitting

[1] These comments do not purport to represent the views, if any, of New York University School of Law.
[2] Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property, 88 Fed. Reg. 89220 (proposed Dec. 26, 2023) (to be codified at 26 C.F.R. pt. 1) [hereinafter Proposed Rule].
[3] *See* 26 U.S.C. § 45V.
[4] Institute for Policy Integrity & WattTime, Supplemental Comments to U.S. Department of Treasury & Internal Revenue Service on Notice No. 2022–58 (Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production) (Dec. 2, 2022), https://perma.cc/5HF2-CFW6.
[5] *See* Proposed Rule, 88 Fed. Reg. at 89228.

generation to serve this load, and (3) leaving a gap that is filled by increased fossil generation.

- Treasury should preserve the integrity of the incrementality requirement by declaring that electricity from fossil plants that install carbon capture and storage (CCS) cannot be incremental if the CCS was required by law. That less-emitting generation would have otherwise served the grid.
- Similarly, Treasury should abandon the idea of treating 5% of the hourly generation of existing minimal-emitting generators as incremental. This is a poor proxy for the periods in which new electrolyzer load would absorb otherwise-curtailed renewables.
- Instead, Treasury should finalize a marginal-emissions-based exception for when the electrolyzer's induced emissions fall under the limits enumerated in Section 45V.

**Time Matching:**

- Hourly matching of electricity consumption and EAC purchases will help ensure the emissions induced by electrolysis equal the avoided emissions of the generator that sold the EACs. When those values are equal, and when the incrementality criterion has been satisfied, the emissions of the EAC-accruing resource become a good proxy for the hydrogen's overall emissions intensity.
- Some entities have advocated for more lenient time-matching regimes based on policy arguments about quickly growing the electrolytic hydrogen industry. To the extent this concern is legally relevant, Treasury's proposed timeline for the transition from annual to hourly matching reasonably balances emissions prevention with scaling up electrolytic hydrogen.

**Deliverability:**

- Treasury's proposed deliverability requirement would also help ensure that the emissions induced by electrolysis are exactly canceled out by the avoided emissions associated with the purchased EACs. Again, when this canceling out happens and when incrementality is satisfied, the emissions of the EAC-accruing resource serve as a good proxy for the hydrogen's overall emissions intensity.
- Treasury could improve its geographic-matching requirement by making use of locational marginal prices to establish deliverability.

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## I. The Proposed Incrementality Requirement Would Help Prevent Electrolyzers from Claiming the 45V Credit While Inducing Significant Grid Emissions—Unless Treasury Creates Unwarranted Exceptions

The first requirement that Treasury proposes for EACs sold to grid-connected electrolyzers is incrementality: whether the EACs are generated by an incremental source of electricity responding to the availability of the tax credit, such as a newly built generation facility, rather than a source that would have produced its electricity regardless. Without this requirement, electrolyzers would induce significant grid emissions notwithstanding their EAC purchases, as explained below.

Yet Treasury raises possible exceptions to its incrementality requirement that would substantially undermine the goal of accurate emissions accounting. Treasury should reject these exceptions and instead finalize an exception grounded in the marginal-emissions approach. Under a marginal-emissions approach, an electrolyzer could rely on EACs from existing generators when the electrolyzer's load induces grid emissions below the limits of Section 45V (e.g., <0.45 kg $CO_2e$/kg $H_2$ for $3/kg $H_2$) based on the emissions of the local marginal generator.[6]

### A. Without an incrementality requirement, electrolyzers could claim the 45V credit while inducing significant grid emissions

Treasury proposes that a grid-connected electrolyzer can use EACs to demonstrate the emissions intensity of electrolytic hydrogen if the generator began its commercial operations no earlier than three years before the electrolyzer was placed into service.[7] An electrolyzer could also contract with existing plants that have been uprated if the uprate occurred no earlier than three years before the electrolyzer was placed into service and the purchased electricity comes from the uprated production.[8]

As the Department of Energy (DOE) explains, these rules aim to prevent electrolyzers from using EACs to appear "clean" on paper while actually inducing substantial grid emissions.[9] Imagine a new electrolyzer comes online and contracts for EACs from a renewable resource that was producing electricity (and possibly EACs) for a different customer. The electrolyzer would

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[6] *See* 26 U.S.C. § 45V(b)(2) (setting forth the tax credit amounts for different emissions intensities).
[7] Proposed Rule, 88 Fed. Reg. at 89229.
[8] *Id.*
[9] DEP'T OF ENERGY, ASSESSING LIFECYCLE GREENHOUSE GAS EMISSIONS ASSOCIATED WITH ELECTRICITY USE FOR THE SECTION 45V CLEAN HYDROGEN PRODUCTION TAX CREDIT 9 (Dec. 22, 2023), https://perma.cc/AE6X-UYNU [hereinafter DOE WHITE PAPER] ("[C]onsider EACs that are geographically and temporally matched to the buyer's load but do not come from sources of incremental generation. . . . The overall load on the system is increased due to the buyer's new load but that increase is not compensated by an increase in new supply from the generator selling the EACs—thus requiring other existing generations (e.g., GHG emitting dispatchable generators such as natural gas or coal) to supply the overall increase in load immediately . . . . This demonstrates that the absence of an incremental generation attribute would yield an inaccurate assessment of induced grid GHG emissions from the incremental hydrogen load.").

have added new load to the system without adding any new clean generation. If the electrolyzer operates when renewables aren't being curtailed, its incremental demand would likely be met through fossil generation that otherwise wouldn't have occurred—just as if the electrolyzer had directly contracted with those fossil generators. This is because of the merit-order dispatch of generation resources, which generally causes any renewable resources to be dispatched before fossil generation, in light of their respective operating costs.[10]

Stated rigorously, true incrementality means showing that the associated clean generation would not have been deployed but for the revenue from selling EACs to the associated electrolyzer.[11] But demonstrating incrementality with this level of rigor is challenging, given the difficulty of proving a counterfactual. Treasury's three-year rule is an easy-to-implement heuristic that assumes incrementality has been satisfied if the generator did not begin its commercial operations significantly before the electrolyzer began operations. The primary virtue of Treasury's proposal is that, intuitively, generators built more than three years prior to the production of EACs are unlikely to have required EAC-based revenue to cover project costs, and are therefore more likely to be incremental.

### B. The incrementality requirement should exclude fossil generators legally required to install CCS

Treasury asks whether minimal-emitting electricity from an existing fossil generator should be considered incremental after the generator installs new CCS.[12] When the CCS is legally required, the answer is no.

When a generator is compelled by law to install CCS, the resulting minimal-emitting electricity should be considered part of the baseline grid mix—just like electricity from existing renewables. If an electrolyzer contracts for EACs from an existing fossil generator that installed CCS pursuant to a legal mandate, the electrolyzer adds load without adding any clean generation.

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[10] NAT'L ASS'N OF CLEAN AIR AGENCIES, IMPLEMENTING EPA'S CLEAN POWER PLAN: A MENU OF OPTIONS 21-1 to 21-2 (2015), https://perma.cc/MET8-Y2DD ("With all of the information on capabilities and costs in hand, the system operator then ranks the available [electric generating units (EGUs)] in merit order from the least costly to the most costly . . . . Ideally the system operator would want to minimize the costs of meeting electric demand by scheduling EGUs for dispatch based on merit order. The least costly EGU would be scheduled first, and then the next least costly EGU, and so forth until enough generation was scheduled to meet the expected demand.").

[11] *Cf.* GOV'T ACCOUNTABILITY OFF., GAO-11-345, OPTIONS FOR ADDRESSING CHALLENGES TO CARBON OFFSET QUALITY 3 (2011), https://perma.cc/6FUU-ZEG6 ("An offset is additional if it would not have occurred without the incentives provided by the offset program.").

[12] Proposed Rule, 88 Fed. Reg. at 89229 ("The Treasury Department and the IRS request comments on whether the electricity generated by such a facility should be considered incremental under circumstances such as if an existing fossil fuel electricity-generating facility after the addition of CCS (after upgrade), had a [commercial operations date] that is no more than 36 months before the relevant hydrogen production facility was placed in service. Comment is also requested on the related question of whether, depending on its carbon dioxide capture rate, it would be appropriate to treat such a facility as a new source of minimal-emitting generation on the grid that would not be associated with induced grid emissions.").

These circumstances create a gap between electricity supply and demand that may be filled by fossil generation *without* CCS, which would induce significant grid emissions.

In contrast, when a fossil generator is not legally required to install CCS but does so anyway, it may be appropriate to treat its EACs as incremental. Similarly, if a generator were to install CCS before the phase-in date of a legal mandate, the generation may be incremental until the mandate begins to apply.

### C. A formulaic 5% exception for existing generators would allow electrolyzers to claim the 45V credit while inducing significant grid emissions

The logic of the incrementality requirement implies an exception for electrolyzers that consume electricity at a time/location when their incremental load is met entirely with clean existing generation, such that their induced emissions fall within the statutory limits of Section 45V.[13] But, given the complexity of identifying these situations, Treasury seeks comment on a more "formulaic" exception to incrementality: "deem[ing] five percent of the hourly generation from minimal-emitting electricity generators (for example, wind, solar, nuclear, and hydropower facilities) placed in service before January 1, 2023, as satisfying the incrementality requirement."[14] Treasury selected 5% in part because it matches certain statistics regarding the frequency of periods of negative wholesale prices, which are predictive of periods of renewable curtailment.[15]

Treasury seeks comment on how well this formulaic 5% exception "captures the circumstances in which generation . . . does not generate induced grid emissions."[16] This exception could successfully approximate those circumstances in the specific case in which (1) a renewable generator curtails its load 5% of every hour without the added electrolyzer load and (2) the added electrolyzer consumes power during the curtailed hours, thereby offsetting the curtailments. (Even though this proposed exception would apply to nuclear, the curtailment justification does not apply to this generation type, which is not typically curtailed in the United States.[17])

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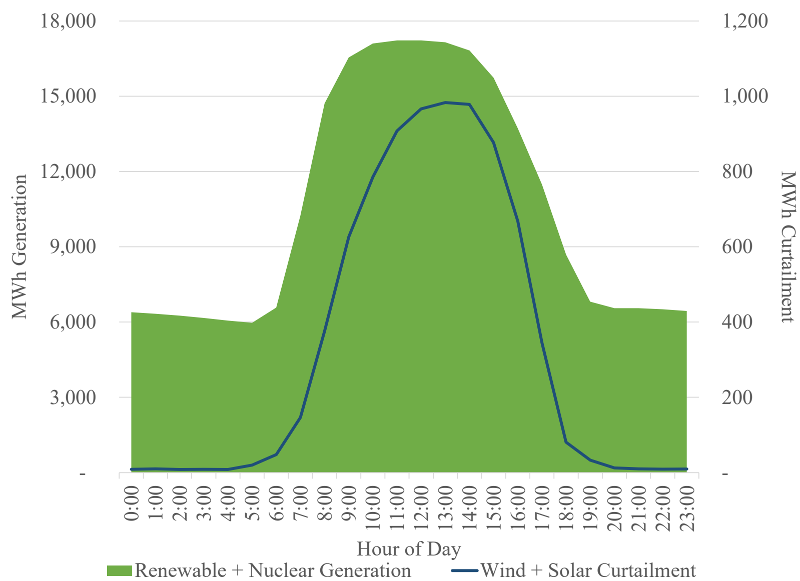
[13] Proposed Rule, 88 Fed. Reg. at 89231.
[14] *Id.*
[15] *Id.* at 89,231–32.
[16] *Id.* at 89232.
[17] *See Nuclear Power Reactors*, WORLD NUCLEAR ASS'N (May 2023), https://perma.cc/M32W-UBEM ("Nuclear power plants are best run continuously at high capacity to meet base-load demand in a grid system. If their power output is ramped up and down on a daily and weekly basis, efficiency is compromised, and in this respect they are similar to most coal-fired plants. (It is also uneconomic to run them at less than full capacity, since they are expensive to build but cheap to run.) However, in some situations it is necessary to vary the output according to daily and weekly load cycles on a regular basis, for instance in France, where there is a very high reliance on nuclear power."). Treasury also justifies the formulaic 5% exception by citing an Energy Information Administration estimate that 5% of the nuclear fleet is at risk of retirement. Proposed Rule, 88 Fed. Reg. at 89232. But this would result in a windfall profit to 95% of nuclear plants that do not need this revenue to continue operating—without any guarantee that this revenue would be sufficient to prevent the retirement of the 5% that are at risk.

But, in practice, curtailment periods are temporally clustered rather than distributed evenly, meaning there is a *timing mismatch* between electrolyzers' consumption of power and the curtailments that Treasury intends to offset. Consider Figure 1, which depicts the average renewable and nuclear generation throughout the day in CAISO compared to the average total curtailment.[18] The important takeaway is that, on average, there is essentially no curtailment for a third of the day, even though there is significant renewable and nuclear generation during these same hours.

Figure 1: 2023 Average CAISO Renewable/Nuclear Generation vs. Curtailment




An electrolyzer load during these no-curtailment hours could not possibly absorb clean generation that otherwise would have been curtailed. Yet, given 2023 levels of renewable and nuclear generation (which will increase in the future), the formulaic 5% exception would allow approximately 2,100 MWh of cumulative clean generation to be diverted from CAISO during these hours for hydrogen production—every single day.[19] This gap would necessarily be backfilled with fossil generation, as there are no curtailed renewables available. Assuming that marginal generator was a natural gas plant with an emissions rate of 970 lbs $CO_2$/MWh,[20] the 2,100 MWh of daily diverted generation would result in more than two million additional pounds of $CO_2$ per day.

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[18] *Managing oversupply*, CAL. ISO (Feb. 14, 2024), https://www.caiso.com/informed/Pages/ManagingOversupply.aspx (last visited Feb. 26, 2024) (derived from data on this page).

[19] We arrived at 2,100 MWh by multiplying the ~7 hours of no curtailment by the ~6,000 MWh of renewable/nuclear generation that occurs during those hours, and then taking 5% of that product.

[20] *See Frequently Asked Questions*, ENERGY INFO. ADMIN. (Dec. 7, 2023), https://perma.cc/32QM-JC2Z (listing the emissions of natural gas plants at 0.97 lbs $CO_2$ per kWh).

Aside from the temporal mismatch, there is also a *spatial mismatch* that would cause the formulaic 5% exception to induce grid emissions. Curtailment rates vary significantly across plants due to localized transmission constraints. The formulaic 5% exception would produce windfall revenue for plants that, due to their location within the transmission network, have low curtailment rates. And, for plants with high curtailment rates, the extent to which the electrolyzer load will offset curtailments is highly uncertain: The electricity from the curtailed generator may not be deliverable to the electrolyzer given congestion, meaning the curtailment would persist and the electrolyzer's load would be met by other generation, perhaps natural gas or coal.[21] Indeed, the very reason why these renewables are being curtailed frequently is the absence of transmission infrastructure to deliver their electricity. Although Treasury also proposes a deliverability requirement, its chosen regions are too large to solve this problem.[22] Given this deliverability problem, the formulaic 5% exception would frequently induce emissions even when curtailment and electrolyzer load are temporally aligned.

In sum, this exception would do little to absorb renewable generation that would have otherwise been curtailed. Instead, it could divert up to 5% of non-curtailed renewable generation from many parts of the grid during many hours—with fossil generation filling the resulting gap. One analysis has concluded that, if this happened, this exception could cause up to 1.5 billion metric tons of $CO_2$ emissions through 2035.[23]

### D. Treasury should instead adopt a targeted exception when/where the marginal generator is sufficiently clean

Instead of the formulaic 5% exception, Treasury should pursue its proposed "targeted" approach of excusing electrolyzers from the incrementality requirement when their induced emissions satisfy the statutory limits for the 45V credit.[24] We describe how a marginal-emissions methodology can reveal whether this has occurred, and why it would be administrable. Although we describe this approach as an exception to the incrementality requirement, when the proposed conditions have been met, electrolyzers should also be excused from the time-matching and deliverability requirements. As evidenced by the discussion below, those requirements become unnecessary when an electrolyzer complies with Section 45V based on the local marginal emissions rate.

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[21] *See infra* Section III.A (describing how a lack of deliverability can lead to significant grid emissions).

[22] *See infra* Section III.B (recommending a more granular deliverability analysis for the final rule).

[23] BEN KING ET AL., RHODIUM GROUP, HOW CLEAN WILL US HYDROGEN GET? UNPACKING TREASURY'S PROPOSED 45V TAX CREDIT GUIDANCE (Jan. 4, 2024), https://perma.cc/766H-F83D.

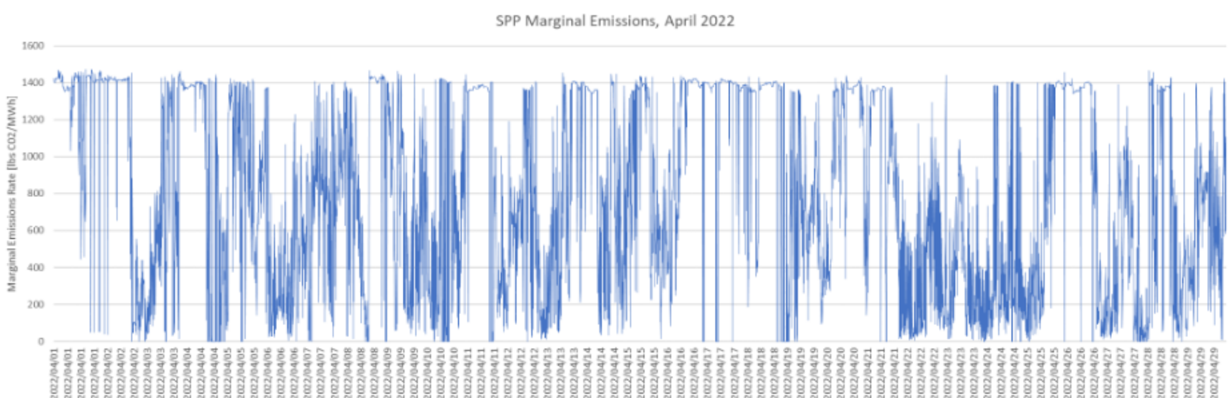
[24] *See* Proposed Rule, 88 Fed. Reg. at 89231 ("A demonstrated or modeled minimal-emission approach could treat electricity produced by certain existing electricity generating facilities under certain circumstances as satisfying the incrementality requirement if it is demonstrated that such sources and circumstances would not give rise to significant induced grid emissions. . . . Periods of curtailment or zero or negative pricing is one such circumstance.").

### 1. Incremental new load induces grid emissions according to the local marginal emissions rate

Given the realities of grid operation, the most accurate way to measure emissions from grid-connected electrolyzers involves looking at the emissions rate of the "marginal" generator serving the local grid at the moment of electrolysis. The marginal generator is whichever generator the grid operator would ask to increase its output to meet additional demand for electricity. The emissions from the marginal resource would be avoidable if the electrolyzer did not run; therefore, the electrolyzer is deemed to cause the emissions of this marginal generator. When the marginal emissions rate is zero, new load from an electrolyzer is met by zero-emissions resources and the electrolyzer induces zero emissions.

The challenge to implementing a marginal emissions approach is achieving the temporal and spatial granularity necessary to accurately identify when/where marginal emissions rates are sufficiently low for an electrolyzer to qualify for Section 45V. The identity of the marginal generator changes frequently throughout the day. Figure 2—which depicts the marginal emissions rate in Southwest Power Pool (a regional power grid in the central United States) and which was generated by WattTime[25]—reveals that the marginal emissions rate can swing back and forth from zero lbs $CO_2$/MWh to over 1,400 lbs $CO_2$/MWh repeatedly throughout a single day. DOE also recognizes the significant temporal variation in marginal emissions rates.[26]

Figure 2: Variability in Southwest Power Pool Marginal Emissions Rate




Marginal emissions rates also vary across locations, again a fact discussed by DOE.[27] Figure 3, created by WattTime based on their modeling, is a snapshot of the spatial variation in emissions rates of marginal resources on the afternoon of July 25, 2023. It shows that marginal emissions

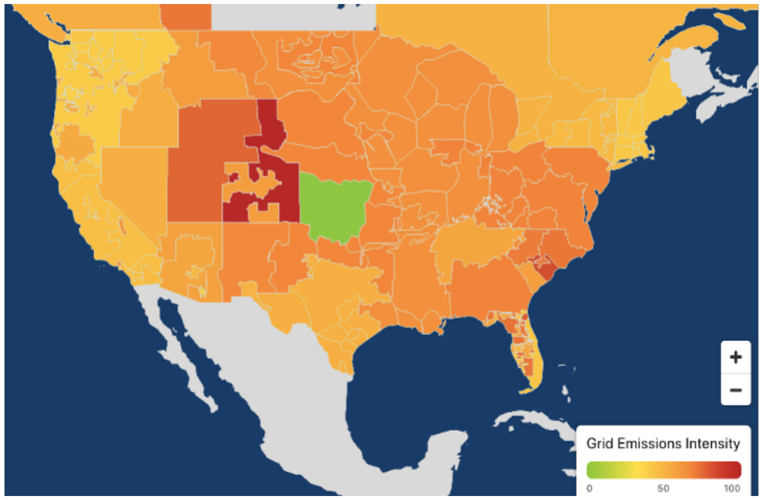
[25] *See Methodology: How Does WattTime Calculate Marginal Emissions?*, WATTTIME, https://perma.cc/NTD8-F88L; WATTTIME, MARGINAL EMISSIONS MODELING: WATTTIME'S APPROACH TO MODELING AND VALIDATION (2022), https://perma.cc/6DMQ-NX7P.

[26] DOE WHITE PAPER, *supra* note 9, at 5 n.9. ("Several organizations have begun to report marginal operational GHG emissions rates on a regional or national basis, employing multiple methods. Research has shown significant temporal and locational variation in operation emissions rates . . . in the United States . . . . ." (citations omitted)).

[27] *Id.*

rates can diverge sharply even between two areas that are geographically proximate. The green and red areas are directly adjacent, but the lack of transmission capacity between them prevents them from sharing a single marginal generator.

Figure 3: Spatial Variability in Marginal Emissions Rates




**2. An exception to incrementality based on local marginal emissions rates would be administrable**

Fortunately, a marginal-emissions approach with the necessary temporal and spatial granularity for verifying the emissions intensity of hydrogen would be feasible to implement. Most significantly, the Energy Information Administration is in the process of releasing real-time or near-real-time marginal emissions data for balancing authorities and pricing nodes.[28] When these data become available, the problem of locating accurate marginal emissions rates may be solved.

Until then, marginal emissions rates are available from private vendors,[29] as well as some grid operators like PJM.[30] Other balancing authorities publicly disclose the marginal fuel,[31] and

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[28] 42 U.S.C. § 18772(a)(2)(B) (instructing the Energy Information Administration to disseminate on a real-time basis, to the maximum extent practicable, "marginal greenhouse gas emissions by megawatt hour of electricity generated within the metered boundaries of each balancing authority" and an online database that may include the same for each node); *see also* Karen Palmer et al., RESOURCES FOR THE FUTURE, OPTIONS FOR EIA TO PUBLISH $CO_2$ EMISSIONS RATES FOR ELECTRICITY (2022), https://perma.cc/6VAA-JEQX.

[29] Palmer et al. *supra* note 28, at 22–25.

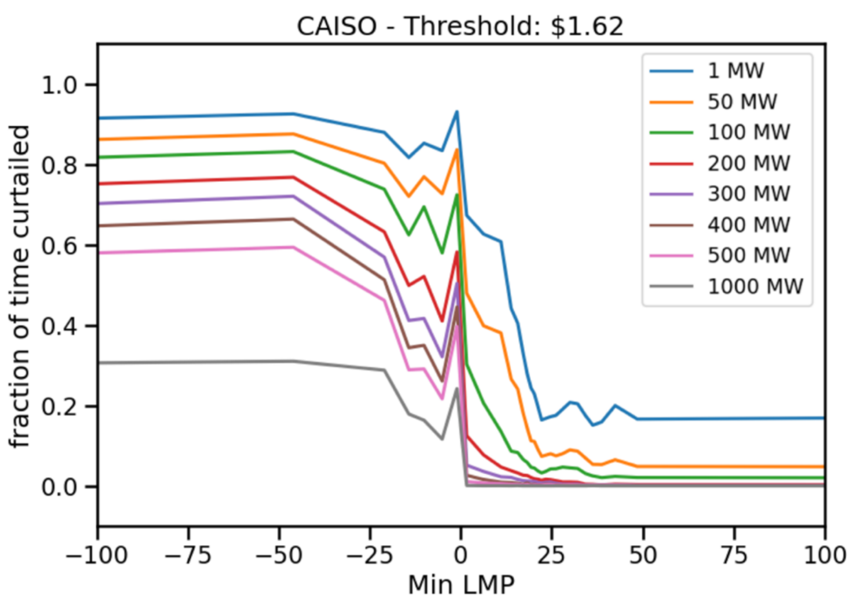
[30] *See Five Minute Marginal Emission Rates*, PJM INTERCONNECTION, https://dataminer2.pjm.com/feed/fivemin_marginal_emissions/definition (last visited Feb. 26, 2024); *Dispatch Fuel Mix*, ISO NEW ENGLAND, https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/gen-fuel-mix (last visited Feb. 26, 2024) (see "marginal flag string"); see also *California Self-Generation Incentive Program*, CALIFORNIA PUBLIC UTILITY COMMISSION & WATTTIME, https://sgipsignal.com/ (last visited Feb. 26, 2024).

[31] *Fuel on Margin*, SPP, https://marketplace.spp.org/pages/fuel-on-margin (last visited Feb. 26, 2024); *Real-Time Fuel on the Margin*, MIDCONTINENT INDEPENDENT SYSTEM OPERATOR, https://www.misoenergy.org/markets-and-operations/real-time--market-data/market-reports/#nt=%2FMarketReportType%3AReal-Time%2FMarketReportName%3AReal-Time%20Fuel%20on%20the%20Margin%20(xlsx)&t=10&p=0&s=MarketReportPublished&sd=desc (last visited Feb. 26, 2024).

marginal emissions rates can be derived from these data using unit-specific or regional emissions factors.[32] If Treasury were to create an exception to the incrementality rules based on real-time marginal emissions rates, generators' resulting need to access these rates would create pressure on grid operators to stand up the necessary systems.

Alternatively, perhaps as a stopgap until sufficiently granular marginal emissions data are available everywhere, it may be desirable for Treasury to use electricity prices that fall below a threshold price as a proxy for when the marginal generator is zero-emissions.[33] WattTime and Meta have developed a methodology to empirically select a price threshold associated with curtailment in regional grids based on the correlation between historical curtailment and locational marginal prices (LMPs).[34] Figure 4, reproduced from their paper, illustrates how the likelihood of curtailment varies as a function of the lowest nodal LMP in a region. For Treasury's purposes, the most important line is "1 MW" because, given merit-order dispatch,[35] whenever at least 1 MW of renewables is being curtailed where an electrolyzer is consuming power, the marginal emissions rate is very likely to be zero.

Figure 4: Probability of Curtailment in CAISO by Minimum LMP




[32] Palmer et al., *supra* note 28, at 3–4, 7 n.3, 21–23, 41.
[33] TESSA WEISS ET AL., RMI, CALIBRATING US TAX CREDITS FOR GRID-CONNECTED HYDROGEN PRODUCTION: A RECOMMENDATION, A FLEXIBILITY, AND A RED LINE (2023), https://perma.cc/MTU9-8HDE ("The $10/MWh proxy helps estimate when the grid is largely clean and the marginal generator is likely renewable.").
[34] BILGE ACUN ET AL., UNLOCKING THE POTENTIAL OF RENEWABLE ENERGY THROUGH CURTAILMENT PREDICTION (2023), https://perma.cc/C8SV-3TRX.
[35] *See supra* note 10 and accompanying text.

Treasury and DOE could use this methodology to determine a price threshold for each geographic-matching region within the final rule.[36] The agencies could then update these regional price thresholds periodically, perhaps annually, to ensure that they remain accurate as renewable penetration grows. Although the chart identifies a "threshold" of $1.62—which refers to the minimum LMP associated with a 50% probability of curtailment in CAISO[37]—Treasury would want to require a higher probability of curtailment before excepting existing resources from the incrementality requirement, to better ensure that the electrolyzer is really using otherwise-curtailed electricity (e.g., 90%).

Finally, the precedent of Colorado underscores the administrability of a targeted exception focused on when/where electrolyzers induce few or zero grid emissions. Colorado's recent hydrogen tax credit law requires the Colorado Public Utilities Commission to develop requirements for "demonstrating that the electricity used to produce clean hydrogen comes from renewable energy that would otherwise have been curtailed or not delivered to load."[38] The existence of this statute suggests that the federal government could implement a similar approach, whether through true marginal-emissions protocols, an LMP-based proxy method, or some other approach.

## II. The Proposed Time-Matching Requirement Would Help Prevent Electrolyzers from Claiming the 45V Credit While Inducing Significant Grid Emissions

The second proposed requirement for EACs from grid-connected electrolyzers is time matching. Time matching refers to the frequency with which the electrolyzer's consumption of electricity and the contracted-for EACs are aggregated—for example, whether total MWh consumed must be matched with contracted-for EACs produced on an hourly, monthly, or yearly basis.[39] Until the end of 2027, electrolyzers could establish the emissions intensity of their hydrogen by contracting for EACs that accrue within the same *year* as the hydrogen was produced.[40] Starting in 2028, the EACs would need to accrue within the same *hour* as the hydrogen.[41] This section provides evidence not contained in the Proposed Rule concerning why the transition to hourly matching is critical and why the timing of the 2028 transition is reasonable.

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[36] *See infra* Section III.A (describing the Proposed Rule's deliverability regions).
[37] ACUN ET AL., *supra* note 34, at 2.
[38] COLO. REV. STAT. § 40-2-138.
[39] Proposed Rule, 88 Fed. Reg. at 89228.
[40] *Id.* 89233-34.
[41] *Id.*

**A. If incrementality is established, the proposed shift to hourly matching would help ensure that EACs purchased by electrolyzers serve as an accurate proxy for electrolyzers' emissions**

An extension of the discussion of marginal emissions from Section I.D helps to illuminate why the proposed shift to hourly matching with incremental generation would allow contracted-for EACs to function as a relatively accurate proxy for electrolyzers' emissions. Treasury should include this explanation in the final rule as additional support.

As described above, the emissions from the marginal resource would be avoided if the electrolyzer did not run; therefore, load from the electrolyzer causes the emissions of this marginal generator in real time. This point has a corollary: Because grid operators generally deploy clean resources like renewables and nuclear before resources with fuel costs, incremental generation from these resources allows a marginal fossil generator to ramp down and thus avoids emissions from the marginal generator. Finally, the resource producing EACs may or may not have its own emissions rate, depending on whether it is a zero-emissions resource like a solar farm or a less-emitting resource like a natural gas plant with CCS. These ideas lead to this critical point: When the marginal emissions rates during electricity consumption and EAC accrual from an incremental generator are the same, the induced emissions from electrolysis and the avoided emissions from the EAC-accruing incremental generator cancel out. The only remaining emissions associated with electrolysis are those of the EAC-accruing generator.

So, when the marginal emissions rates during electrolysis and incremental EAC accrual are the same, the emissions of the incremental EAC-accruing resource will accurately represent the emissions attributable to the hydrogen for purposes of Section 45V. In contrast, if an electrolyzer draws power from the grid at a time when the marginal emissions rate is higher than the marginal emissions rate when the contracted-with generator injects power, the electrolyzer induces more emissions than the generator avoids. In those circumstances, the hydrogen production would have a net positive emissions impact, and the emissions intensity associated with the purchased EACs would serve as a poor proxy for the hydrogen's emissions intensity.

Because the marginal resource can change so quickly and so often within a single day (see Figure 2), the emissions of the EAC-accruing generator become a worse proxy for the emissions of the electrolyzer when there is a large time gap between the electricity consumption and the incremental EAC accrual.[42] The marginal generator is less likely to change when little time has

[42] DOE WHITE PAPER, *supra* note 9, at 11 ("[M]ore granular, and therefore more accurate, timeframes . . . will provide significantly greater certainty about lifecycle GHG emissions outcomes by ensuring that there is actual alignment between load and generation. . . . [A]n annual matching standard means that changes in supply on a month-to-month, day-to-day, and hourly basis during the year are not necessarily matched with load over those same timeframes. That unmatched load can drive induced GHG emissions because of the significant temporal variation in grid-system GHG emissions on a monthly, daily, and even hourly basis. Given hourly changes in grid GHG

passed. For example, for a sample grid region in western Kansas in 2023, WattTime calculated the marginal emissions rate every five minutes and found the standard deviation within each hour to be 77 lbs $CO_2$/MWh on average. In contrast, the standard deviation across five-minute increments for the entire year was 614 lbs $CO_2$/MWh, almost an order of magnitude higher, indicating higher variance throughout the year relative to within the hour. (The mean intensity in the sample was 1,445 lbs $CO_2$/MWh.)

Thus, requiring hourly matching would go a long way toward ensuring that electrolyzers' consumption of electricity does not cause more emissions than their EAC purchases avoid, making the emissions of the EAC-accruing generator into a usable proxy for electrolyzer emissions. But if an electrolyzer merely needs to buy EACs that accrued within the same year as the electrolyzer's power consumption, there is a significant risk that the marginal emissions rates would diverge. When the rates diverge, the EACs become a poor proxy for the emissions intensity of electrolytic hydrogen.

Critically, the above reasoning holds only if incrementality has been established, and, without that, hourly matching alone or in combination with the proposed deliverability requirement is *not* a means for establishing emissions intensity. For example, as noted in Section I.A, a hydrogen producer could contract to purchase EACs from a pre-existing generator. If that generator were non-incremental, the added load from the hydrogen producer would induce emissions from the marginal generator. This result is explored in a recent study published in *Nature Energy*, which compares the emissions impacts of annual vs. hourly matching requirements.[43] The analysis demonstrates that "one cannot generalize emissions impacts of a selected time-matching requirement in isolation from how other qualification requirements are defined."[44]

### B. To the extent it is legally relevant, the proposed transition from annual to hourly matching reasonably balances preventing emissions with scaling up the electrolytic hydrogen industry

Treasury proposes to allow annual matching until 2028—at which point hourly matching would be required—to allow the EAC market time to develop the necessary hourly-tracking capabilities.[45] Some entities, however, have encouraged Treasury to maintain perpetual annual matching or adopt a transition to hourly that preserves perpetual annual matching for electrolyzers built before the transition.[46] To justify these policies, these parties cite the

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emissions, an hourly energy-matching standard provides much stronger assurance that changes in load are matched by changes in supply.").

[43] Michael A. Giovanniello et al., *The influence of additionality and time-matching requirements on the emissions from grid-connected hydrogen production*, 9 NATURE ENERGY 197 (2024).

[44] *Id.* at 198.

[45] Proposed Rule, 88 Fed. Reg. at 89233.

[46] *E.g.*, Comments of American Council on Renewable Energy 6 (Dec. 22, 2022), https://www.regulations.gov/comment/IRS-2022-0029-0070; AM. CLEAN POWER, ACP GREEN HYDROGEN FRAMEWORK 5 (2023), https://perma.cc/4658-ZJ6L.

desirability of quickly scaling up the electrolytic hydrogen industry.[47] But Section 45V does not balance accurate emissions accounting against other goals; it simply establishes tax credits for hydrogen production based on the real emissions intensity of the hydrogen.[48] Still, to the extent that Treasury believes that concerns beyond accurate emissions accounting are legally relevant, research suggests that the proposed transition schedule appropriately balances preventing emissions and scaling up electrolytic hydrogen.

A recent study in *Nature Energy* concluded that, based on the dynamics of the renewable energy market, a transition from annual matching to hourly makes sense in approximately 2030.[49] The authors make this recommendation by balancing how each time-matching regime would affect the addition of new generation resources to the grid and thus grid-wide emissions, the effects on the levelized cost of electrolytic hydrogen (relevant for scaling the nascent industry), and the possibility that a stricter time-matching regime would lead to more methane-based hydrogen production with CCS (potentially increasing overall emissions).[50]

Another analysis concluded that transitioning from monthly matching to hourly matching in 2028 would accelerate the development of electrolytic hydrogen while causing relatively few additional emissions as compared to immediately requiring hourly matching.[51] Imposing a loose initial time-matching standard would help early movers to be cost-competitive for more end-uses and production locations.[52] Meanwhile, given the low initial volumes of electrolytic hydrogen, 95% of hydrogen produced during the lifetime of the 45V credit would be covered by hourly matching.[53]

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[47] Comments of Comments of American Council on Renewable Energy, *supra* note 46, at 6; AM. CLEAN POWER, *supra* note 46, at 3–4.
[48] 26 U.S.C. § 45V.
[49] Giovanniello et al., *supra* note 43, at 204 ("[I]n the medium term (from 2030 onwards), shifting [from annual time-matching requirements] to hourly time-matching requirements may be necessary to avoid the risk of high consequential emissions impacts. Moreover, a phased approach for implementing more stringent hourly time matching may also benefit from capital cost declines for power sector resources ([variable renewable energy], battery storage) and electrolysers that would make the [levelized cost of hydrogen] outcomes for hourly time matching more compelling than values estimated here.").
[50] *Id.* at 203–04.
[51] WEISS ET AL., *supra* note 33 ("A transition to hourly matching rules creates better long-term project outcomes without stifling early-stage industry growth. A transition to hourly matching in 2028 will ensure that hydrogen production maintains long-term emissions reduction ambitions, disincentivizes projects that will be non-competitive and unsustainable in the long term, and provides necessary conditions for the United States to establish itself as a leading presence in the global hydrogen market.").
[52] *Id.*
[53] *Id.*

## III. The Proposed Deliverability Requirement Would Help Prevent Electrolyzers from Claiming the 45V Credit While Inducing Significant Grid Emissions—But Could Be Improved with More Granular Deliverability Analysis

Treasury proposes to restrict EAC purchases to the same region to ensure deliverability.[54] Deliverability refers to whether the contracted-for EACs are associated with electricity that can flow from the generator to the electrolyzer. Electricity cannot deliverable between two regions if transmission capacity is lacking. For its deliverability regions, Treasury proposes to adopt the regions from DOE's National Transmission Needs Study.[55]

This section provides additional support for Treasury's proposed deliverability requirement. We also offer a recommendation for how to improve the requirement so that EAC purchases would be an even better proxy for the emissions of grid-connected electrolyzers.

### A. The proposed deliverability requirement would help ensure that EACs serve as an accurate proxy for an electrolyzer's grid emissions

As with temporal matching, Treasury's deliverability requirement is necessitated by differences in marginal emissions rates—this time, differences across locations instead of time. Without deliverability, an electrolyzer might consume power in a region where the marginal resource is a fossil generator—thus inducing the emissions of that plant—while contracting for EACs with a generator located somewhere where renewables are on the margin. The result would be fossil-powered electrolysis in the first region, while the renewable generation would not avoid any emissions in the second region because renewables were on the margin there.

In other words, the absence of deliverability can create a difference between the marginal emissions rates during electrolysis and EAC accrual. As explained in Section II.A, when this happens, the emissions induced by the electrolyzer and the emissions avoided by the EAC-accruing generator don't cancel out.[56] Only when those values cancel out (and the generation is incremental) are the emissions of the EAC-accruing generator a good proxy for the emissions intensity of electrolytic hydrogen.[57]

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[54] Proposed Rule, 88 Fed. Reg. at 89233.
[55] *Id.* 89228.
[56] *See* DOE WHITE PAPER, *supra* note 9, at 9 ("[C]onsider an example of a hydrogen producer that purchases EACs that are temporally matched and come from incremental clean generation, but without a geographic match. If the hydrogen producer operates in a grid region that is heavily dependent on high-GHG emitting generators but the clean generation operates in an otherwise low-GHG emitting region, then the net effect would be an increase in overall GHG emissions as the emissions caused by the producer would not be fully counterbalanced by the emissions displaced by the clean generation.").
[57] *See supra* Section II.A.

Treasury's proposed deliverability regions are a good start because the National Transmission Needs Study documents the relative lack of transmission capacity between these regions.[58] As such, it is reasonable for Treasury to treat EAC purchases across these boundaries as undeliverable.

### B. EAC purchases would better reflect the emissions intensity of electrolytic hydrogen if the geographic matching were empirically informed by locational marginal prices

Treasury recognizes the existence of congestion within the regions of the National Transmission Needs Study,[59] yet expresses a lack of knowledge of administrable options that would account for these intraregional deliverability constraints.[60] Treasury should consider an empirical approach based on LMPs because a more accurate heuristic for deliverability would make EAC purchases into a better proxy for electrolyzer emissions.

In wholesale electricity markets (which are not limited to Regional Transmission Organizations and include other areas that participate in energy markets[61]), the lack of transmission capacity causes real-time divergences among LMPs. Customers must pay for more expensive sources of generation when electricity from cheaper sources is not deliverable to their area.[62] Treasury should consider whether some difference in LMPs between the node at which an electrolyzer draws power and the node at which an EAC-accruing resource injects power indicates a lack of deliverability.[63] This could be an absolute difference in price, or on a percentage basis.

Alternatively, instead of requiring electrolyzers to satisfy a deliverability requirement subject to real-time fluctuation of LMPs, Treasury and DOE might collaborate to draw more granular regions based on historical LMP patterns. More specifically, the agencies might identify regions that, over the last few years, exhibited relatively similar LMPs most of the time. To perform this analysis, Treasury could draw on the existing academic literature on LMP-based clustering.[64] The agencies could assume that electricity is deliverable within these clusters of nodes, and they could periodically redraw the map to keep them current as the grid evolves.

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[58] DEP'T OF ENERGY, NATIONAL TRANSMISSION NEEDS STUDY 131–33 tbl.IV-4 (2023) (column 2020 GW), https://perma.cc/XV2A-669T.
[59] Proposed Rule, 88 Fed. Reg. at 89233.
[60] *Id.*
[61] *E.g.*, *Price Map*, CAL. ISO, https://www.caiso.com/TodaysOutlook/Pages/prices.html (last visited Feb. 26, 2024).
[62] PJM INTERCONNECTION, TRANSMISSION CONGESTION CAN INCREASE COSTS 1–2 (2023), https://perma.cc/8TNZENZ8.
[63] Volts, We're About to Give Billions of Dollars to Clean Hydrogen. How Should We Define It?, at 29:03 (Mar. 29, 2023), https://perma.cc/87SE-ERN3 (statement of Rachel Fakhry) ("[T]he notion is that electrolyzers and the clean energy supply that is netting out their emissions need to be located within a region where the LMP differential is not bigger than X. . . . That is a very good proxy for . . . no congestion between the two . . . .").
[64] *E.g.*, Dmitry V. Volodin & Tatiana Vaskovskaya, *Clustering approach for determination of congestion zones on nodal electricity markets in long term periods*, 2015 IEEE EINDHOVEN POWERTECH (2015).

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