December 2, 2022

The Honorable Lily Batchelder
Assistant Secretary (Tax Policy)
Department of the Treasury
1500 Pennsylvania Avenue, NW
Washington, DC 20220

Thomas West Jr.
Deputy Assistant Secretary (Tax Policy)
Department of the Treasury
1500 Pennsylvania Avenue, NW
Washington, DC 20220

The Honorable Charles P. Rettig
Commissioner
Internal Revenue Service
1111 Constitution Avenue, NW
Washington, DC 20224

William Paul
Principal Deputy Chief Counsel
Internal Revenue Service
1111 Constitution Avenue, NW
Washington, DC 20224

Re: Notice No. 2022–58 (Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production)

The Institute for Policy Integrity (Policy Integrity) at New York University School of Law and WattTime respectfully submit the following supplemental comments in response to the Department of Treasury (Treasury) and the Internal Revenue Service's (IRS) Notice No. 2022–58 (Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production). Policy Integrity is a non-partisan think tank dedicated to improving the quality of government decisionmaking through advocacy and scholarship in the fields of administrative law, economics, and public policy.[1] WattTime is a non-profit entity that aims to provide research, education, and assistance on the environmental benefits of electricity use timing, and advocates for a data-driven approach to solving environmental problems.

In response to Notice No. 2022–58, Policy Integrity submitted comments on November 4, 2022, referring Treasury and IRS to prior comments from Policy Integrity and WattTime to the Department of Energy on that agency's draft guidance for the clean-hydrogen-production standard.[2] Our supplemental comments more directly address Treasury and IRS's request for comments on the § 45V clean-hydrogen-production tax credits.

Under the Inflation Reduction Act (IRA), the availability and value of tax credits for the production of hydrogen depends on the emissions intensity of the production process, including upstream emissions from electricity generation.[3] The IRA further specifies that the emissions intensity of hydrogen production shall include only those emissions determined by (1) the most recent Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies Model

---

[1] These comments do not purport to represent the views, if any, of New York University School of Law.
[2] Institute for Policy Integrity, Comments to U.S. Department of Treasury and Internal Revenue Service on Implementation Guidance for the Inflation Reduction Act (Nov. 4, 2022); *see* Institute for Policy Integrity & WattTime, Comments to U.S. Department of Energy on Clean Hydrogen Production Standard (Nov. 4, 2022).
[3] Section 45V(b)(2).

(GREET) or (2) a successor model determined by the Secretary of Treasury.[4] **Our comments focus on two methodological points that Treasury and IRS should consider when calculating the carbon intensity of hydrogen produced using grid electricity.**

First, to ensure the accurate accounting of emissions from grid electricity, Treasury and IRS should commit to cooperating with the Department of Energy to promptly update GREET to use marginal emissions rates with appropriate spatial and temporal granularity. Marginal emissions rates with appropriate granularity reflect the true emissions consequences of using grid electricity to produce hydrogen. Additionally, a marginal-emissions approach would promote the efficient allocation of resources by incentivizing clean hydrogen production when and where renewable generation would otherwise be curtailed. In contrast, an annual-average approach to estimating emissions—as used in the current version of GREET—could undermine the goals of § 45V by underestimating the true emissions intensity of hydrogen, which would cause Treasury and IRS to apply incorrect tax credit levels. Alternatively, instead of working with the Department of Energy to update GREET, Treasury could use its discretion to develop a successor model that incorporates a marginal-emissions approach with appropriate spatial and temporal granularity.

Second, the final guidance should state that renewable energy credits (RECs), power purchase agreements (PPAs), and other indirect book accounting factors may be used to characterize the carbon intensity of hydrogen production only when these instruments represent true avoided emissions. Thus, Treasury and IRS should specify that these instruments may be used to reduce the carbon intensity of hydrogen production (1) only when there is additionality and (2) by an amount that is calculated using a marginal-emissions approach.

I. The Marginal-Emissions Approach to Measuring Emissions from Grid Electricity

Question .01(1)(e): How should qualified clean hydrogen production processes be required to verify the delivery of energy inputs that would be required to meet the estimated lifecycle greenhouse gas emissions rate as determined using the GREET model or other tools if used to supplement GREET? (i) How might clean hydrogen production facilities verify the production of qualified clean hydrogen using other specific energy sources? (ii) What granularity of time matching (that is, annual, hourly, or other) of energy inputs used in the qualified clean hydrogen production process should be required?

Question .01(4)(b): What technologies or methodologies should be required for monitoring the lifecycle greenhouse gas emissions rate resulting from the clean hydrogen production process?

Response: Treasury and IRS should endorse the use of a temporally and spatially granular marginal-emissions approach for assessing emissions from grid electricity, rather than GREET's current annual-average approach.

Treasury and IRS's final guidance should make clear that emissions from the use of grid electricity should be calculated based on a temporally and spatially granular marginal-emissions approach, rather than the annual average-emissions approach. **Accordingly, because GREET**

[4] Section 45V(c)(1)(B).

currently uses an annual-average approach, the final guidance should state that Treasury and IRS will work with the Department of Energy to promptly update GREET so that it adheres to a marginal-emissions approach. Alternatively, the guidance should state that Treasury will develop a successor model that incorporates a marginal-emissions approach to grid emissions.

A marginal-emissions methodology is superior to the current GREET methodology for two main reasons. First, a marginal-emissions approach provides a more accurate estimate of the true emissions impact of producing additional hydrogen using grid electricity. Second, using marginal emissions rates better incentivizes hydrogen production when and where renewable energy production would otherwise be curtailed.

A. Compared to the current GREET methodology, a marginal-emissions approach that is temporally and spatially granular would provide a more accurate estimate of the true emissions impact of using grid electricity to produce hydrogen.

A new electrolyzer creates additional electricity demand. The emissions related to this additional demand depend on the emissions intensities of the additional generating resources that are used to meet this demand. Marginal emissions rates show exactly this: the increase in emissions when electricity demand increases by an incremental amount at a given time and location.

Average Estimates Misrepresent the Actual Emissions Impact of Additional Load. A simple example demonstrates the necessity of a marginal-emissions approach for emissions accounting. Imagine that a new electrolyzer were located in the Pacific Northwest, where hydroelectric generation is abundant. If the emissions intensity of the hydrogen produced by that electrolyzer were calculated by looking at the average carbon intensity of the grid, the emissions intensity would be relatively low. But the real effect of the new load from the electrolyzer would be significantly different: Because there is not enough hydropower to meet the full regional demand for electricity, adding load in the Pacific Northwest from an electrolyzer would require more electricity generation from some other resource to meet total demand, likely a coal or natural gas plant. That plant would be the marginal plant in the region, and its emissions intensity would dictate the true emissions intensity of the electrolyzer. Thus, despite a low average emissions intensity of the regional grid, the actual carbon intensity of the hydrogen would be high because the additional generation needed for the electrolysis would come from fossil-fuel resources. GREET estimates electricity-use emissions by looking at the average grid mix, not the emissions of the marginal plant.[5] As the GREET documentation acknowledges, "the bulk average cannot be used within a marginal analysis, which seeks to identify the electrical facility on the margin that would be used if a new electrical load were added to the grid."[6]

Temporal Resolution Must Be Sufficiently Granular to Be Meaningful. Although any averaging approach would obscure the variability in emissions from electricity use, GREET's particular approach to averaging would lead to especially inaccurate estimates of carbon emissions because the model uses *annual* averages of the grid's carbon intensity.[7] Indeed, the GREET documentation recognizes that the timing of electricity use determines actual emissions

[5] J. KELLY ET AL., ARGONNE NAT'L LAB'Y, UPDATING ELECTRIC GRID EMISSIONS FACTORS 1 (2016).
[6] *Id.*
[7] *See id.*

and that the model "may not fully capture some time-of-use features" for flexible loads such as an electrolyzer that can intentionally time when it produces hydrogen.[8]

Hourly or sub-hourly marginal emissions rates change as frequently as the grid dispatch changes. Figures 1 and 2 show sample periods of marginal emissions for California Independent System Operator (CAISO) and Southwest Power Pool (SPP), and each figure depicts how the marginal emissions often oscillate between zero and either approximately 800 lbs CO_2/MWh in CAISO or 1,400 lbs CO_2/MWh in SPP.[9] These variations indicate how dramatic the misestimation could be if an annual-average approach were used instead of an hourly or sub-hourly marginal-emissions approach. **For that reason, Treasury and IRS's final guidance should endorse using temporally granular marginal emissions rates, which will require updating GREET or designating a successor model.**

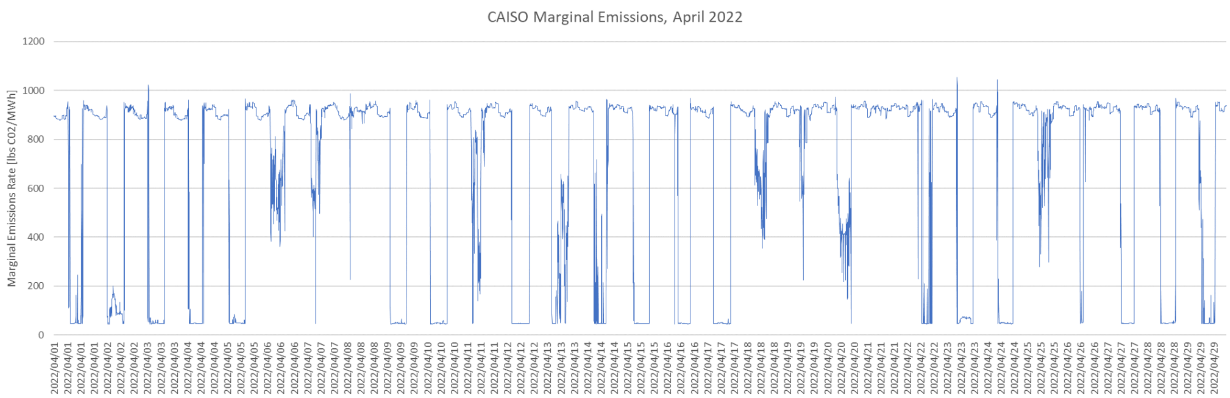

Figure 1: variability in CAISO marginal emissions

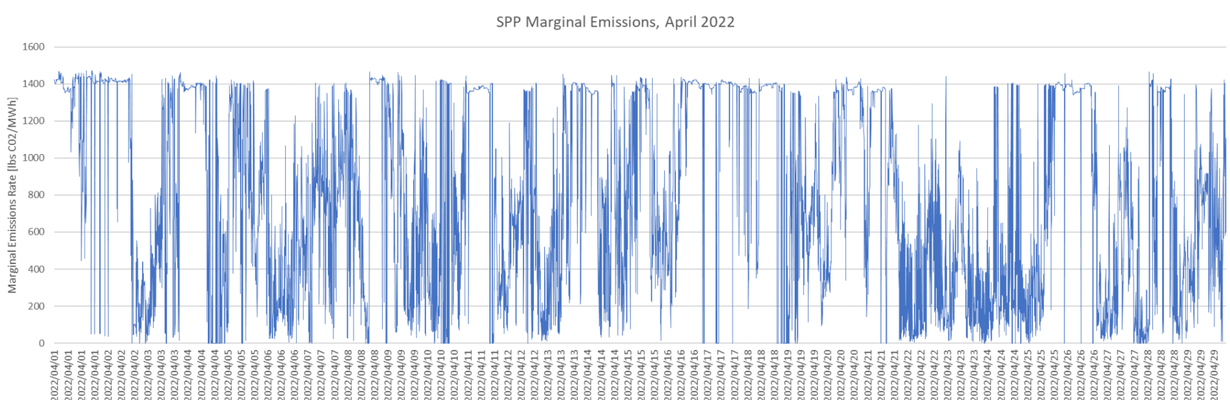

Figure 2: variability in SPP marginal emissions

---

8 *Id.*

9 Each figure reflects marginal emissions rates as modeled by WattTime. *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.

Additionally, GREET's annual-average emissions rates reflect the grid mix from 2017,[10] even though the 2016 GREET update states that emissions data should be updated annually.[11] Using GREET to assess emissions from grid electricity would mean using data that does not fully reflect the rapidly evolving mix of generation resources. In contrast, many of the currently available marginal emissions rates use real-time data. **The age of the GREET data is a further reason why employing GREET's annual averages would lead to inaccurate estimates of carbon intensity of hydrogen production.**

Spatial Resolution Should Reflect Grid-Management Realities. Marginal emissions rates vary not only with time but also with geography. GREET divides the United States into large regions with different average carbon intensities, and these regions generally do not align with grid-operation boundaries.[12] In practice, for any given change in load, a balancing authority (of which there are 66) manages the grid by turning on or off the power plants within its area to meet the changes in load.[13] These decisions happen on the balancing-authority level, or on a smaller spatial scale because of operational constraints (most notably, limitations in transmission). As a result, when an electrolyzer draws electricity from the grid to produce hydrogen, the carbon intensity will depend on where that electrolyzer is located. Figure 3 depicts the spatial variation in marginal emissions rates at a representative moment in time, as modeled by WattTime.[14] **Given this variability, Treasury and IRS should endorse the use of marginal emissions rates that align with the footprints of balancing authorities, or with even smaller areas when available, to better reflect the actual emissions caused by generating hydrogen with grid electricity.**

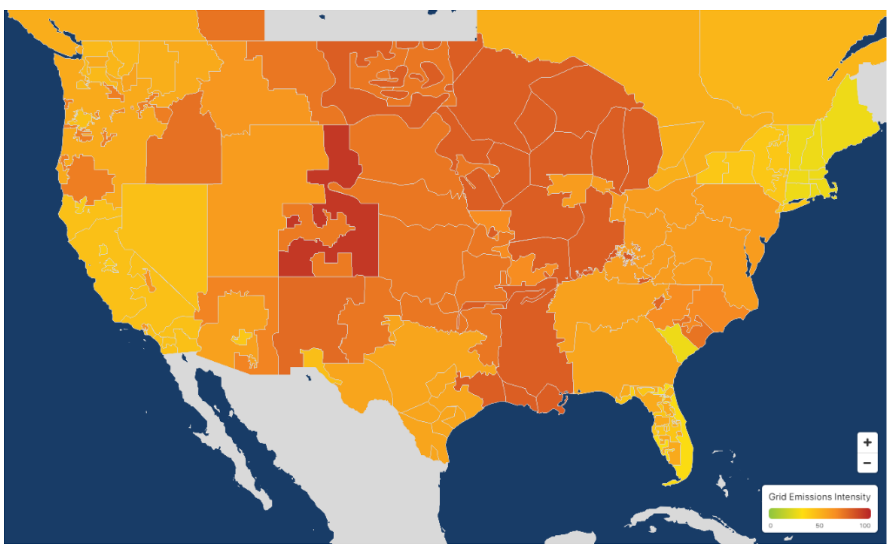

Figure 3: spatial variability in marginal emissions rates

[10] LONGWEN OU & HAO CAI, ARGONNE NAT'L LAB'Y, UPDATE OF EMISSION FACTORS OF GREENHOUSE GASES AND CRITERIA AIR POLLUTANTS, AND GENERATION EFFICIENCIES OF THE U.S. ELECTRICITY GENERATION SECTOR 2 (2020).
[11] KELLY, *supra* note 5, at 1.
[12] *See id.* at 2–3.
[13] *See U.S. Electric System Is Made Up of Interconnections and Balancing Authorities*, U.S. ENERGY INFO. ADMIN. (July 20, 2016), https://perma.cc/5XWJ-WT8X.
[14] *See* Ou & Cai, *supra* note 10; *see also Grid Emissions Intensity by Electric Grid*, WATTTIME, https://www.watttime.org/explorer/#3.89/43.6/-111.64 (last visited Nov. 30, 2022).

B. Using marginal emissions rates would better incentivize hydrogen production when and where there is more renewable energy curtailment.

When clean resources are being curtailed, the marginal emissions rate is zero for that region because any additional demand would be met by clean resources that would have otherwise been curtailed. Many regions of the US grid have an oversupply of renewable generation during certain periods. But the periods when consuming electricity causes no emissions are intermittent and determined by the specific generating resources in a region.

If Treasury and IRS were to measure the carbon intensity of grid electricity based on temporally and spatially granular marginal emissions rates, electrolyzers would be incentivized to locate in regions that experience curtailment and to produce during periods of curtailment. That outcome would reduce total costs to society by aligning hydrogen production with available clean electricity that would have otherwise gone to waste.

Figure 4 illustrates the growing magnitude of curtailment and thus the potential to intentionally pair electrolysis with excess clean generation under a marginal-emissions approach.

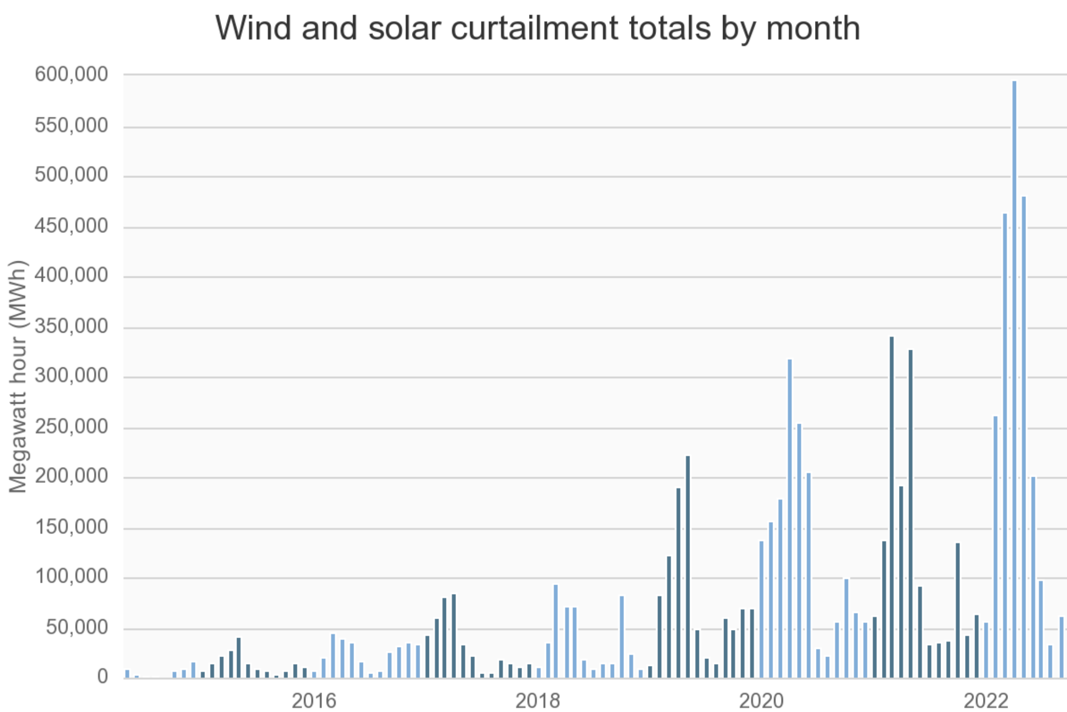

Figure 4: CAISO Curtailment[15]

C. A marginal-emissions approach would be administrable.

A marginal-emissions approach would be administrable because marginal emissions rates are available from a variety of sources (or will be available soon). Most significantly, the Energy Information Administration is in the process of releasing real-time or near-real-time marginal

[15] *Managing Oversupply*, CAISO, https://perma.cc/LG6T-U2SK (select "all" from the menu under "view").

emissions data for balancing authorities and pricing nodes.[16] The simplest way to implement a marginal-emissions approach would be to rely on these data.[17]

Alternatively, Treasury and IRS could solicit marginal emissions data directly from balancing authorities, some of which already release this information publicly.[18] Other balancing authorities publicly disclose the marginal fuel,[19] and marginal emissions rates can be derived from these data using unit-specific or regional emissions factors.[20] Balancing authorities that do not publicly release marginal emissions (or marginal fuel) data may release it upon request.[21]

Granular and real-time marginal emissions estimates are also available for purchase from private vendors.[22] Treasury and IRS could use private data in lieu of data from the Energy Information Administration or balancing authorities. Private data could also be used as a stop-gap measure until different data is available, or to supplement holes in other data sets (e.g., for a balancing authority that has not reported marginal emissions or marginal fuel).[23]

II. Characterization of Emissions Using Indirect Book Accounting Factors

Question .01(4)(f): Should indirect book accounting factors that reduce a taxpayer's effective greenhouse gas emissions (also known as a book and claim system), including, but not limited to, renewable energy credits, power purchase agreements, renewable thermal credits, or biogas credits be considered when calculating the § 45V credit?

Question .01(4)(g): If indirect book accounting factors that reduce a taxpayer's effective greenhouse gas emissions, such as zero-emission credits or power purchase agreements for clean energy, are considered in calculating the § 45V credit, what considerations (such as time, location, and vintage) should be included in determining the greenhouse gas emissions rate of these book accounting factors?

[16] *See* 42 U.S.C. § 18772(a)(2)(B) (requiring the Energy Information Administration to establish an online database that includes, where available, the estimated marginal greenhouse gas emissions per megawatt hour of electricity generated); Karen Palmer et al., RESOURCES FOR THE FUTURE, OPTIONS FOR EIA TO PUBLISH CO_2 EMISSIONS RATES FOR ELECTRICITY 19–20 (2022), https://perma.cc/6VAA-JEQX.

[17] *See* Palmer et al., *supra* note 16, at 40–42 (offering this same recommendation with respect to the Energy Information Administration's mandate to publish marginal emissions data).

[18] *See Five Minute Marginal Emission Rates*, PJM Interconnection, https://dataminer2.pjm.com/feed/fivemin_marginal_emissions/definition (last visited Nov. 30, 2022); *Dispatch Fuel Mix*, ISO New England, https://www.iso-ne.com/isoexpress/web/reports/operations/-/tree/gen-fuel-mix (last visited Nov. 30, 2022) (see "marginal flag string"); *see also California Self-Generation Incentive Program*, California Public Utility Commission & WattTime, https://sgipsignal.com/ (last visited Nov. 30, 2022).

[19] *Fuel on Margin*, SPP, https://marketplace.spp.org/pages/fuel-on-margin (last visited Nov. 30, 2022); *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(xls)&t=10&p=0&s=MarketReportPublished&sd=desc (last visited Nov. 30, 2022).

[20] Palmer et al., *supra* note 16, at 3–4, 7 n.3, 21–23, 41.

[21] *See, e.g.*, *Integrating Public Policy Task Force*, New York Independent System Operator, https://www.nyiso.com/ipptf (last visited Nov. 30, 2022) (releasing marginal emissions data that were not publicly available; select meeting materials from meeting on Mar. 19, 2018).

[22] Palmer et al., *supra* note 16, at 22–25.

[23] *See id.* at 27–29, 41–42.

Response: When calculating the carbon intensity of hydrogen in light of RECs, PPAs, and other indirect book accounting factors, Treasury and IRS should accurately account for the net emissions associated with hydrogen production in light of those instruments.

If electrolyzers seek to use RECs, PPAs, or other indirect book accounting factors to characterize the carbon intensity of hydrogen produced with grid electricity, Treasury and IRS should rely on rigorous carbon accounting principles to ensure accurate estimates of the hydrogen's true carbon intensity in light of those instruments. First, these instruments must satisfy the principle of additionality by representing the production of energy that would not have otherwise happened. Second, the avoided-emissions value of any instrument should reflect the true quantity of displaced carbon emissions that is attributable to the energy represented by the instrument, which will depend on the timing and location of the clean generation.

Renewable Generation Should Be Additional. If an electrolyzer purchases a REC to effectively offset the carbon intensity of the electricity that was used to produce hydrogen, the electrolyzer must show that the clean production associated with the REC is additional to the grid, not simply electricity that was always going to be generated and used by some other consumer.[24] Without this requirement, the use of a REC could merely reshuffle the allocation of electricity on paper and fail to genuinely offset any emissions resulting from the hydrogen production.[25] Because the electrolyzer is actually adding load to the grid, which may be met with fossil-fuel resources, allowing RECs to offset electric load on a 1:1 basis regardless of additionality might lead to misclassifying the lifecycle emissions rate of hydrogen. The same additionality principles apply to PPAs. If a clean generation resource has already been built, then its power was always going to be sold to some consumer. A PPA for this energy would represent the mere reallocation of energy on paper without doing anything to offset the electrolyzer's new load.

Accordingly, Treasury and IRS's final guidance should make clear that, before an electrolyzer can use indirect book accounting factors to characterize the carbon intensity of hydrogen, the electrolyzer should be required to demonstrate that the associated clean generation would not have been built but for the prospect that the clean generator could sell the RECs to or enter into a PPA with the electrolyzer.[26] Additionality is not necessarily satisfied by contracting with a clean generator that has yet to be built. In the context of RECs, if the associated generation would have happened irrespective of any REC sales, the RECs sold by that generator would not represent avoided emissions that could be claimed by an electrolyzer. Thus, no offset purchased under these circumstances should be recognized vis-à-vis the § 45V clean-hydrogen-production tax credits. In these comments, we do not take a stance on which of the multiple tests for assessing additionality is most appropriate for implementing § 45V.[27]

Offset Rules Should Attend to Marginal Emissions Rates. Assuming additionality has been satisfied, there are further accounting principles that Treasury and IRS should adopt in the final guidance to ensure that offsets purchased by electrolyzers are counted in accordance with the

[24] *See* Michael Gillenwater, *Redefining RECs—Part 1: Untangling attributes and offsets*, 36 ENERGY POL'Y, 2109, 2112-2113 (2008).

[25] *See* GOV'T ACCOUNTABILITY OFF., GAO-11-345, OPTIONS FOR ADDRESSING CHALLENGES TO CARBON OFFSET QUALITY 8 (2011), https://perma.cc/6FUU-ZEG6.

[26] *See id.* at 3 ("An offset is additional if it would not have occurred without the incentives provided by the offset program.").

[27] *See id.* at 18–21 (comparing different approaches for testing additionality).

actual emissions reductions that they represent. As explained above, because marginal emissions rates vary by time and location, the emissions displaced by clean energy generation also vary widely depending on the generation mix at a given time and place.[28] The emissions reduction associated with a renewable generator for a given period is the product of (a) the amount of power generated and (b) the marginal emissions rate when and where the renewable generator was operating.[29]

If a clean generator sells RECs (or other offsets) based on energy produced when the marginal generator was coal or natural gas, those RECs would be associated with a high amount of avoided emissions because that same quantity of energy would have been supplied by fossil fuels if the clean generator had not been operating. Thus, an electrolyzer could purchase those RECs and use them to lower the carbon intensity of hydrogen produced with grid electricity. In contrast, when a clean generator produces electricity when renewable resources are being curtailed, the clean generator is displacing no emissions, and an electrolyzer cannot claim any emissions offset based on a REC associated with that energy production. As discussed above, granular marginal estimates are available that would facilitate the calculation of the true avoided-emissions value of RECs based on time and geography. The same accounting principles would apply if an electrolyzer has a financial/virtual PPA involving the purchase of clean energy.[30]

For physical PPAs, assuming additionality has been met, clean power that is physically delivered and used by the electrolyzer within a single region at the time of hydrogen production would have an emissions intensity of zero.[31] But if a clean generator cannot itself source all the power contracted for under a physical PPA, the carbon intensity of the electricity procured from third parties would depend on the resources called upon to fill the deficit.[32] For additional energy purchased on the wholesale market, the carbon intensity would be that of the marginal plant for the region at the moment of generation.

---

[28] *See, e.g.,* Duncan S. Callaway, Meredith Fowlie & Gavin McCormick, *Location, Location, Location: The Variable Value of Renewable Energy and Demand-Side Efficiency Resources,* 5 J. ASS'N ENV'T & RES. ECONS. 39 (2018).

[29] WATTTIME, ACCOUNTING FOR IMPACT: REFOCUSING GHG PROTOCOL SCOPE 2 METHODOLOGY ON 'IMPACT ACCOUNTING' 8 (2022), https://perma.cc/9B6W-BJFQ; Aleksandr Rudkevich & Pablo A. Ruiz, *Locational Carbon Footprint of the Power Industry: Implications for Operations, Planning and Policy Making, in* HANDBOOK OF CO_2 IN POWER SYSTEMS 131 (Qipeng P. Zheng et al., eds. 2012).

[30] *See Financial PPA*, EPA (Feb. 25, 2022), https://perma.cc/67XS-ZQBL.

[31] *See Physical PPA*, EPA (Feb. 25, 2022), https://perma.cc/8YA3-F9GE.

[32] *See* AM. COUNCIL ON RENEWABLE ENERGY, *Renewable Energy PPA Guidebook for Corporate and Industrial Purchasers* 11-12 (2016), https://perma.cc/LJ3K-GZDY.

Respectfully,

/s/ Matthew Lifson
Matthew Lifson
Legal Fellow
INSTITUTE FOR POLICY INTEGRITY
matthew.lifson@nyu.edu

/s/ Burçin Ünel
Burçin Ünel, Ph.D.
Interim Co-Executive Director
INSTITUTE FOR POLICY INTEGRITY
burcin.unel@nyu.edu

/s/ Dara Marks-Marino
Dara Marks-Marino
Partnerships Coordinator
WATTTIME
dara@watttime.org

/s/ David Younan-Montgomery
David Younan-Montgomery
Partnerships Manager
WATTTIME
david@watttime.org

/s/ Henry Richardson
Henry Richardson
Senior Analyst
WATTTIME
henry@watttime.org