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Internal Revenue Service
CC:PA:LPD:PR (Notice 2022-49)
Room 5203
P.O. Box 7604
Ben Franklin Station
Washington, DC 20044

RE: Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production — Notice 2022-58 (Nov. 3, 2022)

REsurety appreciates the opportunity to provide these comments to the United States Department of the Treasury ("Treasury") and the Internal Revenue Service ("IRS"). These comments describe REsurety's role in the clean energy ecosystem, which includes a focus on providing tools and services to facilitate and promote rapid decarbonization of the power sector. These comments respond directly to questions from the November 3, 2022, Request for Comments.

1. Summary of Recommendations

The significant incentives provided by the hydrogen production tax credit are unprecedented and likely to supercharge the domestic hydrogen production industry. In order to maximize the potential carbon reduction benefits, however, REsurety recommends implementing with a focus on the following:

- **Encourage** the use of hourly marginal emissions rates to measure the net annual carbon emissions avoided and induced from grid-connected clean generation and hydrogen production facilities. This can be accomplished by using readily-available data to supplement the GREET model and is significantly more accurate and cost-effective than matching in megawatt-hours, even when restricted by geographic region.
- **Enable** qualified clean hydrogen production facilities to use tradable instruments, such as RECs, to demonstrate ownership over the emissions avoided by clean generation. This is necessary to facilitate the cost-effective utilization of offsite renewable energy generation to power clean hydrogen production and is implementable using existing and in-development tools.

2. REsurety Introduction

REsurety is a mission-driven analytics provider supporting the clean energy economy. For over 10 years, REsurety has built its expertise in accurate modeling and tracking of clean energy generation, power prices, and carbon emissions to enable our customers to reach their clean energy goals with confidence. REsurety has developed sophisticated tools to provide our customers insight into the emissions impacts of their energy decisions, and regularly provides data, tools, and services to some of the world's leading clean energy developers, buyers, investors, and advisors.

3. Responses to the November 3, 2022, Request for Comments

.01 Credit for Production of Clean Hydrogen

(1) Clean Hydrogen.

(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?***

Clean hydrogen production facilities should verify the emissions impact of their clean energy sources by using Renewable Energy Credits (RECs) or similar instruments to represent ownership over environmental and emissions attributes of electricity. Each REC purchased represents ownership over the emissions attributes of that MWh of electricity, based upon when and where it was generated. There is a proven and existing REC ecosystem that exists today[1] for the purposes of demonstrating ownership over clean energy generation.

REsurety suggests that the owner of a REC is entitled to an avoided emissions claim equal to the marginal emissions rate at the time and place of clean energy generation. The use of *hourly* and *location-specific* RECs and marginal emissions rates should be encouraged, to maximize the accuracy of the emissions calculation. Modeling by REsurety has found that using hourly, location-specific marginal emissions rates results in a more accurate measurement of the actual impact of generation or load on the grid than alternatives, such as matching RECs with consumption (either annually or hourly) and applying an average emissions rates to any residual consumption. In modeling, REsurety has found that such an approach can result in large errors[2]. In contrast, applying marginal emissions to RECs created at the location and time of project generation very closely matches the actual emissions reductions achieved by the purchased clean energy.

> ***(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?***

REsurety suggests that emissions should be measured hourly and netted annually. We believe that this approach will minimize costs, limit complexity, and ensure the accuracy of emissions

[1] As an example, S&P Global lists ~160 REC products that are currently in active trading.
[2] See page 6 of REsurety's White Paper: Making It Count

calculations to align with the goals of the IRA. By netting annually, the cost of clean hydrogen is kept low by encouraging the utilization of a wide range of low-cost clean resources, including intermittent technologies. In addition, annual netting of induced and avoided emissions is administratively simple relative to hourly alternatives, limiting overhead. By measuring generation and emissions hourly, however, the emissions impact of generation and load on the grid will be accurately measured.

In order to determine the impact of hourly measurements, REsurety has analyzed the hourly generation and nodal marginal emissions rates at all wind farms in ERCOT and PJM. We have found that using annual marginal emissions rates, rather than hourly, can result in an overestimation of avoided emissions of up to 20%. We have found that using grid-wide marginal emissions rates, rather than nodal marginal emissions rates, can result in the overestimation of avoided emissions by up to 60% for some wind projects. In PJM, we found similar results, with some projects reaching errors of up to 40% when using annual grid-wide marginal emissions rather than nodal, hourly data. As a result of these findings, we believe that preference should be given to high-resolution hourly, location-specific marginal emissions rates when such data is available.

(4) Recordkeeping and Reporting.

> ***(b) What technologies or methodologies should be required for monitoring the lifecycle greenhouse gas emissions rate resulting from the clean hydrogen production process?***

The emissions associated with electricity production should be determined through the use of marginal emissions data, with preference given to data provided at high locational and temporal resolution, which can be incorporated into the GREET model.

This methodology will increase the accuracy of estimates of the carbon impact of hydrogen production, specifically, by measuring the grid emissions *avoided* by clean generation and the grid emissions *induced* by load. The emissions induced by clean hydrogen production can be calculated as the hourly or sub-hourly product of energy consumed and the marginal emissions rate at the location of consumption. Similarly, the emissions avoided by clean energy generation can be calculated as the hourly or sub-hourly product of energy generated and the marginal emissions rate at the location of generation. The net of these two values reflects the total carbon impact of hydrogen production.

The GREET model currently lacks hourly, location-specific marginal emissions data and therefore cannot accurately measure the emissions associated with incremental electricity consumption. Instead, GREET relies on an annual-average approach to estimating emissions, which could significantly miscalculate emissions from hydrogen production.[3] Modeling by REsurety has found that the use of annual-average grid-wide emissions rates applied to residual consumption can overestimate the actual emissions impact of an activity.[4] This meaningful misalignment between actual emissions impacts and annual-average estimates (such as those produced by GREET) means that the use of GREET's current annual-average emissions rates could drive the

[3] Argonne National Lab: Updating electric grid emissions factors
[4] REsurety White Paper: Making it Count

development of hydrogen and clean energy infrastructure to locations that don't actually have the emissions impact intended, and thereby not accomplish the goals of the IRA. We recommend that the GREET model be supplemented by marginal data sets to enable the accurate calculation of emissions associated with hydrogen production and clean energy.

Incorporating hourly, location-specific marginal emissions data into the GREET model will lead to a more accurate calculation of the impact of incremental generation and load, and therefore better support the goals of the IRA. By broadly incentivizing clean hydrogen production when and where renewable generation would otherwise be curtailed, this will also promote the development of clean energy generation when and where that generation can be incorporated into the grid.

Lastly, it is important to note that marginal emissions data is readily available throughout the entirety of the United States, and can be used today. Zonal hourly or sub-hourly marginal emissions data is available across the entirety of the US. High geographic resolution nodal data is already available in PJM and ERCOT, and REsurety plans to make nodal data available in all other wholesale markets in 2023. More broadly, a number of public and private providers[5] currently supply marginal emissions data, and data is available via easy-to-use, automatable interfaces such as APIs.

(c) What technologies or accounting systems should be required for taxpayers to demonstrate sources of electricity supply?

As described in (1)(e)(i), using environmental ownership attribute tracking systems, such as RECs, will allow owners to measure the emissions avoided associated with contracted clean generation. These existing systems are proven to be capable of ensuring accurate tracking of ownership over environmental attributes of clean energy supply.

(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?

Yes, a book and claim system is critical to enable offsite clean generation to contribute to clean hydrogen production. Without such a system, eligible clean energy production above the grid mix would be limited to co-located facilities, which would dramatically increase the cost of both clean energy generation, and by extension, hydrogen production. Renewable energy systems, such as utility-scale wind and solar projects, are most cost-effective if built in locations where land is more affordable and the renewable resource (e.g. wind speed or irradiance) is highest, which are unlikely to coincide with the optimal locations for hydrogen production. The transmission grid exists for this exact reason: to enable the efficient development of generation and load in distinct locations. A book and claim system enables utilization of this existing transmission grid and will result in materially lower costs of clean hydrogen production relative to alternatives. As mentioned in (1)(e)(i), REsurety recommends the utilization of existing and proven systems, such as Renewable Energy Credits

[5] Resource for the Future: Options for EIA to Publish CO2 Emissions Rates for Electricity

(RECs), to track purchases of any offsite renewable energy made by clean hydrogen producers, so long as the use of such systems meet the requirements laid out in the response to (4)(g), below.

> ***(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?***

Indirect book accounting factors, such as RECs, are a proven means of avoiding double counting when it comes to tracking ownership over emissions attributes. There is significant infrastructure, both existing and in development, to support the use of RECs for these purposes. Historically, however, RECs have been used for the purposes of matching megawatt-hours of generation with megawatt-hours of load, which can result in extremely inaccurate estimates of emissions.[6]

The problem with matching megawatt-hours

Context: Each electric transmission in the U.S. is effectively a single, very large, interconnected system. In real-time, the total amount of generation in the system must match the total amount of electricity consumption. The interconnected nature of this system means that the action of any individual generator or load will cause other generators in the system to rebalance, so as to ensure continued equilibrium between generation and demand. The rebalancing of the system, however, is not done at random: specific generators (known as "marginal" generators) are identified in each hourly or sub-hourly interval by the system operator to flex up and down as needed to ensure continued balance. The emissions associated with those generators flexing up or down in response to a change in generation or load in a location is known as the "marginal emissions rate" at that location and at that time. The marginal emissions rate measures the emissions *induced* by an incremental MWh of load, or the emissions *avoided* by an incremental MWh of clean generation. For example, 1 MWh of generation by a solar farm will cause the marginal generators to reduce output by 1 MWh, with the reduction in system emissions determined by the emissions rates of those marginal generators and how they are redispatched. The same logic applies to an incremental MWh of load (from, for example, a hydrogen production facility): marginal generators will increase output in order to meet that load, and emissions will be impacted accordingly.

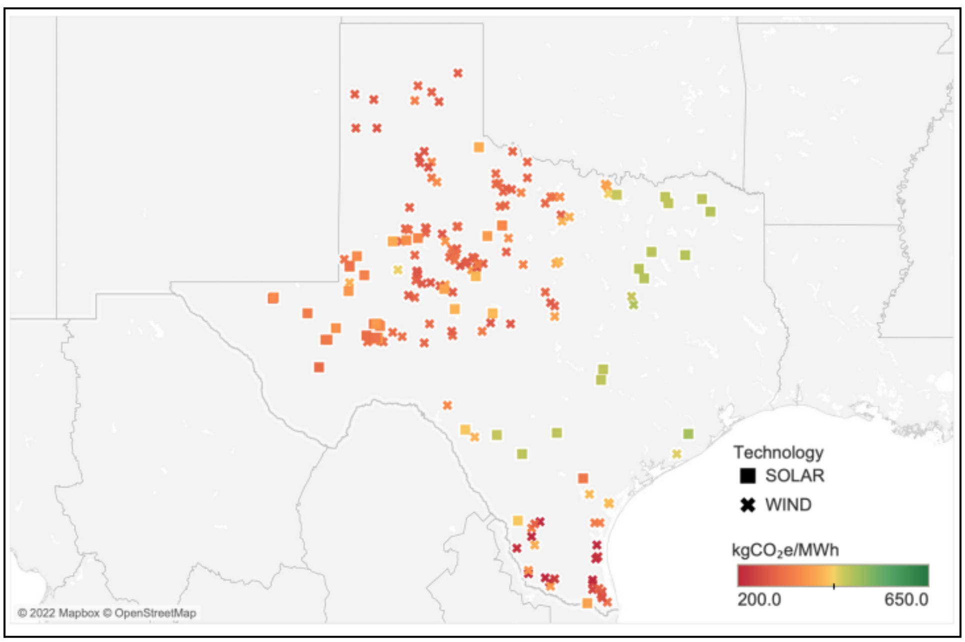
However, the emissions induced by the 1 MWh increase in hydrogen load may not equal the emissions avoided by the 1MWh increase in solar generation: marginal generators will respond differently based upon where the two facilities are within the electric grid, even within the same hour, due to transmission constraints within the grid. REsurety has observed facilities located only tens of

[6] Historical analysis by REsurety has found that annual MWh matching of RECs between generation and load can result in a 50% overestimate in emissions avoided by clean generation.

miles apart in the same grid, where, even in the same hour, the marginal emissions rate at one facility is multiples of that at the other facility.[7]

The problem with MWh-based matching: Historically, some entities have relied upon matching megawatt-hours of clean generation with megawatt-hours of load in order to demonstrate the cleanliness of energy supply. For example, if an entity consumes 100MWh in a given time period, that entity would purchase 100MWh of zero-carbon energy over that same time period to consider the emissions associated with its consumption to be zero. However, as we have seen above, the differences in location (even within the same grid) between points of generation and consumption can result in those two activities resulting in very different levels of emissions impacts, even if they match in units of megawatt hours, such that the net emissions impact is far from zero.

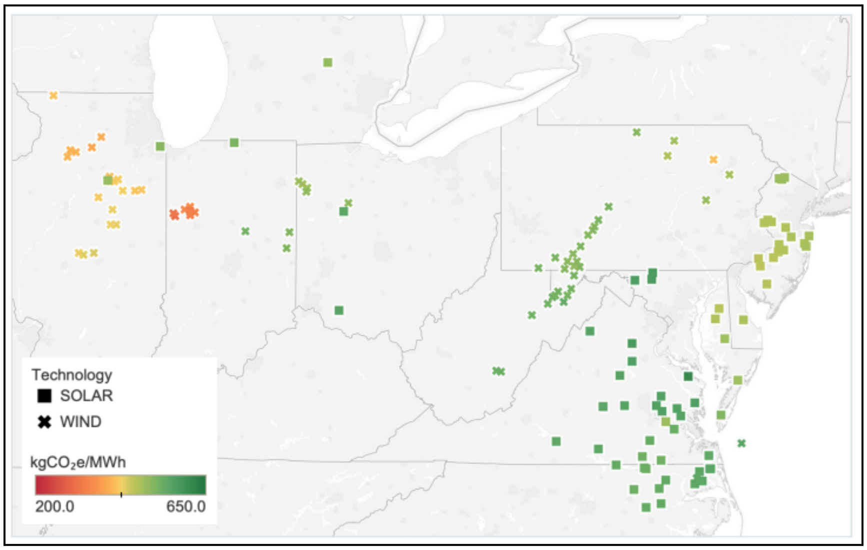
Analysis by REsurety has shown that different generators located within the same grid can have substantially different impacts on grid carbon emissions. The plots below show the wide range of emissions avoided by wind and solar projects from January-July 2022.[8]



Emissions Impact (kgCO_2e /MWh) for ERCOT Wind & Solar Projects, Jan-Jul 2022

[7] REsurety and Brattle Group White Paper: Locational Marginal Emissions, a Force Multiplier for Clean Energy Programs

[8] REsurety White Paper: Q3 State of the Renewables Report



Emissions Impact (kgCO_2e/MWh) for PJM Wind & Solar Projects, Jan-Jul 2022

The impact of locations is relevant at both hourly and annual timescales. Annual MWh matching typically results in the most erroneous emissions estimates, because differences in timing between production and consumption will cause their emissions impacts to be different. Hourly MWh matching, while more accurate than annual MWh matching, is substantially more complex and results in a much higher cost per unit of emissions avoided.[9]

Recommended approach: Annual matching of *emissions,* rather than MWh, between the emissions avoided by clean generation and emissions induced by load is technologically feasible and would allow for the cost-effective development of clean hydrogen resources. While the matching of emissions is performed annually, the emissions should be calculated at the hourly level.

A book and ledger approach will allow for contracting with cost-effective offsite utility-scale renewables. Annual matching enables the utilization of a wide range of renewable technologies, including the most cost-effective intermittent resources (such as wind and solar). Moreover, calculating emissions on an hourly basis using a marginal emissions rate will accurately measure the carbon intensity of hydrogen production and associated clean energy generation. Lastly, this approach is highly feasible by leveraging data and REC systems that are currently available.

REsurety appreciates the opportunity to provide this feedback. Please contact Adam Reeve (areeve@resurety.com) with any further questions.

[9]Page 76: Xu, Qingyu, & Jenkins, Jesse D. (2022). Electricity System and Market Impacts of Time-based Attribute Trading and 24/7 Carbon-free Electricity Procurement. Zenodo. https://doi.org/10.5281/zenodo.7082212