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Internal Revenue Service
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Room 5203
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Re: Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production Under Section 45V and 45 Z

Submitted via www.regulations.gov; Notice 2022-58

The joint-signers below represent a comprehensive cross-section of the clean energy and clean hydrogen industries: wind original equipment manufacturing, wind development, solar development, hydrogen development, long duration storage, and electrolyzer manufacturing. We are here to urge the Treasury and DOE to develop clean hydrogen standards in line with climate goals and to affirm that these standards are technically and economically feasible for the industry.

Nordex Group is consistently ranked within the top four global suppliers of wind turbines globally (outside of China) and has maintained a North American headquarters in Chicago, IL with manufacturing and service operations in West Branch, IA since 2007. Nordex currently employs over 530 people in the United States and has 2,853 wind turbines spinning across 19 States for a total generation of 8,636 MW of power.

Vestas American Wind Technology and its sister company, Steelhead Americas, represent the world's largest wind turbine manufacturer and its corresponding wind project development subsidiary. Vestas has an installed base in the US of over 38 GW from over 23,000 turbines and currently services over 34 GW of wind projects. Vestas employs 6,100 Americans in the manufacturing, installation, and service of onshore and offshore wind turbines. In 2021, Vestas spent $1.7 billion across the USA supply chain with 1,300+ suppliers.

Steelhead Americas has one of the largest wind project pipelines in the United States. Since its inception in 2016, Steelhead has sold 2.1GW of projects now completed or under construction. Steelhead has a pipeline of over 4 GW.

Intersect Power is a clean energy company bringing innovative and scalable low-carbon solutions to its customers in retail and wholesale energy markets. Our current portfolio includes 2.2 GWp of solar PV and 1.4 GWh of co-located storage, which are currently under construction and will be in operation in 2023. Intersect Power's mid to late-stage pipeline includes over 8.5 GW of clean energy generation and 8 GWh of battery storage. Intersect Power is proud to be a green hydrogen leader with over 3 GW of electrolytic green hydrogen facilities under development.

Electric Hydrogen Co. (EH2) is a manufacturer of low-cost electrolyzer systems that produce fossil-free hydrogen at industrial scale. EH2's technology is designed to enable users to efficiently and cost-effectively take advantage of variable renewable energy resources to generate clean power and clean feedstock for multiple industries, including steel manufacturing, fertilizer production, chemical processing, refining, and long-distance heavy transportation.

Synergetic LLC is a developer of green hydrogen production and storage throughout North America with a focus on high-volume, low-cost clean hydrogen capable of meeting the most stringent environmental standards that may be imposed.

Rondo is an American company that has developed an innovative long-duration energy storage technology to deliver zero-carbon heat and/or electricity to a wide range of industrial processes. The Rondo Heat Battery (RHB) captures intermittent electricity, stores the energy from that electricity as high-temperature heat in brick materials, and delivers the stored energy on demand as high-temperature heat and/or electricity. The RHB stores heat energy at temperatures up to 1500°C for hours or days—enabling use cases such as steel, cement, and chemical manufacturing. Rondo is manufacturing its heat batteries in its facilities in Hayward and Alameda, California and has begun commercial deliveries.

Many of the joint-signers of these comments may also be filing their own comments elaborating on details that may differ from what is precisely described herein, but all joint-signers embrace the overall themes promoted in these comments. We appreciate the opportunity to weigh in on this important guidance.

I. QUESTIONS FROM TREASURY/IRS

.*01(1)*. Section 45V provides a definition of the term "qualified clean hydrogen." What, if any, guidance is needed to clarify the definition of qualified clean hydrogen?

In order to promote clean hydrogen production, the IRS should clarify that on-site (behind the meter) renewables used to power electrolyzers as well as grid-connected hydrogen projects that meet IRS's emissions standards—subject to guidelines outlined below—will qualify as clean hydrogen. Further, IRS should clarify that hydrogen produced in the United States but sold or used internationally will still qualify for the 45V tax credit. These clarifications will set the stage for a green hydrogen economy to flourish in the United States and for the United States to become a world leader in hydrogen production, and, therefore, in the fight against climate change.

a) Section 45V defines "lifecycle greenhouse gas emissions" to "only include emissions through the point of production (well-to-gate)." Which specific steps and emissions should be included within the well-to-gate system boundary for clean hydrogen production from various resources?

As emphasized in the phrases “lifecycle greenhouse gas emissions” and “well-to-gate,” IRS must take emissions embodied in hydrogen production into account—excluding construction and materials associated with electrolyzers, transmission, and power plants. Most specifically, this should include methane leaks from natural gas pipelines, flaring, and feedstock production. If left out, the embodied emissions will be underestimated and the federal government will subsidize “clean” hydrogen that in reality is not achieving the intention of the Inflation Reduction Act—to produce near-zero carbon clean hydrogen in the name of climate progress.

The IRS should use the default settings of the Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model, which excludes the emissions associated with the construction of or materials associated with electrolyzers, transmission, and powerplants. This is consistent with current uses of the GREET model. For example, the Environmental Protection Agency (EPA) notes in its use of the GREET model in the Lifecycle Analysis of Greenhouse Gas Emissions under the Renewable Fuel Standard that emissions associated with physical and organizational infrastructure such as construction are excluded from lifecycle GHG emissions:

“The EPA's assessment of fuel production does not include activities that are clearly unrelated to the fuel lifecycle (e.g., offset projects) or emissions associated with physical and organizational infrastructure (e.g., facility construction, employees commuting to the facility).”[1]

Moreover, Congress defined “lifecycle greenhouse gas emissions” in the IRA as:

the aggregate quantity of GHG emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gasses are adjusted to account for their relative global warming potential.[2]

Congress’s definition clearly accounts for production and distribution—including methane leaks—but makes no mention of construction or materials associated with construction. That is consistent with the bookends defined as “feedstock generation or extraction” through “delivery and use of the finished fuel.” Therefore, power plant, electrolyzer, and transmission construction should be outside the scope of a lifecycle emissions analysis.

(d) If a facility is producing qualified clean hydrogen during part of the taxable year, and also produces hydrogen that is not qualified clean hydrogen during other parts of the taxable year (for example, due to an emissions rate of greater than 4 kilograms of CO2-e per kilogram of hydrogen), should the facility be eligible to claim the § 45V credit

[1] https://www.epa.gov/renewable-fuel-standard-program/lifecycle-analysis-greenhouse-gas-emissions-under-renewable-fuel

[2] *26 U.S.C. § 45V (c)(1)(A) (adopting the definition set forth in 42 U.S.C. § 7545(o)(1)(H)).*

only for the qualified clean hydrogen it produces, or should it be restricted from claiming the § 45V credit entirely for that taxable year?

The facility should be eligible to claim the 45V credit for the qualified clean hydrogen it produces on an hourly basis. This will ensure only hydrogen that meets the emissions threshold to receive the 45V credit, while allowing electrolyzer owners to produce at other times as they choose—creating ramping flexibility if the owner desires. Moreover, enabling facility flexibility to produce additional hydrogen that doesn't qualify for incentives fosters more cost-effective green hydrogen installations and more overall hydrogen supply, which will lead to accelerated cost reductions. During hours when the owner cannot show that they are consuming clean energy from a contracted virtual power purchase agreement, the GREET model should be used to determine the grid emissions for that hour. Those grid emissions should then be used to determine whether hydrogen produced in that hour meets the 45V carbon intensity threshold. As described below in .01(4)(d) below, until hourly RECs are more widely adopted, we recommend utilizing a 12x24 structure to account for hourly matching.

(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?

The IRS should create standards based on national and local lifecycle GHG emissions that establish associated emissions from methane or electricity inputs typically used within the GREET model. Importantly, Treasury and the DOE should establish clear rules for grid-connected electrolyzer facilities pursuing 45V tax credits. These rules should be based on recommendations in answers to .01(1)(e)(ii) and .01(4)(g) below. These rules could then be adopted into the GREET model such that all qualification follows the GREET model.

(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?

Climate-aligned hydrogen standards require granular time matching. This is both economically and technically feasible today, given the 45V tax credit. Moreover, non-granular matching will further erode electricity market functionality and exacerbate existing market stressors. Finally, granular matching is critical to the clean energy industry's credibility and is essential to secure the emission-reducing intent of the Inflation Reduction Act. We urge Treasury to set strict matching guidelines that will ensure electrolytic hydrogen complies with the clean hydrogen threshold—a sub-daily granularity as strict as hourly.

The Princeton Zero Lab has shown that either annual or weekly matching will result in double the emissions of the status quo—methane-based hydrogen without carbon capture.[3] Therefore, should annual or weekly matching be used to qualify clean hydrogen production, the federal government will be spending billions

[3] Ricks, Wilson, Xu, Qingyu, & Jenkins, Jesse D. (2022). Minimizing emissions from grid-based hydrogen production in the United States. Working paper. Zenodo. https://doi.org/10.5281/zenodo.7349406

of dollars on effectively doubling emissions. Hourly matching, on the other hand, will result in near-zero carbon hydrogen and meet the 4kgCO_2/kgH_2 45V threshold. The emissions intensity differences are driven by hydrogen production under annual and weekly matching scenarios when clean energy is not being produced—meaning the additional load caused by electrolyzer facilities is powered by gas or coal when the sun is not shining and wind is not blowing. Electrolysis is a less efficient hydrogen production process when burning natural gas than steam methane reformation, due to the extra steps involved—burning natural gas to spin a turbine, sending electricity across wires, and running an electrolyzer. Therefore, it is critical to climate goals that a more granular time matching standard is adopted, as this will ensure that electrolyzers are only running when they are being powered by clean energy.

We encourage the IRS and Department of Energy (DOE) to investigate if there are more flexible standards than hourly matching that would also result in hydrogen production that meets the 4 4kgCO_2/kgH_2 45V threshold. Princeton's Zero Lab has shown that hourly matching works and weekly matching does not, but the lab did not study more flexible granular options. Two options worth exploring are matching of multiple hour blocks as well as intra-day on and off-peak matching. These options should both help mitigate the issue of running electrolyzers on fossil plants, while also allowing the new clean hydrogen industry to operate more flexibility. The more flexible granular matching can be, the easier it will be for developers to create new clean hydrogen products.

Multiple companies have publicly announced plans to build behind-the-meter clean hydrogen facilities, showing the viability of hourly matching. These include many gigawatt-scale projects outside of the US. Moreover, our internal models as well as the Princeton Zero Lab's models show that hourly matching is economically feasible. Although hourly matching will not be feasible everywhere from the beginning, this will promote building the first hydrogen projects in areas that can support near-zero carbon hydrogen—the areas where the industry should start. As more of these projects are built, cost curves will fall, and more geographies will become economically feasible. This pattern of development is most consistent with climate goals—and therefore granular matching is most aligned with the Administration's goals.

Granular matching is also technically feasible. There are electrolyzer technologies that can ramp up and down at a rate that would be consistent with hourly matching. Therefore, technical feasibility does not have to be a concern for Treasury and DOE with regard to temporal matching.

Non-granular matching will further erode electricity markets due to the inherent focus on volume it promotes. When not accounting for diurnal generation profiles, the focus for developing wind and solar power plants inherently becomes volume—the more MWh a plant produces, the more MWh an electrolyzer can consume over the course of a week or a year. In order to amortize the cost of an electrolyzer over as many kilograms of hydrogen as possible, operators will want to run electrolyzers as much as possible. This will drive wind and solar developers to the most resource-rich areas—areas that are already struggling from underbuilt transmission. These areas already experience high congestion on the transmission grid as well as negative pricing. By encouraging more development in these areas without corresponding transmission development, congestion and negative pricing will only become more severe. This is a risk not only to current asset owners, who will see the value of

their assets fall, but also to developers who will see the value of projects not tied to green hydrogen production fall.

On the other hand, granular matching encourages a focus on the daily generation profile of renewable assets such that electrolyzers can run as often as possible. This will encourage a wide distribution of wind and solar plants as well as short-term and long-term duration storage technologies—i.e., the recipe for a true 24/7 renewable power. 24/7 renewable power will be the next challenge for the clean energy industry, as well as for the world in terms of tackling climate change. The 45V tax credit funds could be funnelled towards developing solutions for 24/7 power if time matching is granular—or it could make climate change worse if time matching is not granular.

We see non-granular matching as a risk to the industry's credibility. The foundation of the clean energy industry—which the Administration has worked to promote in the name of climate progress—rests on reducing emissions. Our value is that we can produce power with no emissions, thereby avoiding the climate and health impacts of fossil fuel-based power production. Should the industry begin accepting large subsidies in the name of climate progress while in fact increasing emissions from the status quo, we will tarnish our credibility as well as the credibility of those policymakers who promoted clean energy. This is an uncomfortable, compromising position that the clean energy does not need to be put in—and will avoid if IRS adopts a granular time-matching mechanism.

.01(2) **Alignment with the Clean Hydrogen Production Standard. On September 22, 2022, the Department of Energy (DOE) released draft guidance for a Clean Hydrogen Production Standard (CHPS) developed to meet the requirements of § 40315 of the Infrastructure Investment and Jobs Act (IIJA), Public Law 117-58, 135 Stat. 429 (November 15, 2021). The CHPS draft guidance establishes a target lifecycle greenhouse gas emissions rate for clean hydrogen of no greater than 4.0 kilograms CO2-e per kilogram of hydrogen, which is the same lifecycle greenhouse gas emissions limit required by the § 45V credit. For purposes of the § 45V credit, what should be the definition or specific boundaries of the well-to-gate analysis?**

See answer to question .01(1)(a) above.

.01(4). **Recordkeeping and Reporting.**

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

In instances where generators and electrolyzer facilities are utilizing a PPA, IRS and DOE will need to encourage or develop improvements in existing renewable energy credit (REC) tools. RECs currently are generated alongside timestamped generation data and recorded for review as the basis of financial transactions. However, the RECs themselves are not timestamped hourly. Fortunately, the data to timestamp RECs exists and improvements in how this data is associated with RECs is possible. In order to implement granular matching, this improvement will need to be made. DOE should encourage local registries to add hourly timestamps, tags for clean energy resources, and tags for storage of clean energy. There are some existing 3rd party solutions to this problem, such as M-RETs and Time-based Energy Attribute Certificates (T-EACs), but they have not been

widely adopted to date. M-RETs has offered hourly RECs since January 2021in 15 Midwestern states and is expanding to the rest of the West. PJM Gats, another widely used registry, anticipates an hourly REC offering by the end of 2022.

(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?

There are two possible methodologies that can be used to determine greenhouse gas emissions rates of power purchase agreements and zero emissions credits: locational marginal emissions or a combination of additionality, regionality, and granular time matching. While locational marginal emissions are a legitimate methodology, locational marginal emissions change over time and are therefore difficult to finance a project on. Moreover, they are difficult to calculate. Therefore, we encourage IRS and DOE to focus on other approaches to make clean hydrogen projects predicated on virtual power purchase agreements financeable.

Three criteria are critical to ensuring that virtual power purchase agreements and zero-emission credits for clean energy are considered properly in determining greenhouse gas emissions rates: additionality, regionality, and temporal matching.

1) **Additionality:** New electrolyzer facilities must be powered by new generation. Additionality is the only way to ensure that electrolyzer load does not increase grid emissions by siphoning off existing clean generation, resulting in a dirtier overall grid mix. As an example, consider nuclear power. Should electrolyzer facilities be built and utilize nuclear power, the resulting hydrogen will be zero carbon when only focusing on electricity input. However, a baseload clean resource that was previously powering other load will have been diverted to powering electrolyzers. This baseload power will then be replaced with increased coal or gas generation—resulting in increased emissions from the rest of the grid. The only way to avoid this situation is to require additionality. If new nuclear generation came online to power electrolyzers, then overall grid emissions excluding the electrolyzer system would remain the same and, when considering the electrolyzer facility, overall grid emissions would fall.

   Whenever new generation is added to the grid, it should qualify as additional. Therefore, MWh that would have been curtailed as well as repowers—since repowers greatly increase the clean generation potential of assets—should count as additional resources.

   Notably, unbundled RECs should not qualify as additional unless the RECs originate from new assets and meeting the regionality and granular temporal matching criteria below. Although unbundled RECs are difficult to prove as having caused investment in a new asset, they will provide increased incentive to build a more resource-diverse and time-diverse set of generators and storage such that asset

owners can most fully utilize an electrolyzer. Therefore, unbundled RECs from new assets that are tied to clean hydrogen have a greater value to asset owners than unbundled RECs as utilized today.

Finally, there can be no double-counting allowed. IRS and DOE should ensure no double claiming of benefits of any environmental attributes associated with the electricity used to produce green hydrogen. Therefore, these attributes must be retired and not claimed under other programs, with the exception of the renewable fuels program and in some instances, cap and trade programs (provided that the electricity is not claimed in the cap-and-trade program's voluntary renewable electricity program).

2) **Regionality:** Electrolyzer facilities and clean electricity generation must be on the same grid, such that electricity is deliverable from the generator to the electrolyzer facility. A wind farm in SPP does nothing to clean the hydrogen of an electrolyzer facility in PJM. Therefore, we recommend that IRS and DOE explore the regional granularity necessary to ensure deliverability, and that this should at the least conform to the same ISO. If a project is in WECC or SERC, we recommend ensuring deliverability by requiring network resource interconnection service or transmission service rights between the generator and electrolyzer facility when within the same balancing authority or NITS compatible balancing authorities. When in NITS incompatible balancing authorities within WECC and SERC, we recommend transmission service rights be required between the generator and electrolyzer facility. Regionality guidelines will allow for virtual power purchase agreements between electrolyzer facilities and clean energy producers, while ensuring the clean energy production will in fact clean the same grid electrolyzers are pulling power from.

3) **Granular time matching:** As expanded upon above in .01(1)(e)(ii), We urge IRS to adopt a time matching standard that is consistent with clean hydrogen emissions guidelines. Princeton has shown that hourly matching is consistent, while weekly or annual matching are not. We believe there may be a more flexible standard that complies, such as intra-day on/off peak matching or time matching based on multiple hour blocks. We encourage DOE and IRS to study these other methodologies to see if they would achieve the goal while allowing for more operational flexibility than hourly matching—benefitting the climate and industry.

Conclusion

The 45V tax credit is significant, and we anticipate a rapid, large buildout of green hydrogen to result. Implementing the right standards will be critical to industry credibility and to meeting the Administration's climate goals. Climate aligned hydrogen standards are technically and economically feasible—and that requires additionality, regionality, and granular matching. We see anything that will not result in zero-carbon hydrogen as

a significant risk to the 45V tax credit, the Inflation Reduction Act, and the credibility of the clean energy industry, as it will be an easy target for all policymakers to latch onto and criticize the industry. DOE's determination that additionality, regionality, and granular matching are required for hydrogen to be clean is the difference between promoting true decarbonization or inadvertently spending billions of federal dollars on exacerbating climate change.

We appreciate the opportunity to give input on the 45V tax credit and look forward to further engagement with IRS on this issue.