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The Honorable Lily Batchelder
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Department of the Treasury
1500 Pennsylvania Avenue, NW
Washington, DC 20220

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Internal Revenue Service Internal Revenue Service
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Submitted electronically to www.regulations.gov

Re: Request for Comments on Credits for Clean Hydrogen Under Section 45V and Clean Fuel Production Under Section 45Z (Notice 2022-58)

Dear Ms. Batchelder and Mr. Paul,

Clean Air Task Force ("CATF") is pleased to respond to the Department of the Treasury ("Treasury") and the Internal Revenue Service ("IRS") on their request for comments on credits for Clean Hydrogen Production (26 U.S.C. Section 45V) and Clean Fuel Production (26 U.S.C. Section 45Z). CATF is a global nonprofit organization working to safeguard against the worst impacts of climate change by catalyzing the rapid development and deployment of low-carbon energy and other climate-protecting technologies. With over 25 years of internationally recognized expertise on climate policy and a fierce commitment to exploring all potential solutions, CATF is a pragmatic, non-ideological advocacy group with the bold ideas needed to address climate change. CATF has offices in Boston, Washington D.C., and Brussels, with staff working remotely around the world.

Statutory Background

The Inflation Reduction Act ("IRA") expands and extends existing tax incentives for the development of zero-carbon fuels or the production of such fuels. *See* 26 U.S.C. §§ 45V, 45Z. Tax credits for clean hydrogen production and the clean fuel production credit will help provide cleaner, cheaper, and more secure energy, especially in difficult-to-decarbonize sectors such as aviation, heavy-duty vehicles, marine shipping, and heavy industry.

Section 45V provides tax credits for "qualified clean hydrogen" produced at a "qualified clean hydrogen facility." *Id.* at § 45V(a). The amount of tax credit available is determined by multiplying the kilograms ("kg") of qualified clean hydrogen produced with the "applicable amount" set out by the statute. *Id.* at (b). IRA defines "qualified clean hydrogen" as "hydrogen which is produced through a process that results in a lifecycle greenhouse gas ("GHG") emissions rate of not greater than 4 kilograms of CO_2e per kilogram of hydrogen." *Id.* at (c)(2)(A). The "applicable amount" is a percentage of $0.60 per kg, depending on the lifecycle GHG emissions rate. The "applicable amount" can be multiplied by 5 (for a maximum possible credit of $3.00 per kg) if certain labor and wage requirements are met. *Id.* at (b).

As a result, the 4 $kgCO_2e/kgH_2$ standard is the baseline requirement a hydrogen producer must meet to receive tax credits under section 45V. Hydrogen producers can receive larger tax credits depending upon the amount of CO_2e emitted per kg of hydrogen at their facility. *Id.* at (b). For example, a taxpayer who produces hydrogen that results in a lifecycle GHG emissions rate of not greater than 4 $kgCO_2e/kgH_2$ and not less than 2.5 $kgCO_2e/kgH_2$ is eligible to receive 20 percent of the applicable amount. *Id.* at (b)(2)(A). This metric continues: the lower the lifecycle GHG emissions rate resulting from producing hydrogen, the higher the percentage and the resulting tax credit. *See id.* at (b)(2). Because the exact amount of emissions from hydrogen production determines the tax credit, it is critical that the IRS set out clear guidelines for calculating lifecycle GHG emissions.

IRA defines "lifecycle GHG emissions" as having the same meaning as section 211(o)(1) of the Clean Air Act ("CAA"). CAA section 211(o)(1)(H) defines lifecycle GHG emissions as the "aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes) . . . 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 gases are adjusted to account for their relative global warming potential." 42 U.S.C. § 7545(o)(1)(H). IRA imports this definition, subject to section 45V(c)(1)(B), which further provides that lifecycle GHG emissions "shall only include emissions through the point of production (well-to-gate), as determined under the most recent [GREET Model], or a successor model (as determined by the Secretary)." It is important that the IRS utilize both definitions.

Section 45Z provides a "clean fuel production credit," which is determined by multiplying the applicable amount per gallon of the transportation fuel produced and sold by the taxpayer with the emissions factor for that particular fuel. *Id.* at § 45Z(a)(1). The statute specifically sets out how the transportation fuel must be sold to qualify for credits. It provides that fuel is "sold" if the producer sells it to an "unrelated person," and the unrelated person uses it "in the production of a fuel mixture," or "in a trade or business," or sells it to a third person. *Id.* at (a)(4). IRA also directs the Secretary to "annually publish a table which sets forth the emissions rate for similar types and categories of transportation fuels." *Id.* at (b)(1)(B). As with section 45V, rates must be "based on the amount of lifecycle greenhouse gas emissions" as set out in CAA section 211(o)(1)(H) and using the most recent GREET model or a successor model. *Id.* at § 45Z(b)(1)(B)(i)-(ii). Section 45Z sets special rates and instructions for sustainable aviation fuels. *Id.* at (a)(3); (b)(1)(B)(iii).

Introduction

The effective development of GHG standards for clean hydrogen production is absolutely essential to ensure that the section 45V clean hydrogen production tax credit creates incentives for hydrogen production with the lowest possible GHG emissions impact. CATF is pleased to provide the following comments to the Treasury and IRS regarding the implementation of the clean hydrogen and clean fuels tax credits.

As part of the Bipartisan Infrastructure Law ("BIL"), Congress ordered the Secretary of Energy to develop a standard for the carbon intensity of clean hydrogen production (the clean hydrogen production standard, or "CHPS"). The Department of Energy ("DOE") plans to align its lifecycle analysis ("LCA") for CHPS with the IRA definition of "qualified clean hydrogen" for purposes of the section 45V tax credit. CATF supports this plan: alignment between CHPS and section 45V helps prevent confusion amongst hydrogen stakeholders, many of whom may apply for funding under the BIL and also intend to receive the section 45V credit under IRA. More importantly, alignment in GHG standards for the BIL and IRA will aid in the rapid deployment of the clean hydrogen production methods and infrastructure being researched, developed, and deployed by the public and private sectors over the coming years. CATF therefore strongly recommends that Treasury and IRS confer with DOE to achieve alignment. In addition, both agencies must consult the U.S. Environmental Protection Agency ("EPA"), given its role as an emissions regulation agency and its experience with the imported CAA definition, regarding carbon intensities of various options for hydrogen and electricity production. Given the importance of alignment, CATF has provided similar comments to both DOE (regarding the draft CHPS) and Treasury and IRS (regarding Notice 2022-58).

<u>Part 1: Credit for Production of Clean Hydrogen (45V)</u>

Section 1: Clean Hydrogen

<u>Question 1</u>*: 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?*

CATF recommends that the global warming potential ("GWP") timeframe used to specify the 4 $kgCO_2e/kgH_2$ criteria be included in the definition to provide more clarity. Section 45V defines "qualified clean hydrogen" as "hydrogen which is produced through a process that results in a lifecycle greenhouse gas emissions rate of not greater than 4 kilograms of CO_2e per kilogram of hydrogen." 26 U.S.C. § 45V(b)(2). While section 45V specifies that the boundaries of the LCA should match the "well-to-gate" definition in the most recent Greenhouse Gases, Regulated Emissions, and Energy use in Transportation ("GREET") model, it does not specify what GWP basis to use. As noted above, the IRA incorporates CAA section 211(o)(1), which includes a GWP basis in the definition of lifecycle GHG emissions. Lifecycle GHG emissions are defined there as the "aggregate quantity of greenhouse gas emissions…where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential." 42 U.S.C. § 7545(o)(1)(H). Both GWP_{20} and GWP_{100} can be useful for climate mitigation planning, and GWP_{20} can help illustrate the impacts of short-lived climate pollutants like methane. While collecting both can be helpful, Treasury and IRS should use GWP_{100} to better capture long-term impacts and align with standard practice. For comparison, CATF has recommended that DOE also use GWP_{100} and collect GWP_{20} data for more insight into long versus short term impacts.

<u>Question 1a</u>*: 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?*

CATF recommends that the well-to-gate definition include emissions arising from manufacturing and construction of the equipment used to produce primary energy and to convert that energy to hydrogen. IRA defines "lifecycle greenhouse gas emissions "as "include[ing] emissions through the point of productions... as determined under *the most recent* ...GREET model....” *Id*. at (c)(1)(A) (emphasis added). On October 11, 2022, DOE’s Argonne National Laboratory issued a new version of GREET, which added the capability to include upstream emissions from manufacturing and construction of the equipment for primary energy.[1] To match the most recent GREET model, section 45V implementation must include these emissions, as well as emissions from manufacturing and constructing the equipment used to convert energy into hydrogen.

These emissions can be quite significant, especially for photovoltaic power. According to the National Renewable Energy Laboratory (“NREL”), the lifecycle GHG emissions associated with manufacturing and installing photovoltaic modules are around 40 grams of CO_2e per kWh of electricity produced, although this will vary considerably with panel type and details of installation.[2] These emissions are particularly dependent on the operating capacity factor of the installation, which in turn depends on both the technology (e.g., use of tracking) and the location (e.g., Arizona compared to Vermont). An electrolyzer with electricity consumption of around 53 kWh per kg of hydrogen produced would result in more than 2 kg of CO_2e per kg of hydrogen produced.[3] These emissions have roughly the same magnitude as some estimates of methane emissions from natural gas supply chains tied to hydrogen made from steam methane reformers.[4] To support innovation and reward better-performing projects and technologies, these emissions should be included in hydrogen GHG accounting protocols. Industries in the U.S. are poised to supply photovoltaic panels with far less embedded carbon if U.S. policy appropriately recognizes differentiated GHG performance for this sector.[5]

<u>Question 1b(i)</u>: *How should lifecycle greenhouse gas emissions be allocated to co-products from the clean hydrogen production process? For example, a clean hydrogen producer may valorize steam, electricity, elemental carbon, or oxygen produced alongside clean hydrogen.*

CATF recommends that Treasury and IRS consider an approach similar to the one used in the European Commission’s proposal for the revision of the European Union’s (“EU”) Renewable Energy Directive 2018/2011 (“REDII”), a delegated act specifying a methodology for assessing GHG emissions savings from Renewable Fuels of Non-Biological Origin (“RFNBO”), covering renewable hydrogen and Recycled Carbon Fuels (“RCF”):

1) Where the process allows for changing the ratio of the co-products produced, the allocation shall be done based on physical causality by determining the effect on

[1] Argonne National Laboratory, The Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) Model, https://greet.es.anl.gov/ (last visited Dec. 2, 2022).
[2] National Renewable Energy Laboratory, Life Cycle Greenhouse Gas Emissions from Solar Photovoltaics (2012), https://www.nrel.gov/docs/fy13osti/56487.pdf.
[3] Fraunhofer Institute for Solar Energy Systems, Cost Forecast for Low Temperature Electrolysis – Technology Driven Bottom-Up Prognosis for PEM and Alkaline Water Electrolysis Systems (Oct. 2021), https://www.ise.fraunhofer.de/en/press-media/press-releases/2022/towards-a-gw-industry-fraunhofer-ise-provides-a-deep-in-cost-analysis-for-water-electrolysis-systems.html
[4] National Energy Technology Laboratory, Comparison of Commercial, State-of-the-Art, Fossil-Based Hydrogen Production Technologies (2022), https://netl.doe.gov/projects/files/ComparisonofCommercialStateofArtFossilBasedHydrogenProductionTechnologies_041222.pdf.
[5] *See*, *e.g.*, Ultra Low-Carbon Solar Alliance, https://ultralowcarbonsolar.org/ (last visited Nov. 1, 2022).

the process' emissions of incrementing the output of just one co-product while keeping the other outputs constant.

2) Where the ratio of the products is fixed and the co-products are all fuels, electricity, or heat, the allocation shall be done by energy content. If the allocation concerns heat that is exported on an energy content basis, only the useful part of the heat may be considered.
3) Where the ratio of the products is fixed and some co-products are materials not used for fuels, the allocation shall be done by the economic value of the co-products. The economic value considered shall be the average factory-gate value of the products over the last three years. If such data is not available, the value shall be estimated from commodity prices minus the cost of transport and storage.

IRS must further define what is a "useful" co-product; co-products that are not useful (i.e., released into the environment) should be excluded from this allocation methodology. Electrolysis, for example, produces both oxygen and heat in a fixed ratio as co-products. Producers, however, often waste both products by releasing them into the atmosphere. Allowing taxpayers to allocate GHG emissions to these waste co-products would artificially deflate the carbon intensity of the hydrogen, allowing taxpayers to claim more credits than they would have otherwise earned. For co-products that are "useful," IRS must establish further methods to verify the final use of the co-product (e.g., liquefy the oxygen for medical use). This prevents the establishment of shell corporations that would buy the waste co-product only to vent it on the other side of the fence.

Question 1c(ii): How is byproduct hydrogen from these processes typically handled (for example, venting, flaring, burning onsite for heat and power)?

In 2020, 18 percent of the world's hydrogen production came as a by-product from processes primarily designed for other products like chlor-alkali production or catalytic reforming.[6] Oil refineries use by-product hydrogen in processes commonly referred to as hydrocracking, hydrotreating, and/or hydroprocessing. These processes are crucial in the oil industry since they convert crude oil into refined products such as gasoline, jet fuel, and diesel and maximize the bottom-of-the-barrel upgrade. After hydrogen is deployed in these processes, it is downgraded to the fuel gas system where it is burned in furnaces or turbines to generate heat or additional power. In some cases, such as operational upsets or start-up and shut-down of process units, hydrogen could be directed to the facilities' flare.

[6] International Energy Agency, Global Hydrogen Review 2022 (Sept. 2022), https://www.iea.org/reports/global-hydrogen-review-2022

Question 1d: *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 CO_2-e per kilogram of hydrogen), should the facility be eligible to claim the § 45V credit only for the qualified clean hydrogen it produces, or should it be restricted from claiming the § 45V credit entirely for that taxable year?*

As a statutory matter, IRA plainly states that the credit is available for the kg of qualified hydrogen produced in a year, and IRA does not disqualify a taxpayer from claiming credits from otherwise qualified clean hydrogen purely because the taxpayer also produced hydrogen at some point during the taxable year that would not qualify for the credit. Section 45V provides credits based upon the "kilograms of clean hydrogen produced during the taxable year" multiplied by the "applicable amount," as described above. The statute therefore accounts for the fact that taxpayers may produce some hydrogen during the taxable year that does not "qualify" for the credit, and the production of "unqualified" hydrogen is simply not counted toward the credit.

As a policy matter, if facilities produce hydrogen that is not qualified as "clean" under the definition during parts of the taxable year, they should still receive credits for any qualified clean hydrogen they *do* produce during the year. The cost to produce clean hydrogen is one key barrier inhibiting the widespread adoption of hydrogen as a decarbonization solution. The section 45V credit is designed to temporarily help bridge the pricing gap, reaching cost parity with high-emissions hydrogen (e.g., steam methane reforming hydrogen without carbon capture). Doing so would encourage the rapid deployment of clean hydrogen production and infrastructure and catalyze progress along the technology learning curve—the key to reducing costs in the long run. Disqualifying facilities from receiving any tax credits for a taxable year because they produced some non-clean hydrogen during parts of that year would discourage the development of technologies that may be crucial to meeting future hydrogen demand.

Fossil-based clean hydrogen producers likely will not have difficulty producing clean hydrogen year-round. For electrolytic hydrogen producers, there are two methods of ensuring high capacities: (2) connecting to behind-the-meter zero-carbon electricity, or (2) plugging into the grid. To ensure the hydrogen produced is low-carbon for either method, developers should use low-carbon electricity that is *additional* to the low-carbon electricity that would have already been generated for other electric loads. This additionality criteria is especially important for grid electrolysis given that producers may want to use offsets like Energy Attribute Credits ("EACs") to compensate for the higher carbon intensity of the electricity grid. Please see questions 4f and 4g below regarding important criteria for allowing the use of EACs.

In order to allow taxpayers to qualify for more credits if certain production methods produce cleaner hydrogen and to ensure collection of information that will be valuable in understanding the challenges operators face in consistently maintaining the section 45V criteria, CATF recommends that plants that can operate in different production modes that each produce clean hydrogen of a specific carbon intensity provide documentation for each production method when filing (i.e., one LCA documentation for the first mode, a second LCA documentation for the second mode, etc.). CATF recommends that taxpayers indicate the onstream percentage of these different production modes during their application, which would apply even if the different carbon intensities fall under the same PTC category.

Question 1e: 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?

Verifying the estimated emissions rate of low-carbon electricity should be straightforward for any behind-the-meter connections (i.e., an electrolyzer connected directly to a low-carbon electricity source). For producers using grid-sourced electricity, it will likely be difficult to verify the carbon intensity for the delivered electricity. Ideally, Treasury and IRS will work with states to establish hourly carbon intensity values for grid electricity similar to what California's Air Resource Board ("CARB") has created to support the California Low Carbon Fuel Standard ("LCFS") Program.[7] For producers that use grid-sourced electricity and offsets like EACs, see CATF's responses to questions 4f and 4g below regarding important criteria to ensure that the energy inputs used to produce hydrogen meet the estimated LCA GHG rates required for the tax credit.

Question 1e(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?

Hourly time matching of energy inputs must be required for confirming that hydrogen is "clean." Without hourly-matching, energy demands from hydrogen production can increase the overall demand for energy, particularly during times when high-emitting energy sources would meet that demand (e.g., during peak demand hours, low solar or wind conditions, etc.). Hourly-matching is necessary to ensure that low-carbon energy sources are available to meet the energy demand from hydrogen production at any given time, thus ensuring that there are no unintentional increases in GHG emissions from energy used to produce hydrogen. See CATF's responses to questions 4f and 4g below for further detail on the importance of hourly matching.

Section 2: Alignment with Clean Hydrogen Production Standard

Question 2: 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).[4] The CHPS draft guidance establishes a target lifecycle greenhouse gas emissions rate for clean hydrogen of no greater than 4.0 kilograms CO_2-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 CATF's response to question 1a above regarding specific boundaries of the well-to-gate analysis, as well as how to align with the CHPS.

[7] *See* CARB, LCFS Pathways Requiring Public Comments, https://ww2.arb.ca.gov/resources/documents/lcfs-pathways-requiring-public-comments (last visited Dec. 2, 2022).

Section 3: Provisional Emissions Rate

For hydrogen production processes for which a lifecycle greenhouse gas emissions rate has not been determined for purposes of § 45V, a taxpayer may file a petition with the Secretary for determination of the lifecycle greenhouse gas emissions rate of the hydrogen the taxpayer produces.

Question 3a: *At what stage in the production process should a taxpayer be able to file such a petition for a provisional emissions rate?*

CATF strongly advocates that section 45V credits be allowed only for truly clean hydrogen.[8] To ensure this, only taxpayers that use real emissions data for their LCAs should be able to qualify for these credits. While provisional emissions rates can be filed to expedite the tax filing process, credits should not be allocated until real emissions data is submitted.

If Treasury and IRS allow taxpayers to use a provisional emissions rate to receive section 45V credits, there must be strict guardrails regarding how the provisional emission rate is determined. See CATF's response to question 3b below for more information.

For either method (i.e., taxpayers receiving 45V credits with either provisional or real emissions data), taxpayers for both new clean hydrogen production facilities and existing but retrofitted facilities who file with provisional emissions rates should be required to submit real emissions data within a finite time frame after the tax filing date. For reference, projects applying to the EU Innovation Fund, a funding program for innovative low-carbon technologies, have 4.5 months to finalize their applications which include the calculation of provisional GHG emissions avoidance.[9] In this program, the maximum grant amount will be paid out only if, over the entire project duration, the project reaches at least 75 percent of the total amount of the provisional GHG emissions avoidance indicated in the application. This timeline is only an example; Treasury and IRS should consult with DOE regarding feasible timelines for conducting LCAs. Key questions that must be answered include the time it takes to build a model, gather real emissions data for the LCA, and maintain the model year to year. To potentially expedite the timeline, taxpayers could submit LCA models, which can be built using the project design basis, in the petition for a provisional rate.

Question 3b: *What criteria should be considered by the Secretary in making a determination regarding the provisional emissions rate?*

Decisions regarding provisional emissions rates must be determined using verifiable, documented information, such as process simulations, material balances, LCA models, and other technical documents to justify the provisional rate. The provisional rate should not be determined based on generic studies on specific production methods; it should use information developed specifically for the project of interest. Plants that have claimed 45V credits in previous years may use real emission rates from previous years of filing as backing for provisional rates, assuming

[8] CATF does not take a position about whether there should be guardrails limiting petitions to specific stages of the production process.

[9] *See* Innovation Fund, Call for Proposals (2022), https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/innovfund/wp-call/2022/call-fiche_innovfund-2022-lsc_en.pdf.

there have not been significant operational changes. As noted above, plants that can and have operated in different production modes that each produce hydrogen of a different carbon intensity should provide documentation for each production method (i.e., one LCA documentation for the first mode, a second LCA documentation for the second mode, etc.).

CATF suggests that Treasury and IRS build tables detailing potential carbon intensity ranges for common hydrogen production pathways. Each production pathway would have a range of potential carbon intensity values due to differences in energy sources, leak rates (for both hydrogen and methane), carbon capture rates, and other key parameters. These values can then be used as a quick litmus test to ascertain whether the preliminary carbon intensity values in the petition are feasible. GTI Energy has built a simple LCA tool that may be helpful for this process, as it outputs values based on the 2021 version of GREET.[10] This table would be similar to the carbon intensity Lookup Tables for California's LCFS, which serve as a useful guide indicating a range of carbon intensities achievable for different fuel production pathways.[11]

Section 4: Recordkeeping and Reporting

Question 4(a): What documentation or substantiation do taxpayers maintain or could they create to demonstrate the lifecycle greenhouse gas emissions rate resulting from a clean hydrogen production process?

Facilities that plan to claim section 45V credits but are not currently required to report under Greenhouse Gas Reporting Program ("GHGRP") guidelines should still be required to follow the same GHGRP reporting requirements to claim section 45V credits. Hydrogen producers that fall under 40 C.F.R. § 98.2(a)(1) or (a)(2) of the GHGRP will already have to report CO_2 emissions for each hydrogen production unit. They likewise must report "CO_2, CH_4, and N_2O emissions from each stationary combustion unit other than the hydrogen production process unit." These emissions can be calculated using a monthly mass and energy balance and/or a continuous emissions monitoring system ("CEMS"). Taxpayers that produce, process, and/or distribute petroleum and natural gas who satisfy 40 C.F.R. § 98.2(a) must also report their GHG emissions. CATF recommends that IRS coordinate with EPA, given EPA's role as an emissions regulation agency and their experience with the facilities reporting GHG emissions under the GHGRP, to potentially streamline these reporting processes.

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

To assure that climate mitigation has been achieved, taxpayers must be required to verify their life cycle analyses with independent third parties before receiving credits. This is an international best practice for credible GHG monitoring under ISO 14064. To facilitate this process, Treasury and IRS could help create a list of independent verifiers or verification bodies similar to what

[10] GTI Energy, Hydrogen Production Emissions Calculator, https://hypec.gti.energy/?utm_source=GTI-Energy-Landing&utm_medium=webpage&utm_id=HyPEC-Launch#contact (last visited Dec. 2, 2022).
[11] CARB, LCFS Pathway Certified Carbon Intensities, https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities (last visited Dec. 2, 2022).

CARB has created for the California LCFS.[12] Below are further discussions of monitoring for upstream methane emissions, hydrogen leakage, and downstream CO_2 sequestration.

CATF endorses the design criteria laid out by the Environmental Defense Fund ("EDF") for programs that would verify upstream methane emissions.[13] Existing certification schemes and protocols that seek to address this issue (e.g., Veritas, OGMP 2.0, QMRV, etc.) may be able to satisfy these criteria. As specified in the EDF paper, programs should employ robust monitoring that includes:

- "a methodology informed by direct measurement across varying spatial and temporal scales and based on statistically representative samples;"
- "a methodology which integrates and reconciles top-down and bottom-up measurement data to validate emissions estimates;" and
- "emissions estimates reported with associated uncertainty."

In addition to the above criteria, a measurement program should encompass a sufficiently large geographical area (e.g., all of an operator's assets in a given region or sub-basin). This is essential to avoid cherry-picking the lowest emitting sites without reflecting an operator's actual average methane leak rate.[14]

Any certification should also be independently verified by a credible third party. While measurement technology is improving, we are not yet in a world where we can have continuous monitors at every GHG emitting facility across the country. One solution is for operators to assume a national (or regional) average leak rate (based on top-down measurement studies), unless they can sufficiently prove that their leak/emission rate is lower.

With respect to hydrogen leak detection, it is important to acknowledge hydrogen's indirect climate impact. At the same time, it is important to keep in mind and compare those indirect impacts with the impacts of the carbon-intensive processes that hydrogen will replace.

In that context, understanding that hydrogen's efficacy as a climate solution can be reduced by leaks underscores the importance of establishing robust leak detection and prevention programs. Combating leaks during the design phase for greenfield projects could make this issue easier to address. To better assess the risk of hydrogen's indirect warming impact, there must be more robust real-world emissions data across the supply chain and on the efficacy of leak detection programs. Current available emission data mainly consists of estimates regarding leak percentages. Given that there are many ways to produce, transport, and use hydrogen, it is important to assess these emission rates across each permutation. Emissions data should include leaks; venting from start-up, shutdown, and maintenance; and hydrogen-slip from incomplete

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[12] List of Accredited Individual Verifiers, CARB, https://ww2.arb.ca.gov/resources/documents/accredited-individual-verifiers (last visited Dec. 2, 2022).

[13] Maureen Lackner & Kristina Mohlin, Env't Defense Fund, Certification of Natural Gas with Low Methane Emissions: Criteria for Credible Certification Programs (2022), https://blogs.edf.org/energyexchange/files/2022/05/EDF_Certification_White-Paper.pdf.

[14] For criteria for companies seeking certification, *see* Maureen Lackner & Kristina Mohlin, Env't Defense Fund, Certification of Natural Gas with Low Methane Emissions: Criteria for Credible Certification Programs (2022), https://blogs.edf.org/energyexchange/files/2022/05/EDF_Certification_White-Paper.pdf.

combustion or reaction. Regarding leak detection methods, a report from Columbia's School of International and Public Affairs detailed the existing detection, monitoring, and prevention technologies.[15] While the report concludes that most technologies still require significant research and development—a conclusion CATF agrees with—it would also be valuable to understand what emission rates could be achieved with a robust hydrogen leak detection program built out of existing mitigation solutions. These solutions could include not only hydrogen detection technologies such as Nitto's hydrogen detection tape used by NASA, but also leak detection technologies available for gas-based operations as a whole.[16]

Best practices for quantifying CO_2 leakage and losses during geologic sequestration activities are required for recipients of income tax credits under section 45Q. Those requirements were developed over many years and incorporate significant public-sector and private-sector stakeholder input, several EPA regulations, and methods of the International Standards Organization.[17] Geologic storage of CO_2 requires a Class VI well permit regulated under EPA's Underground Injection Control Program. Class VI wells have stringent requirements that are tailored specifically for ensuring the safety and permanence of CO_2 injection.[18] The Class VI rule has extensive requirements to ensure that wells used for permanent storage of CO_2 are appropriately sited, constructed, tested, monitored, funded, and properly closed, and that the storage site is appropriately characterized. Developers that have received a Class VI permit are also required to report under GHGRP subpart RR.[19] The two programs work complementarily to ensure secure, permanent storage of CO_2 and to provide monitoring and reporting that identifies and addresses any potential leakage risks and provides public transparency. Under subpart RR, facilities are required to develop and implement a monitoring, reporting, and verification plan that is approved by EPA. CATF recommends that for purposes of evaluating a project's potential or actual sequestration-related CO_2 emissions under the section 45V credits, IRS should assume negligible CO_2 leaks and losses over the geological CO_2 sequestration lifecycle unless a case-specific evaluation by using the relevant IRS procedures determines a different value is more appropriate. Best practices for monitoring CO_2 injected into geologic formations are dependent on site-specific geology, and specific monitoring techniques should be considered on a case-by-case basis.

Question 4(c): *What technologies or accounting systems should be required for taxpayers to demonstrate sources of electricity supply?*

In addition to monitoring and verification systems discussed above, two key areas may require new systems or frameworks. The first is additionality, or the idea that any low-carbon electricity that is used for the purposes of hydrogen production should be *in addition to* the low-carbon electricity that already exists or that was already planned to be added for other purposes, such as decarbonizing the electricity grid. An accounting system will be needed for hydrogen producers

[15] Zhiyuan Fan et al., Columbia Center on Global Energy Policy, Hydrogen Leakage: A Potential Risk for the Hydrogen Economy (2022), https://www.energypolicy.columbia.edu/research/commentary/hydrogen-leakage-potential-risk-hydrogen-economy#:~:text=The%20leakage%20rate%20stands%20between,%242%2Fkg%2DH2.
[16] Nitto Hydrogen Detection Tape, https://nittodetectiontape.com/products/pc/Hydrogen-Detection-Tape-5p3.htm (last visited Nov. 1, 2022).
[17] *See* 86 Fed. Reg. 4728 (codifying 1 C.F.R. § 1.45Q-0 – 5)
[18] 40 C.F.R. § 146.81 *et seq.*
[19] 40 C.F.R. § 98.440 *et seq.*

to demonstrate that the electricity they are using is additional. Please see CATF's response to 4g below for more detail on additionality.

The second is a 24/7 carbon-free electricity ("CFE") accounting system to enable hourly-matched EACs (i.e., the purchasing of EACs for carbon-free electricity that is generated during the same hour(s) in which the hydrogen production facility consumes electricity). Work to develop this type of accounting system is already underway and should be supported for use by hydrogen producers.

Question 4(e): *If a taxpayer serves as both the clean hydrogen producer and the clean hydrogen user, rather than selling to an intermediary third party, what verification process should be put in place (for example, amount of clean hydrogen utilized and guarantee of emissions or use of clean electricity) to demonstrate that the production of clean hydrogen meets the requirements for the § 45V credit?*

Hydrogen facilities should be required to install high accuracy billing meters to draw artificial boundaries between their hydrogen production and use. There should be standardized guidelines regarding the accuracy of these meters along with an established calibration schedule. Producers with this setup should submit specification sheets for the billing meter along with the flow data and calibration records when filing. Mass balances should not be a substitute for billing meters given the need for high accuracy measurements.

Question 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?*

Some indirect book accounting factors should be considered when calculating the applicable section 45V credit amount. Legislative history clarifies that electrolyzers that consume grid electricity and use offsets like EACs are meant to be eligible for the PTC at the highest tiers.

> Mr. CARPER: It is …my understanding of the intent of section 13204, is that in determining ''lifecycle greenhouse gas emissions'' for this section, the Secretary shall recognize and incorporate indirect book accounting factors, also known as a book and claim system, that reduce effective greenhouse gas emissions, which includes, but is not limited to, renewable energy credits, renewable thermal credits, renewable identification numbers, or biogas credits. Is that the chairman's understanding as well? Mr. WYDEN. Yes. Mr. CARPER. Thank you, Mr. Chairman. Additionally, I would like to clarify that the intent of section 13701 allows the Secretary to consider indirect book and claim factors that reduce effective greenhouse gas emissions to help determine whether the greenhouse gas rate of a qualified fuel cell property, which does not include facilities that produce electricity through combustion or gasification, is ''not greater than zero.'' Is that the chairman's understanding? Mr. WYDEN. Yes

168 Cong. Rec. S4165 (Aug. 6, 2022).

Therefore, EACs—including renewable energy credits ("RECs")—should be allowable, but CATF strongly urges that they only be used for offsetting emissions from electricity (e.g., to offset emissions from the grid for a grid-connected electrolyzer, or to offset the electricity used in fossil-based hydrogen production processes) or otherwise unavoidable upstream emissions (e.g., the upstream manufacturing emissions for energy equipment like solar panels). EACs should not be allowed to offset emissions from fuels (i.e., purchasing of RECs should not be able to outweigh emissions from natural gas feedstocks), because emissions from fuels should first be avoided if at all possible. EACs cannot substitute for methodologies and technologies that would have prevented emissions in the first place, and hydrogen producers should not have avenues to receiving the hydrogen tax credit without making every effort to minimize the GHG intensity of that hydrogen prior to the use of EACs. CATF strongly advocates that section 45V credits should only be allowed for truly clean hydrogen, as intended by the requirements of the tax credit. Fossil-based hydrogen production processes should instead be encouraged to use high rates of carbon capture and storage ("CCS") to bring down their hydrogen's GHG intensity. Finally, Renewable Thermal Credits (i.e., credits generated from renewable natural gas) and biogas credits *must not* be counted toward the GHG intensity of hydrogen production under any circumstances due to the significant uncertainties around the net climate impact of biogenic processes.

Given the challenges of implementing a book and claim system, Treasury should implement a two-step approach, as follows:

1) Through preliminary guidance, Treasury and IRS should make clear that any hydrogen production projects that can meet the section 45V carbon intensity requirements using the existing GREET model (as updated in 2022) will be able to qualify for the section 45V credit. This initial accreditation should include electrolyzers that are powered by off-grid, behind-the-meter zero-carbon electricity. Initially, electrolyzers that are powered primarily by grid-connected electricity should use the GREET model and its associated grid electricity emissions assumptions.

2) Through final guidance, Treasury and IRS—with support from DOE and EPA—should develop and implement a rigorous emissions accounting system to allow for offsetting of use of grid electricity in hydrogen production. For example, a 24/7 CFE approach that requires that electricity demand from hydrogen production be matched with additional clean electricity generation on an hourly basis with regionality requirements would meet these needs. Treasury should prioritize the development of a 24/7 CFE framework or a similar approach that meets the guardrails outlined in question 4g below. This framework should be incorporated into a future version of GREET or a successor model.[20]

[20] Section 45V allows for such criteria. *See* 26 U.S.C. § 45V(c)(1)(B) (providing that lifecycle GHG emissions must be determined by the most recent GREET model "or a successor model.").

Question 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?*

To ensure that the hydrogen produced through electrolysis is actually low-emissions, the operation of the electrolyzer should not result in any additional emitting generation produced for either the electrolyzer or for the pre-existing electricity demand served by the grid. This is most easily achieved through additional directly connected, behind-the-meter zero-carbon electricity like renewables or nuclear that power the electrolyzer. This is also possible for electrolyzers that consume grid electricity and use EACs, but it is important to ensure that such hydrogen production results in sufficient emissions reductions. As noted above, the legislative history makes clear that "the Secretary shall recognize and incorporate indirect book accounting factors… *that reduce effective greenhouse gas emissions*…" (emphasis added).[21] To this end, the three additional criteria outlined below are necessary guardrails for ensuring that hydrogen produced from electrolyzers consuming grid electricity results in emissions reductions.[22]

- **Additionality:** This means that electrolytic hydrogen producers must be able to show that the low-carbon electricity used by or claimed by the electrolyzer is *additional* to the quantity of low-carbon electricity that would have otherwise been generated to serve other electric loads. For example, the low-carbon electricity could be new (in addition to what was already planned) or could have otherwise been curtailed or retired.
- **Geography-matching:** Due to the challenges of producing zero-carbon electricity around the country and the limitations of transmission capabilities to bring that electricity where it is needed, the EACs must be purchased in the same region (most likely, the same ISO/RTO) as the electrolyzer operations so that the electricity generation and demand are occurring within the same region.
- **Temporal-matching:** Finally, the electrolyzer must be operated only when additional low-carbon electricity generation is available. To be sure that hydrogen production has low GHG-intensity, the electricity consumed by the hydrogen production facility and the EACs procured should be matched on an hourly-basis. This requirement would ensure that there is clean electricity available at the times when the electrolyzer consumes electricity; otherwise, electrolyzers would increase demand on the grid when only higher-emitting sources of generation are available and could result in much higher GHG-intensity than intended.

Meeting these three criteria is absolutely essential for a broad climate-technology deployment program like the hydrogen production tax credit, which rewards hydrogen producers for meeting stringent GHG-intensity standards. Given the significant deployment support of the hydrogen tax credit, these strict guardrails are both reasonable and necessary.

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[21] 168 Cong. Rec. S4165 (Aug. 6, 2022)

[22] For additional context on the importance of these guardrails, *see* Armond Cohen, Clean Air Task Force, It's Time We Update Our Corporate Electricity Procurement Standards to Decarbonize the Electric Grid, (Aug. 17, 2022); and Wilson Ricks, Qingyu Xu & Jesse D. Jenkins, Enabling Grid-Based Hydrogen Production with Low Embodied Emissions in the United States (2022), https://zenodo.org/record/7183516#.Y2FaZOzMK3I.

Section 6: Coordinating Rules

<u>Question 6c</u>: *Are there any circumstances in which a single facility with multiple unrelated process trains could qualify for both the § 45V credit and the § 45Q credit notwithstanding the prohibition in § 45V(d)(2) preventing any § 45V credit with respect to any qualified clean hydrogen produced at a facility that includes carbon capture equipment for which a § 45Q credit has been allowed to any taxpayer?*

Section 45V(d)(2) states that:

> No credit shall be allowed under this section with respect to any qualified clean hydrogen produced at a facility which includes carbon capture equipment for which a credit is allowed to any taxpayer under section 45Q . . . for the taxable year or any prior taxable year.

Although this language forbids a single "facility" from simultaneously claiming both the section 45V and section 45Q credits, "facility" is not defined in IRA. Thus, IRS retains discretion to determine the boundaries of what constitutes a single "facility" for purposes of section 45V(d)(2) (the "45Q exclusion").

Based upon the statutory language and context, taxpayers that operate unrelated chemical process trains for carbon capture and clean hydrogen production should still be able to receive both 45V and 45Q credits. For example, IRS should consider the following pairs of processes as occurring at distinct facilities even if they are co-located:

- Fluidized catalytic cracker unit ("FCCU") with CCS plus separate autothermal reforming ("ATR") with CCS;
- Cogeneration and the ATR it supports by providing power; and
- Sustainable aviation fuel production with captured CO_2 combined with other clean hydrogen produced nearby.

There are three reasons the IRS should adopt this narrow interpretation of when clean hydrogen is "produced at a facility which includes carbon capture equipment."

First, the 45Q exclusion is most reasonably interpreted as a restriction on a taxpayer's ability to receive double credit for producing "blue" hydrogen via processes that convert methane into hydrogen and CO_2 in a single interrelated chemical process. For example, clean hydrogen can be produced using ATR with natural gas feedstocks and CCS. Without the 45Q exclusion, a taxpayer producing hydrogen using ATR and CCS would be able to claim both credits for the processing of outputs of a single chemical process: for both producing clean hydrogen under section 45V and for capturing the CO_2 resulting from that same process under section 45Q.

Second, reading the 45Q exclusion broadly would create an artificial split in the tax treatment of equivalent processes based only on the corporate control or locations of those processes. For example, under a broad reading of the 45Q exclusion, a refinery using a cogeneration unit with CCS to power the production of hydrogen through ATR could not claim credit under 45V. But another refinery producing hydrogen through ATR powered by a cogeneration unit owned by a different corporate entity could claim both credits, even though both refineries are engaged in the same processes. As a note, clean hydrogen producers procuring electricity in this fashion may be indirectly benefiting from 45Q credits because the low-carbon electricity is helping to reduce the carbon intensity of the produced hydrogen. However, this is no different than operators procuring electricity from the grid where other generation facilities may be benefiting from 45Q. As a result, allowing both credits under these circumstances incentivizes the adoption of low-carbon electricity, assuming this generation is additional to the generation capacity that would have been installed to serve other electric loads. And accounting for low-carbon variants of all inputs is the benefit of establishing carbon intensity criteria based on rigorous GHG LCAs.

Third and finally, prior IRS guidance on determining the scope of a "facility" is consistent with this interpretation. In 2016, the IRS published guidance on the construction of energy facilities.[23] As part of this guidance, the IRS defined "facility" as follows:

> a facility . . . *generally includes all components of property that are functionally interdependent*. Components of property are functionally interdependent if the placing in service of each of the components is dependent upon the placing in service of each of the other components in order to generate electricity.

Id. at *10-11 (emphasis added). Replacing "generate electricity" with "produce hydrogen," this guidance is useful in defining the scope of the 45Q exclusion. The above definition of "facility" would consider producing hydrogen with ATR plus CCS a single "facility" because the production of clean hydrogen is dependent on the ATR plus CCS, and the carbon capture equipment in this case services the production of clean hydrogen. Conversely, the previously outlined above examples illustrate pairs of processes that can operate independently of one another and would therefore be separate facilities under this definition.

Additionally, a 2013 IRS guidance provides the same definition as the 2016 guidance with a useful example.[24] The 2013 guidance reads as follows:

> [O]n a wind farm for the production of electricity from wind energy, an electricity-generating wind turbine, its tower, and its supporting pad comprise a single facility. Each such facility can be separately operated and metered and can begin producing electricity separately.

This example sheds light on the potential components of a single facility: turbines, towers, and pads are parts of electricity generation that are interdependent and cannot work separately. A similar definition, as applied to the production of clean hydrogen, would allow an entity to receive both 45Q and 45V credits for processes that are both unrelated and operate independently, such as the above-listed examples.

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[23] *See* 2016 IRB LEXIS 317, Notice 2016-31, 2016-1 C.B. 1025, 2016-23 I.R.B. 1025 (I.R.S. May 5, 2016).

[24] 2013 IRB LEXIS 231, *6-7, Notice 2013-29, 2013-1 C.B. 1085, 2013-20 I.R.B. 1085 (I.R.S. April 15, 2013).

Part 2: Clean Fuel Production Credit (45Z)

Section 2: Establishment of Emissions Rate for Sustainable Aviation Fuel

Question 2: Section 45Z(b)(1)(B)(iii) provides that the lifecycle greenhouse gas emissions of sustainable aviation fuel shall be determined in accordance with the Carbon Offsetting and Reduction Scheme for International Aviation or "any similar methodology which satisfies the criteria under § 211(o)(1)(H) of the Clean Air Act (42 U.S.C. 7545(o)(1)(H)), as in effect on the date of enactment of this section." What methodologies should the Treasury and IRS consider for the lifecycle greenhouse gas emissions of sustainable aviation fuel for the purposes of § 45Z(b)(1)(B)(iii)(II)?

As detailed in CATF's recent report, *Decarbonizing Aviation: Challenges and Opportunities in Emerging Fuels*, despite the sustainability challenges associated with the production of many common types of biofuels, biofuels account for the vast majority of the fuels that are collectively referred to as "sustainable aviation fuels" ("SAF").[25] In light of biofuels' current dominant role in the SAF market, it is imperative that Treasury and IRS select appropriate and reliable methodologies for establishing emissions rates for SAF.

Any such methodology must fully account for "significant indirect emissions such as significant emissions from land use changes," also known as indirect land use change ("ILUC") emissions, per the definition of "lifecycle greenhouse gas emissions" established in section 211(0)(1)(H) of the CAA and incorporated by reference in section 45Z(b)(1)(B)(iii). The Carbon Offsetting and Reduction Scheme for International Aviation ("CORSIA") does not fully account for ILUC emissions and therefore should not be adopted as the sole methodology to be used by Treasury and IRS to determine the lifecycle GHG emissions of biomass-derived SAF.

A report commissioned by Transport & Environment from the consultancy Cerulogy, *Understanding the Indirect Land Use Change Analysis for CORSIA*, outlines CORSIA's shortcomings with respect to ILUC emissions.[26] In short, the CORSIA approach considers the results generated by two lifecycle GHG models (GTAP-BIO and GLOBIOM) and "base[s] ILUC values on only the lower modelled value where [the] models disagree," thereby "introduc[ing] an obvious and significant optimism bias into the default values that is not analytically justified."[27] Utilizing the CORSIA approach to determine the lifecycle GHG emissions of biomass-based SAF would likely result in an underestimation of the ILUC emissions associated with the fuels, which in turn could cause the IRS to effectively overcompensate producers of such fuels (i.e., by allowing the producers to take a larger SAF tax credit than they are entitled to). Treasury and IRS should consult with EPA to assess whether and to what extent the SAF tax credit would be over-claimed due to the "significant optimism bias" in the CORSIA approach for ILUC values.

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[25] CATF, Decarbonizing Aviation: Challenges and Opportunities in Emerging Fuels at 15 (2022), last visited Nov. 27, 2022, https://cdn.catf.us/wp-content/uploads/2022/09/13101935/decarbonizing-aviation.pdf

[26] Cerulogy, Understanding the Indirect Land Use Change Analysis for CORSIA (Dec. 2019), last visited Nov.27, 2022, https://www.transportenvironment.org/wp-content/uploads/2021/07/2019_12_Cerulogy_ILUC-in-CORSIA.pdf

[27] *Id*. at 4-5

Respectfully submitted,

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