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Understanding the proposed guidance for the Inflation Reduction Act's Section 45V Clean Hydrogen Production Tax Credit

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Signed into law on August 16, 2022, the Inflation Reduction Act (IRA) contains a number of provisions related to climate change, including several to encourage private-sector investment in clean energy. Among these are incentives for several types of low-carbon fuels, including hydrogen. On December 22, 2023, the U.S. Department of the Treasury and the Internal Revenue Service (IRS) released proposed guidance about how to determine eligibility for two such incentives, the Clean Hydrogen Production Tax Credit under Section 45V of the Internal Revenue Code and the Energy Credit under Section 48.

This brief reviews key aspects of the 2023 proposed guidance. After explaining the IRA's requirements for the hydrogen production tax credit, it summarizes how the guidance would address such issues as determining life-cycle greenhouse gas (GHG) emissions during the hydrogen production process, accounting for the GHG emissions of electricity use, and rules about renewable natural gas (RNG), among other topics. We end by explaining how eligibility for the energy credit is determined under the proposal. The guidance for both credits is still provisional and subject to further revision; the ICCT submitted comments in February 2024.[1]

IRA FRAMEWORK FOR THE CLEAN HYDROGEN PRODUCTION TAX CREDIT

The Clean Hydrogen Production Tax Credit under Section 45V of the Internal Revenue Code (hereafter, "the Section 45V credit") allows for the crediting of hydrogen produced

1 International Council on Clean Transportation, "Comments on Proposed Regulations Relating to the Credit for Production of Clean Hydrogen," February 26, 2024, https://theicct.org/comments-on-proposed-regulations-relating-to-the-credit-for-production-of-clean-hydrogen-feb24/.

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with life-cycle GHG emissions (measured in terms of CO_2 equivalent) below 4 kg for each 1 kg of hydrogen produced. There are four life-cycle GHG emissions tiers, each with a corresponding credit amount. The taxpayer may obtain the life-cycle GHG emissions rate of their hydrogen production through either the 45VH2-GREET model or by requesting the provisional emissions rate (PER) from the U.S. Department of Energy (DOE). The system boundary used for determining life-cycle GHG emissions is well-to-gate, which includes upstream emissions associated with feedstock growth, gathering, extraction, processing, and delivery to a hydrogen production facility. It also includes emissions onsite at the hydrogen production plant and any carbon capture and sequestration (CCS). The system boundary excludes any downstream emissions once the hydrogen exits the production gate (facility), such as emissions from hydrogen distribution and refueling.

A taxpayer can claim the Section 45V credit for hydrogen produced after December 31, 2022, for the first 10 years after the qualifying hydrogen generation facility was placed into service. The IRA does not specify any initial construction or service commencement date for credit eligibility, meaning any existing hydrogen facilities placed in service after December 31, 2012, could potentially qualify for the credit for at least some part of its first 10 years of service: For example, a production facility placed in service on December 31, 2013, can claim the Section 45V credit for 1 year. However, to qualify, construction of the facility must have commenced before January 1, 2033.

Additionally, the value of the credit is influenced by whether the facility meets the prevailing wage and apprenticeship (PWA) requirements.[2] Those that meet PWA requirements receive five times the baseline credit, as shown in Table 1. Additionally, an applicable entity can make a direct-pay election that allows it to receive the tax credit through a refund.[3] Taxpayers that are not applicable entities can also make a direct-pay election for the first 5 years, after which the credits again become nonrefundable.[4] The Section 45V credit is also transferable, and taxpayers can sell any excess credits to other taxpayers.[5]

Table 1

Credit amounts under the IRA's Section 45V credit

Life-cycle GHG emissions (CO_2e)	Tax credit per kg of hydrogen produced by a facility that does not meet the PWA requirements	Tax credit per kg of hydrogen produced by a facility that meets the PWA requirements
2.5 to less than 4 kg GHG/kg of hydrogen	$0.12	$0.60
1.5 to less than 2.5 kg GHG/kg of hydrogen	$0.15	$0.75
0.45 to less than 1.5 kg GHG/kg of hydrogen	$0.20	$1.00
Less than 0.45 kg GHG/kg of hydrogen	$0.60	$3.00

2 The prevailing wage requirement mandates that taxpayers ensure that wages paid to laborers and mechanics, either employed directly or by contractors/subcontractors during the construction, alteration, or repair of a facility and within the 10-year period from its original service date, meet or exceed prevailing rates as determined by the Davis-Bacon Act in the facility's locality. The apprenticeship requirement mandates that a minimum percentage of total labor hours for constructing qualified facilities is work by qualified apprentices, that any requirements for apprentice-to-journeyworker ratios from the Department of Labor or the applicable state apprenticeship agency are met, and that a ratio for apprentices to construction, alteration, and repair workers is met.

3 An "applicable entity" is a tax-exempt organization, a state or a subdivision of a state, the Tennessee Valley Authority, Indian tribal governments, any Alaska Native corporation, and rural electric cooperatives.

4 Internal Revenue Service, "Section 6417 Elective Payment of Applicable Credits," 2023, https://www.federalregister.gov/documents/2023/06/21/2023-12798/section-6417-elective-payment-of-applicable-credits.

5 Internal Revenue Service, "Section 6418 Transfer of Certain Credits," 2023, https://www.federalregister.gov/documents/2023/06/21/2023-12799/section-6418-transfer-of-certain-credits.

PROPOSED GUIDANCE RELATING TO THE SECTION 45V CREDIT

PLACED-IN-SERVICE DATE FOR MODIFIED AND RETROFITTED FACILITIES

The proposed guidance includes rules for determining the placed-in-service date for facilities that are modified and retrofitted to produce qualified hydrogen (i.e., hydrogen produced with life-cycle GHG emissions less than 4 kg CO_2e/kg). A modified facility is one that was placed in service before January 1, 2023, and did not originally produce qualified hydrogen. Under the proposal, when a facility is modified to produce qualified hydrogen, the modification completion date would be treated as the original in-service date for tax credit purposes. In addition, for the modified facility to be eligible for the Section 45V credit, the modification needs to occur after December 31, 2022, and the cost of the modification must be recorded in the taxpayer's capital account for the facility.

A retrofitted facility is an existing facility that has been expanded, regardless of whether it previously produced qualified hydrogen or when it was placed in service. Under the proposal, a retrofitted facility could qualify for a new placed-in-service date for the purpose of the Section 45V credit if the fair market value of old property within the facility does not exceed 20% of the retrofitted facility's new total value, including all "properly capitalized costs" of new property within the facility—a provision known as the 80/20 Rule. Per the guidance, the placed-in-service date of such a facility would be the date on which the new property is put into operation.

LIFE-CYCLE GHG EMISSIONS EVALUATION

The well-to-gate life-cycle GHG emissions of hydrogen can be determined by the 45VH2-GREET model, which was released alongside the proposed guidance in December 2023.[6] In cases where the hydrogen production pathway or feedstock used is not covered by the 45VH2-GREET model, the taxpayer may go through the PER process and obtain the GHG emissions rate from the DOE.

45VH2-GREET

For production pathways contained within 45VH2-GREET, producers must use the latest version of the 45VH2-GREET model that is publicly available on the first day of the taxable year in which the qualified hydrogen is produced and the tax credit is being claimed. On the date the proposed guidance was issued, 45VH2-GREET included the following hydrogen production pathways:

- Steam methane reforming (SMR) of natural gas with potential carbon capture and sequestration (CCS)
- Autothermal reforming (ATR) of natural gas with potential CCS
- SMR of landfill gas with potential CCS
- ATR of landfill gas with potential CCS
- Coal gasification with potential CCS
- Biomass gasification with corn stover and logging residue with no significant market value with potential CCS

6 "Clean Hydrogen Production Credit (45V) Resources," U.S. Department of Energy, last modified December 19, 2023, https://www.energy.gov/articles/clean-hydrogen-production-tax-credit-45v-resources.

» Low-temperature water electrolysis using electricity

» High-temperature water electrolysis using electricity and potential heat from nuclear power plants

In the 45VH2-GREET model, the emissions rate of electricity generated from renewable sources—solar, wind, and hydropower—is treated as 0 g CO_2e/MMbtu, and the emissions rate of electricity generated from nuclear sources is treated as 820.633 g CO_2e/MMbtu.[7] Other parameters, such as upstream methane losses, are predetermined and referred to as "background data"; these parameters are currently fixed and cannot be adjusted. However, the Treasury Department and the IRS are asking for input on whether there are verification mechanisms ready for use that could allow certain background data to become foreground data in a future version of 45VH2-GREET. This would allow taxpayers to input the parameters based on their real-world hydrogen production process. For example, the methane loss rate could become foreground data if a certification system could demonstrate different methane loss rates for different natural gas sources and the work could be verified by a third party.

In terms of GHG emissions related to co-products from hydrogen production, the 45VH2-GREET model adopts a system expansion approach for all three co-products: steam, oxygen, and nitrogen.[8] This approach allows users to supply the quantity of co-products that are sold or utilized, and emissions are then adjusted based on the system expansion. To avoid incentivizing excessive generation or over-production of steam co-product to artificially reduce the calculated carbon intensity of hydrogen and potentially increase the tax credit value, the 45VH2-GREET model limits the amount of steam co-product that reformers can claim.

Users cannot input steam as a co-product if the system employs CCS. For hydrogen production pathways that involve CCS, the user must also provide the mass of CCS consistent with the amounts reported to the U.S. Environmental Protection Agency's Greenhouse Gas Reporting Program.

Provisional emissions rate (PER) process

The PER process will be specified by DOE. Alongside the PER request, the taxpayer must show that they have completed a front-end engineering and design (FEED) study or provide similar evidence of project maturity. In evaluating emissions values in such cases, DOE will use the same well-to-gate system boundary, the same guidance on use of energy attribute certificates (EACs; see below), and the same background data as defined in 45VH2-GREET, where applicable. More specific guidance on DOE's PER process is to be published prior to the opening of the emissions value request process on April 1, 2024.

FILING AND VERIFICATIONS

Upon obtaining an emissions value though either 45VH2-GREET or the PER process, the taxpayer can then file the Section 45V credit for each taxable year by attaching Form 7210 and production and sale or use verifications to their federal income tax

7 The emissions rate for electricity generated from nuclear sources reflects the upstream emissions from uranium extraction, conversion, and enrichment.

8 U.S. Department of Energy, *Guidelines to Determine Well-to-Gate Greenhouse Gas (GHG) Emissions of Hydrogen Production Pathways Using 45VH2-GREET 2023* (Washington, DC: 2023), https://www.energy.gov/sites/default/files/2023-12/greet-manual_2023-12-20.pdf.

return.[9] If the taxpayer obtained the GHG emissions rate through the PER process, the taxpayer also needs to attach the emissions value obtained from DOE and the original emissions value request to DOE, including all relevant information provided to DOE in support of that request.

The needed verifications include production attestation, sale or use attestation, conflict attestation, a qualified verifier statement, and other substantiating information. The production attestation is to confirm that the data provided in 45VH2-GREET or to DOE and the volume of hydrogen produced are both accurate. Verifiable sale or use can occur outside the United States, and thus exported hydrogen is eligible for the Section 45V credit. The sale or use of hydrogen must not include hydrogen venting or flaring, or the use of hydrogen to generate electricity in more hydrogen production, either directly or indirectly.

HYDROGEN PRODUCED USING ELECTRICITY

Use of energy attribute certificates (EACs) for "minimal-emitting" electricity sources

An EAC is a tradable instrument issued by a qualified registry that represents the energy attributes of a specific unit of energy produced. One example of an EAC is a renewable energy certificate (REC), which is issued when 1 MWh of electricity is generated and delivered to the electricity grid from a renewable energy source. Even though EACs do not directly measure or quantify emissions from specific sources or from induced generation when adding load to the grid, the Treasury Department and the IRS, in consultation with the U.S. Environmental Protection Agency and DOE, have preliminarily determined that EACs can be used to document that electricity was purchased from minimal-emitting (i.e., zero or near zero) sources and in evaluating the emissions impacts of electricity used in hydrogen production for the purposes of the Section 45V credit.[10] In the proposed guidance, for an EAC to be qualified to document this electricity, it must meet the requirements for incrementality, temporal matching, and deliverability described below. These are meant to ensure that the generation of renewable electricity and the production of electrolysis hydrogen are aligned, and that the production of hydrogen does not place a strain on the electricity grid. If demand for electricity for electrolysis hydrogen strains the electricity grid, it could lead to induced GHG emissions from the use of fossil fuels to compensate for the higher demand.

Incrementality

Under the incrementality requirement, the electricity used in qualified hydrogen production must come from a minimal-emitting facility with a commercial operations date (COD) not more than 36 months before the date that the relevant hydrogen production facility was placed into service. For electricity that comes from a facility that went through an uprate (i.e., an increase in rated nameplate capacity) to be represented by a qualified EAC, the uprate needs to have occurred within 36 months of when the hydrogen production facility was placed in service and the electricity should reflect the uprated production only.

The Treasury Department and the IRS are investigating alternative approaches to establishing incrementality for minimal-emissions electricity generators that have a COD

9 Internal Revenue Service, "Form 7210: Clean Hydrogen Production Credit," https://www.irs.gov/pub/irs-dft/f7210--dft.pdf.

10 Minimal-emitting sources include renewable and zero-emission sources; however, the Treasury Department and the IRS are also seeking input on other sources, including fossil fuels with CCS and biomass.

more than 36 months prior to when hydrogen production began. There are three proposed approaches:

1. **Avoided retirements**

Under this approach, minimal-emitting generators with retirement risk can be deemed as meeting the incrementality requirements by submitting information showing the risk of retirement could be mitigated by adding sales to hydrogen producers. The Treasury Department and the IRS are seeking comments on various aspects of this approach, including on criteria for assessing retirement risk and the likelihood that an electricity generator's association with a hydrogen production facility prevents or delays retirement of the generator, and on the period during which an incrementality determination would be maintained before another such determination would be required.

2. **Evidence of zero or minimal induced grid emissions through modeling or other evidence**

The Treasury Department and the IRS are also seeking comments on how modeling or other evidence could be used to demonstrate the incrementality requirement by showing zero or minimal induced grid emissions, specifically with respect to the circumstances in which this approach could be available, best practices for such demonstrations, and how the eligibility could be determined, among other factors. For example, if all the electricity in a specific region is generated from minimal-emitting generators, then any increased load might not increase induced grid emissions.

3. **Formulaic approaches to addressing incrementality from existing clean generators**

Because there could be limitations when accounting for all minimal-emissions electricity generators that have a COD over 36 months before the start of hydrogen production, the Treasury Department and the IRS propose an alternative "blanket allowance" approach. One such approach would deem 5% of the hourly generation from minimal-emitting electricity generators placed in service before January 1, 2023, as meeting the incrementality requirement. The Treasury Department and the IRS seek comment on various aspects of this potential allowance, including how it should be assessed, tracked, and administered, and how to determine the eligibility of the generators to be qualified. The Treasury Department and the IRS would also like to see proposals for other alternative approaches.

Temporal matching

Temporal matching is when the production of electricity from minimal-emitting sources and the production of hydrogen with that electricity both occur within a set time period. This has been proposed because some renewable electricity production is intermittent; electrolyzer operation during periods when the supply of minimal-emitting electricity is low could trigger additional electricity generation from high-emitting sources (and thus induced GHG emissions, as mentioned above). The temporal matching requirement would be enforced through the EAC market, which would track and verify compliance for each transaction.

In the proposed guidance, temporal matching guidelines would require that, beginning January 1, 2028, the electricity represented by an EAC be generated in the same hour that the hydrogen production facility uses the electricity to produce hydrogen. Because the hourly tracking system for EACs is not yet sufficiently developed, a

transition rule would permit annual matching through 2027. Under annual matching, an EAC generated in the same calendar year that the hydrogen production facility uses the electricity for hydrogen production can be deemed as meeting the temporal matching requirement.

Deliverability

To meet the deliverability requirement, under the proposed guidance, the hydrogen production facility must be in the same geographical region as the facility in which the minimal-emitting electricity is produced. This prevents any induced grid emissions from high-emitting sources that could be triggered by the power demand of electrolyzers. Regional definitions are outlined in DOE's National Transmission Needs Study, released in October 2023.[11] The location of both the electricity generation source and the hydrogen production facility are determined by the balancing authority to which they are electrically interconnected; in general, each balancing authority is associated with a single region. Alaska, Hawaii, and each U.S. territory are treated as separate regions.

Hydrogen producers that use electricity represented by EACs rather than the regional electricity grid can indicate this in 45VH2-GREET or in their PER process. This is permissible only if the taxpayer acquires and retires a qualifying EAC for each unit of electricity claimed. The taxpayer's acquisition of qualifying EACs must be recorded in a qualified EAC registry for verification.[12]

Intersection with other credits under Section 45 of the Internal Revenue Code

In cases where a taxpayer generates eligible clean electricity and subsequently uses it and the related EACs for qualified hydrogen production, they can additionally claim either the Section 45 renewable electricity production credit (before 2025) or the Section 45Y clean electricity production credit (starting in 2025), or they may claim the Section 45U zero-emission nuclear power production credit. For each credit, a qualified verifier must attest that the electricity used in hydrogen production originated from the relevant facility for which either the Section 45, Section 45Y, or Section 45U credit was claimed, that the amount of electricity used is accurately reported, and that the corresponding EACs are retired. In contrast, the Section 45V credit cannot be combined with the Section 45Q carbon capture and sequestration tax credit.

HYDROGEN PRODUCED USING RENEWABLE NATURAL GAS

There is little information in the proposed guidance about hydrogen production pathways using RNG or captured fugitive methane, on which the Treasury Department and the IRS have solicited comments. RNG refers to biogas upgraded to biomethane, which is chemically equivalent to fossil natural gas. Fugitive methane refers to the release of methane through various means, including equipment leaks and venting during the extraction, processing, transformation, and delivery of fossil fuels to the point of final use, such as coal mine methane.

11 U.S. Department of Energy, *National Transmission Needs Study* (Washington, DC: 2023), https://www.energy.gov/sites/default/files/2023-10/National_Transmission_Needs_Study_2023.pdf.

12 Qualified EAC registries currently include, but are not limited to: Electric Reliability Council of Texas (ERCOT); Michigan Renewable Energy Certification System (MIRECS); Midwest Renewable Energy Tracking System, Inc. (M-RETS); North American Registry (NAR); New England Power Pool Generation Information System (NEPOOL-GIS); New York Generation Attribute Tracking System (NYGATS); North Carolina Renewable Energy Tracking System (NC-RETS); PJM Generation Attribute Tracking System (PJM-GATS); and Western Electric Coordinating Council (WREGIS).

The proposed guidance indicates taxpayers will use a book-and-claim system to acquire attribute certificates for RNG and fugitive methane, in instances of both direct claims of use (involving a direct, exclusive pipeline connection for RNG or fugitive methane to a hydrogen production facility) and non-direct claims of use (in which RNG or fugitive methane is "sourced from a commercial or common-carrier natural gas pipeline"). The Treasury Department and the IRS state that existing systems for tracking and verifying RNG and fugitive methane use for Section 45V crediting purposes are limited, and note that they are considering issuing rules on whether or how a book-and-claim system could be used to attribute the environmental impact of RNG or fugitive methane used to produce hydrogen. They write that any such system would need to align with the incrementality, temporal matching, and deliverability requirements of EACs, but would also need to be different because of the distinctions between RNG and electricity, including with respect to sources of emissions, markets, and tracking methods. For Section 45V credit purposes, hydrogen producers using RNG or fugitive methane are also required to have a connection to the gas grid, including a revenue-grade meter for measuring the volume of gas flow.

The proposed guidance leaves undecided several important factors related to the GHG emissions for RNG and fugitive methane pathways that would have a large impact on the value of the credit that the hydrogen producer may receive. The Treasury Department and the IRS are seeking comments on these factors, which include how to best account for GHG emissions from RNG and fugitive methane pathways, the availability of tracking systems and verification mechanisms that could be used, and measures to mitigate indirect emissions from diverting RNG or biogas from potentially productive uses in the future. Previous ICCT studies have shown that baseline feedstock management, the frequency of uncontrolled venting of biogas, and other factors have a large impact on the GHG intensity of RNG.[13]

Landfill gas is included in 45VH2-GREET, allowing a hydrogen production facility that obtains RNG through a direct, dedicated pipeline connection measured with a revenue-grade meter to apply for the tax credit. The PER process will not entertain any emissions rate requests for hydrogen production pathways using biogas and RNGs until the final guidance is issued.

INTERACTION WITH THE SECTION 48 ENERGY CREDIT FOR QUALIFIED CLEAN HYDROGEN PRODUCTION FACILITY

The Section 48 Energy Credit is designed to support investment in energy properties, including hydrogen production facilities. It is a one-time, upfront credit and to be eligible to receive it, no Section 45V or Section 45Q credit should have been previously claimed for the facility. The credit is calculated by multiplying the tax basis, or the amount spent on the eligible property, by an energy percentage that the property qualifies for, as indicated in Table 2. The energy percentage for a qualified hydrogen facility refers to a percentage rate determined by the life-cycle GHG emissions of the hydrogen produced,

13 The life-cycle analysis of RNG from waste feedstocks considers the energy use and GHG emissions from both baseline feedstock management (i.e., the current waste management practice) and RNG production. The GHG intensity of RNG pathways thus depends on assumptions of their pre-existing, baseline feedstock management practices, and the production of the RNG itself. For more, see Jane O'Malley, Nikita Pavlenko, and Yi Hyun Kim, *2030 California Renewable Natural Gas Outlook: Resource Assessment, Market Opportunities, and Environmental Performance* (Washington DC: ICCT, 2023), https://theicct.org/publication/california-rng-outlook-2030-may23/.

consistent with the requirements of the Section 45V credit. For facilities that meet PWA requirements, the energy percentage can be elevated by five times.

For Section 48 purposes, the GHG emissions rate for a hydrogen production facility is determined using the same methodology as for Section 45V purposes: either by the most recent 45VH2-GREET or by a PER process. The Section 48 credit is available for hydrogen production facilities that are placed in service after December 31, 2022, and began construction before January 29, 2023. Like the Section 45V credit, Section 48 requires third-party verifications in the credit-claiming process.

Table 2

Energy percentage of a qualified hydrogen production facility by life-cycle GHG emissions under the Section 48 credit

Life-cycle GHG emissions (CO_2e)	Energy percentage for a facility that does not meet the PWA requirements	Energy percentage for a facility that meets the PWA requirements
2.5 kg to less than 4 kg of GHG/kg of hydrogen	1.2%	6%
1.5 kg to less than 2.5 kg of GHG/kg of hydrogen	1.5%	7.5%
0.45 kg to less than 1.5 kg of GHG/kg of hydrogen	2%	10%
Less than 0.45 kg of GHG/kg of hydrogen	6%	30%

To claim the Section 48 credit, the taxpayer needs to file Form 3468 with third-party verifications or any successor forms attached, along with the taxpayer's federal income tax return for the taxable year in which the specified hydrogen production facility is initially placed in service.[14] For the third-party verifications, all requirements outlined in the Section 45V credit, excluding production attestation, are required. Section 48 additionally requires a statement attesting that the GHG emissions rate of hydrogen produced at a specified hydrogen production facility aligns with the data provided in 45VH2-GREET or submitted to the DOE in the PER process. An attestation that the emissions rate of hydrogen produced is consistent with or lower than the emissions rate that the facility is expected to produce is also required.

All the verifications are required during a 5-year credit recapture period that starts in the first taxable year after the facility is placed in service and ends on the last day of the fifth year. Cases of failure to obtain an annual verification report by the tax return deadline, or instances in which the life-cycle GHG emissions rate of the taxable year exceeds the emissions rate that was used to claim the Section 48 credit, will result in credit recapture and the taxpayer will have to pay back part of the credit they received. The recapture amount is equal to 20% of the difference between the Section 48 credit claimed in the taxable year in which the facility was placed in service and the Section 48 credit that would have been allowed, given the actual GHG intensity in that year. Likewise, if PWA requirements are not met, the amount representing the increased credit for meeting these requirements will also be subject to credit recapture.[15]

14 Internal Revenue Service, "Form 3468, Investment Credit," https://www.irs.gov/pub/irs-pdf/f3468.pdf

15 Internal Revenue Service, "Definition of Energy Property and Rules Applicable to the Energy Credit," 2023, https://www.federalregister.gov/documents/2023/11/22/2023-25539/definition-of-energy-property-and-rules-applicable-to-the-energy-credit.

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