Clean Hydrogen Production Tax Credit: Overview and Implications

A Clean Hydrogen State Working Group Tool

NASEO
National Association of State Energy Officials

Breakthrough Energy

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Introduction and Objective

This NASEO issue brief provides State and Territory Energy Offices with a high-level overview of the proposed guidance for the clean hydrogen production tax credit (45V); implications for states and the private sector; and opportunities for state-level incentives that compliment or expand on the federal tax credit.[1] State Energy Offices are working with public and private partners to explore production, end-use opportunities, related economic development and workforce considerations, private sector investment, and emissions reduction potential of clean hydrogen. An understanding of the 45V tax credit and the different requirements it entails are important to support and move clean hydrogen policies, programs, projects, and planning efforts forward. Due to the large volume of comments, the discussions at the public hearing (held in March 2024), and potential legal challenges, the timeline for final guidance is unknown.

What is 45V?

On December 22, 2023, the U.S. Department of the Treasury (USDT) and the Internal Revenue Service (IRS) released a Notice of Proposed Rulemaking (NPRM) for 45V. 45V was created by the Inflation Reduction Act of 2022 (IRA) and aims to incentivize reduced lifecycle greenhouse gas emissions associated with the production of hydrogen. Specifically, it provides a tax credit ranging from $0.60 per kilogram to $3 per kilogram of hydrogen produced. There are different tiers of the tax credit with different values depending on the intensity. For example, to get the maximum credit ($3.00/kgH2), the emissions intensity would need to be 0 – 0.45 kg of CO2e per kg of hydrogen. Table 1 below provides a detailed overview of the different tiers.

Table 1 – Emissions Intensity and 45V Credit Tiers[1]

Emissions Intensity (kg of CO2e per kg of H2)	Maximum credit ($/kgH2, assuming prevailing wage and apprenticeship requirements are met)
0 - .45kg	$3.00
.45 - 1.5kg	$1.00
1.5 - 2.5kg	$0.75
2.4 - 4kg	$0.60

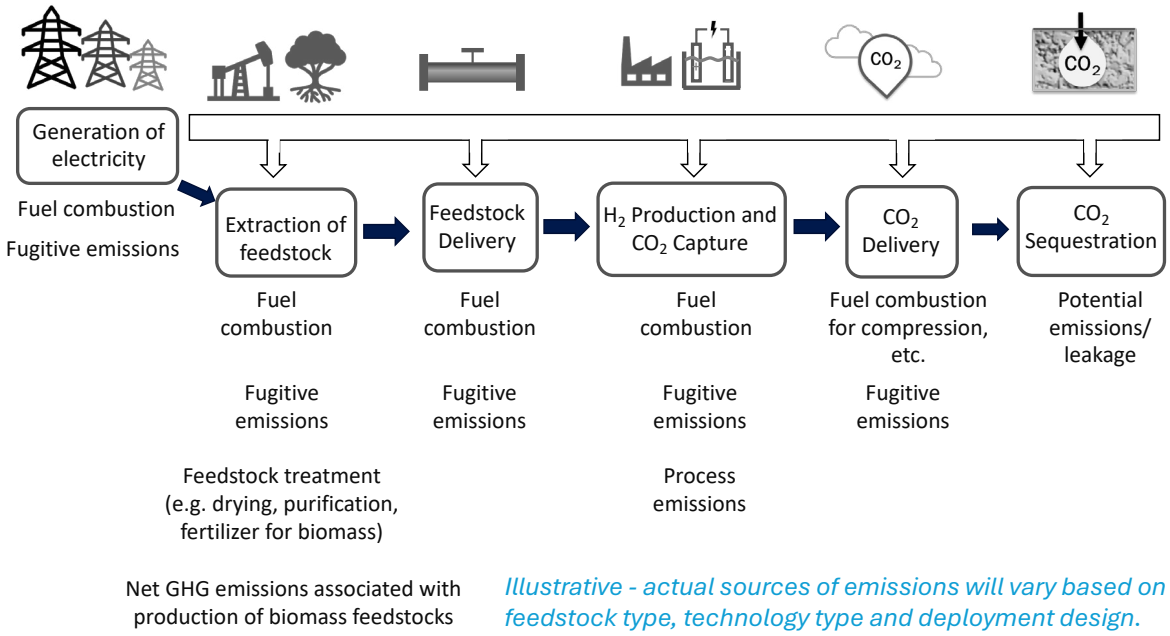
When determining emissions intensity to qualify for 45V, producers should be aware that, according to the NPRM, the method of measuring these emissions will need to align with the Clean Air Act and the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model developed by Argonne National Laboratory. For background, in December 2023, the U.S. Environmental Protection Agency (EPA) submitted a letter to USDT on the definition of lifecycle greenhouse gas emissions under the Clean Air Act and how that supports USDT's interpretation of 45V. The letter stipulates that while the EPA has not yet analyzed emissions related to clean hydrogen production, the EPA still believes that the proposed process outlined by USDT would be consistent with the Clean Air Act.[2]

1 This brief is based on the proposed guidance released in December 2023.

The GREET model measures energy consumption, emissions from air pollutants and greenhouse gases, and water consumption. It is used across sectors and by federal agencies such as the EPA. For example, in 2010, the EPA utilized GREET when developing the Renewable Fuels Standard. California also designed their own version of GREET (CA-GREET) to analyze and develop the state's Low Carbon Fuel Standard.[3]

A more specific GREET model was developed for 45V, the 45VH2-GREET model (see Figure 1 below) which calculates emissions across the spectrum of the hydrogen production process ranging from feedstock to any potential carbon dioxide (CO2) sequestration.[4] The U.S. Department of Energy has prepared *Guidelines to Determine Well-to-Gate Greenhouse Gas Emissions of Hydrogen Production Pathways using 45VH2-GREET 2023* that provides an overview of the model and instructions on how to use it.

Figure 1 – 45VH2-GREET Model: Measuring Emissions[5]

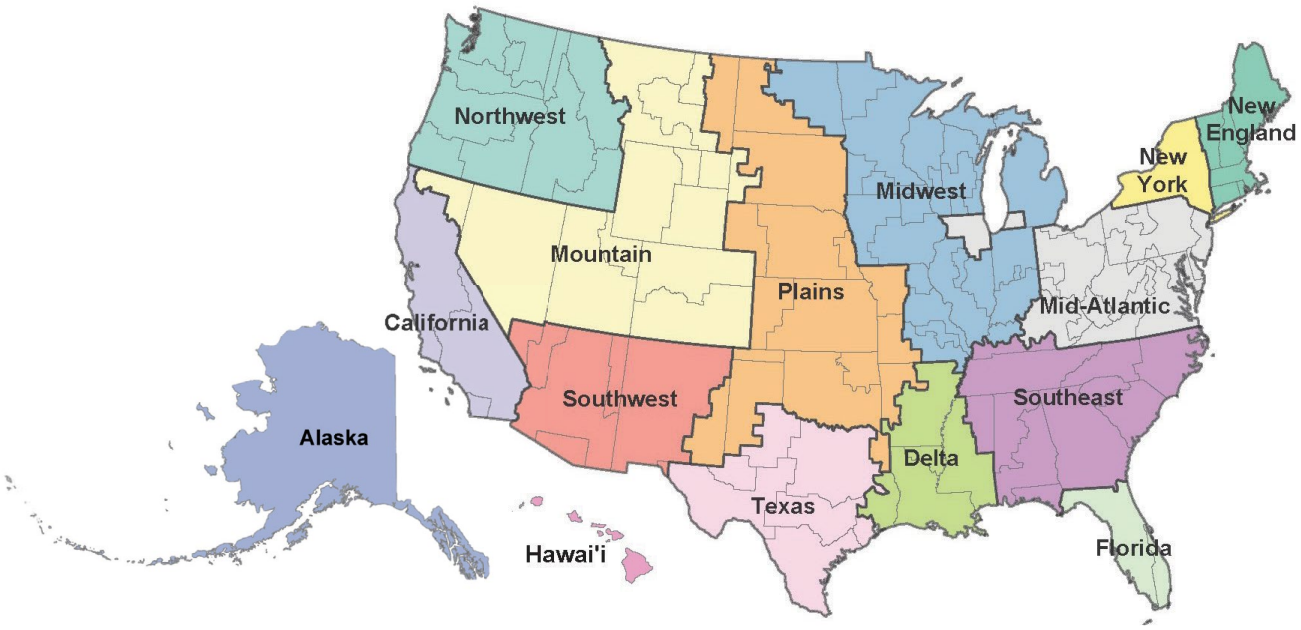


Eligibility

For hydrogen produced using electrolysis, producers would use energy attribute certificates (EACs) that determine how much of the tax credit can be claimed. According to the NPRM, EACs represent the energy attributes of a unit of produced energy. Specifically, producers will need to get information on the technology and feedstock used to generate the electricity that will be used to produce the hydrogen; the amount of electricity; a unique project identification number; and the date that the electricity generating facility began commercial operation. For electricity generated before January 1, 2028, information needs to include the calendar year that the electricity was generated; for electricity generated after December 31, 2027, the date and hour when the electricity was generated.[6] According to the NPRM, renewable energy credits (RECs) would qualify as an EAC when thinking about measuring carbon intensity under 45V. This is relevant for producers who will need to rely on grid electricity to power their facilities, rather than utilizing an on-site clean energy source.

Electricity generation would need to meet three pillars to qualify for the tax credit: incrementality, temporal matching, and deliverability. **Incrementality** (also known as additionality), is centered around the timing of projects. The electricity generating facility that is being used to produce the hydrogen must have a commercial operation date that is no earlier than 36 months prior to the date that the hydrogen production facility came online.[7] This pillar was proposed to ensure clean hydrogen production is powered by additional clean power, rather than adding additional demand. It also aims to limit the amount of direct emissions and incentivize more clean energy build-out. For **temporal matching**, the proposed rule would be met if the electricity represented by the EAC is generated in the same hour that the hydrogen production facility is using electricity. Prior to January 1, 2028, a transition period is permitted to allow for the proper tools to be developed to verify hourly matching. During the transition period, the proposed temporal matching requirement could be met if the electricity is generated in the same calendar year that the hydrogen production facility is using electricity. This pillar was proposed to ensure the credit is going to production of hydrogen with clean energy sources, rather than hydrogen produced by fossil fuels. Finally, when it comes to **deliverability**, an EAC would meet these proposed requirements if the electricity represented by the EAC is generated by a source in the same region as the hydrogen production facility. DOE determined these regions based on different criteria, including transmission constraints and congestion as outlined in the DOE National Transmission Needs Study (see Figure 2 below). There are additional circumstances that are under consideration to be addressed in the final guidance – such as a fossil fuel power plant that added carbon capture and storage (CCS). This pillar was proposed to ensure there is a more accurate way to track what power is available and where it is going.

Figure 2 – DOE National Transmission Needs Study Regions[8]



Hydrogen Production Methods

The proposed guidance focuses mainly on hydrogen produced with electrolysis. Producers may also utilize 45VH2-GREET to measure emissions from hydrogen produced through:

- Steam methane reforming of natural gas with potential CCS,
- Autothermal reforming of natural gas with potential CCS,
- Steam methane reforming of landfill gas with potential CCS,
- Autothermal reforming 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,
- Low-temperature water electrolysis using electricity, and
- High-temperature water electrolysis using electricity and potential heat from nuclear power plants.[9]

For other production or feedstock methods with emissions rates not determined under 45VH2-GREET, a producer may file a petition with the Secretary of Energy for a provisional emissions rate (PER). DOE will need to assess the lifecycle greenhouse gas emissions rate for the production pathway and provide that value to the hydrogen producer. The IRS will then determine if the PER is accepted or not when the producer files their tax return and includes the DOE assessment and original petition language with their submission.[10]

What's Missing

The proposed regulations do not provide guidance on hydrogen production from existing nuclear, hydropower, renewable natural gas (RNG), or geologic sources.

However, the USDT and the IRS requested comments on existing nuclear and hydropower, emphasizing the need for specific feedback on facilities that will need to undergo relicensing and may be at risk of retirement. The NPRM outlines interest in better understanding how hydrogen production may decrease that risk and how to determine electricity generation and EACs.[11] There has been a lot of concern regarding whether hydrogen production from these sources will qualify for the credits. Within their comments on the NPRM, many states have outlined the role that existing nuclear energy and hydropower can play in supporting the clean hydrogen economy in their plans, programs, and other activities. Depending on the final guidance, one way to stress the importance of existing hydro and nuclear for hydrogen production is when states are evaluating relicensing or delaying retirements of facilities. States can assemble a plan for a particular facility and make clear that a key reason they are pursuing relicensing or retirement delays is due to the role that facility can play in supporting hydrogen production and the overall hydrogen economy.

There are several hydrogen demonstration projects underway at existing nuclear facilities including Nine Mile Point in New York and Davis-Besse in Ohio. Nuclear power plants can produce carbon-free hydrogen and are often located near a water source needed to produce hydrogen through electrolysis. Still, states should be aware of potential emissions implications. It will be important to consider that if these clean sources (such as a nuclear

power plant) shift from supplying electricity to the grid to producing hydrogen, there may be significant increases in emissions depending on the number of facilities. Of note, the Rhodium Group conducted analysis on different relicensing scenarios and found that if all 28 GW of existing nuclear plants with licenses expiring through 2035 were used for hydrogen production that would lead to an estimated 33-360 million metric tons (MMT) net increase in emissions from 2024. For the around 13 GW of hydropower facilities seeking relicensing, the analysis found that emissions would increase by 23-165 MMT.[12] This increase is because if all nuclear and hydropower was being used to produce hydrogen rather than supplying the grid, that power would most likely be supplemented, at least partially, by fossil fuels or other emitting sources. As states navigate this process, it will be important to balance the benefit of utilizing existing clean energy sources with potential long-term emissions impacts depending on the number of plants being utilized and other factors.

Guidance on renewable natural gas (RNG) and fugitive sources of methane is expected to be provided in future versions of the guidance but an overview of potential conditions for these sources to qualify is included in this NPRM. The conditions would not be identical to the incrementality, temporal matching, and deliverability requirements for electrolytic hydrogen and would instead consider the difference in emissions, markets, and verification methods. There are specific questions about RNG outlined in the NPRM including (1) What data sources and peer reviewed studies provide information on RNG production systems? (2) What conditions for use of biogas and RNG would ensure that emissions accounting for purposes of 45V reflects and reduces the risk of indirect emissions effects from hydrogen production using biogas and RNG? (3) What are the emissions associated with different methods of transporting RNG or fugitive methane to hydrogen producers? (4) Are geographic or temporal deliverability requirements needed? and (5) How should variation in methane leakage across the existing natural gas pipeline system be considered?[13]

Geologic hydrogen is not considered in the initial version of the 45VH2-GREET model, but if it becomes commercially viable in the future, the PER process outlined above (which includes DOE separately assessing the lifecycle emissions) may be used to get information on its carbon intensity.

The IRS also requested comments on circumstances when diversion of zero-emitting generation to hydrogen production is unlikely to result in significant induced GHG emissions including periods when this generation would have otherwise been curtailed.

Implications for States and the Private Sector and Coordination with Other Programs

The 45V tax credit is expected to help increase demand and spur additional market growth and certainty for clean hydrogen while also providing significant emissions reductions. This is critical as states and the private sector seek to decarbonize different hard to abate sectors including heavy-duty transportation, industry, and agriculture. The final guidance will also aim to ensure that clean hydrogen production and use is not exacerbating greenhouse gas emissions and that it will bring costs down while providing more market certainty.

The Rhodium Group conducted modeling work that looks at specific implications for the proposed guidance and how it will drive net emissions reductions. For example, the analysis

looked at different scenarios for deployment of electrolyzers in the United States through 2027. Depending on the final guidance and industry demand, the slow growth scenario would lead to 2 GW of electrolyzers being deployed and emissions reductions of 8-20 million metric tons (MMT), a mid-growth scenario would lead to 4.7 GW of capacity and 14-45 MMT of emissions reductions, and the fast growth scenario would lead to 23.4 GW of capacity and emissions reductions up to 236 MMT.[14] These scenarios were determined with data from the Rhodium Group-MIT Clean Investment Monitor and with the expectation that this electrolytic hydrogen being produced is offsetting hydrogen produced by steam methane reforming and other methods. Work by Energy Innovation found that, broadly, if 45V did not maintain the three pillars (incrementality, temporal matching, and deliverability), hydrogen produced from electrolysis could emit between 1.5 to 5 times more greenhouse gases than from current methods.[15]

In addition to demand and emissions reduction opportunities, one of the benefits of the proposed guidance includes the direct pay mechanism's applicability. For 45V, all eligible taxpayers, rather than only certain non-taxable entities, can claim the tax credit through direct pay as outlined in the IRA. This is beneficial as it is expected to provide more benefits directly to project developers rather than having the benefits shared or transferred to other equity investors.[16] Direct pay ensures that the tax credits are effectively refundable. According to the IRS, the entity can receive the full value of the credit as a tax payment. It is counted as an overpayment on the return and refunded.[17] Other credits that similarly qualify are 45Q and 45X. For entities interested in stacking tax credits, there are some limitations. For example, the 45Q tax credit, which supports carbon capture and sequestration or carbon capture and utilization, is not able to be stacked with 45V. Therefore, producers of hydrogen utilizing a pathway such as steam methane reforming paired with CCS may be interested in claiming 45Q instead.

Some concerns center around coordination with other programs and the eligibility pillars outlined earlier (incrementality, temporal matching, and deliverability). For example, 45V will greatly impact the economic feasibility and long-term success of the Regional Hydrogen Hubs (H2Hubs). Many of the H2Hubs will depend on the credits to offset costs and spur demand, and some of the items not clearly addressed in the draft guidance may have strong repercussions. In February 2024, all seven H2Hubs submitted a joint letter to USDT and the White House expressing concerns about the narrow scope of the guidance.[18]

Several of the H2Hubs will be using hydrogen produced by nuclear power, which may not qualify them for the 45V under the currently proposed rule. There are also challenges around data collection and additionality. Taxpayers should be able to update the 45VH2-GREET model by inputting more granular, state-level data to more accurately capture life-cycle emissions estimates and carbon intensity calculations. There are also potential implications for states regarding the proposed additionality requirement. For states with substantial amounts of existing renewables or other qualified energy sources, they may be at a disadvantage based on the current proposed guidance around construction timelines.[19] On the flip side, for states with a lower penetration of renewables, opportunities to qualify for 45V may also be limited. For example, in April 2024, the Kentucky Office of Energy Policy released a hydrogen-powered trucks feasibility study for the state which provided an overview of 45V while

also acknowledging that entities in Kentucky and the larger region may have a harder time qualifying for the credit as they have less renewable generation on the grid.[20]

Additionally, several states with clean grid statutes already in place flagged concerns about the lack of alternative compliance pathways. For example, Washington's comments on the NPRM reference the state's 100% clean electricity standard and statutory greenhouse gas emission cap-and-invest regulation as a reason the additionality requirements are unnecessary and overcomplicated. Allowing an alternative compliance pathway would allow states like Washington to build projects faster and more affordably. Several northeast states flagged that these requirements will lead to higher hydrogen prices as the responsibility for adjusting the renewable energy generation will fall to the clean hydrogen producers. In states with existing clean energy standards, the cost would be spread among ratepayers helping to keep costs low.

States may also wish to explore state-level incentives to further develop opportunities for the hydrogen industry (see the State Incentives section below). In modeling work led by the Washington Department of Commerce, the final report outlined the importance of the Washington State Energy Office helping taxpayers better understand the tax credits and how to take advantage of them. The State Energy Office is also looking at getting funding and authorization from the state legislature to support additional program development and approaches to expand access to the tax credits for underserved communities.[21] An additional recommendation laid out in the report focuses on imported hydrogen and how to best include the lifecycle greenhouse gas emissions for imported hydrogen in Washington state policies like the Climate Commitment Act.

State Incentives

States may be interested in implementing their own state-level incentive to support or align with 45V. For example, Colorado HB23-1281, signed into law in May 2023, will offer tax credits to users in hard to decarbonize industrial applications and heavy-duty transportation that are designed to complement 45V. In order to claim the tax credits, the hydrogen used must meet certain standards to demonstrate that the hydrogen meets lifecycle emissions intensity standards set in the statute (which align with the federal prosed guidance). If electricity that was used for hydrogen production is claimed to be zero emissions, it must be located in the same geographic region and have come online within the last three years.[22] In order to support this effort, the Colorado Public Utility Commission is required to develop an accounting standard that can be used by producers to prove that the electricity being used to produce the hydrogen is indeed carbon-free and was developed in the last three years. There will also be hourly- matching requirements.[23]

Pennsylvania has established the Regional Clean Hydrogen Hubs Tax Credit for qualified taxpayers (manufacturers) purchasing clean hydrogen and natural gas for use in manufacturing at a facility in the state. According to the Pennsylvania Department of Revenue, the tax credit will be equal to $0.81 per kilogram of clean hydrogen purchased and/or $0.47 per unit of natural gas that is purchased and used. There are several requirements for the manufacturer to qualify for the credit including (1) their facility must be located within one of the two Pennsylvania H2Hubs, (2) they must commit to purchasing

clean hydrogen only from within one of the two H2Hubs, (3) a capital investment of at least $500,000,000 must be made in the state to construct the manufacturing facility, (4) at least 1,200 new and permanent jobs must be created during construction and operation of the facility and they must meet prevailing wage requirements, and (5) efforts must be made to recruit and employ employers from the local labor market.[24]

There is also pending legislation similar to Pennsylvania's in Illinois. Whether or not this legislation is adopted, it is an interesting example of a potential state incentive. In March 2023, a bill to create a Hydrogen Fuel Replacement Tax Credit was re-referred to the Illinois Rules Committee. The proposed legislation would create an income tax credit for eligible taxpayers in an amount equal to $1 per kilogram of eligible clean hydrogen (referred to as "zero-carbon").[25] Additional credits will be available if the hydrogen is used in an "equity investment eligible community" which are identified through a mapping tool that considers different qualifications including areas with residents who have historically been excluded from economic opportunities as established under the Cannabis Regulation Tax Credit and environmental justice communities defined under the Illinois Power Agency Act.[26]

Conclusion and Other Resources

While the guidance is still not final at the time of this issue brief, many State Energy Offices and other entities have submitted comments on the NPRM. NASEO's comments can be viewed **here**. Due to the large volume of comments, the results of the public hearing, and potential legal challenges, the timeline for final guidance is unknown.

For states interested in additional resources on the proposed guidance, the following may provide further insights:

- NASEO Hydrogen Resources
- Resources for the Future *Unlocking the Proposed Guidance on the 45V Tax Credit for Clean Hydrogen*
- Rocky Mountain Institute *Clean Hydrogen Tax Credit (45V) Guidance Explained*
- Baker Botts *Section 45V Clean Hydrogen Production Tax Credit*
- Rhodium Group's *How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit* Guidance

Endnotes

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