Understanding the 45V Clean Hydrogen Production Tax Credit

REQUIREMENTS, EXCEPTIONS, AND PROJECT IMPACTS

The 45 V Clean Hydrogen Production Tax Credit (45V) was enacted through the Inflation Reduction Act of 2022 (IRA), which created a production tax credit for clean hydrogen under Section 45V of the Internal Revenue Code. 45V provides a credit of up to $3.00 per kilogram of qualified clean hydrogen produced during a given year. The US Treasury Department (Treasury) released final guidance regarding 45V in January 2025.

How is the credit calculated?

45V is a tiered tax credit. To be eligible for the credit, hydrogen must be produced with lifecycle greenhouse gas emissions of less than 4 kilograms (kg) of carbon dioxide equivalent (CO_2e) per kg of hydrogen. There are four tiers of increasing credit value as lifecycle greenhouse gas emissions go down. The highest tier and greatest credit value is for hydrogen produced with greenhouse gas emissions of 0.45 kg CO_2e per kilogram of hydrogen or less.

How are lifecycle greenhouse gas emissions determined?

Hydrogen producers must generally use the 45VH2-GREET model to calculate the lifecycle greenhouse gas emissions of hydrogen from their facility. In 1994, the US Department of Energy developed the Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) model, a free software for analyzing emissions of different technologies. The 45VH2-GREET model, most recently updated in January 2025, was developed specifically to calculate the lifecycle greenhouse gas emissions of hydrogen produced within a "well-to-gate" system boundary, meaning it only covers emissions associated with the production of the hydrogen, and not the transportation or end-use of the hydrogen once it has left the facility. Learn more about 45VH2-GREET, and its potential pitfalls, here.

How are emissions assessed for the electricity used to produce hydrogen?

Hydrogen requires energy to produce. It is typically made by either a chemical reaction using natural gas and steam (also known as steam methane reforming, commonly associated with grey or blue hydrogen), or by running an electric current through water to separate out the hydrogen molecules (also known as electrolysis, commonly associated with green or pink hydrogen). Because it is so energy intensive, hydrogen production can spike electricity demand on the grid, causing dirtier and more expensive peaker power plants to have to power up to meet the higher demand. To prevent this issue, Treasury has required that hydrogen production facilities that are connected to the electrical grid must purchase energy attribute certificates (EACs). These EACs must meet three requirements, sometimes referred to as " Three Pillars," described below.

WHAT ARE ENERGY ATTRIBUTE CERTIFICATES?

Because almost all energy is produced and distributed through a shared network, it is impossible to tell which electrons come from where—there is no physical difference between electricity from a gas power plant and electricity from a solar array. EACs are contracts between an energy producer (such as a solar farm or gas plant) and an energy user (such as a hydrogen producer), which convey information about a unit of electricity produced, where it came from, and the lifecycle greenhouse gas emissions of that unit of electricity. EACs are typically tracked through third-party verification organizations.

PILLAR 1: TEMPORAL MATCHING

Starting in 2030, for every hour that a hydrogen production facility is online and producing hydrogen, it will be required to purchase an equivalent amount of hourly EACs from an energy producer for electricity generated within the same hour it was used by the facility. The greenhouse gas emissions associated with the EAC are included in the lifecycle greenhouse gas emissions of the hydrogen produced. Before 2030, hydrogen producers will only be required to buy EACs to match their total annual production, rather than hourly.

Energy Storage

Hydrogen producers are allowed to use energy storage (such as a battery) to shift the temporal matching requirements, provided the energy storage facility is in the same region as the hydrogen facility and the energy generating facility. For example, if a hydrogen facility purchased hourly EACs from a solar farm, these EACs would not be available at night when the solar is not producing. If the facility wished to produce hydrogen at night, they could procure EACs from a battery storage facility that was charging the batteries from the solar farm during the day and discharging the batteries at night.

PILLAR 2: INCREMENTALITY

Under the 45V guidelines, hydrogen producers can only purchase EACs for electricity generated by a facility that has come online no more than three years prior to the hydrogen facility coming online.

CAVEATS TO INCREMENTALITY

In the final 45V guidance, Treasury created several pathways to meet this requirement through existing electricity sources:

- **Carbon Capture and Storage (CCS):** EACs can be obtained from an existing fossil-fuel power plant that installed CCS technology no more than three years prior to the hydrogen facility coming online. The emissions resulting from this electricity will be factored into the lifecycle greenhouse gas emissions of the hydrogen produced, so the CCS technology would need to operate at a high rate of capture—something that has not been proven at scale. The Boundary Dam plant in Saskatchewan, Canada, one of the few currently operating power plants with CCS in the world, has never sustained a continuous rate of 90 percent capture. CCS also increases other air pollutants like nitrogen oxides (NO_x) and fine particulates.
- **Electricity from 100% Decarbonized States:** EACs procured from energy producers in states with laws requiring that 100 percent of retail energy sales be decarbonized by 2050, even if the EACs are from existing energy generation facilities, can satisfy the incrementality requirement. Currently, only Washington and California meet this standard.
- **Nuclear:** A hydrogen facility may either establish a direct connection to an existing nuclear plant or establish a 10-year contract with a nuclear plant to purchase EACs, if the nuclear plant would have otherwise been retired.

PILLAR 3: DELIVERABILITY

Energy attribute certificates must be procured from energy-generating facilities located within the same region as the hydrogen production facility. These regions were determined using geographic data in the US Department of Energy National Transmission Needs Study. See the map of these regions on p. 3.

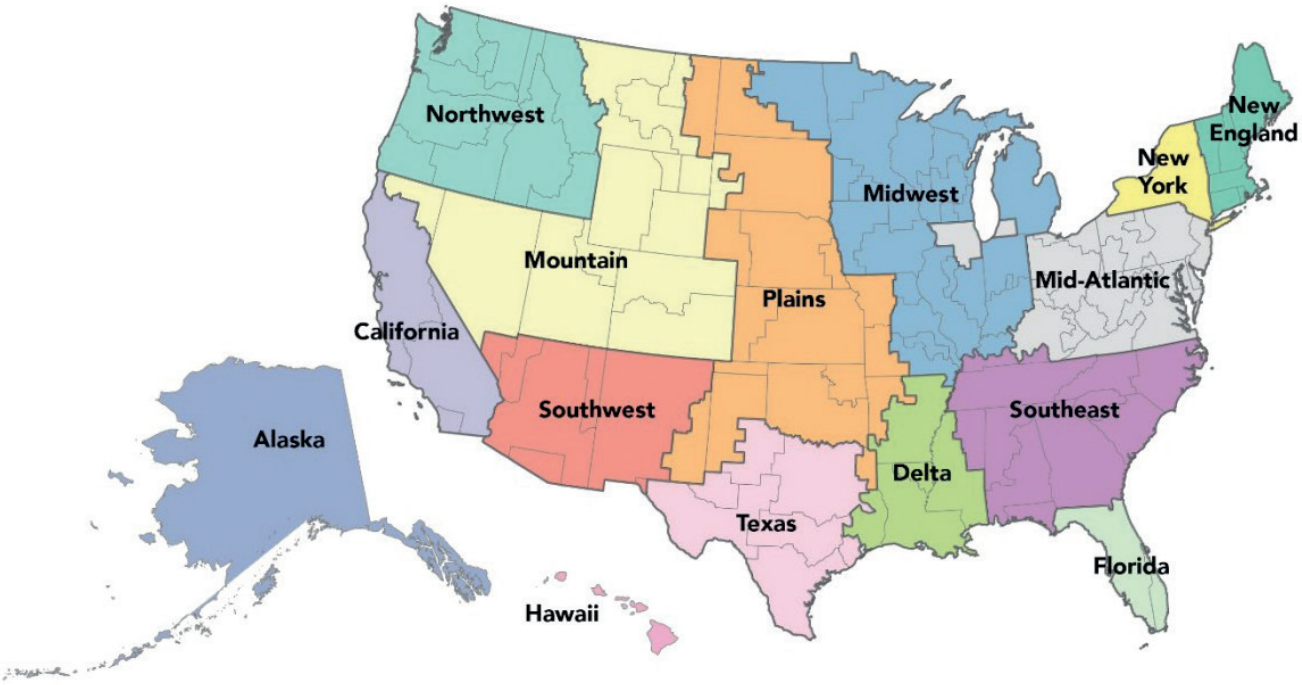
Emissions accounting for fossil fuel alternatives

The final guidance on 45V includes clarifications around the use of fossil fuel alternatives for hydrogen production. Any direct or indirect emissions associated with methane use for hydrogen production will be factored into the lifecycle greenhouse gas emissions for the hydrogen. However, several fossil fuel alternatives, such as methane from animal waste or wastewater resource recovery facilities, are considered "carbon negative" because it is assumed that if the methane is not used it would be flared into the atmosphere instead. This means it is possible that hydrogen produced from these sources would be eligible for the highest tier of the credit, even if it is made using methane, a potent greenhouse gas.

How will 45V impact hydrogen production projects?

- **Green hydrogen:** Projects producing hydrogen from zero- or very low-emissions sources will likely be eligible for the highest tier of the credit, although the three pillars requirements may add some administrative burden.
- **Blue hydrogen:** Hydrogen made using CCS will need to demonstrate a high rate of capture in the production process to be eligible for the highest tier of 45V, although it may qualify for the lower tiers of the credit. Many producers may decide to apply for the 45Q Carbon Capture and Storage tax credit instead, which is based on the amount of carbon captured rather than on overall emissions.

FIGURE 1 Geographic Regions Used in National Transmission Needs Study



Source: US Department of Energy National Transmission Needs Study/NREL.

- **Pink hydrogen:** Hydrogen made using nuclear energy, sometimes referred to as pink hydrogen, received a major boost through the nuclear energy exemption to the incrementality requirements for 45V, as it is unlikely that many pink hydrogen projects would be able to source nuclear energy from new nuclear plants cost effectively.
- **Hydrogen from alternative fossil fuels:** Hydrogen made from fossil fuel alternatives will have varied eligibility for the tax credit depending on the type of fuel used. The final guidance does require that emissions from hydrogen are looked at per feedstock, meaning that producers could not blend a "carbon negative" fuel like methane from animal manure into fossil fuel to lower the overall emissions. This may inhibit some projects.

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To learn more about other harms associated with hydrogen's production and use, visit www.cleanegroup.org/initiatives/hydrogen.