Clean Hydrogen Tax Credit (45V) Guidance Explained

A deep dive into the Treasury guidance for hydrogen electrolysis
Speakers

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Agenda

• Review of Proposed Clean Hydrogen Tax Credit (45V) Rules
• Discussion: Understanding the Impacts of 45V
• Q&A
• What’s Next?
Basics and Background

• Section 45V of the Inflation Reduction Act provides a tax credit to produce low carbon intensity hydrogen

• The value of the credit is based on emissions intensity (as calculated by GREET) and is technology-neutral

• Prevailing wage and apprenticeship unlocks full value

• Congressional intent included allowance of “book and claim” systems to reduce "effective GHG emissions"

Timeline:
• February 26th: Public comment period closes
• March 25th: Public hearing

<table>
<thead>
<tr>
<th>CO2e kilograms (kg) to produce a kg of H2</th>
<th>PTC per kg</th>
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<tbody>
<tr>
<td>&lt;0.45</td>
<td>$3</td>
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<tr>
<td>0.45 to &lt; 1.5</td>
<td>$1</td>
</tr>
<tr>
<td>1.5 to &lt; 2.5</td>
<td>$.75</td>
</tr>
<tr>
<td>2.5 to &lt; 4 kg</td>
<td>$.60</td>
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Inflation adjusted
Direct pay for 5 years
Proposed Rule - Summary

1. The guidance provides clarity to developers on the details of a "well-to-gate" lifecycle systems to demonstrate the production of low carbon hydrogen

2. Enables the use of Energy Attribute Certificates (EACs) and EAC trading, opening the door to a diversity of contract types

3. EACs must demonstrate: incrementality, deliverability, and temporal matching

4. Developers can propose new hydrogen production pathways

5. Further comments are requested on gas-based pathways and edge cases
Incrementality

**Proposed rule:** New clean electricity must be placed in service less than 36 months prior to the hydrogen facility being placed in service.

**Flexibility points:** 3-year grace period, technology inclusive, repowering, ability to “lock-in” attributes from facilities, curtailment, and clean grids.

**Outstanding questions that could expand eligibility:**
- 5% rule for existing clean power
- Curtailment
- Grids with very high clean electricity penetrations
- Eligibility of existing facilities
Why are the incrementality rules important?

• Incrementality enables grid-connection and attempts to mitigate direct emissions

• Diverse resource procurement and innovating clean firm technology is incentivized

• Developers and regions that are building clean power projects and expand the grid will be more competitive; active queue positions are in play

• 3 year vintage offers a growing pie of clean electricity from which hydrogen producers can procure EACs
Temporal Matching

Proposed rule: Clean electricity and clean hydrogen production can be annually matched until 2028. Starting on January 1, 2028, projects must match clean electricity and hydrogen production at an hourly level.

Flexibilities: Transition period allows projects to execute hourly matching optimization.

Outstanding questions:
- How will missed hours be accounted for?
- How will storage play into hourly matching?
- Data infrastructure and project certainty?
Emissions dynamics associated with annual phase-out

Electrolysis Dominates Market: Emissions from the 10 MMt Clean Hydrogen Production Goal

<table>
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<th>SMR + CCS</th>
<th>Electrolysis</th>
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<tr>
<td>Annual Matched Over Lifetime</td>
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<tr>
<td>Hourly Matched Starting in 2028</td>
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<tr>
<td>Hourly Matched Starting Now</td>
<td>360</td>
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SMR + CCS Dominates Market: Emissions from the 10 MMt Clean Hydrogen Production Goal

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<tr>
<td>Annual Matched Over Lifetime</td>
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<tr>
<td>Hourly Matched Starting in 2028</td>
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<tr>
<td>Hourly Matched Starting Now</td>
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<td>50</td>
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Deliverability

**Proposed rule:** Clean electricity must be generated in the same DOE Grid Congestion Zone as the hydrogen production.

**Outstanding questions:**
- Are there other ways to prove deliverability when the facilities are in different grid regions?
- Should these regions be adjusted?
How will the proposed clean hydrogen tax credit rules impact…

…emissions outcomes?
…the development of clean hydrogen projects and hubs?
…the future of the hydrogen commodity market?
As proposed, 45V will drive net emission reductions from electrolyzer deployment through 2035.

- **Electrolyzer deployment scenarios**
  - Fast growth, 23.4 GW
  - Mid growth, 4.7 GW
  - Slow growth, 2 GW

4.7GW of announced electrolyzer projects as of EOY2023 (RhG-MIT Clean Investment Monitor)

Source: Rhodium Group

(range of cumulative emissions impacts in 2024-2035)

(Emission impacts are from electrolysers online through 2027, based on 45V rules published by Treasury on 12/22/23. 80% capacity utilization rate assumed.)
What if the rules are tweaked?

What if grandfathering is allowed?

Range of cumulative emissions impacts in 2024-2035 with grandfathering provision
Million metric tons CO₂-e

- Slow growth: 61
- Mid growth: 145
- Fast growth: 685

Source: Rhodium Group

What if existing clean generation qualifies?

Range of cumulative emissions impacts in 2024-2035 under existing generation qualification options
Million metric tons CO₂-e

- Nuclear relicens <2036: 358
- Hydro relicens <2036: 165
- 5% of clean generation (cleanest): -101
- 5% of clean generation (dirtiest): 1,479

Source: Rhodium Group

Takeaway: there are always tradeoffs
Several factors will play a role in how the clean hydrogen industry evolves in the next ten years, which interplay with 45V:

- Clean hydrogen technologies are still innovating — the hydrogen “rainbow” continues to grow and GREET will need to evolve to keep up with innovation
  - Emerging technologies: electrolyzers, pyrolysis, natural hydrogen
- Demand for clean H2 is limited, long-term offtake is hard to come by
  - Other federal and state hydrogen incentives will influence new end uses for H2
- Contract terms and structures are complex, especially for first movers
- Enabling energy infrastructure will be a rate limiter for clean energy deployment, grid congestion and transmission constraints in particular
- Broader macroeconomic conditions
Proposed guidance creates **opportunities** to accelerate clean hydrogen market development by **clarifying compliant business models**, **expanding the pool of eligible projects**, and unlocking access to immediate and secure **off-take markets in Europe**.
Allowing use of clean energy built within the past three years can bolster early project development and continued development will expand the pool of eligible electricity.
Harmonization with Europe’s standards for renewable hydrogen ensures U.S. has access to the immediate and sizeable European off-take market.

*Clean power assets installed within 3 years of hydrogen production

**EU does not allow subsidized upstream electricity generation
Proposed guidance may pose challenge for viable projects by heightening the need for electrolyzer **flexibility**, intensifying a need of **storage**, and elevating the need for hydrogen **pipelines**.
Questions?
What’s Next?
Thank you!
Financial analysis for bankers includes: Optimization of hydrogen storage, electrolyzer sizing, interconnect, and forecasts of both renewables and power prices, and create algorithms that drive ramping decisions to create contracts for offtakers (+ risk analysis).
The Two Steps of the Three Pillars

Qualifying facility – rules that determine the pool of power plants that can create attributes for 45V

1. New clean power - defined as placed in service less than 36 months before the hydrogen facility is placed in service
2. Deliverability – same eGrids subregion

Credit Measurement – rules on how to use facility data to calculate credit

3. Hourly matching – e.g. 2028 phase-in, no-grandfathering

Core question: how many zero carbon attributes from qualifying facilities are available per region?
Three Pillars as Emissions Guardrails

- The pillars are a proxy for additionality and tightens the pool of available attributes.
- Removing any one pillar expands the market so significantly that the accounting system is flush with free attributes and has minimal emissions impacts (supply is far greater than demand).
- The pillars also prevent certain credit gaming strategies.

Three pillars: spatial & temporal alignment, near term buildout
The three paths of attributes

- To receive the 45V credit, producers would need to purchase both power and qualifying attributes (3P).
- This allows flexibility for hubs to contract directly with hydro/nuclear and purchase qualifying attributes separately.