Natural Resources Defense Council

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The Honorable Daniel Werfel
Commissioner
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Re: The Notice of Proposed Rulemaking for Section 45V Credit for Production of Clean Hydrogen, published in the Federal Register on 12/26/2023. Comments focused on the electrolytic hydrogen production pathway.

Dear Acting Assistant Secretary Aron-Dine, Commissioner Werfel, and Principal Deputy Chief Counsel Paul:

Please find enclosed comments by the Natural Resources Defense Council (NRDC) and its more than three million members on the Notice of Proposed Rulemaking for the Inflation Reduction Act's (IRA) Section 45V clean hydrogen production tax published by the Department of the

Treasury and the Internal Revenue Service in the Federal Register on December 26, 2023. NRDC's mission is to safeguard the earth – its people, its plants and animals, and the natural systems on which all life depends.

Below is NRDC's comment on the NPRM as it relates to the **electrolytic hydrogen pathway**. In addition, the two attached documents outline NRDC's comments as it relates to lifecycle greenhouse gas accounting for hydrogen production pathways that rely on 1) biomethane book and claim systems; and 2) forest biomass book and claim systems.

We thank the Department of Treasury for diligently considering the legal, climate, economic and technical evidence in publishing their NPRM for electrolytic hydrogen projects and urge the Department to finalize the strong proposed guidance in its current form. A wide-ranging and diverse set of U.S. taxpayers similarly support the NPRM, including climate and environmental groups[1], industry groups spanning the hydrogen value chain[2,3], members of Congress[4,5], consumer advocate groups[6] and environmental justice groups[7,8,9].

Any additional flexibilities offered to hydrogen producers relative to the current proposal must be narrow and targeted to avoid substantial induced grid emissions from hydrogen production in violation of the IRA's statutory requirements.

In these comments, NRDC provides the best available evidence that substantiates Treasury's proposal and the need for the three pillars of incrementality, hourly matching, and deliverability for the production of electrolytic hydrogen (referred to throughout the document as "the three pillars" or "the three criteria"). We also offer recommendations for targeted approaches to allow a

[1] CAP, EarthJustice, Environmental Defense Fund, LCV, NRDC, NHMA, Sierra Club, Union of Concerned Scientists, WEACT For Environmental Justice, "CAC Policy Principles for Hydrogen in US", Action Climate, October 2023 https://www.actonclimate.com/wp-content/uploads/2023/10/CAC-Hydrogen-Principles.pdf

[2] Members of the Green Hydrogen Catapult, "WHAT THEY ARE SAYING: U.S. Treasury Department Framework Will Grow Clean Hydrogen Industry" US Department of Treasury, December 2023 https://content.govdelivery.com/accounts/USTREAS/bulletins/381482f

[3] Air Products, ACCIONA & Nordex Green Hydrogen, CWP Global, EDP Renováveis, S.A, Electric Hydrogen, Hystor Energy, Syngergetic, "Hydrogen Industry Support of Strong 45V Rules" Hystore Energy, December 2023, https://hystorenergy.com/hydrogen-industry-support-of-strong-45v-rules/

[4] Members of Congress: Jamie Raskin, et al, "Letter to Treasury on Strong Climate Standards in 45V Implementation Raskin-Beyer" Congress of the United States, December 2023, https://raskin.house.gov/_cache/files/f/3/f3cdbda3-b4e6-4894-b5f0-fd22e8c8dce6/948623656BCC3E1C5F54ACF203659467.letter-to-treasury-on-strong-climate-standards-in-45v-implementation-raskin-beyer.pdf

[5] United States Senators: Sheldon Whitehouse, Martin Heinrich, Jeffrey A. Merkley, Peter Welch, Elizabeth Warren, Bernie Sanders, Cory A. Booker, Edward J Markey, "Letter to Treasury on 45V Hydrogen Tax Credit" United States Senate. October 2023, https://www.whitehouse.senate.gov/imo/media/doc/letter_to_treasury_on_45v_hydrogen_tax_credit.pdf

[6] Alliance for Affordable Energy (Louisiana), et al "Consumer Advocates 45V Letter" Consumer Advocates, October 2023, https://www.citizen.org/wp-content/uploads/Consumer-Advocates-45V-Letter.pdf

[7] Black Labor Week Project Inc., et al, "Letter to MachH2", EnergyNews, February 2024, https://energynews.us/wp-content/uploads/2024/02/Midwest-Advocates-Letter-to-MachH2-February-2024.pdf

[8] Asian Pacific Environmental Network, et al, "45V Advocates Letter to Gov Newsom" Politico, February 2024, https://static.politico.com/2f/90/1afdd26e4561918c93caaf53fa83/feb-2024-45v-advocates-letter-to-gov-newsom.pdf

[9] Center for Earth Energy & Democracy,et al, "Letter to Clean Energy Innovation and Implementation, Department of the Treasury" November 2023, https://subscriber.politicopro.com/f/?id=0000018b-d509-deac-a19b-f58907a60000

narrow share of existing clean energy to qualify as incremental for 45V purposes, in a manner that adheres to section 45V's statutory requirements.

Our comments are organized along the five main sections outlined below:

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3. **Allowing for grandfathering of annual matching is unnecessary and would constitute explicit violation of section 45V's statutory requirements.**
    A. Grandfathering would lead to hydrogen production that results in significant induced grid emissions.
    B. Grandfathering annually matched projects is unnecessary for project financing, as demonstrated by on-the-ground evidence.
    C. Grandfathering threatens the longevity of projects and would support hydrogen projects that will struggle to remain competitive after the large 45V subsidy ends.

4. **Broad loopholes for existing clean power resources will increase emissions beyond section 45V's lifecycle greenhouse gas emissions thresholds.**
    A. A broad 5-10 percent allowance entirely fails to capture the discrete circumstances in which existing clean generation is incremental and results in minimal or no induced emissions. It is therefore inconsistent with the statute.
        1. *The pace and magnitude of near and long-term nuclear retirements are very uncertain and hinge on a variety of factors that are difficult to predict. A broad proxy is therefore categorically inappropriate at capturing retirement risk. Any solution to address retirement risk must consider individual plant circumstances and be based on demonstrated financial stress and retirement risk of an individual plant.*
        2. *Pathways to accommodate times of clean energy curtailment must capture its highly variable occurrence, in terms of magnitude, geography and time.*
        3. *Incorporating shares of existing clean energy located in states that cap total GHG emissions in a formulaic proxy is inappropriate. Few states have enacted those policies and even in those relevant states, hydrogen production carries high risk of induced grid emissions without additional evidence that necessary protections are in place.*

    B. A broad 5-10 percent allowance for existing clean energy resources will result in significant induced grid emissions, in violation of the IRA lifecycle emissions thresholds. An exemption for states with policies capping emissions from incrementality would similarly result in substantial emissions increases. It would not be reasonable for Treasury to adopt either of those approaches as a methodological proxy for no to minimal induced emissions.

        1. *The formulaic 5 to 10 percent proxy will drive substantial induced grid emissions and support hydrogen production with a lifecycle GHG intensity up to 5 times worse than section 45V's lowest threshold.*

        2. *Exempting states with binding emissions caps from incrementality will support hydrogen production in those states with a lifecycle GHG intensity up to 4 times worse than section 45V's lowest threshold. State policy*

limitations render any automatic exemptions from incrementality inappropriate and unjustified.

5. **NRDC proposed *targeted* flexibilities for existing clean energy to qualify as incremental without violating section 45V's statutory requirements and that meet EPA's threshold of "appropriately stringent criteria" for determining no to minimal induced emissions.**

    A. NRDC proposed approach to exempting hydrogen projects from incrementality during hours of clean energy curtailment.

    B. NRDC proposed application-based approach to determine that a nuclear plant is reasonably facing retirement and qualify a defined portion of its power as incremental, based on an application-based approach.

    C. NRDC proposed approach to exempt some hydrogen projects from incrementality in states with binding emissions caps, provided that states submit to Treasury strict and rigorous evidence of zero or minimal induced grid emissions.

The following is an executive summary of our comments:

1. **The proposed guidance has robust legal basis, adheres to best available evidence, and delivers on Congressional intent to scale a *clean* hydrogen market effectuating the Inflation Reduction Act's stated purpose to reduce U.S. GHG emissions.**
   We enumerate and summarize the substantial legal, technical, and economic evidence – including both on-the-ground and analytical evidence – in support of Treasury's proposal. Treasury's proposal fully effectuates section 45V's purpose to scale a clean hydrogen industry that supports reductions in U.S. greenhouse gas emissions – the stated purpose of the IRA.
    - **Treasury is <u>statutorily required</u> to consider significant indirect emissions from hydrogen production, which are predominantly induced grid emissions in the case of electrolytic hydrogen production.** Accounting for induced grid emissions is also consistent with the Environmental Protection Agency's (EPA) longstanding interpretation and application of section 211(o) of the Clean Air Act.
    - **The three pillars of 1) incrementality, 2) hourly matching, and 3) deliverability, are the best method for demonstrating zero or minimal induced grid emissions and reasonable and appropriate for this determination.** Overwhelming evidence – including by the Department of Energy (DOE) and the EPA – shows that the risks of significant induced grid emissions from hydrogen production are high without the three pillars.

- **The three pillars will deliver on Congressional intent of scaling a clean hydrogen industry that supports the IRA's stated purpose –** which is supporting the decarbonization of the U.S. economy. Weakening the three pillars would lead to significant net emissions increases from hydrogen production and fundamentally undermine the animating purpose of the enabling statute. Treasury may not promulgate regulations that undermine the expressly stated (and structurally implied) goal of the IRA. Weakening the pillars would therefore be inherently arbitrary.
- **Parties calling on Treasury to weaken the three pillars as outlined in the NPRM** consistently fail to explain why their position in support of laxer rules is consistent with Congress's stated purpose to reduce greenhouse gas emissions, or the IRA's explicit incorporation of section 211(o) of the Clean Air Act.
- **The three pillars will support substantial industry growth.** This is substantiated via both on-the-ground factual evidence as well as an overwhelming base of analytical evidence. The bulk of first mover hydrogen projects in the U.S. and globally are three pillar compliant. Parties who argue otherwise consistently ignore on-the-ground evidence, and the handful of studies –which constitute the minority – that draw a different conclusion incorporate flawed assumptions that do not track current market realties.
- **The collective scale of interest and planning of three-pillar compliant projects** spanning a contingent of supportive industry groups would alone drive significant electrolyzer cost reductions by the early 2030s, enabling the widespread deployment of truly clean hydrogen across the U.S.
- **Hourly matching beginning in 2028 with no grandfathering of annual matching reflects the best available technical and on-the-ground evidence and prevents emissions from increasing beyond IRA statutory requirements.** Parties arguing for a transition delay predicated on the uncertainty that U.S. registries will scale hourly tracking infrastructure by 2028 entirely ignore provisional pathways that will enable hydrogen producers to demonstrate hourly matching by 2028, even without scaled hourly tracking infrastructure. Extending the transition period beyond 2028 would be arbitrary and needlessly extend the period whereby significant induced emissions from hydrogen projects exceed section 45V's emissions thresholds. We refer Treasury to the joint comments by EnergyTag on the NPRM and to which NRDC is a signatory; those joint comments detail the supportive arguments and evidence.

2. **Broad loopholes for existing clean power resources will support hydrogen production with induced grid emissions that far exceed section 45V's lifecycle greenhouse gas emissions thresholds.**
We offer responses to Treasury's prompts related to potential carveouts for existing clean energy resources in specific circumstances.

- The formulaic proxy based on a 5-10 percent broad allowance categorically fails to capture the three circumstances – 1) avoided retirements of existing clean energy generation; 2) hours of clean energy curtailment; and 3) states with policies that will prevent significant induced grid emissions – defined by Treasury and would lead to unlawful and substantial induced grid emissions in violation of the IRA's statutory requirements.
    - The Rhodium Group found that a 5 percent formulaic proxy would drive a huge increase in induced grid emissions from hydrogen production – up to nearly **1.5 billion metric tons** of increased emissions cumulatively through 2035.[10]
    - Energy Innovation assessed the implications of a 5-10 percent formulaic proxy on the lifecycle greenhouse gas intensity of hydrogen production in the California Independent System Operator footprint in the context of their analysis examining the effectiveness of the broad proxy at capturing instances of clean energy curtailment.[11] They found that the lifecycle emissions intensity of hydrogen produced would be **more than *4 to 5 times higher* than section 45V's *lowest* emissions threshold of 4 kgCO2e/kgH2, *30 to 45 times higher* than the 0.45 kgCO2/kgH2 threshold, and 1.*5 to 2 times higher* than today's incumbent gas-derived hydrogen production"[12]**
    - In a new analysis, Princeton ZERO Lab examine the impacts of a 5 and 10 percent formulaic proxy on induced grid emissions from hydrogen production in Southern California. [13] They find that the proxy would support hydrogen production with a lifecycle GHG intensity ***5 times worse*** than section 45V's *lowest* emissions threshold. They also estimate that a 5 to 10 percent formulaic proxy would drive induced grid emissions of up to **2.5 million metric tons** per year in Southern California.

[10] Ben King, John Larsen, Galen Bower, Nathan Pastorek, "How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit Guidance" Rhodium Group, January 2024, https://rhg.com/research/clean-hydrogen-45v-tax-guidance/
[11] Energy Innovation, LLC. "45V Exemptions Need Strong Guardrails To Protect Climate, Grow Hydrogen Industry" Energy Innovation Policy and Technology LLC, February 2024, https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/
[12] Energy Innovation, "45V Exemptions Need Strong Guardrails To Protect Climate, Grow Hydrogen Industry", Energy Innovation Policy & Technology LLC, February 2024, https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/
[13] https://zenodo.org/records/10689836 , Research Addendum, NOPR Proposals `

- Exempting states with emissions caps from incrementality would similarly lead to significant induced emissions from hydrogen production. A range of nuance and policy limitations in states with emissions caps diminish their capacity to protect against induced grid emissions from hydrogen production. **Exemptions for states that cap their GHG emissions will lead to significant induced emissions from hydrogen production that far exceed section 45V's thresholds and are thus inappropriate absent further evidence that states have implemented the necessary protections to prevent significant grid induced emissions.**
    - Princeton ZERO Lab examined the impact of the Pacific Northwest's binding regional carbon cap policy on the emissions intensity of electrolytic hydrogen production.[14] They find that while the binding emissions cap prevents *local* increases in induced grid emissions in the Pacific Northwest zone, it does *not* prevent significant induced grid emissions from hydrogen production exempted from incrementality requirements. Those induced grid emissions would occur beyond the Pacific Northwest zone boundaries and result in hydrogen production in the zone with a lifecycle GHG intensity of up to ***4 times worse*** than section 45V's lowest threshold and more than ***30 times worse*** than the 0.45 kgCO2/kgH2 threshold.[15] **It would therefore not be reasonable nor appropriate for Treasury to exempt hydrogen production in states with emissions caps from incrementality predicated on the assurance that the caps will prevent induced emissions.**

3. NRDC proposed targeted flexibilities for existing clean energy to qualify as incremental without violating section 45V's statutory requirements and that meet EPA's threshold of "appropriately stringent criteria" for determining no to minimal induced emissions.

We offer alternative solutions that offer well-designed flexibilities for existing clean energy resources without compromising on the emissions reduction intent of the policy and driving unlawful emissions increases from hydrogen production.

- **Avoided nuclear retirements:** Considering the intricacy of reasonably determining that a nuclear plant is facing retirement risks, the reality that

[14] Wilson Ricks, Qingyu Xu, Jesse D. Jenkins, "Minimizing emissions from grid-based hydrogen production in the United States" Zenodo, December 2023, https://zenodo.org/records/10689836

[15] Wilson Ricks, Qingyu Xu, Jesse D. Jenkins, "Minimizing emissions from grid-based hydrogen production in the United States" Zenodo, December 2023, https://zenodo.org/records/10689836

45V revenues would likely be one factor out of many in a nuclear operator's decision to continue operating, and the high risks of significant induced emissions should the share of nuclear power qualifying as "incremental" be overestimated, NRDC does not see a solution outside of an **application-based approach**. A nuclear operator should be required to demonstrate that it is facing retirement via a test similar to the Civil Nuclear Credit test outlined in the Infrastructure Investment and Jobs Act and which DOE is already administering. Furthermore, only nuclear operators who invest in behind-the-meter, co-located electrolyzer can qualify for 45V given the more reasonable determination that the hydrogen investment meaningfully contributed to shoring up a nuclear plant's economics. The operator is not allowed to sell EACs to grid-connected hydrogen projects, given the high risk of significant induced emissions should the market be flooded with non-incremental nuclear EACs.

- **Hours of clean energy curtailment:** considering its varying occurrence in both time and location, solutions to capture instances of clean energy curtailment can only embed reasonable fidelity it they are directly linked to locational marginal prices (LMPs). Treasury can relax incrementality requirements during hours where hydrogen producers demonstrate LMPs of $0/MWh or less at their electrolyzer's nodal location.
- **Exemptions from incrementality for states with binding emissions caps:** To qualify for any exemption from incrementality for hydrogen projects, states with legislated binding emissions caps must further meet one of the following criteria: 1) they demonstrate to Treasury and DOE that they have legislated additional protections in state policy that necessary to prevent significant induced emissions from hydrogen production; or 2) DOE or the National Renewable Energy Laboratory conducts high-fidelity, and publicly-available capacity expansion modeling to determine whether hydrogen projects seeking an exemption will not drive significant induced emissions.

NRDC's comments are detailed below.

1. The proposed guidance has robust legal basis, adheres to best available evidence, and delivers on Congressional intent to scale a *clean* hydrogen market effectuating the Inflation Reduction Act's stated purpose to reduce U.S. GHG emissions.

By defining lifecycle greenhouse gas emissions under 45V by reference to the Clean Air Act's definition under the Renewable Fuel Standard (RFS), the IRA expressly provides Treasury with clear direction to consider significant indirect emissions as EPA does under the RFS. By requiring use of the three pillars to calculate lifecycle emissions, Treasury has made a reasonable, factual determination that follows the express statutory directive of Congress. The following section elaborates on prior comments submitted by NRDC and the Clean Air Task Force (CATF) in support of the Biden administration's requirements for 1) incrementality; 2) hourly matching; and 3) deliverability for all electrolytic hydrogen projects seeking to qualify for the top 45V tax credit.[16] **These three criteria are consistent with the clear statutory directive in the IRA, comport with EPA's longstanding interpretations in the context of the reliable determination of lifecycle greenhouse gas emissions, and are appropriate for the determination of no or minimal induced grid emissions.**

A. Treasury's proposed guidance 1) adheres to the clear statutory directive in the IRA, 2) is consistent with longstanding legal precedent, 3) enables the determination of no to minimal induced emissions with high fidelity, and 4) is practical and administrable.

1. *EPA confirms that accounting for induced grid emissions from hydrogen production is consistent with longstanding legal precedent. Opponents to Treasury's strong proposal are effectively arguing for a departure from precedent.*

NRDC is in full agreement with Treasury's incorporation of the three criteria of incrementality, hourly matching and deliverability for all electrolytic hydrogen projects, without any arbitrary exemptions or unjustifiable delays. NRDC and CATF have previously argued in comments to Treasury (attached) that use of the three criteria is appropriate because lifecycle greenhouse gas emissions under 45V are defined by reference to section 211(o)(1)(H) of the Clean Air Act. As such, we are in full agreement with the EPA's communication to Treasury on December 20, 2023, confirming that the inclusion of hydrogen projects' "induced grid emissions" in lifecycle

[16] NRDC-CATF Legal Memo, "Notice 2022-49 Request for Comments on Certain Energy Generation Incentives – Hydrogen (IRC Section 45V). https://www.nrdc.org/sites/default/files/2023-04/nrdc-catf-memo-ira-45v-legal-necessity-3-pillars-20230410.pdf *See* [NRDC/CATF comments], attached.

emissions analyses would be consistent with EPA's longstanding interpretation and application of CAA section 211(o)(1)(H).

The following is a summary overview of arguments supporting the reasonableness of the three criteria as fleshed out in the NRDC-CATF comments, submitted in April and May of 2023 (attached, and incorporated by reference here). Our comments are in strong alignment with EPA's legal interpretation of the 45V statute and its clear support for the appropriateness and reasonableness of requiring all hydrogen projects to submit EACs adhering to the three criteria for purposes of demonstrating no induced grid emissions.

- In the IRA, Congress defined "lifecycle greenhouse gas emissions" under 45V as having "the same meaning" as that given to the term under the Clean Air Act's Renewable Fuel Standard.[17] Treasury must look to how EPA has defined lifecycle emissions, and accordingly, must impose an accounting regime-- for both grid-connected and behind-the-meter electrolytic hydrogen projects-- that measures systemwide grid emissions—or induced grid emissions:
    - Under section 211(o) of the Clean Air Act, lifecycle greenhouse gas emissions include "direct" and "significant indirect" emissions related to the "full fuel lifecycle."[18] Section 211(o) implements the Renewable Fuel Standard (RFS), which creates procurement quotas for automotive biofuels.[19] The prevailing interpretation of section 211(o)'s reference to "significant indirect" emissions in the biofuel context logically requires Treasury to measure systemwide grid emissions in the hydrogen context.
    - EPA has defined a biofuel's "significant indirect emissions" to include biofuel-related emissions resulting from "indirect land use changes."[20] In other words, the agency does not just include the emissions from the farm that grows feedstock. It also considers other land use-related emissions—even those outside the United States—that stem from the first farm's decision to grow biofuel feedstock. If the farm supplying corn to ethanol producers has stopped growing corn for human consumption, then other farms will expand their operations to fill that market gap, deforesting more land to provide corn for humans. The increase in aggregate demand will lead to more emissions across the entire agricultural system. And EPA will include the resulting emissions in a biofuel's lifecycle carbon footprint.
    - By considering indirect emissions under section 211(o), EPA measures how biofuel production causes *systemwide* changes in land use-related emissions. EPA has concluded that the statutory text mandates this approach, because section

[17] *See* 26 U.S.C. § 45V(c)(1)(A) ("[T]he term 'lifecycle greenhouse gas emission' has the same meaning given such term under subparagraph (H) of section 211(o)(1) of the Clean Air Act.").
[18] 42 U.S.C. § 7545(o)(1)(H). The phrase "full fuel lifecycle" does not directly apply here, because section 45V only refers to "well-to-gate" emissions "through the point of production." 26 U.S.C. § 45V(c)(1)(B); see also infra at Part II(b)(ii). This does not alter the analysis. Hydrogen electrolysis uses electricity as a production input. Therefore, any emissions related to electricity generation—that is, the generation of a critical input for electrolysis—clearly occur before the final "point of production."
[19] See generally 42 U.S.C. § 7545(o).
[20] Id.

211(o) requires the agency to consider "*all stages* of fuel and feedstock production . . . ."[21] Therefore, the agency cannot legally ignore systemwide increases in land use-related emissions, even if they occur overseas.[22]

- Replace the concept of "indirect land use change" with "indirect power use change," and the parallel to hydrogen production becomes clear. Consider a grid-connected hydrogen project. The decision on the part of the hydrogen producer to draw grid electricity (i.e., a feedstock for hydrogen electrolysis) drives up overall grid demand, and therefore the need for additional electricity supply to "bridge [at least some of] the gap."[23] If most of the gap-filling electricity draws on fossil fuels (per the current U.S. generation mix), then the carbon intensity of the power grid will go up. The hydrogen producer will indirectly increase systemwide grid emissions, even if it purchases clean energy attributes from existing clean energy resources to match its grid electricity consumption. A similar logic applies to a behind-the-meter producer. A producer that draws on existing clean energy will divert that energy from the grid, increasing the overall carbon intensity of the grid. The producer will therefore increase systemwide grid emissions, even if they do not directly draw grid power.
- Industry commenters insist that Treasury's regulations may not consider systemwide grid emissions.[24] But their arguments eerily resemble industry comments that EPA rejected in 2010 when interpreting section 211(o). In 2010, commenters argued that EPA could not consider systemwide land use changes that stemmed from biofuel production, because they were not tied to a specific biofuel project. [25] Here, hydrogen producers make an analogous argument—that Treasury may not consider systemwide grid emissions, because they do not tie to a specific hydrogen electrolysis project. [26] But EPA rejected commenters' arguments then, and Congress would not have referenced the RFS definition in the IRA if it did not intend for Treasury to follow EPA's lead and reject the same arguments now.

EPA has expressly confirmed that Treasury should consider systemwide emissions – or "induced grid emissions" -- from hydrogen production and that the three pillars are appropriate and reasonable to make a reliable determination of no induced grid emissions:

> [I]t would be reasonable for Treasury to determine that induced grid emissions are an anticipated real-world result of electrolytic hydrogen production that must be considered in lifecycle greenhouse-gas analyses under IRC section 45V. Such interpretation would be consistent with the

[21] Id. at 14,766 (emphasis added)
[22] Id.
[23] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407
[24] See, e.g., Constellation Comment Letter at 11.
[25] Id. at 14,766
[26] See, e.g., Constellation Comment Letter at 11

> EPA's long-standing interpretation and application of CAA section 211(o)(1)(H) in the context of the RFS program. Moreover, EACs with attributes that meet the criteria of new incremental capacity, geographic matching and temporal matching are an appropriate way of verifying the generation and delivery of zero greenhouse-gas-emitting electricity and can serve as a reasonable methodological proxy for quantifying induced grid emissions associated with electrolytic hydrogen production.[27]

2. *Overwhelming evidence—including evidence by the Department of Energy-- substantiates that induced grid emissions from hydrogen production absent the three criteria—or governed by a weak version thereof-- will be significant and exceed the IRA lifecycle emissions thresholds as defined by CAA 211(o)(1)(H). The three criteria are therefore the best way to implement the IRA's express directive to Treasury in Section 45V.*

Overwhelming independent analytical and technical evidence demonstrates with high assurance that absent the three criteria—or the adoption of a weak version thereof—electrolytic hydrogen production would lead to induced grid emissions that far exceed the IRA lifecycle emissions thresholds (we outline a subset of the evidence below).

In its brief "*Assessing Lifecycle Greenhouse Gas Emissions Associated with Electricity Use for the Section 45V Clean Hydrogen Production Tax Credit,"* DOE puts forth as an underlying principle the "understanding that grid emissions are addressed when an **incremental** unit of low-GHG electricity generation is supplied to the grid at the same **location** and **time** as an incremental unit of load consumes power from the grid." *(emphasis by NRDC).* The clear inference here is that grid emissions **are not** addressed unless all three of those criteria materialize.

DOE goes on to rightly explain that "purchasing an EAC from any low-GHG generator is not in and of itself sufficient to justify a claim of low lifecycle GHG emissions due to the presence of induced effects." DOE further explains that "without the three **specific** criteria, EACs procured by hydrogen producers will "not reflect important ways in which added loads can impact grid GHG emissions under a lifecycle framework." *(emphasis by NRDC).* EACs that do not meet the three criteria fail to capture with any fidelity the operational and structural impacts of a hydrogen project on the grid – both of which DOE confirms are necessary to accurately assess induced emissions of a hydrogen project, including for 45V compliance purposes. NRDC and CATF agree with DOE. In our legal comments, we argue that a hydrogen producer may not simply purchase *any* renewable credit to comply with section 45V. The EACs must demonstrate compliance with the three pillars to reliably determine no induced grid emissions from hydrogen projects. Put simply, the three pillars effectuate section 45V's ironclad emissions thresholds.

[27] Janet G. McCabe, "45V NPRM EPA Letter" United States Environmental Protection Agency, December 2023, https://home.treasury.gov/system/files/136/45V-NPRM-EPA-letter.pdf

DOE concludes that if EACs do not meet all three criteria, "there is a strong likelihood that the hydrogen production would in many cases significantly increase induced grid GHG emissions beyond the allowable levels required to qualify for 45V."

DOE also explains that the three criteria are necessary to address a hydrogen producer's induced grid emissions regardless of whether the hydrogen project is connected to the grid or directly connected to a clean energy generator in a behind-the-meter configuration. This is because a hydrogen project's operational and structural impacts on the grid – and therefore its induced grid emissions—are similar regardless of whether the hydrogen project is connected to the grid and contracted with an existing clean energy generator *or* co-located with an existing clean energy generator behind-the-meter. DOE expressly notes that "Even if all the electricity used for hydrogen production comes from co-located generation, if the new hydrogen load is co-located with an existing electricity generator that was previously providing electricity to the grid and that is not otherwise at risk of retirement, the same induced grid GHG emissions impacts occur." This irrefutably discounts any technical basis for treating grid-connected and behind-the-meter hydrogen projects differently if they are powered by an existing clean energy generator—as argued by some in the nuclear industry. Both must procure EACs that meet all three criteria.

The clear inference from DOE's assessment is that EACs that do not meet all three criteria 1) are inappropriate at reliably accounting for induced grid emissions linked to a hydrogen project, and 2) carry high risks of supporting hydrogen production with induced grid emissions that exceed the IRA thresholds. EACs that do not meet *all three criteria* – for both grid-connected and behind-the-meter projects-- should therefore be categorically discarded as a compliance mechanism for purposes of 45V.

A wide range of independent studies that account for both operational and structural impacts on the grid linked to hydrogen production draw very similar conclusions to DOE. The studies find that absent a strong version of *all three pillars*, induced emissions from hydrogen production would be substantial and far exceed IRA thresholds:

- **Meta literature review by ERM Consulting of 30 independent reports and analyses—**finds that there is very strong consensus across the overwhelming majority of studies about the detrimental emissions impact of projects that fail to comply with the three pillars. ERM concludes that *"Although the numbers vary based on modeling assumptions, the consensus in the analysis is clear that GHG emissions will increase considerably without incrementality requirements"* ERM goes further to say that: ***"****Hydrogen with intensity factors greater than the current grey hydrogen defeats the purpose of the IRA."*[28]
- **Studies by Princeton ZERO Lab, Energy Innovation, and the MIT Energy Initiative**- - evaluate emissions on a project-level basis and find that if hydrogen projects

[28] Angelina Bellino, Harrison Branner, Cameron Movahhedian, Lauren Slawsky, Mackay Miller, "Assessment of Grid Connected Hydrogen Procution Impacts" ERM, February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf

are not required to comply with all three criteria, they could have up to *5 times* the emissions of today's status quo gas-based hydrogen and upwards of *100 times* above the 45V threshold to qualify for the $3/kgH2 credit value.[29]

- **Study by the Rhodium Group** – finds that annual matching would drive emissions increases of up to 100 million tons through 2030.[30] Rhodium did not explicitly evaluate the effect of incrementality but notes that not requiring it would lead to a worse emissions outcome.
- **Study by Evolved Energy Research** – finds that hydrogen that fails to meet incrementality and is governed by annual matching would drive emissions increases of 250 to 650 million tonnes relative to the three criteria through 2032.[31] The upper bound of emissions is equivalent to more than 40 percent of annual U.S. power sector emissions.[32]
- **Study by the Electric Power Research Institute (EPRI)—** which funded by electric utilities-- finds that three-pillar scenario is **the only scenario that reduces net emissions in 2030 and 2035** (see Figure 1 below)**.** All other approaches – i.e., rules that are weaker than Treasury's NPRM-- would see the credit driving *net emissions increases* through 2040. EPRI finds that the change in total cumulative net carbon emissions – on an economywide basis-- ranges from a *reduction* of 670 million metric tons with a three-pillar requirement to an *increase* of 340 million metric tons in a no requirement case, relative to a baseline case without the 45V credit.[33] EPRI finds that annual matching *triples* hydrogen's emissions impact compared to hourly matching.[34]

[29] Angelina Bellino, Harrison Branner, Cameron Movahhedian, Lauren Slawsky, Mackay Miller, "Assessment of Grid Connected Hydrogen Procution Impacts" ERM, February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf

[30] Ben King, "How Clean Wil US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit Guidance, Rhodium Group. January 2024. https://rhg.com/research/clean-hydrogen-45v-tax-guidance/

[31] Ben Haley, "45V Tax Credit: Three-Pillars Impact Analysis, Evolved Energy Research. June 2023. https://www.evolved.energy/post/45v-three-pillars-impact-analysis

[32] Id.

[33] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407

[34] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407

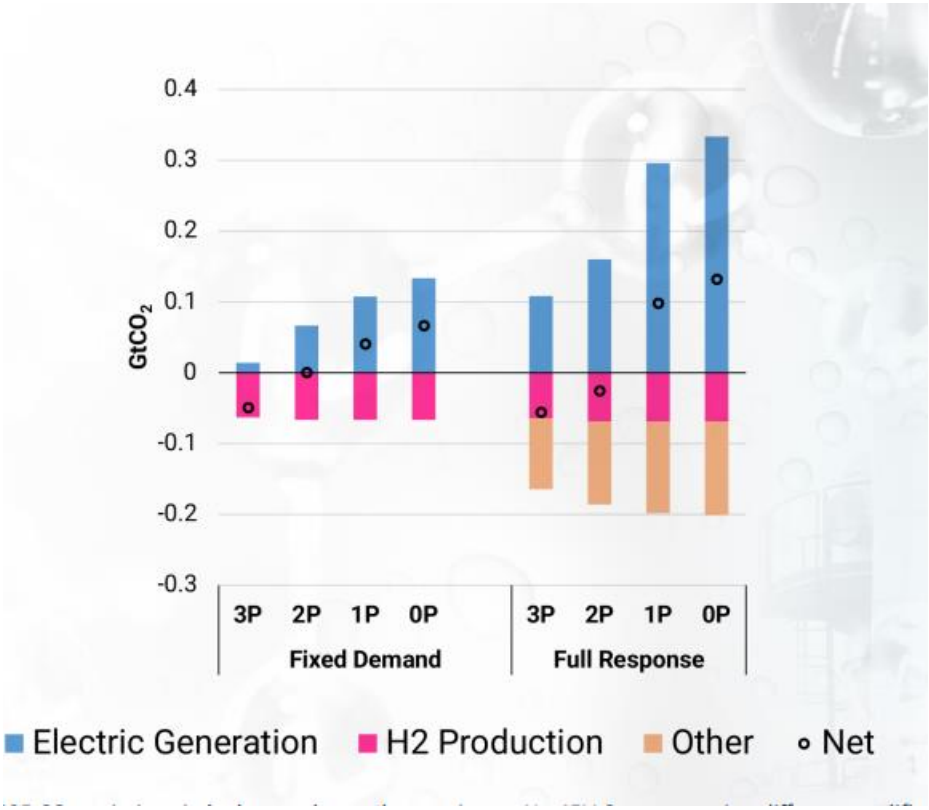

Figure 1: Change in 2035 CO2 emissions in hydrogen demand scenarios vs. No 45V Case, assuming different qualification criteria.[35] 3P includes requirements for hourly matching, new clean generation, and deliverability; 2P removes hourly matching; 1P removes hourly matching and new generation requirements; and 0P removes all three pillars. Fixed Demand assumes no incremental non-electric hydrogen demand, while Full Response includes non-electric demand feedback.

3. *EPA and DOE confirm that three-pillar EACs are a reasonable proxy for demonstrating no induced grid emissions, conferring a strong basis that the three-pillars are "appropriately stringent criteria" and "a reasonable and administrable approach" to make that determination.*

EPA argues that it would be reasonable for Treasury to *"use EACs with attributes that meet appropriately stringent criteria as a methodological proxy in lieu of calculating induced grid emissions as part of a lifecycle greenhouse-gas analysis"* and confirms that *"it would be reasonable to expect that the purchase and use of zero-emitting electricity represented by three-pillar EACs does not result in induced grid emissions."* This is consistent with DOE's assessment, as the Department notes that:

[35] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407

- "if hydrogen producers acquire and retire EACs whose attributes meet these criteria, it would be reasonable to treat induced grid emissions as zero." And
- "EACs are a sound mechanism to establish contractual claims of electricity purchases from specific sources, but EACs from low-GHG generators must have attributes that meet certain criteria to address the impacts of a hydrogen producer's electricity load on induced grid GHG emissions."

In sum, EPA and DOE's assessments, supported by overwhelming scientific and technical evidence, lead to the robust conclusion that the current Treasury proposal requiring that *all* electrolytic hydrogen projects submit EACs that meet the three criteria of incrementality, hourly matching, and deliverability:

1) adheres to the clear statutory directive in the IRA;

2) is consistent with longstanding legal precedent;

3) relies on sound mechanisms that reliably capture the dynamics of the electricity grid;

4) enables the determination of no to minimal induced emissions with high fidelity; and

5) is practical and administrable.

Any weakening of the current proposal would be arbitrary, break from longstanding legal precedent and lead to an unlawful exceedance of IRA emissions thresholds.

NRDC and CATF agree with those arguments. The three pillars make section 45V workable and administrable for hydrogen producers. A producer that purchases non-three pillar EACs cannot prove with high fidelity no to minimal induced grid emissions. Moreover, it is impossible for hydrogen producers to prove that any individual electrons that they draw from the bulk transmission system come from clean sources.[36] By purchasing three-pillar EACs, producers can prove conclusively that clean energy— and only clean energy—is powering their electrolyzers. This will allow hydrogen producers to qualify for section 45V, and to confidently predict that they will qualify in future years, leading to robust industry growth.

[36] Id. at 2 ("[I]t is physically impossible to reliably track flows of power between individual producers and consumers in the bulk electricity system, making verification of clean electricity inputs for grid-connected hydrogen producers a significant challenge.")

B. Treasury's proposed guidance satisfies Congressional intent – which is to scale a clean hydrogen industry that supports the decarbonization of the U.S. economy.

1. Absent the three criteria, hydrogen production would drive substantial emissions increases and compromise the decarbonization of the U.S. economy. This would be unlawful, as it would undercut an animating purpose of section 45V and the IRA.

First of all, Congress knew about EPA's interpretation of section 211(o) when it drafted the IRA.[37] By incorporating section 211(o) into the IRA, Congress blessed EPA's interpretation of that provision, and ordered Treasury to apply EPA's logic to hydrogen production.[38] And post-hoc statements by individual Congresspersons implying that such strict rules were not intended "carry little if any weight" and "cannot change the effect of the plain language of the statute itself."[39,40] Second, hydrogen projects that do not comply with the three pillars and induce GHG emissions on the grid in a manner that stymies the decarbonization of the U.S. economy would expressly undermine Congress's stated purpose for the IRA, which is to *reduce* U.S. GHG emissions.

i. A central purpose of both section 45V and the IRA is the reduction of greenhouse gas emissions through subsidized clean energy deployment.

The text and legislative history of the IRA (and section 45V) show that Congress passed the law to reduce nationwide greenhouse gas emissions by subsidizing clean energy deployment. Congress did not want to promote the hydrogen industry for its own sake. It wanted to promote low-carbon hydrogen that would reduce overall greenhouse gas emissions.

Consider the precise structure of the 45V tax credit. For a lifecycle greenhouse gas emissions rate below 0.45 kg CO2e per kilogram of hydrogen, the credit is $3 per kilogram of hydrogen.[41] If the lifecycle emissions rate is between 0.45 and 1.5 kg CO2e per kilogram of hydrogen, then the credit drops by two-thirds to $1 per kilogram.[42] And after two more step-down tiers, the credit is unavailable if the lifecycle greenhouse gas emissions rate is above 4 kg CO2e per kilogram of hydrogen.[43] Thus, Congress explicitly designed a tax credit regime to incentivize low-carbon hydrogen deployment. The steep step-down from $3 to $1 (and then to $0) shows

[37] *Lorillard v. Pons*, 434 U.S. 575, 581 (1978) (Congress is "presumptively aware" of an existing administrative interpretation of a statutory provision when it incorporates that provision, by reference, into a new law).
[38] *Id.*
[39] *Bread Political Action Comm. v. FEC*, 455 U.S. 577, 582 n.3 (1982) ("[P]ost hoc observations by a single member of Congress carry little if any weight.")
[40] *Los Angeles Dep't of Water & Power v. Manhart*, 435 U.S. 702, 714 (1978) ("We conclude that [one Senator]'s isolated comment on the Senate floor [regarding a statute passed a year prior] cannot change the effect of the plain language of the statute itself.").
[41] 26 U.S.C. § 45V(b)
[42] Id.
[43] Id.

that Congress did not want to promote all hydrogen production. On the contrary, the legislature put a thumb on the scale in favor of the cleanest hydrogen production.

The legislative history of section 45V and the IRA also demonstrates that greenhouse gas reductions were a core legislative purpose. The hydrogen production tax credit in the IRA draws almost word-for-word from the Build Back Better Act,[44] which repeatedly references climate change in its legislative history.[45] When the IRA passed the House, then-Chairman Neal emphasized that the "legislative intent" of the statute's clean energy tax credits—including section 45V—was to "unleas[h] clean energy deployment, in line with President Biden's pledge of a 50-52 percent reduction" in net emissions by 2030.[46] The original drafter of section 45V described the hydrogen production credit as one that would "promote clean energy [and] fight climate change."[47] And during the bill's signing ceremony, President Biden referred to the IRA as the "biggest step forward on climate ever."[48]

ii. *Failing to require the three pillars would be unlawful, because it would undermine the emission reduction goals of the IRA and section 45V.*

Congress made clear that the IRA was a climate bill.[49] One of its central goals was to reduce emissions. And the clarity of Congress's intent is important for two reasons.

First, section 45V requires Treasury to issue regulations that "carry out the purposes of this section." [50] But if Treasury were to allow hydrogen producers to qualify for 45V by presenting EACs that do not comply with the three pillars, it would entirely undermine the purpose of section 45V.[51] A grid-connected or behind-the-meter hydrogen project's actual emissions could far exceed section 45V's lifecycle emissions thresholds, but then receive tax subsidies based on EACs that fail to reliably capture their induced emissions on the grid. [52] Treasury would disburse billions of dollars in exchange for increased GHG emissions and hydrogen projects that compromise achievement of U.S. climate goals. As listed above, independent studies by the

[44] 0 See 168 Cong. Rec. at H7664 (Aug. 12, 2022) (statement of Representative Neal) ("Many provisions of Subtitle D [the clean energy subtitle of the IRA] remain substantially similar to those that the House developed and passed [in the Build Back Better Act].")

[45] See H. Rept. 117-130 at 3-4 (2021) ("The climate crisis is displacing families, upending local economies, and endangering our national security."); id. at 4 ("[W]e face a catastrophic climate crisis that threatens life as we know it."); id. at 5 ("The climate crisis is an existential threat that must be handled immediately . . . . The Build Back Better Act will provide comprehensive investments, including clean energy and transportation tax credits, to help us reduce our carbon footprint.")

[46] Id.

[47] 168 Cong. Rec. S4165-03, S4165 (statement of Senator Carper).

[48] Remarks By President Biden at Signing of H.R. 5376, the Inflation Reduction Act of 2022, 2022 WL 3367985, at *3

[49] See supra at Part III(a).

[50] 26 U.S.C. § 45V(f).

[51] Angelina Bellino, Harrison Branner, Cameron Movahhedian, Lauren Slawsky, Mackay Miller, "Assessment of Grid Connected Hydrogen Production Impacts" ERM, February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf

[52] See supra at note 35.

Electric Power Research Institute (EPRI), Evolved Energy Research and the Rhodium Group found that **U.S. net economywide emissions would increase by up to 650 million tons through the mid-2030s** driven by emissions-intensive hydrogen projects that fail to comply with one or more of the three pillars.[53] In fact, even opponents of the three pillars concede that emissions would increase if the three pillars are not required.[54] It is simply implausible that Congress intended that result when it passed the avowedly pro-climate change mitigation IRA. Opponents of the three pillars fail to explain why their position is consistent with Congress's stated purpose to reduce greenhouse gas emissions, or the IRA's explicit incorporation of section 211(o) of the Clean Air Act.

Second, regulations that fundamentally undermine an animating purpose of their enabling statute are inherently arbitrary. Even when a statutory provision confers general regulatory authority, a rule promulgated under that provision must reflect Congress' "general intent."[55] EPA agreed when it chose to count systemwide land use-related emissions stemming from biofuel production under section 211(o). There, the agency noted that the purpose of the RFS was to "achieve some reduction in [greenhouse gas] emissions in order to help address climate change."[56] A reading of section 211(o) that excluded indirect international land use changes would "essentially undermine the purpose of the provision" and would therefore be "arbitrary interpretation of the broadly phrased text used by Congress."[57] The same principle applies here. A central purpose of the IRA is the reduction of greenhouse gas emissions. Treasury may not promulgate regulations that undermine that expressly stated (and structurally implied) goal.[58] Because a regulation that does not require all three pillars would do just that, Treasury has no authority to issue one.

[53] Net emissions account for avoided GHG emissions linked to hydrogen replacing fossil fuels in various end-uses. Net emissions increase when avoided GHG emissions are insufficient to counterbalance or offset the high GHG emissions linked to hydrogen production.

[54] Daniel Moore, "Zero-Carbon Hydrogen Tax Rules Spark Divide Over Grid Emissions" Bloomberg Law, January 2024, https://news.bloomberglaw.com/environment-and-energy/zero-carbon-hydrogen-tax-rules-spark-divide-over-grid-emissions

[55] See U.S. v. Haggar Apparel Co., 526 U.S. 380, 392-93; cf. Michigan v. EPA, 576 U.S. 743, 751 (2015) (EPA decision to exclude cost when considering whether a power plant regulation was "appropriate and necessary" strayed "far beyond" the bounds of reasonable statutory interpretation).

[56] See 75 Fed. Reg. at 14,766.

[57] Id.

[58] 1 Cf. Ragsdale v. Wolverine World Wide, 535 U.S. 81, 95 (2002) (striking down a penal regulation under the Family Medical Leave Act because it was, inter alia, "inconsistent with Congress' [remedial] intent."); NationsBank of North Carolina v. Variable Annuity Live Ins., 513 U.S. 251, 257 (1995) (a regulation only receives "controlling weight" if it fills a statutory gap in a manner consistent with the legislature's "revealed design").

2. *Treasury's proposal requiring the three criteria will support substantial growth of a clean hydrogen industry, effectuating the intent of section 45V.*

Opponents of the three pillars have repeatedly argued that the rules are too burdensome and will stymie industry growth, in violation of Congressional intent of scaling a clean hydrogen industry. NRDC and a wide range of partners and industry groups—spanning hydrogen developers and suppliers, electrolyzer manufacturers, hydrogen consumers, renewable energy developers, and large clean energy buyers—have advanced a substantial based of robust evidence demonstrating that opponents are simply wrong. Moreover, opponents have consistently failed to explain why their position in support of laxer rules is consistent with Congress's stated purpose to reduce greenhouse gas emissions, or the IRA's explicit incorporation of section 211(o) of the Clean Air Act.

Claims that Treasury's proposed guidance requiring the three pillars will hinder industry growth are neither substantiated in facts on the ground, nor in best available analytical evidence. **To the contrary, both categories of evidence robustly demonstrate that Treasury's proposal will support substantial growth of a *clean* hydrogen industry that will deliver on the IRA's stated purpose of reducing U.S. GHG emissions, thereby fully effecting Congressional intent.**

i. *Facts on the ground clearly demonstrate that the three pillars are feasible, practical and will support robust clean hydrogen deployment. The bulk of first moving commercial scale projects in the U.S. and globally are set to be powered by new, hourly matched clean electricity – i.e. comply with the three pillars.*

The bulk of first mover projects in the U.S. and globally are compliant with the three pillars of 1) incrementality; 2) hourly matching; and 3) deliverability. We provide below a subset of planned three pillar-compliant projects in the U.S., the EU, and elsewhere.

These on-the-ground examples provide undeniable proof that the three pillars will support robust industry growth and support cost-effective and competitive projects today. It is particularly noteworthy that opponents of the three pillars fail to acknowledge these real-world examples.

It bears noting that projects listed below likely pale in comparison with the volume of three-pillar projects that have yet to be publicly announced. Treasury should therefore consider this list as a snapshot and proof point of the feasibility of its NPRM.

- **Large-scale three-pillar compliant projects are being planned and executed in the U.S.**

  - Hy Stor Energy projects include the announced Mississippi Clean Hydrogen Hub (MCHH), an over 2 GW-scale off-grid green hydrogen and hydrogen salt storage

ecosystem with an expected in-service date of late 2026, as well as a soon-to-be-announced GW scale project in the western U.S.[59]

- Air Products and AES Corporation announced plans to build, own and operate a green hydrogen production facility in Wilbarger County, Texas.[60] This mega-scale renewable power to hydrogen project would include approximately 1.4 GW of wind and solar power generation, along with electrolyzer capacity capable of producing over 200 metric tons per day of green hydrogen, making it the largest green hydrogen facility in the United States.[61]

- Intersect Power is planning to produce more than 1 GW of green hydrogen in the U.S.[62]

- APEX Clean Energy signed a memorandum of understanding with Infrastructure and Power strategy of Ares Management Corporation, EPIC midstream Holdings, LP, and the Port of Corpus Christi Authority to explore the development of green hydrogen production, storage, and transportation and export operation to be located at the Port of Corpus Christi on the Texas Gulf Coast.[63]

- TotalEnergies and TES are a planning to develop a 1 GW electrolyzer in the U.S. that will be powered by 2 GW of wind and solar. The companies will reach a Final Investment Decision in 2024.[64]

- Projects by a U.S. based wind developer (stands ready to meet with Treasury as needed):
    - A Mountain West Sustainable Aviation Fuel (SAF) project will employ a Power-to-Liquids process powered by a new 1.6 GW wind farm to create

[59] Hy Store Energy LP, "Funding to Develop Large-Sacle Clean Hydrogen Production and Storage at Mississippi Clean Hydrogen Hub", Hy Stor Energy, May 2023, https://www.globenewswire.com/en/news-release/2023/05/11/2666776/0/en/Hy-Stor-Energy-Submits-Formal-Application-to-the-U-S-DOE-for-Funding-to-Develop-Large-Scale-Clean-Hydrogen-Production-and-Storage-at-Mississippi-Clean-Hydrogen-Hub.html

[60] Air Products, "Air Products and AES Announce Plans to Invest Approximately $4 Billion to Build First Mega-scale Green Hydrogen Production Facility in Texas", Air Products, December 2022, https://www.airproducts.com/company/news-center/2022/12/1208-air-products-and-aes-to-invest-to-build-first-mega-scale-green-hydrogen-facility-in-texas

[61] Air Products, "Air Products and AES Announce Plans to Invest Approximately $4 Billion to Build First Mega-scale Green Hydrogen Production Facility in Texas", Air Products, December 2022, https://www.airproducts.com/company/news-center/2022/12/1208-air-products-and-aes-to-invest-to-build-first-mega-scale-green-hydrogen-facility-in-texas

[62] Jonathan Tourino Jacobo, "Us developer Intersect secures US$750 million for renewables, energy storage pipeline" Energy Storage, July 2022, https://www.energy-storage.news/us-developer-intersect-secures-us750-million-for-renewables-energy-storage-pipeline/

[63] Apex Clean Energy, "Apex Clean Energy, Ares Management, Epic Midstream, and Port of Corpus Christi Authority Sign Memorandum of Understanding for Gigawatt-Scale Green Fuels Hub on Texas Gulf Coast" Apex Clean Energy, February 2022, https://www.apexcleanenergy.com/news/apex-clean-energy-ares-management-epic-midstream-and-port-of-corpus-christi-authority-sign-memorandum-of-understanding-for-gigawatt-scale-green-fuels-hub-on-texas-gulf-coast/

[64] TotalEnergies, "United States: Total Energies and TES Join Forces to Develop a Large-Scale e-NG Production Unit", TotalEnergies, May 2023, https://totalenergies.com/system/files/documents/2023-05/EN_United_States_TotalEnergies_and_TES_Join_Forces_to_Develop_a_Large-Scale_e-NG_Production_Unit.pdf

up to 150M ga./yr of synthetic, carbon-neutral jet fuel used as a drop-in replacement for conventional jet fuel at a nearby major airport. This project will result in up to $3 billion of green energy investment, hundreds of construction jobs, and avoid up to 1,350,000 tons of CO2 emissions per year.

- A Texas project of a similar size with a new 1+ GW wind energy deployment to power hydrogen electrolyzers near the Gulf of Mexico. This green hydrogen will have dual uses, both as a feedstock for the creation of green ammonia and as an input for oil refining and petrochemicals, reducing the emissions of U.S. downstream facilities by up to 70 percent.

- A contingent of hydrogen suppliers and developers have indicated that they have a collective scale of planning and interest in the U.S. **exceeding 50 GW in the U.S which would produce more than 6 million metric tons of clean hydrogen.**[65] The contingent wrote to the Biden administration underscoring that this is "*ample volume to achieve large electrolyzer cost reductions according to a range of studies, incentivize investments in projects, hubs, and supporting infrastructure, and ensure cost-competitiveness."*
    - A study by the National Renewable Energy Laboratory (NREL) which analyzed costs of PEM electrolyzers shows that total installed system costs could decrease by about 55 percent with an annual production rate of 50 GW/year. Specifically, a 1-MW PEM electrolyzer system that has a total cost of about $1100/kW at a 10 MW/year production rate (meaning a rate where 10 units of the 1-MW systems are produced a year) is estimated to decrease to $500/kW at a 50 GW/year production rate. The estimated decrease in cost accounts for the increased production rate and the impact of economies of scale in all cost components, but it is noted that even further cost reductions could result from additional learning and cumulative experiences from developers over time.[66]
    - Companies go on to express *confidence that proposed 45V guidance requiring the three pillars […] will support scaled industry growth and enable the creation of a successful U.S. and global clean electrolytic hydrogen market"* and urged the administration to *"be skeptical of claims that proposed strong guidance will kill the industry. This is demonstrably false."*

[65] Air Products, ACCIONA & Nordex Green Hydrogen, CWP Global, EDP Renováveis, S.A, Electric Hydrogen, Hystor Energy, Syngergetic, "Hydrogen Industry Support of Strong 45V Rules" Hystore Energy, December 2023, https://hystorenergy.com/hydrogen-industry-support-of-strong-45v-rules/

[66] Ahmad Mayyas, Mark Ruth, Bryan Pivovar, Guido Bender, and Keith Wipke, "Manufacturing Cost Analysis for Proton Exchange Membrane Water Electrolyzers,", National Renewable Energy Laboratory, August 2019, https://www.nrel.gov/docs/fy19osti/72740.pdf

- NextEra/CF Industries are planning a project in Oklahoma which will include a 450 MW renewable supply powering a 100 MW electrolyzer.[67] This is an appropriate renewable energy to electrolyzer capacity ratio to meet hourly requirements at high electrolyzer utilization rates.

The following supportive statements by companies spanning the hydrogen value chain further underscores the feasibility of Treasury's NPRM and the potential for the proposal to enable industry growth.

- The "What They Are Saying" page accompanying Treasury's NPRM rules platforms an **impressively wide range of industry support** that spans the hydrogen and clean energy value chain, including hydrogen suppliers, electrolyzer manufacturers, hydrogen offtakers, clean energy developers, REC registries, foremost hourly matching standardization bodies. They all expressed strong support for the NPRM, and full confidence that it will support robust clean hydrogen deployment.[68]
- Additional supportive statements by the following major companies and industry groups further strengthen the ironclad, on-the-ground-evidence that the three pillars are pragmatic and will support large-scale clean hydrogen deployment:
    - Air Products – the largest hydrogen supplier in the world.[69]
    - Hy Stor Energy—one of the foremost hydrogen developers in the U.S. planning large-scale projects.[70]
    - AES—one of the largest renewable energy developers in the U.S. expanding into the hydrogen market[71]
    - The Green Hydrogen Catapult—a contingent of the largest companies along the hydrogen value chain globally and in the U.S. and with large-scale projects planned in the U.S.— came out in support of the three pillars as necessary to ensure "truly" clean hydrogen production and for global harmonization with European Union rules.[72]

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[67] NextEra Energy, "CF Industries and NextEra Energy Resources announce a memorandum of understanding", April 2023, https://newsroom.nexteraenergy.com/2023-04-24-CF-Industries-and-NextEra-Energy-Resources-announce-a-memorandum-of-understanding-for-a-green-hydrogen-project-in-Oklahoma-to-support-decarbonization-of-the-agriculture-supply-chain?l=12

[68] Members of the Green Hydrogen Catapult, "WHAT THEY ARE SAYING: U.S. Treasury Department Framework Will Grow Clean Hydrogen Industry" US Department of Treasury, December 2023 . https://content.govdelivery.com/accounts/USTREAS/bulletins/381482f

[69] Air Products' Statement on U.S. Department of Treasury, IRS Guidance on Hydrogen Production, December 22, 2023. https://www.airproducts.com/energy-transition/air-products-response-to-45v

[70] Hystor Energy Champions Strict Hydrogen Standards that Prioritize Decarbonization and Climate. December 12, 2023. https://www.globenewswire.com/news-release/2023/12/12/2794815/0/en/Hy-Stor-Energy-Champions-Strict-Hydrogen-Standards-that-Prioritize-Decarbonization-and-Climate.html

[71] AES Statement on Proposed Hydrogen Guidance, December 22, 2023. https://www.aes.com/about-us/news

[72] Green Hydrogen Catapult, Joint Letter on 45V Implementation, November 6, 2023. https://greenh2catapult.com/2023/11/06/joint-letter-on-45v-implementation/

- **The pipeline of large-scale three-pillar compliant projects continues to rapidly grow in the European Union, subsequent to the bloc's adoption of the three pillars in law. This is further robust evidence that the three pillars will similarly support rapid industry growth in the U.S.**

The European Commission adopted draft legislation that included the three pillars on February, 13, 2023 and finalized this legislation with no changes as European Union law on June 20, 2023.[73,74] Tracking market growth, planned hydrogen projects, and investor appetite in the EU therefore offers a robust indicator of how the three pillars as outlined in Treasury's NPRM will affect the growth of a U.S. clean hydrogen industry. **The three pillars did not compromise project development in the EU after they were adopted as some industry players threatened. In fact, the EU is recording sustained and rapid growth in announced three-pillar compliant projects.** This yet another proof point that the three pillars will similarly support robust industry growth in the U.S., contrary to false claims by some industry interests.

It bears noting that the EU is endowed with lesser quality and abundance of renewable energy compared with the U.S. Therefore, the success of the three pillars in the EU underscores the strong prospects of a robust U.S. market growth with Treasury's NPRM.

Specifically:

- In February 2024, results of the EU's innovation fund hydrogen auction far exceeded expectations. The auction was only open to hydrogen projects that are three-pillar compliant *and* that have secured hydrogen off-takers. While the Hydrogen Bank was only awarding 800-million euros to support up to 400 MW of projects, nearly 135 projects applied with a total capacity of around 8,500 MW. [75] According to the European Commission, the first bidding round was a success. *"This shows that industry is keen to take on the challenge of spearheading the transition from fossil to clean fuels,"* said Paloma Aba Garrote, director of CINEA."[76] This clearly demonstrates that the three pillars did *not* inhibit early market creation in the EU.
- The number of announced hydrogen projects since the EU adopted the three pillars in February 2023 have continued to grow rapidly and consistently. Figure 2 below represents a tracker sourced from the EU's main hydrogen trade association. This should

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[73] Directorate-General for Energy, "Renewable hydrogen production: new rules formally adopted" European Commission, June 2023, https://energy.ec.europa.eu/news/renewable-hydrogen-production-new-rules-formally-adopted-2023-06-20_en

[74] King & Spalding, LLC, "Europe's Definition of Green Hydrogen (RFNBO) Adopted into EU Law" King & Spalding, LLC, https://www.kslaw.com/news-and-insights/europes-definition-of-green-hydrogen-rfnbo-adopted-into-eu-law?locale=en

[75] Camilla Naschert, "Bidding frenzy in Europe's 1st green hydrogen auction – EC," S&P Global, February 2024, https://www.capitaliq.spglobal.com/apisv3/spg-webplatform-core/news/article?id=80502078&KeyProductLinkType=63

[76] Id.

provide confidence that the U.S. industry will follow suit – especially considering the 45V tax credit is even more lucrative than incentives offered in the EU.

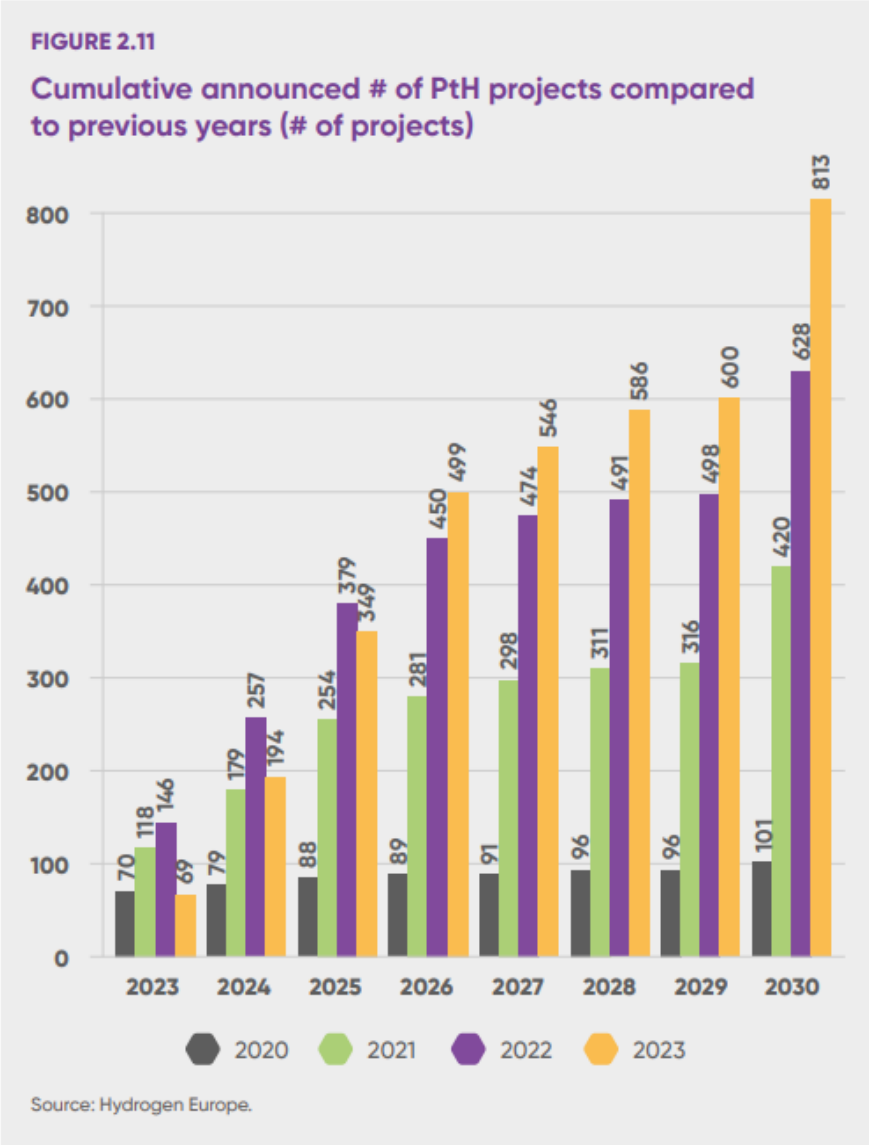

Figure 2: Cumulative number of announced three pillar compliant or PtH projects announced each year in the EU. Source: Hydrogen Europe.[77]

[77] Joana Fonseca, et al, "Clean Hydrogen Monitor 2023" Hydrogen Europe, 2023, https://hydrogeneurope.eu/wp-content/uploads/2023/10/Clean_Hydrogen_Monitor_11-2023_DIGITAL.pdf

- According to BNEF data, EU announced project volumes have *increased* by 18 percent with the volume of projects going to Final Investment Decision (FID) increasing by 60 percent since the three pillars were adopted (Figure 3).[78]

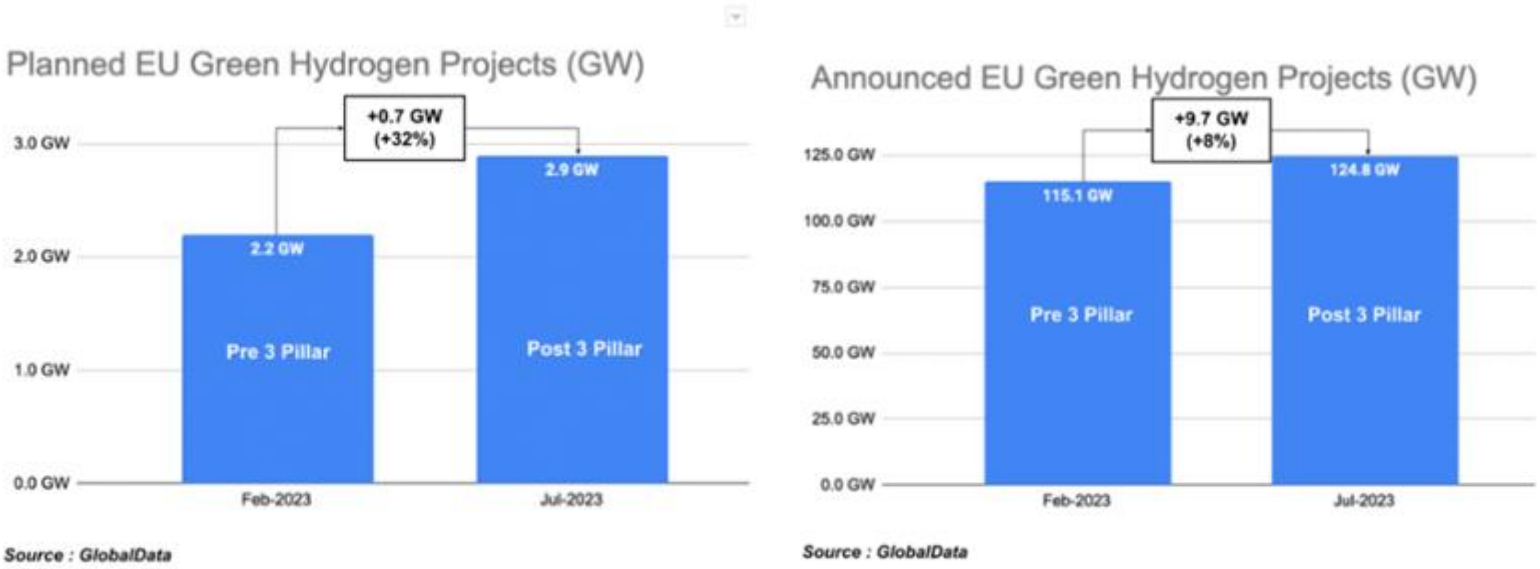

Figure 3: Growth in the European Union's electrolytic hydrogen project pipeline subsequent to the bloc's adoption of the three pillars in early 2023.[79]

- Data from the IEA shows that the EU is also now leading the world on planned clean hydrogen projects.[80]

Furthermore, we outline a subset of noteworthy large-scale three-pillar compliant projects planned in the EU:

- TotalEnergies launched a call for tenders for the supply of 500,000 tons per year of green hydrogen. This would avoid around five million tons of CO2 each year from the

[78] Bloomberg New Energy Finance project tracker, https://docs.google.com/spreadsheets/d/1QQbI7BXfEppXn1wKO250EbBu3mwEP25zdif4let4GMY/edit#gid=634475755

[79] Jeff St. John, "The new hydrogen tax credits could revolutionize how clean energy is counted" Canary Media, January 2024, https://www.canarymedia.com/articles/hydrogen/the-new-hydrogen-tax-credits-could-revolutionize-how-clean-energy-is-counted

[80] International Renewable Energy Agency, "Hydrogen production projects interactive map," November 2023, https://www.iea.org/data-and-statistics/data-tools/hydrogen-production-projects-interactive-map

company's European refineries by 2030.[81]

- A 200 MW electrolyzer by Air Liquide's ELYgator, Netherlands will be located in Terneuzen, Netherlands. The ELYgator project would enable the avoidance of about 3.3 million tons of CO2 over the first ten years of the plant's operation, which is the equivalent to the emissions of 3.6 million kilometers driven by truck.[82]

- A 200 MW electrolyzer by Air Liquide's Normand'Hy, France will be located in Port-Jerome, France and will use nearby solar and wind to power the electrolyzers. It scheduled to be commissioned in 2025.[83]

- A 200 MW electrolyzer by Shell on the Tweede Maasvlakte in the port of Rotterdam will become operational in 2025. [84] The renewable power for the electrolyzer will come from the offshore wind farm Hollandse Kust.

- Asturias H2 Valley by EDP Renewables, a 150 MW electrolyzer project in Spain expected to be in service by early 2026.[85]

- GreenH2Atlantic by EDP Renewables and 12 other European partners, a 100 MW electrolyzer project in Portugal.[86]

[81] TotalEnergies, "Decarbonizing Refining: TotalEnergies Launches a Call for Tenders for the Supply of 500,000 tons per year of Green Hydrogen" TotalEnergies, September 2023, https://totalenergies.com/media/news/press-releases/decarbonizing-refining-totalenergies-launches-call-tenders-supply-500000

82 AirLiquide, "Air Liquide's 200 MW electrolyzer project in the Netherlands enters the final selection round of European Innovation Fund" AirLiquide, June 2022, https://be.airliquide.com/fr/news/air-liquides-200-mw-electrolyzer-project-netherlands-enters-final-selection-round-european-innovation-fund

[83] AirLiquide, "Building the future of renewable hydrogen in Normand'Hy" AirLiquide, March 2023, https://www.airliquide.com/stories/hydrogen/building-future-renewable-hydrogen-normandhy

84 Shell, "Shell to start building Europe's largest renewable hydrogen plant" Shell, July 2022, https://www.shell.com/media/news-and-media-releases/2022/shell-to-start-building-europes-largest-renewable-hydrogen-plant.html

85 Francisco Blanco, "EDP presents the Asturian green hydrogen valley project to the General Secretary of Industry and SME" EDP, April 2023, https://espana.edp.com/en/news/edp-presents-asturian-green-hydrogen-valley-project-general-secretary-industry-and-sme

86 GreenH2Atlantic, "GreenH2Atlantic, creation of 100 MW hydrogen production hub in Sines, Portugal", GreenH2Atlantic, https://www.greenh2atlantic.com/project

- **Large-scale three-pillar compliant projects are similarly being planned and executed globally, outside the U.S. and EU.**

  - The vast majority of announced electrolytic hydrogen projects recorded by the International Renewable Energy agency are hourly matched (and are largely behind-the-meter projects).[87]

  - CWP Global has multiple three pillar compliant green hydrogen projects across the globe, including:
    - The AMAN project in northern Mauritania is expected to produce up to 30GW of mixed generation.[88]
    - The AMUN project in southern Morocco aimed at producing green ammonia and other derivatives as needed. It's expected to provide up to 17GW of mixed generation capacity. [89]
    - Australian Renewable Energy Hub (AREH) is CWP Global's flagship, ultra large-scale green hydrogen and ammonia production facility. At its maximum capacity it's set to be the largest energy production facility in the world. It's located in North-western Australia in the Pilbara and can produce up to 26GW of mixed generation. [90]
    - Green Star is located in Djibouti and is expected to provide up to 5GW of mixed generation. It's well located alongside major shipping and trade routes and is close to wind and solar resources.
    - Southern Core is located in Argentina and is a collection of large-scale green hydrogen production facilities spread across multiple locations. At full scale, each cluster is expected to have around 8.5GW of wind generation.[91]
    - Western Green Energy Hub (WGEH) located in South-eastern corner of Australia was developed with Intercontinental Energy and the Miring People, the project aims to establish commercial feasibility for an ultra-scale green hydrogen production facility. Potential to generate more than 50 GW of hybrid wind and solar power.[92]

  - In December 2023, EDP Brazil began producing three-pillar compliant green hydrogen at its new generation unit in São Gonçalo do Amarante, Ceará.

[87] International Renewable Energy Agency, "Global Hydrogen Review 2022,", 2022, https://iea.blob.core.windows.net/assets/c5bc75b1-9e4d-460d-9056-6e8e626a11c4/GlobalHydrogenReview2022.pdf
[88] CWP Global, "Our Projects", CWP Global, https://cwp.global/projects/
[89] CWP Global, "Amun" CWP Global, https://cwp.global/projects/?p_id=338
[90] CWP Global, "Australian Renewable Energy Hub", CWP Global, https://cwp.global/projects/?p_id=337
[91] CWP Global, "Southern Cone", CWP Global, https://cwp.global/projects/?p_id=335
[92] CWP Global, "Western Green Energy Hub (WGEH)", CWP Global, https://cwp.global/projects/?p_id=320

ii. The overwhelming majority of analyses – including by developers, manufacturers, and reputable research groups—conclude that the three pillars will support substantial industry growth and enable cost-competitive hydrogen from day 1.

Corroborating the choir of industry support and on-the-ground evidence, the overwhelming majority of studies – by electrolyzer manufacturers, hydrogen and renewable developers, academics and research groups – find three-pillar projects will be *very cost-competitive from day one.*[93] The IRA subsidies for renewable energy and hydrogen are sufficiently generous (more than ~8 cents/kWh) to support clean hydrogen costs at and/or below the cost of today's status quo, gas-derived hydrogen. The handful of studies finding the three criteria are too expensive rely on outlier and unreasonable assumptions. When corrected, even those studies support the conclusion the three criteria will support very cost-competitive projects.

First, it bears the reemphasis that electrolyzers **do not need to run 24/7** for their economics to pencil out. Instead, at the current high capital costs of electrolyzers, they need to operate around 70 percent on average.[94] This is because electricity costs are the largest cost component for electrolyzers; at a certain threshold of high utilization, projects start running into expensive peak or near-peak electricity costs and the advantage of higher utilization diminishes.

On a general, catch-all note summarizing the following sections, a recent meta-literature review by ERM Consulting offers powerful analytical evidence that the three pillars will enable very cost-competitive hydrogen and support substantial industry growth. **ERM reviewed 30 analyses and studies and concludes that "in the regions where electrolysis is competitive [against steam reformation facilities] – which is the vast majority of regions – *the three pillars requirement adds $0.10 - $0.40/kg to the marginal cost of hydrogen."***[95] This is a modest cost increase relative to weak rules that would not hinder the cost-competitiveness of hydrogen production while ensuring that section 45V's statutory requirements are not violated.

[93] Wilson Ricks and Jesse Jenkins, "The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies," Princeton ZERO Lab, April 2023, https://zenodo.org/records/7948769 ERM Consulting, "Assessment of Grid Connected Hydrogen Production Impacts Part I Literature Review and Framework Key Insights,", February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf ; Wilson Ricks and Jesse Jenkins, "The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies," Princeton ZERO Lab, April 2023, https://zenodo.org/records/7948769

[94] IEA for the G20, Japan, "The Future of Hydrogen" IEA, June 2019, iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf (Figure 13)

[95] Angelina Bellino, Harrison Branner, Cameron Movahhedian, Lauren Slawsky, Mackay Miller, "Assessment of Grid Connected Hydrogen Procution Impacts" ERM, February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf

- *The vast majority of studies evaluating the levelized cost of hydrogen on a project level find that three-pillar compliant projects can be very cost-competitive from day one.*

A meta-analysis by Princeton ZERO lab finds that the majority of studies – including by developers, electrolyzer manufacturers, and research groups-- indicate that three pillar compliant projects will achieve the optimal level of utilization and more (i.e., 70 percent-90 percent utilization) when they procure an appropriate portfolio of wind and solar resources that is oversized relative to the electrolyzer (Figure 4 below). **The studies find that three-pillar compliant projects will achieve a levelized cost of clean hydrogen production that is cost-competitive with the cost of today's incumbent gas-derived hydrogen even assuming *high* electrolyzer capital costs in the near term (**Figure 5 below**).**

The handful of outlier studies that conclude that hourly-matched hydrogen production costs would be universally cost-prohibitive make overly pessimistic and unreasonable assumptions about electrolyzer costs and renewable energy procurement strategies. The 2023 study by Wood Mackenzie assumes an extremely high electrolyzer capital cost, that far exceeds both today's costs as well as near-term projections. [96]Analyses by the Rhodium Group and Energy Futures Initiative (EFI) make very pessimistic assumptions around electrolyzers' renewable energy procurement.[97] Both assume that an hourly-matched electrolyzer must run off a single renewable generator with identical capacity to the electrolyzer. This results in very low electrolyzer utilization rates below 40 percent and therefore prohibitive costs (see Figures 4 and 5 below). But these assumptions do not match the reality of how operators of three-pillar compliant projects will design – and are already designing—their business models and operational paradigm.

It bears noting that since the Rhodium Group published that first analysis where they find that hourly matching would be cost-prohibitive in the near term, they have since corrected their assumptions and findings to acknowledge that hourly-matched projects can achieve high utilization rates that will enable cost-competitive hydrogen production. Rhodium assumes an **80 percent utilization rate** for hourly-matched electrolyzers in their most recent study on 45V.[98]

[96] Wood Mackenzie, "Green hydrogen: what the Inflation Reduction Act means for production economics and carbon intensity" Wood Mackenzie, March 2023, https://www.woodmac.com/news/opinion/green-hydrogen-IRA-production-economics/
[97] Rhodium Group, "Scaling Green Hydrogen in a post-IRA World", Rhodium Group, 2023, https://rhg.com/research/scaling-clean-hydrogen-ira/ ; Rhodium Group, 2023. 'Scaling Green Hydrogen in a post-IRA World.' https://rhg.com/research/scaling-clean-hydrogen-ira/ ; https://efifoundation.org/reports/the-u-s-hydrogen-demand-action-plan-2/
[98] Ben King, John Larsen, Galen Bower, Nathan Pastorek, "How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit Guidance", Rhodium Group, January 2024, https://rhg.com/research/clean-hydrogen-45v-tax-guidance/#_ftnref1

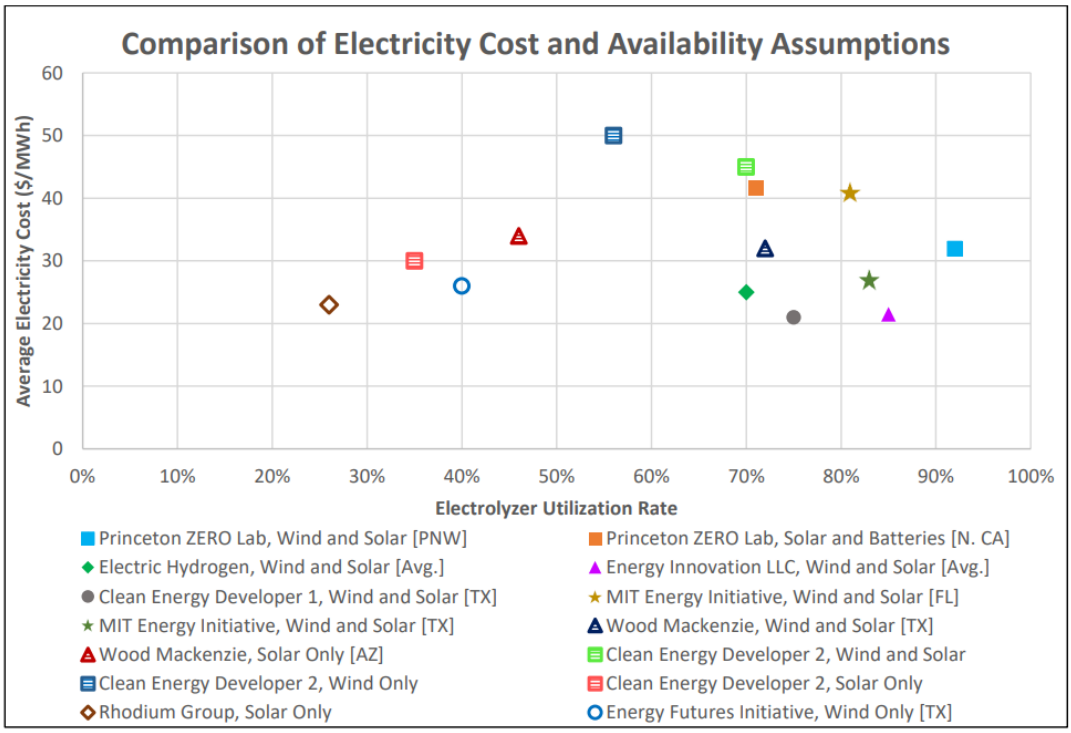

Figure 4: Comparison of Electricity Cost and Availability Assumptions for hourly-matched hydrogen projects.[99]

[99] Wilson Ricks, Jesse Jenkins, "The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies" Zenodo, April 2023, https://zenodo.org/records/7838874

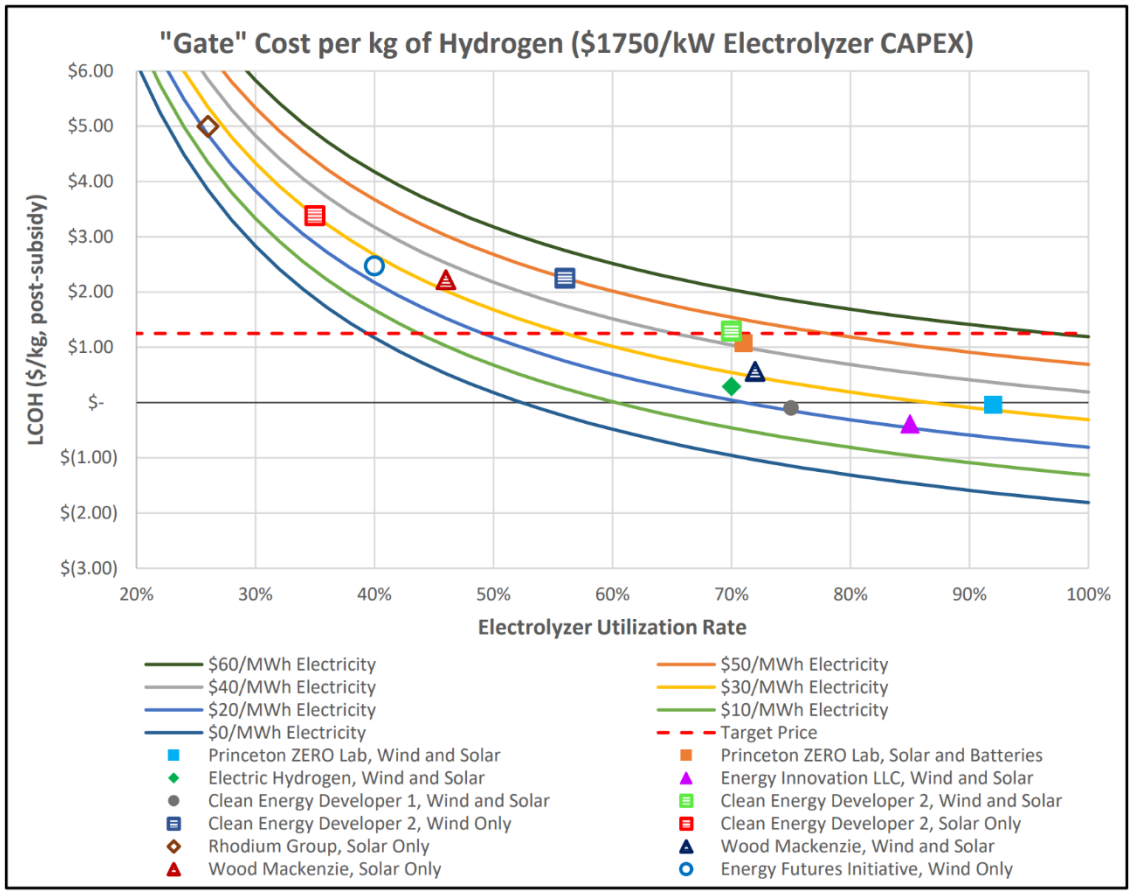

Figure 5: Levelized cost of hydrogen production for high capital cost electrolyzers at $1,750/kW.[100]

A study by Energy Innovation finds that there are many regions in the U.S. where hourly matching can enable optimal electrolyzer utilization rates and cost-competitive three-pillar compliant hydrogen production from day one (Figure 6 below). [101]

[100] Wilson Ricks, Jesse Jenkins, "The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies" Zenodo, April 2023, https://zenodo.org/records/7838874

[101] Leigh Collins, Letting US Green hydrogen use existing renewable could increase emissions by factor of five', April 2023. https://www.rechargenews.com/energy-transition/letting-us-green-hydrogen-use-existing-renewables-could-increase-emissions-by-factor-of-five/2-1-1433132

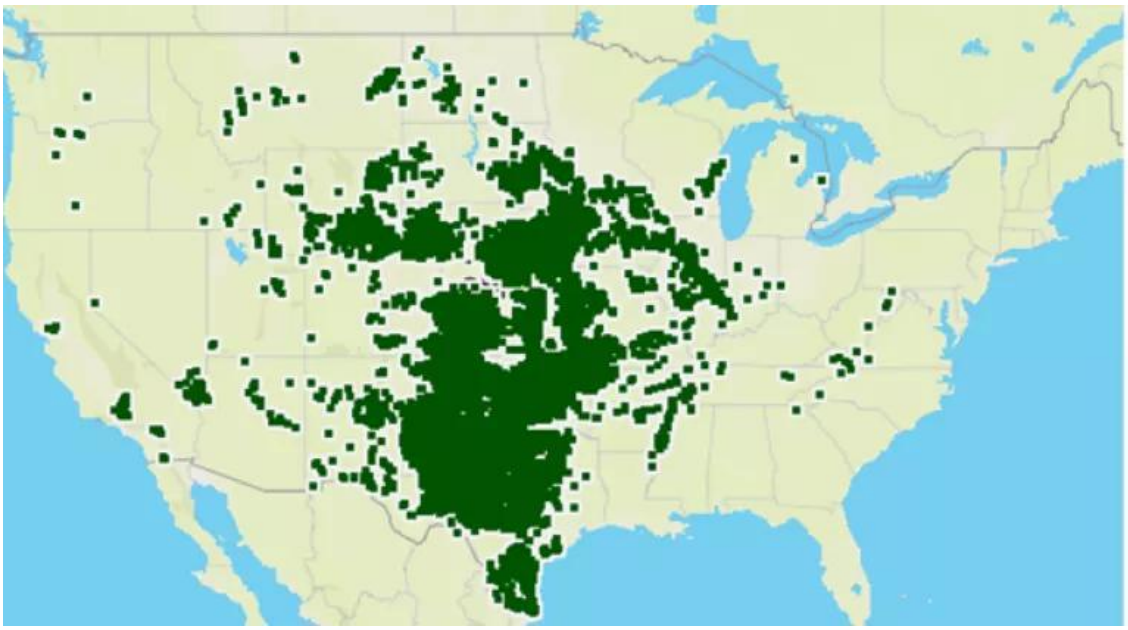

Figure 6: Map showing U.S. locations where wind and solar prices average $25/MWh or less, and where three-pillar compliant projects may be financially viable from day one.[102]

Energy Innovation underscores that if electrolyzer deployment is as rapid as many predict, then capital costs for electrolyzers will fall quickly in this next decade greatly expanding U.S. geographies where three pillar-compliant projects can be cost-competitive. The Princeton meta-analysis draws a similar conclusion. When electrolyzer capital costs are assumed to drop to approximately $550/kW by 2030— tracking projections by the DOE in their Clean Hydrogen Liftoff report— **clean hydrogen production becomes cost-competitive even at low utilization rates assumed in the EFI and first Rhodium Group reports** (Figure 7 below). Thus, the majority – if not the entirety—of U.S. regions can support cost-competitive, three-pillar compliant hydrogen projects by the early 2030s. This is precisely the purpose of a public subsidy like 45V: to kick the technology down the cost curve by supporting the deployment of a sufficiently large volume of first mover projects and deliver technology cost reductions that will enable widespread uptake and deployment. The three pillars in Treasury's NPRM will deliver on this natural course.

[102] Dan Esposito, Eric Gimon, Mike O'Boyle, "Smart Design of 45V Hydrogen Production Tax Credit will Reduce Emissions and Grow The Industry", Energy Innovation, April 2023 https://energyinnovation.org/wp-content/uploads/2023/04/Smart-Design-Of-45V-Hydrogen-Production-Tax-Credit-Will-Reduce-Emissions-And-Grow-The-Industry.pdf

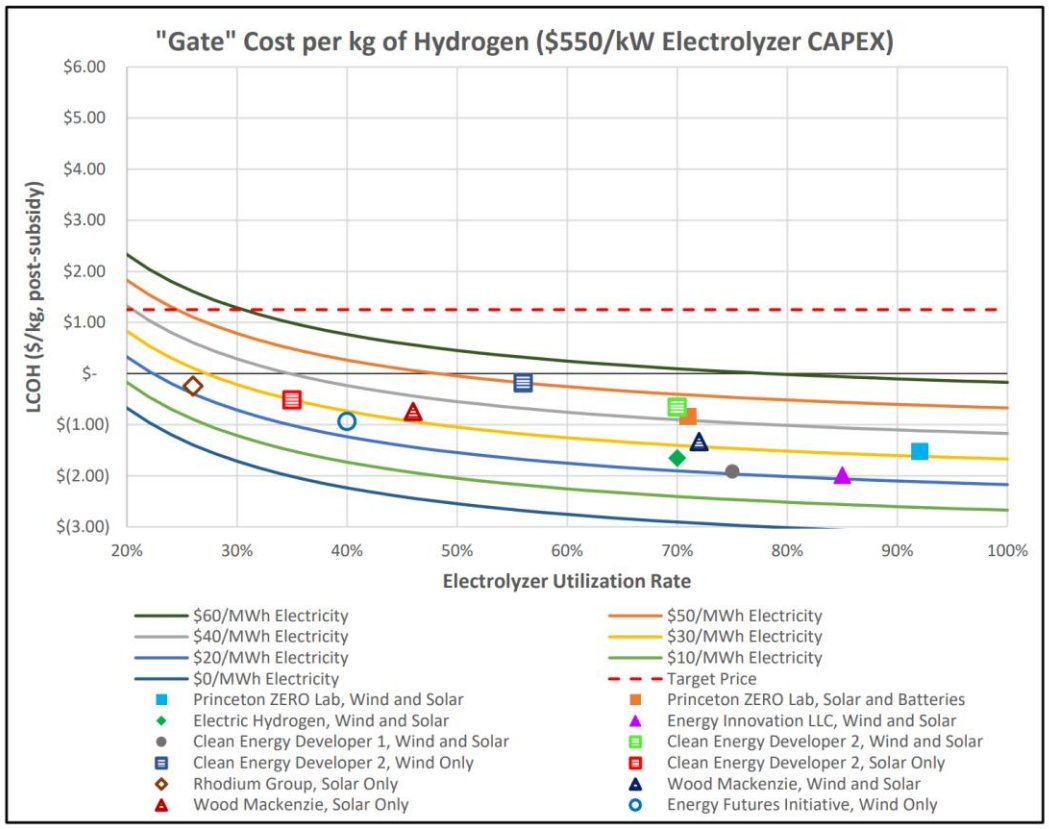

Figure 7: Levelized Cost of Hydrogen at electrolyzer capital costs projected to be achieved by 2030.[103]

It would be unreasonable to speculate that Congress intended that section 45V support hydrogen deployment *everywhere* from day one, because doing so would 1) contravene section 45V's emissions limits and the IRA's stated purpose of supporting the reduction of U.S. greenhouse gas emissions and 2) set up an industry doomed to fail because section 45V-supported hydrogen would be deployed in regions that do not have the adequate resources for cost-competitive clean hydrogen production and that cannot survive after the 45V subsidy sunsets. As noted above, Congress intended to scale a *clean* hydrogen industry that supports U.S. decarbonization goals. Nothing dictates that every single region in the U.S. must tap into the generous 45V subsidy from day one.

- *Studies evaluating the scale of hydrogen deployment find that three pillars will support substantial clean hydrogen deployment by 2030 and beyond.*

A study by Evolved Energy Research study finds ***that the three pillars will drive near identical electrolyzer deployment through 2032 relative to lax rules*** (no incrementality and annual

[103] Ricks, W., & Jenkins, J. D. The Cost of Clean Hydrogen with Robust Emissions Standards: A Comparison Across Studies. https://zenodo.org/record/7838874#.ZEqfE3bMKUk

matching – see Figure 8 below).[104] Evolved finds the IRA renewable energy and hydrogen tax credits spur rapid scaling of clean hydrogen with the three criteria.

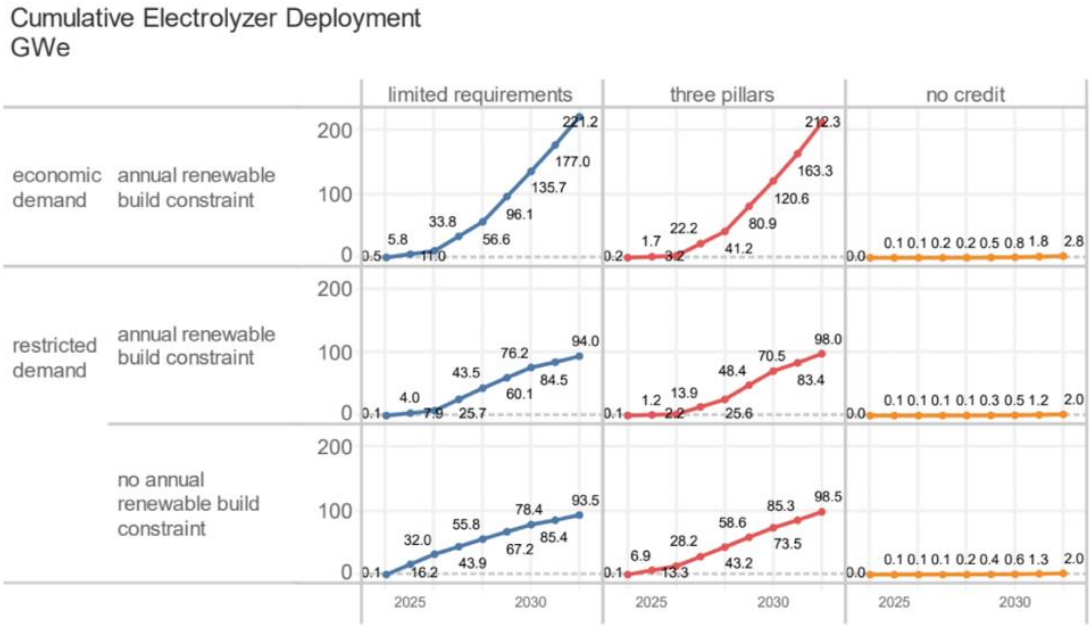

Figure 8: Cumulative electrolyzer deployment (GWe) across various scenarios. Limited requirements assume no incrementality and annual matching.[105]

The three pillars support more than 70 GW of electrolyzer capacity by 2030, which is far greater than the capacity deployment needed to achieve transformative electrolyzer cost reductions. Evolved concludes: *"[w]hile the three criteria may have an impact on hydrogen production costs, our analysis finds that they do so from a subsidized price approaching zero, and so have very little impact on economic deployment through the period of 45V tax credit eligibility."*[106]

Evolved finds the administration's decision to adopt the criteria or not becomes ***"a question of the expected returns for investors for hydrogen production and not whether IRA will be successful in driving electrolyzed hydrogen adoption."*** The role of taxpayer-funded, public subsidies is to support needed deployment of flexible electrolyzers, to drive cost reductions and enable a flourishing, unsubsidized market; the three pillars do this. Evolved notes that if deployment will be limited by some factor, it is more likely going to be tied to supply chain considerations. We offer a developer's perspective to further qualify the expected near-term dynamics:

[104] Ben Haley, "45V Tax Credit: Three-Pillars Impact Analysis", Evolved Energy Research, June 2023 https://www.evolved.energy/post/45v-three-pillars-impact-analysis
[105] Ben Haley, "45V Tax Credit: Three-Pillars Impact Analysis", Evolved Energy Research, June 2023 https://www.evolved.energy/post/45v-three-pillars-impact-analysis
[106] Ben Haley, "45V Tax Credit: Three-Pillars Impact Analysis", Evolved Energy Research, June 2023, Page 5-30. https://www.evolved.energy/post/45v-three-pillars-impact-analysis

"...the electrolyzer manufacturers are all clogged with requests and will struggle to meet the demand. Projects will fail for want of electrolyzers. Put differently, the $3/kg incentive is large enough to get both hourly matching and a maxed-out supply chain. 45V guidelines should ensure limited electrolyzers are deployed to projects that will be an enduring success, rather than a frivolous credit harvesting operation. Hourly matching ensures projects will be the former, rather than the latter. Under annual matching, jurisdictions adding fossil capacity get rewarded while those decarbonizing are disfavored."

EPRI draws a similar conclusion to Evolved Energy Research. EPRI finds that the three pillars will support 20 million metric tons per year of clean hydrogen production by 2036.[107] This is *double* DOE's 2030 clean hydrogen production target. EPRI explains that the section 45V credit is very generous and could cover up to 90 percent of hydrogen production costs in the most favorable cases (e.g., where high quality wind resources are available combined with lower electrolysis capital costs).[108]

EPRI finds that loosening the three pillars increases overall hydrogen production, but primarily for use in "hydrogen-sink applications" like cycling back into electricity or gas distribution networks that *retire the moment the credit stops flowing*. **This would contravene the anti-abuse rule** in the proposed § 1.45V–2(b)(1) that would *"make the section 45V credit unavailable in extraordinary circumstances in which, based on a consideration of all the relevant facts and circumstances, the primary purpose of the production and sale or use of qualified clean hydrogen is to obtain the benefit of the section 45V credit in a manner that is wasteful, such as the production of qualified clean hydrogen that the taxpayer knows or has reason to know will be vented, flared, or used to produce hydrogen."*

Treasury goes on to duly explain that *"Producing and selling or using qualified clean hydrogen with the primary purpose of obtaining the benefit of the section 45V credit in a wasteful manner would not, in certain circumstances, satisfy the requirement in section 45V(c)(2)(B)(i)(II) for hydrogen to be produced in the ordinary course of a trade or business of the taxpayer."* Treasury duly does not want to subsidize projects exclusively undertaken for the harvesting of the credit; but as EPRI's analysis shows, weaker rules compared with the NPRM would incentivize hydrogen projects that are solely deployed to capture the 45V credit and cease to operate once the credit sunsets.

Bloomberg New Energy Finance acknowledges the strength of the aforementioned studies.[109] They note:

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[107] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407

[108] EPRI, "Impacts of IRA's 45V Clean Hydrogen Production Tax Credit" EPRI, November 2023, https://www.epri.com/research/products/000000003002028407

[109] Adithya Bhashyam, Hydrogen, BloombergNEF, "US Hydrogen Guidance: Be Strict or Be Damned" Bloomberg NEF, September 2023, https://about.bnef.com/blog/us-hydrogen-guidance-be-strict-or-be-damned/

"Companies preferring less strict annual matching argue that hourly matching raises production to a level where clean hydrogen production becomes uneconomic while having a minimal emissions benefit.

Three studies on this topic from Princeton University, MIT, and Evolved Energy show that this is not entirely true. Hourly matching comes with additional costs over annual matching but this amounts to just $0.1-0.5 per kilogram in most scenarios modeled by these studies. This cost is completely mitigated by the $3/kg tax credit for hydrogen."

2. Hourly matching beginning in 2028 is supported by robust technical evidence and expert opinion. Further delaying the transition would have tenuous technical basis and be arbitrary.

This section addresses the following prompts by Treasury in its NPRM:

- *request comments on the appropriate duration of this transition rule to hourly matching, including specific data regarding current industry practices;*
- *the predicted timelines for development of hourly tracking mechanisms, and*
- *the predicted timeline for market development for hourly EACs.*

NRDC supports and is a signatory to joint comments by EnergyTag to this NPRM regarding the feasibility of scaling hourly tracking infrastructure by 2028 to support widespread hourly-matched clean hydrogen deployment. We strongly support Treasury's proposed phase-in of hourly matching by 2028 and strongly recommend that it hold course in final guidance. **The 2028 phase-in date is substantiated by best available technical evidence and allows sufficient time for registries to scale nationwide hourly tracking.** Indeed, the majority of U.S. registries have confirmed that they can implement hourly tracking in under 2 years. **In the unlikely event that registries are delayed in offering hourly tracking, there are provisional approaches for projects to achieve hourly matching without the need for scaled hourly tracking infrastructure**, and that are already in use today by a wide range of companies pursuing 24/7 clean energy procurement strategies. Thus, **arguments advanced by some commentators for delaying the hourly transition predicated on the uncertain timeline of scaled hourly tracking infrastructure are tenuous and do not reflect available market options.**

We summarize toplines below and refer Treasury to the EnergyTag joint comments for further detail.

- Further delaying the hourly phase-in will increase **the risks of hydrogen production resulting in significant induced grid emissions and the risks of violating section 45V's emissions thresholds.** A study by Princeton ZERO Lab finds that a 2030 phase-in would result in ***4 times more emissions*** relative to the current 2028 phase-in, and a 2032 phase-in would result in ***15 times more emissions*** relative to a 2028 phase-in.

- **Hourly tracking is available today** and offered by both M-RETS and PJM GATS. Those registries **are already able to offer hourly tracking throughout most of the U.S.** even if other registries are not able to.
- Treasury's proposed 2028 phase-in date is based on **best available technical evidence** contained in the survey and report by the Center for Resource Solutions (CRS) whereby **all surveyed registries have confirmed that they can implement hourly tracking in under 2 years, and up to no more than 3 years.** This indeed comports with the viewpoints by experts who had already estimated a 2-year timeline as sufficient to scale a nationwide hourly tracking infrastructure.[110]
- There are **provisional approaches that hydrogen producers can implement** to qualify for 45V while registries are implementing hourly tracking. Those are based on using monthly/annual EACs already in widespread use today in conjunction with hourly metered electricity consumption and clean energy generation-- an approach already in use by a range of companies pursuing 24/7 clean energy procurement. Thus, arguments by commentators that the uncertainty of the timeline until hourly tracking infrastructure is scale warrants a significant delay to the hourly phase-in are tenuous; **they fail to acknowledge both best available technical evidence and the availability of straightforward provisional approaches that hydrogen producers can employ on the off chance that registries do not scale hourly tracking by 2028.**

We also note that even if hourly tracking were not yet widely available, there is nothing inherently arbitrary about a technology-forcing regulation. In the context of environmental regulations that require (and do not merely, as here, encourage) the adoption of certain technologies, the D.C. Circuit has held that an agency "may base a standard or mandate on future technology when there exists a rational connection between the regulatory target and the presumed innovation."[111] Unless there are "theoretical objections" to a technology's viability, an agency need only give "plausible reasons for its belief that the industry" will be able to adopt the technology within the time frame provided by the regulation.[112] Thus, even if hourly tracking were not yet available, Treasury would be well within its authority to require that technology over a reasonable timeframe. And as discussed, there is strong evidence substantiating 2028 as a reasonable timeframe.

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[110] Angelina Bellino, Harrison Branner, Cameron Movahhedian, Lauren Slawsky, Mackay Miller, "Assessment of Grid Connected Hydrogen Procution Impacts" ERM, February 2024, https://www.erm.com/globalassets/documents/publications/assessment-of-grid/assessment-of-grid-connected-h2-electrolysis-impact_part-i_lit-review_final.pdf, "ERM finds that hourly matching by 2028 is feasible. In particular, they share that the Midwest Renewable Energy Tracking System (M-RETS) and Energy Tag estimate that building a national hourly tracking system is feasible within 12 to 18 months. This would be ahead of Treasury's proposed timeline of January 1, 2028."

[111] *See Am. Petrol. Inst. v. E.P.A.*, 706 F.3d 474, 480 (D.C. Cir. 2013) (collecting cases).

[112] *See Nat. Petrochemical & Refiners Ass'n v. E.P.A.*, 287 F.3d 1130, 1144 (D.C. Cir. 2002) (quoting *Nat. Res. Defense Council v. E.P.A.*, 655 F.2d 318, 333 (D.C. Cir. 1981)).

3. Allowing for grandfathering of annual matching is unnecessary and would constitute explicit violation of section 45V's statutory requirements.

Some industry groups are calling for Treasury to allow for the grandfathering of annually matched projects through the early 2030s. They predicate this ask on both the necessity of grandfathering for project financing and the uncertain timeline of scaled hourly tracking infrastructure. Both of those claims are demonstrably false. Furthermore, grandfathering annual matching would be in egregious violation of section 45V's emissions thresholds and statutory requirements as it would support hydrogen production with significant induced grid emissions through the late 2030s and early 2040s (accounting for the 10-year 45V credit availability). **We therefore applaud Treasury for disallowing the grandfathering of annual matching in the NPRM and strongly recommend it to hold course in final guidance.**

Specifically, grandfathering weak rules – including grandfathering projects that comply with annual matching:

- Will support hydrogen projects that result in significant induced emissions throughout the 10-year 45V availability, in explicit violation of section 45V's statutory requirements.
- Is unnecessary for project financing, as purported by some industry groups.
- Will funnel through unsustainable hydrogen projects that will struggle to remain competitive after the large 45V subsidy ends.

A. Grandfathering will lead to hydrogen production that results in significant induced grid emissions.

Princeton ZERO Lab have assessed induced grid emissions of various structures of an hourly phase-in – including grandfathering. They evaluate a hydrogen uptake scenario that parallels the growth achieved during the early years of the U.S. solar PV industry, a plausible analog for a readily achievable scale-up of the nascent electrolysis industry over a similar time period (Figure 9).[113] **The analysis demonstrates how grandfathering of annual matching has significant impact on emissions-- as it locks in carbon intensive, annually matched projects for ten years**. In particular, a "commence construction" grandfathering structure enables orders of magnitude more hydrogen to qualify under annual matching, with corresponding emissions impacts in violation of section 45V's statutory requirements.

[113] This scenario begins with only 0.1 million metric tons (MMT) per year of electrolysis capacity installed in 2026, or 0.6 gigawatts of electrolyzer capacity (the same as the annual solar PV capacity installed in 2010). Annual installations then grow at the same average rate from 2026-2032 as the solar sector over 2010-2016 before tapering off to a slower growth rate thereafter (also mirroring the experience in solar PV). This conservative scenario results in only 2 MMT/year of hydrogen production in 2030, well short of the Department of Energy's goal of 10 MMT by the end of the decade.

	Total MMT H2 covered by annual matching								
Date of phase-out	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Phase-out (no grandfathering)	0	0	0	0	**1**	2	**4**	8	15
Placed in service (grandfathering)	0	0	1	3	6	11	21	39	69
Commence construction (grandfathering)	6	11	21	39	**69**	103	141	182	227

	Total MMT CO2e induced by phase-in								
Date of phase-out	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Phase-out (no grandfathering)	0	0	1	4	10	21	**42**	81	**150**
Placed in service (grandfathering)	0	0	10	28	59	115	213	387	694
Commence construction (grandfathering)	59	115	213	387	**694**	1033	1405	1815	2266

	Total $B Spent on Annual Matched H2 Subsidies								
Date of phase-out	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Phase-out (no grandfathering)	0	0	0	1	3	6	**13**	24	**45**
Placed in service (grandfathering)	0	0	3	8	18	34	64	116	208
Commence construction (grandfathering)	18	34	64	116	**208**	310	422	545	680

Note: The blue bolded cells represent the EU rules for a phase-in to hourly matching for all projects in 2030 and the red bolded cells represent ACP's proposed exemption for projects that commence construction before the end of 2028.

Figure 9: Emissions and fiscal impacts of different hourly matching phase-in schemes by certain dates.[114]

The tables above summarize emissions outcomes under three phase-in approaches – one which disallows grandfathering (similar to Treasury's NPRM and the EU Delegated Act), and two that allow it:

- A full phase-out assumes no grandfathering. Phasing in hourly matching/phasing out annual matching in 2028 means that all projects need to comply with hourly matching in 2028 onwards, which reflects the NPRM.
- A placed in-service scheme allows grandfathering of annual matched projects that are placed in service (i.e., operational) by a specific date.
- A commence construction scheme allows grandfathering of annual matched projects that commence construction by a specific date. A four-year safe harbor between commencing construction and placed in service date is assumed.

The tables show that the timing and structure of the phase in of hourly matching will have significant impact on the emissions outcome. This is driven by 1) the energy intensity of hydrogen production – and thereby its high emissions intensity under weak 45V rules– 2) the ineffectiveness of annual matching at preventing emissions increases, which has been very

[114] Inputs and the underlying methodology for this data are summarized in comments by Princeton ZERO Lab to this NPRM.

robustly demonstrated (as we discussion in sections 1.A and 1.B above), and 3) the long duration of the 45V credit (10 years).

Both grandfathering schemes lead to significant emissions increases – ranging between roughly *60 and 700 million tons of carbon emissions* over the lifetime of the credit, if the 2028 phase-in date currently required in the NPRM is shifted to a grandfathering cut-off date in the final rules and a 2028 date is adopted as a placed-in-service or commence construction date. The proposal by the American Clean Power association—to allow for grandfathering of annually matched projects that commence construction by 2028 would thus lead to a *net emissions increase of 700 million tons* over the lifetime of the 45V credit. **This is approximately 6x – 70x more emissions compared with a phase-in by 2028 without grandfathering, outlined in the NPRM.**

B. Grandfathering annually matched projects is unnecessary for project financing, as demonstrated by on-the-ground evidence.

The EU disallows grandfathering of monthly matching (which is currently in place in the EU) and requires all projects to switch to hourly matching in 2030. **The growth in the pipeline of hydrogen projects – including a sharp increase in projects reaching FID—as outlined in section 1.B above, is a clear demonstration that project deployment and financing are not undermined or compromised by a shift in rules during a project's lifetime.**

Industry groups calling for Treasury to allow the grandfathering of annual matching predicated on its necessity for project financing entirely fail to consider what a phase-in is *actually* intended to serve. They argue that absent grandfathering, annually matched projects would need to modify operations and design midway through to meet the requirements of hourly matching come 2028. This uncertainty would undercut the bankability of projects and their financing prospects. **The fatal flaw in this logic lies in the fact that it assumes that a phase-in is intended to give full impunity for producers to design and build projects without consideration of their induced grid emissions. This is categorically not the case.** The phase-in is meant to accommodate the leeway that the market may need to scale hourly tracking infrastructure, as substantiated by the CRS survey and expert recommendations. Producers must still design their projects *from the start* in a manner to achieve zero or minimal induced grid emissions—i.e., three pillar-compliant projects-- as required by section 45V's statutory requirements. As substantiated by overwhelming evidence, large-scale three-pillar compliant projects are being planned and financed in the U.S. and worldwide (refer to section 1.B above). Proponents of long phase-ins with grandfathering of annual matching are effectively requesting that millions of tons of hydrogen production be grandfathered in under annual matching and induce substantial grid emissions throughout the ten years of their receiving the 45V credit. **This unlawful outcome would be in egregious violation of section 45V's statutory requirements and should be categorically rejected by Treasury.**

C. Grandfathering threatens the longevity of projects and will support hydrogen projects that that will struggle to remain competitive after the large 45V subsidy ends.

Grandfathering of weak rules will support projects that will annually match throughout their lifetime. Those are inflexible projects, unable to vary operations with fluctuating power prices. Hydrogen projects will have a service life of up to thirty years. If they are not planned from day-one to include flexible operations, the harmful effects are at least two-fold:

i. Grandfathered, annually matched projects have compromised longevity once the 45V credit phases out and will end up either stranded or in need of a subsidy extension.

The electricity price is the largest cost for electrolytic hydrogen producers, accounting for roughly 80 percent of the hydrogen production cost. Given the outsized impact on production costs, unsubsidized hydrogen producers must vary operations based on power prices– maximizing hydrogen production during low priced hours (generally not exceeding $20/MWh) and minimizing production during high priced hours. Hours where clean energy is abundant tend to be low priced hours, and therefore, varying operations depending on power prices means that hydrogen producers will naturally maximize operations when clean energy is abundant. However, the 45V subsidy blunts those price signals and operational paradigms; by offering the equivalent of an $80/MWh subsidy when combined with renewable energy tax credits – which is higher than wholesale power prices in most hours– subsidized hydrogen producers are able to operate nearly non-stop, regardless of power prices. Annual matching entrenches nonstop operations, as unlike hourly matching, producers are not required to match operations with the availability of clean energy.

When the 45V subsidy phases out, annually matched projects will need to begin varying operations based on power prices that vary by the hour and will need to largely limit operations to low-priced hours at or below $20/MWh to produce cost-competitive hydrogen (Figure 10). But those projects will not be set up to flexibly operate, resulting in one of two outcomes:

- The grandfathered annually matched projects will become uneconomic and stranded, resulting in job losses and a derailed industry; or
- The projects will require a subsidy extension, driving pressure on the federal budget and likely public opposition due to harmful impacts on carbon emissions and electricity prices linked to those projects.

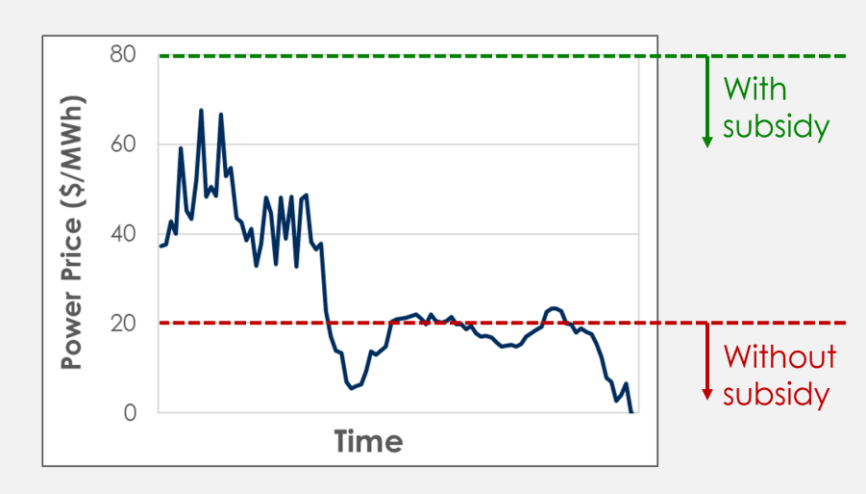

Figure 10: The power price that a hydrogen producer is willing to pay to produce cost-competitive hydrogen, with and without the 45V subsidy.

ii. Grandfathering forgoes the early learning opportunity to gain hydrogen's best value propositions.

One of hydrogen's most attractive value propositions is its potential to serve as a beneficial link between various sectors of the economy. As our power sector becomes more reliant on variable renewable electricity, we anticipate increased occurrences of excess wind and solar electricity. Electrolyzers can operate flexibly and utilize this excess renewable electricity to produce and store hydrogen. This helps reduce electricity system costs, because it's a better use of assets, while serving targeted hydrogen end-uses cost-effectively.

But this picture will **not** materialize if annual matching is adopted (in line with ACP's position for example). Because annual matching allows hydrogen projects to balance their operations by drawing power from the grid with near full impunity, there is no need to ramp operations with the availability of renewable electricity or invest in hydrogen storage. In contrast, hourly matching incentives the right and needed behavior and investments – flexible electrolyzers that work in harmony with renewable electricity availability and supported by hydrogen storage.

Evolved Energy Research argues that "encouraging this type of learning is as important to the development of hydrogen markets as is simply buying down the cost of electrolyzers". Evolved also asserts that if hydrogen projects do not adopt flexible operations *"[the hydrogen market] will not have nearly as large a role in a decarbonized energy system as we have projected in previous net-zero analyses."*

4. Broad loopholes for existing clean power resources will increase emissions beyond section 45V's lifecycle greenhouse gas emissions thresholds.

The following section specifically responds to the following comment prompts raised by Treasury in the NPRM:

- *Whether 5 percent is the appropriate magnitude for an allowance. The Treasury Department and the IRS seek comments on whether a higher amount, such as up to 10 percent, would be appropriate, either in general or in certain cases or circumstances.*
- *Whether the five percent should apply to all existing minimal-emitting electricity generators in all locations or a subset and for what reasons;*
- *Whether and how the "averaging" approach of a proxy appropriately captures the circumstances in which generation is incremental or does not generate induced grid emissions.*

The NPRM requests comments on several specific circumstances regarding the incrementality requirement in which existing minimal emissions power generation to hydrogen production may not result in significant induced GHG emissions. These circumstances include generation from minimal-emitting power generation plants that 1) would retire without the opportunity to sell electricity used for clean hydrogen production, 2) during periods when generation would have otherwise been curtailed, and 3) in locations where grid-electricity is met by 100 percent minimal-emitting generation or where increases in load do not increase grid emissions.

The proposed rules suggested three approaches for determining whether incrementality is satisfied in the specific circumstances described above:

1) avoided retirements;

2) zero or minimal induced grid emissions through modeling or other evidence, and

3) formulaic approaches to addressing incrementality from existing clean generators.

The first approach, the avoided retirement approach, is primarily intended to consider at-risk nuclear plants and allow for certain existing nuclear generation to satisfy the incremental requirement if it meets some financial distress criteria. The second approach, which accounts for minimal induced grid emissions through modeling, could allow existing clean electricity generation to satisfy incrementality during periods of curtailment or in locations where increased load is met by minimal-emitting electricity generators. The third approach, the formulaic approach, suggests a broad proxy of five percent of the hourly existing clean generation meant to reflect the collective occurrence of at least two out of the three circumstances on the basis of projections by the Energy Information Agency on nuclear retirements and the occurrence of clean energy curtailment as assessed by the Department of Energy and Lawerence Berkeley National Laboratory. Treasury is also requesting comment on whether 10 percent would be a more appropriate proxy.

While each of the three specific circumstances may be valid, *targeted* approaches are necessary to reasonably capture their occurrence. Broad loopholes that apply to *all* existing clean generation as in the third formulaic approach—regardless of whether existing clean generators satisfy any of the three circumstances—are categorically inappropriate and unreasonable at capturing the three discrete circumstances identified by Treasury.

The 5-10 percent formulaic proxy that Treasury is seeking comment on for existing clean power to qualify for 45V:

1) Entirely fails to capture the circumstances in which existing clean generation is incremental and results in minimal or zero induced emissions, as the existing clean energy resource a) may not be facing retirement; b) may not be experiencing curtailment; and c) may not be in states in sufficiently ambitious and rigorous climate policies that protect against major emissions inducement; and

2) Will drive induced grid emissions far exceeding the IRA emissions thresholds, and therefore entirely fails the reasonableness test that can be inferred from EPA's communication, when it confirms the reasonableness of relying on three pillar EACs that meet **appropriately stringent criteria** as a reasonable methodological proxy in demonstrating no to minimal induced grid emissions from hydrogen production.

A. A broad 5-10 percent allowance entirely fails to capture the three circumstances in which existing clean generation is incremental and results in minimal or no induced emissions. It is therefore legally tenuous.

1. *The pace and magnitude of near and long-term nuclear retirements are very uncertain and hinge on a variety of factors that are difficult to predict. A broad proxy is therefore categorically inappropriate at capturing retirement risk. Any solution to address retirement risk must consider individual plant circumstances and be based on demonstrated financial stress and retirement risk of an individual plant.*

Allowing *all* existing nuclear plants to have a share of their power and/or attributes qualify for 45V is at complete odds with the identified circumstance – avoiding nuclear retirements– that Treasury aims to address. The bulk of the existing nuclear fleet is *not* currently facing retirement, and the projected pace and magnitude of retirements is highly uncertain and dependent on a wide range of market and policy factors, such that attempting to implement any broad and simplistic proxy to capture the occurrence of future retirements has very low fidelity.

Nuclear retirements in the near to medium term are possible according both to the U.S. EIA and independently modeled projections of future U.S. electricity grids. However, there is significant uncertainty around the pace and magnitude of retirements. As cited in the NPRM, the EIA 2023 Annual Energy Outlook projects a decrease in nuclear capacity of about 4.6 GW from 2022 to

2032.[115] Other recently published modeling studies project a wide range of changes in nuclear capacity between now and 2035. For example, a multi-model study of the impacts of the IRA on the power sector, which includes both energy-economy models and power sector models, was conducted by researchers at Princeton, EPRI, NREL, Rhodium Group, NETL, NRDC, EPA, RFF, Center for Global Sustainability, and Energy Innovation. Six of the eleven models project that nuclear retirements would occur by 2035 with an average annual decrease in capacity ranging from 1-30 GW (Figure 11).[116] **This is a very broad range.** The other five models in the study show starkly different results, projecting **no change in nuclear capacity**. The multi-model study's findings indicate that nuclear retirement risks primarily increase with low natural gas prices and low wholesale power prices.

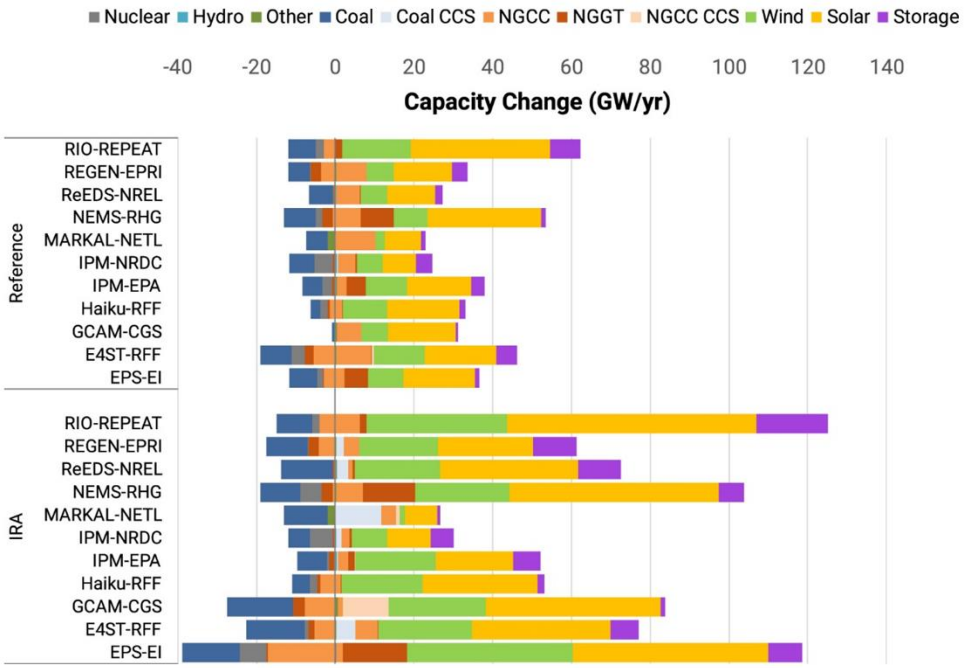

Figure 11: Capacity additions and retirements by technology and model.[117] Average annual rate through 2035 under the reference and IRA scenarios. Utility-scale and distributed capacity are shown. Historical additions and retirements come from Form EIA-860 data. NGGT = natural gas turbines; NGCC = natural gas combined cycle; CCS = carbon capture and storage.

[115] EIA AEO 2023, Table 9. Electricity Generating Capacity. https://www.eia.gov/outlooks/aeo/
[116] Bistline et al 2024, Environmental Research Letters, Power sector impacts of the Inflation Reduction Act of 2022. https://iopscience.iop.org/article/10.1088/1748-9326/ad0d3b
[117] Id.

In summary, the large uncertainty in projected future nuclear retirements can be attributed to several key factors: the location of plants (in competitive wholesale markets vs. vertically integrated cost of service states), natural gas prices, ongoing operational costs (including relicensing and operating and maintenance (O&M) expenses), wholesale power prices, and policy – including state or federal climate policy creating bankable value for the low-carbon attributes of nuclear plants, extended federal nuclear production tax credits, and specific state support policies for nuclear plants similar to the Climate and Equitable Jobs Act (CEJA) in Illinois[118] and Zero-Emission Credit (ZEC) programs in New Jersey and New York that explicitly support the continued operation of some state nuclear plants. [119,120] State and federal policies have been enacted in recent years to deter a large volume of nuclear retirements.

Federal policies include:

- IIJA Civil Nuclear Credit, or CNC (direct support for nuclear plants): $6 billion relief fund meant to help preserve the existing U.S. reactor fleet and prevent nuclear retirements;
- IRA 45U nuclear production tax credit (direct support for nuclear plants): up to 1.5 cents/kWh for plants in low wholesale price environments;
- EPA power plant standards for fossil fuel power generators (indirect support for nuclear plants): not yet finalized. For example, EPRI's Analysis of Proposed Greenhouse Gas Standards for Power Plants found that the EPA proposed rules contributed to the retention of nuclear power plants.[121]

State policies include: [122]

- Power purchase agreements (PPAs): in place for two reactors in Connecticut through 2029 at a purchase price of $49.99/MWh, resulting in a subsidy of about $174M/year;
- Zero emissions credits: in place for three reactors in Illinois through 2027 at an adjustable credit price of $16.50/MWh, three reactors in New Jersey from 2019-2022 that totaled about $100 per reactor over three years, and four reactors in New York through 2029 at a credit price from $17.48-27.62/MWh per year;
- Nuclear resource credits: initially set for two reactors in Ohio but repealed in 2021;
- Subsidies for clean power: $694M paid to three plants in Illinois over five years;

[118] State of Illinois, Public Act 102-0662, the Energy Transition Act. https://epa.illinois.gov/content/dam/soi/en/web/epa/topics/ceja/documents/102-0662.pdf
[119] New Jersey Senate and Genearl Assembly of the State of New Jersey, Chapter 16. https://pub.njleg.gov/bills/2018/PL18/16_.PDF
[120] Will McDermott, NY Creates New Emissions Credit for Nuclear Plants, September 2016. https://www.energybusinesslaw.com/2016/09/articles/environmental/ny-creates-new-emissions-credit-for-nuclear-plants/
[121] EPRI, "Analysis of EPA's Proposed New and Existing Source Standards for Power Plants", EPRI, January 2024, https://www.epri.com/research/products/000000003002028858
[122] Holt and Brown, 2021

- Regional carbon market: participation of Pennsylvania in the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade program, which places a carbon dioxide emissions cap on fossil-fuel power plants.

Although twelve nuclear reactors have closed since 2013, mostly due to low-cost natural gas power generation and increased operating costs, sixteen reactors previously scheduled for closure have continued operating after state interventions supported them with additional revenue.[123] State interventions applied to 15,734 MW of capacity, or 16.5 percent of current U.S. nuclear capacity, and occurred in Connecticut, Illinois, New Jersey, New York, Ohio, and Pennsylvania, all of which are in states with deregulated electric utility markets.[124] In fact, and notably, at the time of this comment's submission, no nuclear operator has submitted an application to the CNC program's second award cycle.[125] This further indicates that the U.S. nuclear fleet is in strong financial health.

Plant location also meaningfully bears on the prospects of a nuclear plant's retirement. About 55 percent of the nuclear generating capacity operates in vertically integrated, cost-of-service states, where nuclear plants are able to receive full cost recovery from captive ratepayers (Figure 12).[126] A recent report by the National Association of Regulatory Utility Commissioners (NARUC) surveying the status of nuclear plants in utility long-term planning found that:[127]

- "Most utilities propose keeping existing nuclear resources online to maintain reliability and progress toward decarbonization goals; this includes keeping ownership stakes in nuclear plants, as well as extending the operating life of existing nuclear units."
- "Of the 17 integrated resource plans (IRPs) reviewed, all but one recommended extending the licenses of existing plants."[128]

[123] Congressional Research Service, "U.S. Nuclear Plant Shutdowns, State Interventions, and Policy Concerns, June 10, 2021. https://crsreports.congress.gov/product/pdf/R/R46820/3

[124] Ed.

[125] See: Brian Dabbs, "No takers for Biden's nuclear bailout" Politico, January 2024, https://subscriber.politicopro.com/article/eenews/2024/01/08/no-takers-for-bidens-nuclear-bailout-00134067

[126] U.S. Energy Information Administration, "Five states have implemented programs to assist nuclear power plants." October 7 2019. https://www.eia.gov/todayinenergy/detail.php?id=41534

[127] Kathryn Kline, Sam Stephens, Kiera Zitelman, "Nuclear Generation in Long-Term Utility Resource Planning: A Review of Integrated Resourec Plans and Considerations for State Utility Regulators", NARUC, November 2023, https://urldefense.com/v3/__https://pubs.naruc.org/pub/7CE3939B-F659-0270-21D7-7456B16F6F2E__;!!NO21cQ!CAt6auayOPYmO2B4Ly6JXQrk8JO7HRlFUDhLnOjE67m1cKvhwzMJ3SS02MJ8O7ZpkFsrM_Wy5PtQI63ZYGM8YyrYfhc$

[128] The one exception is Indiana Michigan Power, which plans to keep the Cook Nuclear Plant operating at full capacity until 2034, then phases it out by 2037.

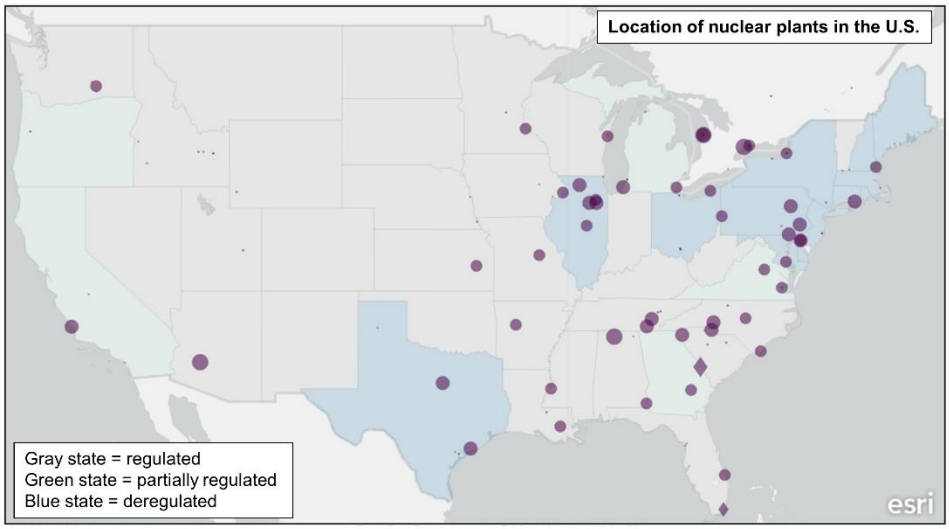

Figure 12: Operating nuclear plants in regulated, partially regulated and deregulated states.[129]

Those findings robustly suggest that the majority of plants in cost-of-service service face favorable prospects of remaining online throughout the timeline relevant for 45V. NARUC's assessment– together with the fundamental difference in the degree of exposure to market dynamics between a nuclear plant located in a competitive wholesale market compared with a regulated state—confer the reasonable conclusion that plants located in regulated states face meaningfully lower risks of retirements. Therefore, a broad five percent formulaic approach for qualifying nuclear retirements as incremental based on a uniformly assumed avoided retirement risk fails to capture this key dynamic.

Given the large uncertainty in the pace and magnitude of near and long-term nuclear retirements and the various determining factors that are difficult to predict with any high fidelity, a broad five percent exemption of hourly generation for *all* nuclear does not represent the reality of retirement risks, which vary by individual plant and depend on the various factors described above.

Furthermore, any broad approach to account for nuclear retirement could lead to significant induced grid emissions from hydrogen production. For example, recent analysis by the Rhodium Group – which evaluated the emissions impact of allowing the portion of the current nuclear fleet retiring by 2035 (about 30 percent of the current fleet) to divert its electricity for hydrogen production – estimated a net increase **of 33-360 million metric tons of CO2e** from 2024-2035 relative to these facilities continuing to supply grid electricity.[130] While real world dynamics will likely result in a less extreme outcome, **the order of magnitude of induced emissions** of an untargeted approach accommodating existing nuclear underscores its inappropriateness to meet

[129] Map produced by NRDC. Data from: S&P CIQ Power Plant Summary

[130] Ben King, "How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V tax Credit Guidance, Rhodium Group. January 2024. https://iopscience.iop.org/article/10.1088/1748-9326/ad0d3b

section 45V's statutory requirements and purpose. Instead, any rules to account for potential nuclear retirements qualifying under incrementality should be targeted based on individual facility circumstances and be inextricably linked to plants meeting criteria demonstrating financial distress and higher likelihood of retirement risks.

2. *Pathways to accommodate times of clean energy curtailment must capture its highly variable occurrence, in terms of magnitude, geography and time.*

The proposed formulaic proxy approach of allowing 5 to 10 percent of *all* existing clean energy generation to qualify as "incremental" intended to partially capture instances of clean energy curtailment is inappropriate as it entirely fails to reflect the variable nature and magnitude of curtailment across regions and time periods.

In addressing this question, the proposed rules acknowledge the geographic and temporal differences in curtailment rates, identifying that average annual wind curtailment in 2022 was about 5.3 percent within ISO regions and that curtailment rates for solar PV ranged from an average of 10 percent in ERCOT and 3 percent in CAISO. H**istorical curtailment data show that rates vary widely by region on average throughout the year and by month and hour within the same region.** Allowing 5 to 10 percent of *all existing clean generators across regions, months, and hours* to qualify as incremental on the basis of addressing clean energy curtailment is therefore inappropriate and unreasonable as curtailment may not be happening at all.

Curtailment varies widely by region on average throughout the year and does not necessarily have a consistent average across regions. The average annual curtailment rate has increased in some regional electric grids from 2012-2018 and has declined in others (Figure 13).[131]

[131] National Renewable Energy Laboratory, 2018 Renewable Energy Grid Integration Data Book https://www.nrel.gov/docs/fy20osti/74823.pdf

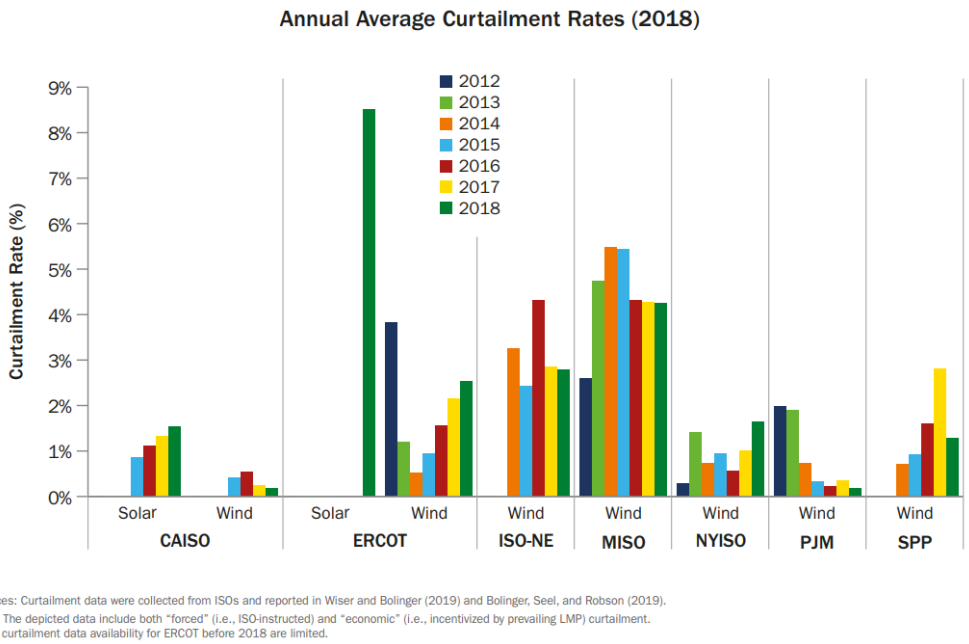

Figure 13: Annual average curtailment rates (2018).[132]

The future occurrence and magnitude of curtailment are highly uncertain and generally driven by several factors, including insufficient transmission capacity, insufficient storage capacity and surplus generation during periods with high availability of renewable energy that puts downward pressure on wholesale power prices.[133]

Curtailment also varies significantly during times of the year, even within a single region. For example, average monthly curtailment rates in CAISO are lowest in summer months (roughly <1 percent) and highest in spring months (roughly 3-12 percent), according to historical curtailment and generation data from 2018-2023 (Figure 14).

[132] Id.

[133] U.S. Energy Information Administration, 2023, A Case Study of Transmission Limits on Renewables Growth in Texas. https://www.eia.gov/electricity/markets/quarterly/archive/2023/transmission_limits_07_2023.pdf

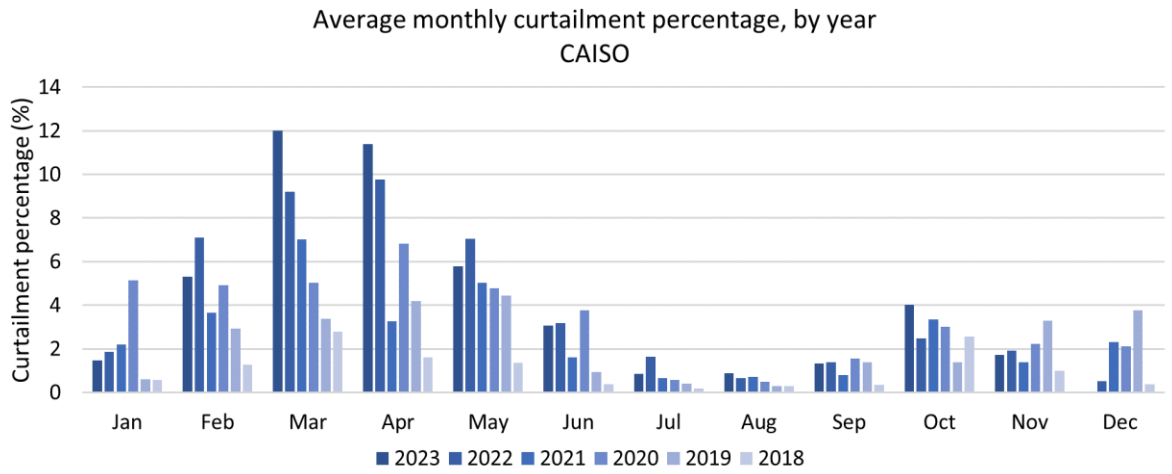

Figure 14: Average monthly curtailment percentages, by year, CAISO.[134]

In addition to monthly differences in curtailment rates within a region, the hourly differences within each month are equally as pronounced. In CAISO, the average hourly curtailment percentage was around 30 percent in February and March of 2022 during the middle hours of the day (approximately 11:00 AM to 3:00 PM), while at 0-5 percent during night hours in those same months (Figure 15).

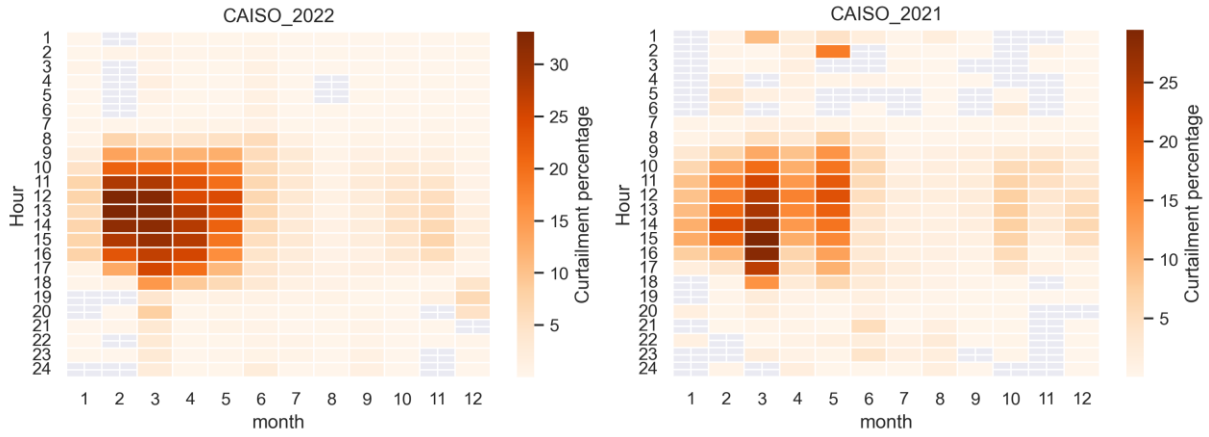

Figure 15: Percentage of clean energy curtailment by month and hour in 2021 and 2022, CAISO.[135]

As the graphs above illustrate, there are trends of typical levels of curtailment rates in certain hours of the day and certain months of the year. This suggests that any solution for allowing

[134] California ISO, Managing Oversupply. https://www.caiso.com/informed/Pages/ManagingOversupply.aspx
[135] Id.

existing renewable generation to satisfy the incrementality requirement under curtailment circumstances should account for variation across regions and time intervals.

Figure 16 below included in a new analysis by Energy Innovation underscores the inappropriateness of a broad 5 percent carveout applied to *all* hours to capture clean energy curtailment that varies substantially on an hourly basis and is heavily concentrated in a small share of hours (no more than 10 percent of hours).[136] The area labeled (A) represents hours where clean energy curtailment is not occurring and yet would qualify as hours of clean energy curtailment under a 5 percent formulaic proxy. *This would translate into huge volume of EACs that erroneously qualify as "incremental" for 45V and support hydrogen production with significant induced grid emissions.*

Figure 3. CAISO ranked curtailment vs. 5 percent general carve-out (2023)

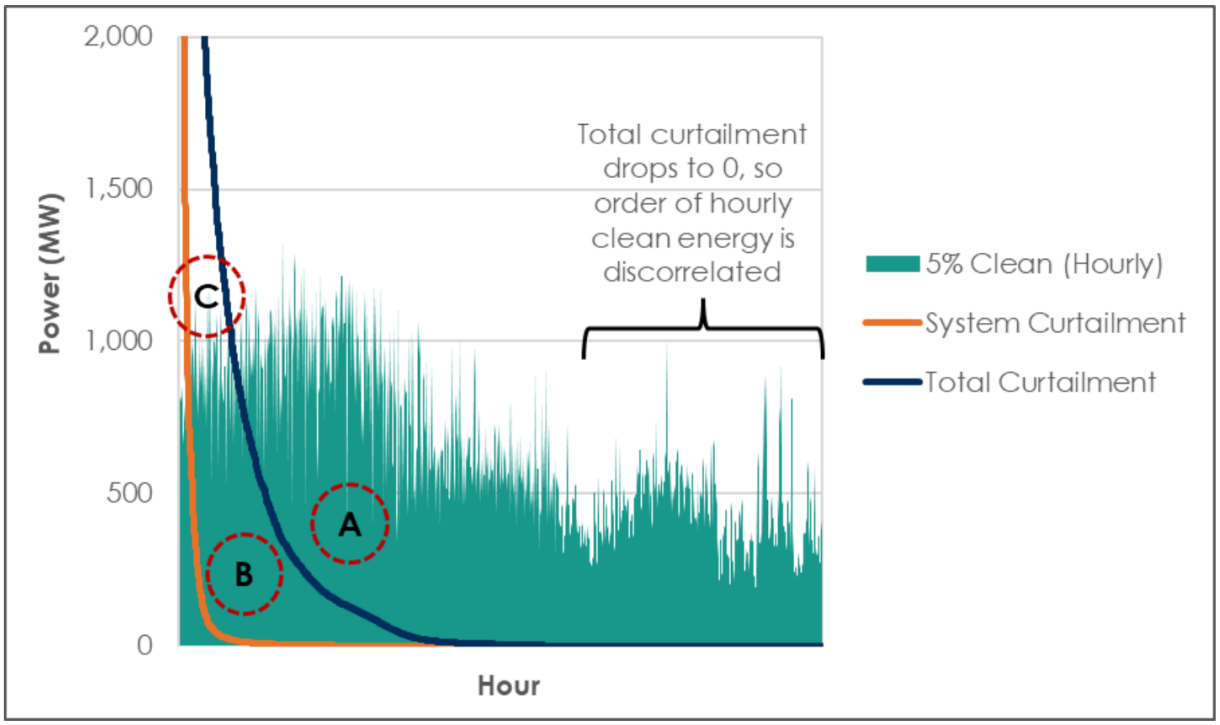

Figure 16: Clean energy curtailment vs. 5 percent formulaic proxy, CAISO (2023). Based on new analysis by Energy Innovation included in their comments to the section 45V NPRM.[137,138]

[136] Energy Innovation Policy & Technology, LLC, "45V Exemptions Need Strong Guardrails to Proect Climate, Grow Hydrogen Industry" Energy Innovation Policy & Technology LLC, February 2024, https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/

[137] Energy Innovation Policy & Technology, LLC, "45V Exemptions Need Strong Guardrails to Proect Climate, Grow Hydrogen Industry" Energy Innovation Policy & Technology LLC, February 2024, https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/

3. *Incorporating shares of existing clean energy located in states that cap total GHG emissions in a formulaic proxy is inappropriate. A handful of states have enacted those policies and even in those relevant states, hydrogen production carries high risk of induced grid emissions without additional evidence that necessary protections are in place.*

First, it would be categorically inappropriate to factor shares of existing clean energy in states that cap total GHG emissions into a formulaic proxy that would allow the diversion of shares of existing clean energy for 45V purposes *in all U.S. states and regions*. At the time of submission of these comments, only 13 states have a binding emissions cap covering 80 to 100 percent of power sector emissions and/or economywide GHG emissions. A 5-10 percent formulaic proxy that factors in shares of existing clean energy in the state of Washington with a high share of existing clean energy could enable hydrogen producers in the state of Indiana to divert 5-10 percent existing clean energy from the grid, despite having a grid powered by more than 90 percent fossil fuels (predominantly coal power), no emissions caps, and no renewable portfolio standard. This perverse outcome should be categorically rejected by Treasury.

Second, even states that *do* cap total GHG emissions are unlikely to have the requisite protections to prevent that diversion of existing clean power for purposes of 45V results in significant induced grid emissions.

1- The requisite level of policy ambition to protect against induced emissions is unlikely to align with the timeframe relevant for 45V;

2- The design and implementation of state policies may embed room for fossil fuel generation to operate; and

3- Even the most ambitious state policies are most likely unequipped to curb significant induced grid emissions occurring outside of their state boundaries but driven by their in-state hydrogen production. Assessments have shown a lack of effectiveness of state caps at preventing emissions leakage beyond state borders, and new modeling by Princeton ZERO lab shows substantial induced grid emissions from hydrogen production in states with enacted emissions limits.

Therefore, it would be unreasonable and in violation of section 45V's statutory requirements for Treasury to automatically offer exemptions from incrementality to states that have emissions caps without requiring additional evidence that they have the requisite protections to prevent significant induced emissions from diverting existing clean energy for hydrogen production.

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[138] In this graph, (A), (B) and (C) represent the following: (A) the area above the curtailment curves but below the 5 percent clean indicator, showing the huge volume of EACs that a general carve-out would mistakenly qualify for 45V (false positives); (B) the area below the curtailment curves and below the 5 percent clean indicator, showing the comparatively much smaller volume of EACs that a general carve-out would incidentally accurately qualify for 45V (true positives); and (C) the area below the curtailment curves but above the 5 percent clean indicator (mostly not visible), representing the significant volume of curtailed power that, if captured, would make sense to qualify for 45V but would not be eligible under a general carve-out (false negatives).

We detail the range of state policy limitations below.

i. The requisite level of policy ambition to protect against induced emissions is unlikely to align with the timeframe relevant for 45V.

Renewable Portfolio Standards (RPS) or Clean Energy Standards (CES) requiring 100 percent of electricity retail sales to be served by renewable or clean energy do not take effect until the 2040 to 2050 timeframe for the entire pool of states that have enacted such policies (Figure 17). Similarly, states that have enacted an emissions cap – either on the power sector or economywide– do not require 80 percent or more emissions reductions until 2045 or 2050 (Figure 18). Section 45V would subsidize hydrogen projects through 2046, at the very latest, with a large pool of faster moving projects exhausting their 10-year 45V payments earlier.[139] Therefore, there is fundamental misalignment between when the requisite stringency in state policy to minimize induced grid emissions takes effect and the timeline relevant for 45V.

State	Final Target Year	Year Established	Bill or Order Number
California	2045	2018	SB 100[140]
Connecticut	2040	2022	SB 10[141]
District of Columbia	2032	2018	B22-0904[142]
Hawaii	2045	2018	HB 2182[143]
Illinois	2045	2021	SB2408[144]
Maine	2050	2019	LD 1679[145]
Maryland	2045	2022	SB 528[146]
Michigan	2040	2023	SB 0271[147]
Minnesota	2040	2023	SF 4[148]

[139] Assuming a 4-year safe harbor allowing all projects placed in service by the end of 2036 to qualify for the 10-year credit.

[140] "SB-100 California Renewables Portfolio Standard Program: emissions of greenhouses gases." September 2018, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

[141] Rep. Brandon Chafee, 33rd District, Sen. Will Haskell, 26th District, et al, "S.B. No. 10 Session Year 2022 AN ACT CONCERNING CLIMATE CHANGE MITIGATION" Connecticut General Assembly, May 2022, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100

[142] Council of the District of Columbia, B22-0904 - CleanEnergy DC Omnibus Amendment Act of 2018 http://lims.dccouncil.us/Legislation/B22-0904

[143] House Of Representatives, Twenty-Ninth Legislature, 2018, State of Hawaii, HB2182 https://www.capitol.hawaii.gov/session2018/bills/HB2182_CD1_.htm

[144] Illinois General Assembly, 2021, Climate and Equitable Jobs Act SB2408 https://www.ilga.gov/legislation/BillStatus.asp?DocNum=2408&GAID=16&DocTypeID=SB&SessionID=110&GA=102

[145] Maine Legislature, 2019, An Act To Establish the Maine Climate Change Council To Assist Maine To Mitigate, Prepare for and Adapt to Climate Change. https://legislature.maine.gov/bills/getPDF.asp?paper=SP0550&item=1&snum=129

[146] Maryland State Senate, Climate Solutions Now Act of 2022. https://mgaleg.maryland.gov/2022RS/bills/sb/sb0528E.pdf

[147] Michigan Senate, 2023, Senate Bill 271. https://www.legislature.mi.gov/(S(0azgtrqlmcafpjyat4vmkxhq))/mileg.aspx?page=getObject&objectName=2023-SB-0271

[148] Minnesota State Senate, 2023, Senate Bill SF4. https://www.revisor.mn.gov/bills/bill.php?f=SF4&y=2023&ssn=0&b=senate

New Mexico	2045 (IOUs and munis); 2050 (co-ops)	2019	SB 489[149]
New York	2040	2019	SB 6599[150]
Oregon	2040	2021	HB 2021[151]
Virginia	2050	2020	HB 1526[152]
Washington	2045	2019	SB 5116[153]
North Carolina	2050	2022	HB 951[154]

Figure 17: List of states with a legislated 100 percent RPS or CES.

State	Emissions Reduction Target (percent)	Target Year	Year Enacted	Baseline Year	Bill No.
California	100	2045	2022	1990	AB 1279[155]
Colorado	100	2050	2019; 2023	2005	HB19-1261;[156] HB19-1313;[157] SB23-016[158]
Connecticut	80	2050	2009; 2022	2001	PA 08-98;[159] PA 18-82[160]
Delaware	100	2050	2023	2005	HB 99[161]

[149] New Mexico State Senate, 2019, Senate Bill SB489 https://www.nmlegis.gov/Sessions/19 percent20Regular/final/SB0489.pdf
[150] New York State Senate, 2019, Climate Leadership And Community Protection Act. https://legislation.nysenate.gov/pdf/bills/2019/S6599
[151] Oregon House of Representatives, 2021, Clean Energy Targets Bill HB2021 https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2021
[152] Virginia General Assembly, 2020, Virginia Clean Economy Act. https://lis.virginia.gov/cgi-bin/legp604.exe?201+sum+HB1526
[153] Washington State Legislature, 2019, SB 5116 http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session percent20Laws/Senate/5116-S2.SL.pdf
[154] North Carolina General Assembly, 2022, HB 951 https://www.ncleg.gov/BillLookup/2021/H951
[155] California, 2022, California Climate Crisis Act. https://legiscan.com/CA/text/AB1279/id/2606946
[156] Colorado General Assembly, 2019, Climate Action Plan To Reduce Pollution https://leg.colorado.gov/bills/hb19-1261
[157] Colorado General Assembly, 2019, Electric Utility Plans To Further Reduce Carbon Dioxide. https://leg.colorado.gov/bills/hb19-1313
[158] Colorado General Assembly, 2023, Greenhouse Gas Emission Reduction Measures. https://leg.colorado.gov/bills/sb23-016
[159] Connecticut General Assembly, 2009, An Act Concerning Connecticut Global Warming Solutions. https://www.cga.ct.gov/2008/ACT/Pa/pdf/2008PA-00098-R00HB-05600-PA.pdf
[160] Connecticut General Assembly, 2022, An Act Concerning Climate Change Planning And Resiliency. https://www.cga.ct.gov/2018/act/pa/pdf/2018PA-00082-R00SB-00007-PA.pdf
[161] Delaware General Assembly, 2005, An Act To Amend Titles 7 And 29 Of The Delaware Code Relating To Climate Change. https://legis.delaware.gov/json/BillDetail/GenerateHtmlDocument?legislationId=130272&legislationTypeId=1&docTypeId=2&legislationName=HB99

Hawaii	100	2045	2007; 2018; 2022	1990	Hawai'i Act 234[162]; HB 2182[163]; HB 1800[164]
Maryland	100	2045	2009; 2016; 2022	2006	SB 323[165]; SB 528[166]
Massachusetts	100	2050	2021	1990	S.9[167]
Minnesota	80	2050	2007	2005	Minnesota Statute 216H.02[168]
New York	100	2050	2019	1990	S6599[169]/A8429[170]
Rhode Island	100	2050	2021	1990	S-0078A[171]
Vermont	80	2050	2020	1990	HB 688[172]
Virginia	100	2045	2020		CHAP 1191[173]
Washington	100	2050	2020	1990	HB 2311[174]

Figure 18: List of states with a legislated 80 percent or net-zero economywide emissions cap.

Consider the California case. The state RPS does not require 100 percent of its retail electricity sales to be powered by carbon-free power until December 31, 2045. Similarly, California policy does not require achievement of a net-zero GHG economy until 2045. Thus, even if California

[162] House Of Representatives, Twenty-Ninth Legislature, 2018, State of Hawaii, Hawaii Act 234. https://health.hawaii.gov/cab/files/2014/07/GM1005_.pdf

[163] House Of Representatives, Twenty-Ninth Legislature, 2018, State of Hawaii, HB2182 https://www.capitol.hawaii.gov/session2018/bills/HB2182_CD1_.htm

[164] House Of Representatives, Thirty-First Legislature, 2022, State of Hawaii, HB1800. https://www.capitol.hawaii.gov/sessions/session2022/bills/HB1800_CD2_.htm

[165]Maryland State Senate, 2016, Greenhouse Gas Emissions Reduction Act – Reauthorization. https://mgaleg.maryland.gov/mgawebsite/legislation/details/sb0323?ys=2016rs

[166] Maryland State Senate, Climate Solutions Now Act of 2022 https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/sb0528?ys=2022RS

[167] Commonwealth of Massachusetts, "An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy" Bill S.9. https://malegislature.gov/bills/192/S9

[168] 2023 Minnesota Statutes, "Greenhouse Gas Emissions Control, 216H.02 https://www.revisor.mn.gov/statutes/cite/216H.02

[169] New York Senate, 2019-2020 Legislative Session, "Relates to the New York state climate leadership and community protection act," S6599. https://www.nysenate.gov/legislation/bills/2019/S6599

[170] New York Senate, 2019-2020 Legislative Session, "Relates to the New York state climate leadership and community protection act," A8429. https://www.nysenate.gov/legislation/bills/2019/A8429

[171] State of Rhode Island General Assembly, January 2021 Session, Relating to State Affairs and Government – 2021 Act on Climate, S0078A. http://webserver.rilin.state.ri.us/BillText/BillText21/SenateText21/S0078A.pdf

[172] General Assembly of the State of Vermont, 2020, Vermont Global Warming Solutions Act of 2020, HB 688. https://legislature.vermont.gov/Documents/2020/Docs/ACTS/ACT153/ACT153%20As%20Enacted.pdf

[173]Virgina Acts of Assembly, 2020 Session, An Act to amend and reenact §§ 67-100, 67-101, 67-102, and 67-201 of the Code of Virginia, relating to the Commonwealth Energy Policy and Virginia Energy Plan. Chapter 1191. https://lis.virginia.gov/cgi-bin/legp604.exe?201+ful+CHAP1191+pdf

[174] State of Washington 66th Legislature, Laws of 2020, House Bill 2311. https://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/House/2311-S2.SL.pdf#page=1

policies could diminish the need for an incrementality requirement in the future, they will unlikely do so during the timeframe relevant to 45V, where the bulk of hydrogen production in California carries high risk of inducing grid emissions in exceeding of IRA thresholds.

ii. The design and implementation of state policies may embed room for fossil fuel generation to operate.

A range of design and implementation details characterizing state policy have major bearing on the policy's effectiveness at preventing increased fossil fuel generation to support hydrogen production and significant induced grid emissions. Exempting states with strong policies from incrementality entirely fails to reflect this reality.

California's RPS requires zero-carbon resources to "supply 100 percent of all retail sales of electricity to California end-use customers" by the end of 2045. In their interpretation, state agencies have determined that the 100 percent RPS requirement must apply to electricity *sales* to customers (i.e., the volume of megawatt-hours sold to end-users) but does not cover the significant electricity losses resulting from transmission and distribution line losses or energy storage losses. Those can still be trued up with fossil fuel generation without violating the 100 percent RPS. As Energy Innovation has commented, emissions associated with line losses alone can bring hydrogen production out of compliance with 45V emissions thresholds, if the lost energy is trued up by fossil fuel generation.[175] Therefore, even when the 100 percent state RPS takes effect, the margin for fossil fuel generation could still drive significant induced emissions from hydrogen production.

Washington state implements its CES in a similar manner and therefore presents similar emissions risks. Furthermore, while the state has a policy requiring that all retail sales of electricity to Washington retail customers be GHG- neutral by January 2030, it allows utilities to satisfy up to 20 percent this obligation by making a monetary payment instead of procuring carbon-free electricity until as far out as December 2044. Therefore, 20 percent or more of Washington's grid energy over the next two decades may be supplied by fossil fuel resources resulting in significant grid emissions linked to hydrogen production receiving 45V credits.

Those policy design limitations are pervasive. The National Conference of State Legislatures assess that only four jurisdictions have 100 percent targets that take effect prior to 2045: Minnesota (2040), New York (2040), Rhode Island (2033), and the District of Columbia (2032). In all four, the 100 percent standard is explicitly tied to the percentage of retail sales or demand, raising the risk that fossil fuel generation will ramp up as load increases to provide energy for line losses and energy storage losses. Additional policy design limitations bear mention. New York, Rhode Island, and the District of Columbia's policies also provide offramps from compliance, raising the risk profile of hydrogen projects inducing grid emissions during the 45V timeframe and reducing the fidelity of exempting them from incrementality. Furthermore,

[175] Dan Esposito, Eric Gimon, Mike O'Boyle, "Smart Design of 45V Hydrogen Production Tax Credit will Reduce Emissions And Grow The Industry", Energy Innovation, April 2023, https://energyinnovation.org/wp-content/uploads/2023/04/Smart-Design-Of-45V-Hydrogen-Production-Tax-Credit-Will-Reduce-Emissions-And-Grow-The-Industry.pdf

while Oregon's clean energy target requires that electric utilities reduce GHG emissions 100 percent below a baseline level by 2040, the state provides exemptions from this target to manage compliance costs and ensure reliability. If for example, hydrogen production exempt from incrementality diverts existing clean energy from the Oregon grid and puts pressure on costs of compliance with the clean energy target, it is far from guaranteed that fossil fuel generation will not be allowed to ramp to manage those costs, driving large induced grid emissions.

iii. Even the most ambitious state policies are most likely unequipped to curb significant induced grid emissions occurring outside of their state boundaries but driven by their in-state hydrogen production. Assessments have shown a lack of effectiveness of state caps at preventing emissions leakage beyond state borders, and new modeling by Princeton ZERO lab shows substantial induced grid emissions from hydrogen production in states with enacted emissions limits.

Even assuming that state emissions caps and/or RPS/CES policies are perfectly tight and fully prevent induced in-state emissions increases from hydrogen production – as discussed above, they are often not airtight – those policies are unequipped at preventing significant induced grid emissions that occur outside of their state boundaries but linked to hydrogen production within their state boundaries. Treasury is statutorily required to account for those induced grid emissions.

The Regional Greenhouse Gas Initiative (RGGI) cap does not cover emissions linked to electricity imports into participant states.[176] If Treasury were to allow an incrementality exemption for those states, hydrogen production would draw on existing clean power and potentially increase the need for electricity imports from neighboring non-RGGI states to plug the gap. But emissions linked to those imports are not capped by RGGI and at least a portion of this increased imported power will be supplied by fossil fuel plants ramping up in neighboring states. Therefore, the hydrogen produced in RGGI states and exempt from incrementality would in effect be inducing substantial grid emissions.

While some state or regional cap-and-trade policies—including in California and the Pacific Northwest—incorporate border adjustment mechanisms with the aim of mitigating emissions leakage from electricity imports, there is a significant body of research demonstrating that the mechanisms used in state policies today are ineffective at delivering on this goal.[177] Furthermore, no existing state or regional policy accounts for emissions leakage resulting from reduced clean energy exports, i.e., the primary driver of significant induced grid emissions from hydrogen production exempted from incrementality in the Pacific Northwest region, as modeled by Princeton ZERO Lab (detailed below).

[176] The Regional Greenhouse Gas Initiative (RGGI) is a market-based effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector.

[177] 1 Xu, Q. and Hobbs, B. F. "Economic efficiency of alternative border carbon adjustment schemes: A case study of California Carbon Pricing and the Western North American power market," Energy Policy Vol. 156, 2021. 2 Bushnell, J., Chen, Y., and Zaragoza-Watkins, M. "Downstream regulation of CO2 emissions in California's electricity sector," Energy Policy Vol. 64, 2014

B. A broad 5-10 percent broad allowance for existing clean energy resources will result in significant induced grid emissions, in violation of the IRA lifecycle emissions thresholds. An exemption for states with policies capping emissions from incrementality would similarly result in substantial emissions increases. It would not be reasonable for Treasury to adopt either of those approaches as a methodological proxy for no to minimal induced emissions.

As explained above, the 5 to 10 percent formulaic proxy that Treasury is seeking comment on is entirely inappropriate at capturing the three discrete circumstances identified by Treasury whereby existing clean energy can qualify as "incremental": 1) the avoided retirement of a clean generator; 2) instances of clean energy curtailment; and 3) clean energy generators in states with binding emissions caps. This failure effectively translates to qualifying existing clean energy on the grid as incremental for purposes of 45V that would have been on the grid anyway but that is now diverted from the grid in favor of hydrogen production. Fossil fuels will ramp up to meet a portion of the gap, driving induced emissions from a hydrogen project that far exceed the IRA thresholds. Similarly, exempting states which cap their GHG emissions is inappropriate as myriad policy design and implementation limitations will curb the effectiveness of emissions caps at preventing significant induced grid emissions from hydrogen production.

1. *The formulaic 5 to 10 percent proxy will drive substantial induced grid emissions and support hydrogen production with a lifecycle GHG intensity up to 5 times worse than section 45V's lowest threshold.*

The Rhodium Group assessed the emissions impacts of the 5 percent formulaic proxy and found that it could drive a huge increase in induced grid emissions from hydrogen production – up to nearly 1.5 billion metric tons of increased emissions cumulatively through 2035.[178]

Similarly, Energy Innovation assessed the implications of a 5-10 percent formulaic proxy on the lifecycle greenhouse gas intensity of hydrogen production in the California Independent System Operator footprint (inclusive of induced grid emissions consistent with EPA's longstanding application of CAA section 211(o)(H)(1)), in the context of their analysis examining the effectiveness of the broad proxy at capturing instances of clean energy curtailment. They found that the lifecycle emissions intensity of hydrogen produced would be **more than *4 to 5 times higher* than section 45V's *lowest* emissions threshold of 4 kgCO2e/kgH2, *30 to 45 times higher* than the 0.45 kgCO2/kgH2 threshold, and 1.*5 to 2 times higher* than today's incumbent gas-derived hydrogen production** (Figures 19 and 20 below).

More generally, Energy Innovation also finds that exempting 5 percent of all existing clean energy from the incrementality requirement would support on the order of 1.5 MMT of highly

[178] Ben King, "How Clean Will US Hydrogen Get? Unpacking Treasury's Proposed 45V Tax Credit Guidance" January 4, 2024. https://rhg.com/research/clean-hydrogen-45v-tax-guidance/

carbon-intensive electrolytic hydrogen production per year, driving 30 to 60 MMT of carbon emissions annually (equivalent to putting more than 13 million gasoline cars on the road).

Scenario	[A] Share of exempt EACs that are dirty	[B] Share of exempt EACs that are clean	[C] Share of curtailed power that is not captured	Average EAC emissions intensity ($kgCO_2/kgH_2$)
Total curtailment Annual average carve-out	80%	20%	58%	18.0
Total curtailment Hourly carve-out	77%	23%	50%	17.2
System curtailment Annual average carve-out	97%	3%	67%	21.7
System curtailment Hourly carve-out	96%	4%	63%	21.6

Figure 19: Impacts of a 5 percent formulaic proxy in CAISO.[179]

Scenario	[A] Share of exempt EACs that are dirty	[B] Share of exempt EACs that are clean	[C] Share of curtailed power that is not captured	Average EAC emissions intensity ($kgCO_2/kgH_2$)
Total curtailment Annual average carve-out	86%	14%	39%	19.3
Total curtailment Hourly carve-out	84%	16%	32%	18.9
System curtailment Annual average carve-out	98%	2%	53%	21.9
System curtailment Hourly carve-out	97%	3%	48%	21.8

Figure 20: Impacts of a 10 percent formulaic proxy in CAISO.[180]

In a new analysis, Princeton ZERO Lab draws a similar conclusion.[181] They examine the impacts of a 5 and 10 percent formulaic proxy on induced grid emissions from hydrogen production in Southern California. They find that the proxy would support hydrogen production with a lifecycle GHG intensity of approximately 20 kgCO2e/kgH2, *5 times worse* than section 45V's

[179] Dan Esposito, et al. 45V Exemptions Need Strong Guardrails To Protect Climate, Grow Hydrogen Industry. February 2024. https://energyinnovation.org/publication/45v-exemptions-need-strong-guardrails-to-protect-climate-grow-hydrogen-industry/ . Emissions impacts showing significant induced emissions from hydrogen production hold regardless of the manner in which the formulaic proxy is administered—be it on the basis of hourly existing clean generation or the annual average existing clean generation, and be it by capturing total curtailment or system curtailment.

[180] Id.

[181] Wilson, et Al, "Minimizing emissions from grid-based hydrogen production in the United States. December 2023. https://zenodo.org/records/10689836

lowest emissions threshold. They also estimate that a 5 to 10 percent formulaic proxy would drive induced grid emissions of up to 2.5 million metric tons per year in Southern California.

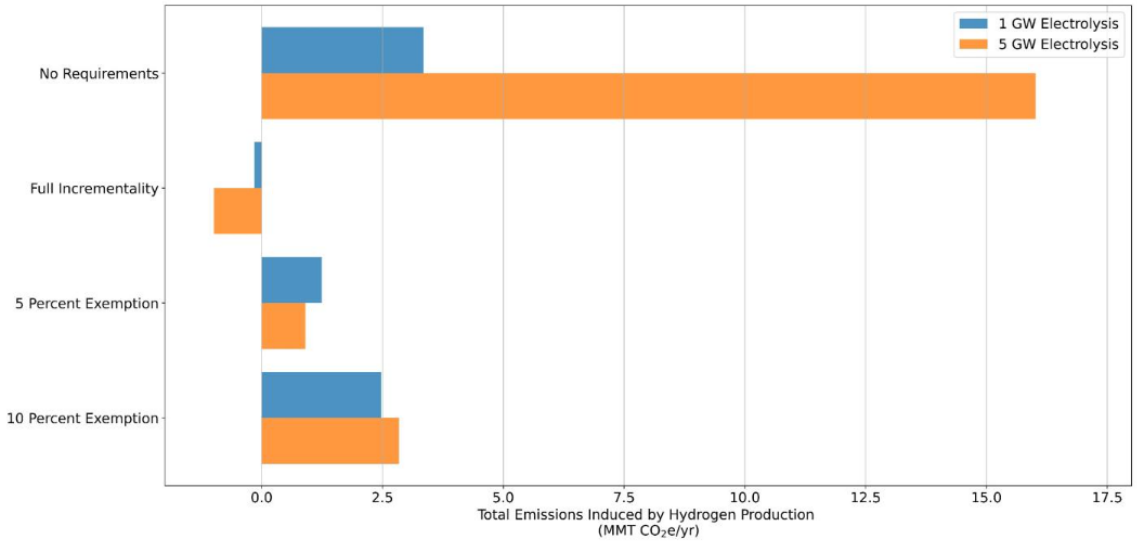

Figure 21: Total emissions induced by subsidized electrolytic hydrogen production in southern California under scenarios with no incrementality requirement, a full incrementality requirement, and a formulaic proxy exemption 5 to 10 percent of existing clean energy generation. Outcomes are reporters for assumed 1 and 5 GW of local installed electrolyzer capacity.[182]

This unlawful outcome relates to the manner in which the 5 to 10 percent allowance would unfold in practice. Hydrogen producers will likely seek EACs from existing clean energy generators during hours where they have insufficient access to three-pillar EACs but want to pursue the 45V credit—i.e., during hours where new clean energy is scarce, and the grid is dominated by carbon-intensive fossil fuel generators and existing clean energy like hydropower and nuclear that either operate for longer hours compared to wind and solar energy or operate nearly around the clock. And yet, those hours will be perversely considered to be hours where there is *excess* clean energy on the grid and/or hours where a nuclear plant would not have operated but for hydrogen production. As discussed above, the broad formulaic proxy is categorically inappropriate at reflecting those instances. Therefore, hydrogen production during those hours would be simply diverting existing clean energy *that would have otherwise gone to the grid*, driving abundant fossil generators on the grid to ramp up. The resulting high induced emissions violate section 45V's statutory requirements and the formulaic 5-10 percent proxy contravenes the threshold of "appropriately stringent criteria" that EPA held in supporting the reasonableness of using three-pillar EACs as a methodological proxy in lieu of calculating induced grid emissions.

[182] Wilson, et Al, "Minimizing emissions from grid-based hydrogen production in the United States. December 2023. https://zenodo.org/records/10689836

2. *Exempting states with binding emissions caps from incrementality will support hydrogen production in those states with a lifecycle GHG intensity up to 4 times worse than section 45V's lowest threshold. State policy limitations render any automatic exemptions from incrementality inappropriate and unjustified.*

As discussed above, a range of limitations linked to state policy design and implementation reduce the effectiveness of state emission caps at ensuring no to minimal induced grid emissions from hydrogen production. Princeton ZERO Lab honed in on the limitation relating to addressing emissions linked to electricity imports and exports, and its impact on induced grid emissions from hydrogen production.

They examined the impact of the Pacific Northwest's binding regional carbon cap policy on the emissions intensity of electrolytic hydrogen production. They find that while the binding emissions cap prevents *local* increases in induced grid emissions in the Pacific Northwest zone, it does *not* prevent significant induced grid emissions from hydrogen production exempted from incrementality requirements. Those induced grid emissions would occur beyond the Pacific Northwest zone boundaries and result in hydrogen production in the zone with a lifecycle GHG intensity of up to *4 times worse* than section 45V's lowest threshold. This emissions 'leakage' primarily results from hydrogen production exempted from incrementality drawing on existing, locally generated hydropower in the Pacific Northwest, and reducing clean energy exports to neighboring regions (Figure 22). Fossil fuel generation in those regions ramp up to meet at least a portion of the gap.

Those results expressly show how policy limitation – in this case, the Pacific Northwest emissions cap not addressing the emissions impacts of reduced clean energy exports— reduce the effectiveness of a state or region's emissions cap at ensuring no to minimal induced grid emissions from hydrogen production exempted from incrementality. **It would therefore not be reasonable nor appropriate for Treasury to exempt hydrogen production in states with emissions caps from incrementality predicated on the assurance that the caps will prevent induced emissions.**

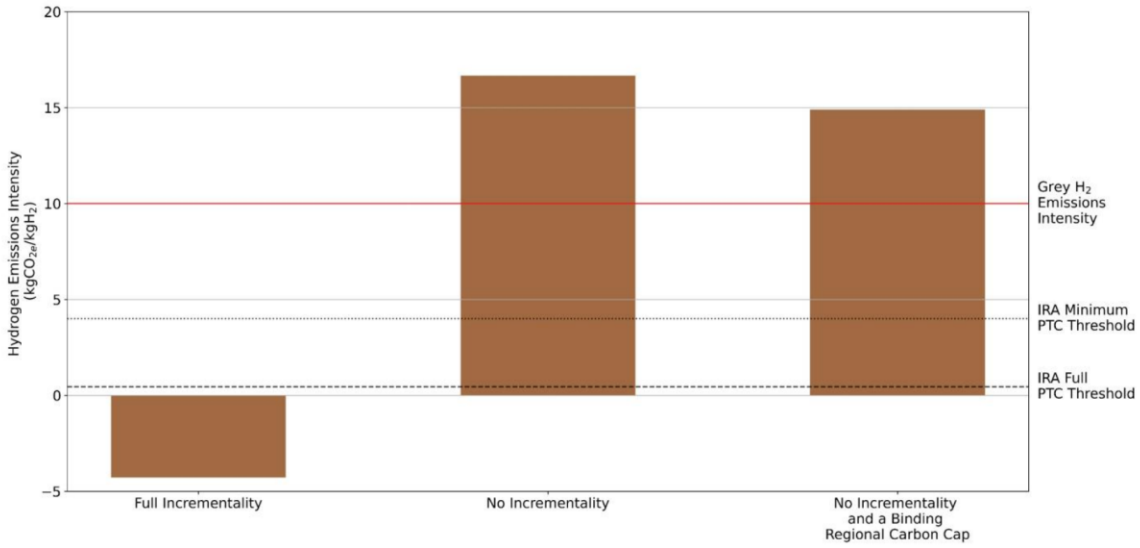

Figure 22: Emissions intensity of hydrogen production in the Pacific Northwest under scenarios with a full incrementality requirement, no incrementality requirement, and no incrementality requirement coupled with a binding emissions cap.[183]

5. NRDC proposed *targeted* flexibilities for existing clean energy to qualify as incremental without violating section 45V's statutory requirements and that meet EPA's threshold of "appropriately stringent criteria" for determining no to minimal induced emissions.

Treasury is seeking comment on several approaches to qualifying existing clean energy as incremental in an effort to capture three discrete circumstances where allowing existing clean energy generators to support hydrogen production for 45V purposes carry low risk of induced grid emissions: 1) avoided retirements; 2) otherwise curtailed power; and 3) states with binding emissions caps. Treasury is seeking comment on the following:

1- An application-based approach to determine risk of retirements of existing clean generators;

2- Zero or minimal induced grid emissions through modeling or other evidence; and

3- A formulaic proxy exempting 5-10 percent of existing clean generation.

As discussed above, the formulaic 5 to 10 percent proxy is categorically inappropriate at capturing the three discrete circumstances identified by Treasury and will qualify hydrogen production for 45V with a lifecycle greenhouse gas intensity that far exceeds the legal thresholds

[183] Wilson, et Al, "Minimizing emissions from grid-based hydrogen production in the United States. December 2023. https://zenodo.org/records/10689836

in section 45V, as underpinned by CAA section 211(o)(H)(1) and EPA's longstanding interpretation and application of said section. The formulaic proxy is therefore an unlawful allowance, and Treasury should not adopt it. We offer below NRDC's proposed targeted approaches to qualify existing clean energy in a manner that far better captures the three discrete circumstances and carries far lower risk of induced emissions from hydrogen production that qualifies for 45V, as required by 45V's statutory requirements.

We strongly reemphasize the importance of adopting narrow and targeted approaches to qualifying existing clean energy for purposes of 45V, considering the high risks of induced emissions from hydrogen production when the three pillar requirements are relaxed, as expressly confirmed by the DOE and a voluminous base of independent analytical evidence. We also strongly emphasize that the requirements of deliverability and hourly matching as currently proposed in Treasury's NPRM should be maintained as part of any approach to qualify existing generators as incremental in discrete circumstances. Further relaxing deliverability and/or hourly matching would compound the risks of high induced emissions from hydrogen production, in explicit violation of section 45's statutory requirements.

A. NRDC proposed approach to exempting hydrogen projects from incrementality during hours of clean energy curtailment.

As discussed above, the occurrence of clean energy curtailment is highly variable by region, year, month, and hour, such that a formulaic proxy qualifying a share of existing clean energy as incremental *in all* regions, *during all years, months, and hours,* predicated on the supposition that this clean energy would have otherwise been curtailed is categorically inappropriate. It will qualify existing clean energy as incremental for 45V purposes that would have otherwise served the electricity grid, driving substantial induced emissions from hydrogen production in violation of section 45V's statutory requirements.

Any approach that purports to reasonably capture hours of clean energy curtailment must reflect the time and geographic variability of its occurrence with high fidelity. A broad, static proxy is inherently unequipped to capture the scattershot nature of curtailment.

An appropriate approach to capturing the occurrence of clean energy curtailment must necessarily be tied to the hour and location of its occurrence. Locational marginal prices (LMPs) offer a reasonable and appropriate indicator to that effect. Very low LMPs (at $0 per megawatthours (MWh) or less) at the nodal location of the electrolyzer generally indicate a high share of clean energy on the grid where the electrolyzer is located and that a portion of existing clean energy generators may be curtailing a share of their power.

Treasury could offer a Special Rule whereby a hydrogen producer can qualify for 45V by presenting to Treasury EACs from *existing* clean energy generators (i.e., in operation before January 2023) that meet the hourly matching and deliverability criteria as proposed in the NPRM, provided that the producer submits books and records demonstrating LMPs of $0/MWh or less at their electrolyzer's node during the hours stamped on the hourly EACs and claimed for 45V purposes. LMPs are published and readily available in organized power markets and zones covered by Regional Transmission Organizations, making it possible for hydrogen producers to factor the prospective availability of "curtailment EACs" into their planned operations and

project economics. Those "curtailment EACs" would likely be predominantly available on an EAC open spot market that would shape and develop as the clean hydrogen production market expands. It bears noting that this Special Rule would mainly apply to organized power markets where LMPs are published and readily accessible. Translating it to the NPRM's proposed Deliverability Zones, the Special Rule would apply to California, Delta, Mid-Atlantic, Midwest, New England, New York, the Great Plains, and Texas. Utilities and load balancing entities in states and regions in non-organized markets can readily begin publishing LMPs to qualify for the Special Rule.

As hydrogen producers ramp up operations during low LMP hours at their electrolyzer nodes, LMPs gradually increase in lockstep with the increased demand. Once the $0/MWh threshold is reached, clean energy curtailment can be reasonably determined to no longer be occurring and any hydrogen produced without adhering to incrementality would drive induced grid emissions in exceedance of section 45's emissions thresholds. A further appealing attribute of this approach is therefore its natural guardrail against large induced grid emissions that is inherent in its dynamic nature (it is price, location and hourly dependent).

The LMP approach that we outline does carry some risks to which we recommend that Treasury remain alert to ensure that hydrogen production qualifying for 45V is not inducing significant grid emissions. While low LMPs generally reflect instances of high shares of clean energy on the grid, this is not always the case. In the Southwest Power Pool, low LMPs are often tied to self-scheduling practices. [184] Utilities choose to dispatch their coal plants on the grid regardless of power prices—including at very low LMPs-- with a view to avoid fluctuating their operations in response to the dynamism of electricity supply and demand – as frequent ramping is costly for a coal plant due to technology limitations. Coal plant operators therefore choose to operate at a loss, an otherwise irrational behavior that is enabled by their ability to receive full cost recovery and a rate of return from their captive customers. Hydrogen production during those low LMP hours would therefore be powered by highly carbon intensive electricity and drive substantial induced grid emissions in violation of 45V's statutory requirements. The availability of a lucrative 45V credit may also confer an additional motivation for self-scheduling practices, as utilities may choose to engage in self-scheduling to shore up and enhance hours of operations and profits linked to any electrolyzers they own (i.e., the low LMPs that the utility artificially creates via self-scheduling would unlock more 45V-qualifying operational hours for its electrolyzers).

Treasury can mitigate this risk by requesting that independent market monitors assess the occurrence of such perverse effects – notably, whether the rates of self-scheduling are on the rise and whether 45V-qualifying hydrogen production is occurring during hours of where self-scheduled coal generators are dispatching power on the grid.

[184] Grid Status "Curtailment: When We Throw Away Clean Energy," November 2023. https://blog.gridstatus.io/curtailment/#dispatchable-yet-inflexible-generation-in-southwest-power-pool

B. NRDC proposed application-based approach to determine that a nuclear plant is reasonably facing retirement and qualify a defined portion of its power as incremental, based on an application-based approach.

The following section addresses the following prompts in the NPRM:

(i) the appropriate criteria that should be considered to assess retirement risk;
(ii) the extent to which demonstration of financial loss, projected or actual local electricity market conditions, presence of out-of-market financial support (which could potentially include financial support driven by Federal or State policy, bilateral contracts for EACs or above-market electricity sales, or revenue provided by cost-of-service regulation), or upcoming relicensing decisions, in combination, are appropriate criteria to assess risk;
(iii) industry best practices for estimating financial loss and the documentation necessary to support those estimates;
(iv) the appropriate criteria that should be taken into account to assess the likelihood that an electricity generator's relationship with a hydrogen production facility avoids retirement of the generator (for example, size of electrolyzer, co-location, contract length, or otherwise);
(v) the appropriate criteria that should be taken into account to ensure that only electricity generation supplying the minimum hydrogen production necessary to avoid retirement is counted as incremental, and, in particular, whether there should be a cap on the amount of generation from a given facility that qualifies as incremental and how such a cap should be determined;
(vi) the period during which any determination of incrementality of existing electricity generators would be maintained before a new showing would be required;
(vii) the process by which eligibility for this approach should be determined and any related administrability considerations.

As discussed above, there is a wide range of uncertainty regarding the prospects, pace, and magnitude of future nuclear retirements. Retirement decisions will hinge on myriad factors, including key factors that are difficult to predict with high fidelity such as wholesale power prices and the passage of federal and state policy that will support—either directly or indirectly—continued nuclear plant operations. Thus, any attempt to design a formulaic approach to capture retirement risk is fraught with risk and uncertainty and could lead to significant induced grid emissions from hydrogen production. For example, the Rhodium Group finds that if Treasury allows all nuclear plants that have licenses that expire through 2035 to qualify as "incremental" predicated on potential incurred costs linked to the license extension, it will result in substantial induced grid emissions from hydrogen deployment, **up to 360 million metric tons *net increase* in emissions from 2024-2035.** As discussed above, a 5 to 10 percent formulaic proxy would be similarly inappropriate at capturing nuclear retirement risks as it would be available to all nuclear plants regardless of whether they indeed face a retirement risk and will drive substantial induced grid emissions from hydrogen production.

Considering the high risks of induced grid emissions and intricacy of applying a formulaic approach to capture retirement risks with any high fidelity, NRDC finds that the sole approach

that would meet section 45V's statutory requirements and adhere to EPA's "appropriately stringent criteria" in defining a methodology for determining no to minimal induced grid emissions is an application-based approach. This approach would require nuclear facilities to claim Civil Nuclear Credit (CNC) program funding from the Infrastructure Investment and Jobs Act (IIJA), the IRA's 45U nuclear production tax credit, and any applicable state support to the fullest extent possible, then demonstrate via a CNC-style application that additional support from 45V is necessary for the nuclear plant to avoid retirement. Congress promulgated the CNC test to determine with robust fidelity the retirement risk of a nuclear plant—which is precisely what Treasury is attempting to achieve in this 45V instance.

More specifically, the application-based approach would require nuclear operators seeking an incrementality exemption for a portion of their output to demonstrate via a CNC-style application that:

(1) they have exhausted the CNC program's funding, to the extent that funding remains available (as the program is intended to prevent nuclear plant retirements by shoring up plant economics);

(2) they are receiving the IRA's 45U nuclear production tax credit (which provides up to $15/MWh in tax credits); and

(3) that nuclear operators exhaust any funding from relevant state policies.

Should a nuclear operator be able to demonstrate that it still requires additional support to avoid retirement, Treasury could consider extending an exemption for a portion of the relevant nuclear plant's output and qualifying it as "incremental" for 45V purposes.

However, this exemption should *only* be made available to nuclear operators who invest in a **behind-the-meter hydrogen project that is co-located with the relevant nuclear reactor**. Such a physical investment offers far greater fidelity in reasonably determining that a 45V-related investment has supported continued plant operations and avoided retirement. Importantly, the nuclear operator *cannot* sell EACs to other hydrogen projects in the relevant deliverability zone, as there will be high risks of significant induced grid emissions from hydrogen projects that will have access to a large volume of nuclear EACs that do not reasonably meet the "incrementality" requirement. The risk would be akin to that posed by the 5-10 percent formulaic proxy which would qualify non-incremental clean energy generation as incremental.

The nuclear operator can periodically request a larger exemption if and only if it can demonstrate via a CNC-style application that its market conditions continue to worsen and that it still faces a retirement risk despite its full use of other subsidies as available – including CNC funds, 45U tax credits, and state support funds. We recommend that Treasury collaborate with DOE to design the appropriate boundaries for this exemption—such as the frequency of application reviews and appropriate limits on the share of the nuclear facility's output that can qualify as incremental for 45V purposes.

C. NRDC proposed approach to exempt some hydrogen projects from incrementality in states with binding emissions caps, provided that states submit to Treasury strict and rigorous evidence of zero or minimal induced grid emissions.

The following section explicitly addresses the following prompts in the NPRM:

(i) the circumstances in which [the demonstrated or modeled minimal-emission approach] should be available and the criteria that are appropriate to evaluate and determine whether those circumstances occur;
(ii) who should apply under this approach, the electricity generation facility, the hydrogen producer, or both;
(iii) what data or modeling should be submitted;
(iv) best practices for making such demonstrations, including for ensuring the impartiality and replicability of calculation approaches;
(v) under what circumstances, if any, it would be appropriate to deem generation to satisfy the incrementality requirement without modeling, and what documentation should be provided in these cases;
(vi) the process by which eligibility for this approach should be determined and any related administrability considerations;
(vii) the period during which any determination of incrementality would be maintained before a new showing would be required.

As discussed above, state policies that cap total GHG emissions – without additional criteria and evidence– are inappropriate and insufficient to automatically demonstrate that hydrogen projects exempted from incrementality would not give rise to significant induced grid emissions. Treasury duly requires the need for strict criteria to "ensure that total GHG emissions are capped with sufficient effectiveness and stringency to require that new load is met with zero-GHG electricity." Considering the high risks of significant induced emissions from hydrogen production should Treasury adopt loose criteria and inappropriate sweeping exemptions for those states, we recommend that Treasury adopt caution and due stringency in defining criteria for any exemptions doled out to hydrogen projects in states with binding emissions caps.

The sole solution that plausibly entails the necessary levels of effectiveness and stringency to adhere to section 45V's statutory requirements is based on the determination of "Zero or Minimal Induced Grid Emissions Through Modeling or Other Evidence".

We offer the following two options for Treasury's consideration – one that is based on specific circumstances linked to state policy and another based on rigorous and publicly-available modeling conducted by the Department of Energy or a trusted third party like the National Renewable Energy Laboratory.

Option 1: States or regions demonstrate that their binding emissions cap incorporate all four of the following legislated design elements:

1- The cap explicitly applies to all electricity generation, including electricity lost to transmission and distribution line losses and losses tied to energy storage.

2- The cap includes effective carbon border adjustments to account for and limit carbon emissions linked to electricity imports. Treasury recognizes the necessity of accounting for significant induced emissions linked to electricity imports by noting in the NPRM that "*if in a particular region, all generation—**including imported generation**—comes from minimal-emitting electricity generators, then increased load is unlikely to significantly increase induced grid emissions."*

3- The state or region includes effective protections to prevent significant induced emissions from hydrogen production that diverts existing clean energy that would have otherwise been exported to neighboring states or regions.

4- The state or region demonstrates that it has implemented clear and meaningful enforcement mechanisms for criteria 1 through 3. This should include penalties with robust teeth to prevent noncompliance.

It is possible that future state or regional policies could rigorously incorporate the four criteria above. However, further analysis (similar to Option 2 outlined below) would likely still be necessary to validate some of the design elements as sufficiently robust—notably as it relates to the effectiveness in limiting significant grid induced emission linked to changes in electricity imports and exports from hydrogen production exempt from incrementality. As we note above, there is important literature casting due doubt on the effectiveness of carbon border adjustments at containing emissions increases.

Option 2: Zero or Minimal Induced Grid Emissions Through Modeling for States with Binding Emissions Caps that Do Not Rigorously Incorporate the Full List of Criteria Above

If a state or region cannot demonstrate that their policy effectively incorporates the full legislated design elements outlined above, Treasury will need to make a determination of zero or minimal induced grid emissions for hydrogen projects in states with binding emissions through modeling, by partnering with the Department of Energy or an independent third party like the National Renewable Energy Laboratory (NREL). **We emphasize that this modeling option should be exclusively reserved to states with binding emissions caps that account for emissions imports, as it is highly improbable that hydrogen production in states that do not meet these criteria will not induce significant grid emissions.** Allowing universal access to the modeling approach would thus constitute an unnecessary and low-fidelity administrative burden.

We outline the following criteria that should define the DOE or NREL modeling, matching Treasury's specific prompts:

- ***What data or modeling should be submitted:***

i. DOE or NREL should undergo high-fidelity capacity expansion modeling that examines the consequential emissions impact of hydrogen projects for which producers are seeking 45V, based on the long-run electricity system-level impacts, compared with a baseline without said projects.
ii. Consequential emissions must also capture changes in regional electricity capacity and generation dispatch linked to hydrogen production seeking 45V. Accounting for

emissions leakage tied to interstate/interregional electricity transfer is a critical part of a rigorous consequential emissions analysis. The reasonableness of capturing emissions leakage to different geographies in the consequential lifecycle emissions of hydrogen production is conferred by EPA's prevailing interpretation of section 211(o)(H) which considers significant indirect emissions of renewable fuels produced in the U.S. that occur beyond U.S. borders.

iii. Modeling must span the 10-year timeframe of the 45V credit, beginning on the planned COD for each relevant hydrogen project seeking the exemption.

- ***Best practices for making such demonstrations, including for ensuring the impartiality and replicability of calculation approaches:***

i. The DOE or NREL modeling must be subject to 60-day comment period. Hydrogen projects that may be exempt from incrementality would be recipients of U.S. taxpayer-funded subsidies. Any exemption must be tied to an appropriate public showing that it adheres to the statutory requirements defining the subsidy.

ii. Key assumptions around the following defining factors – at a minimum– must be made public, and where applicable, reflect latest federal and/or state government data:
   a. Renewable energy costs and capacity factors;
   b. Electricity demand projections;
   c. Gas price projections.

iii. DOE must reasonably demonstrate how it took public comments into account in determining whether an allowance for hydrogen projects is to be granted.

We thank the Department of Treasury and the IRS for the opportunity to submit those comments. Please feel free to reach out to us should you have any further inquiries.

Sincerely,

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