Constellation's Comment on
U.S. Department of Energy Clean Hydrogen Production Standard (CHPS) Draft Guidance

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Constellation Energy Corporation (Constellation) respectfully submits these comments on the U.S. Department of Energy's (DOE) draft guidance: "Clean Hydrogen Production Standard (CHPS) Draft Guidance," published on DOE's Hydrogen and Fuel Cell Technologies Office website on September 22, 2022.

Executive Summary

Through its Clean Hydrogen Production Standard, DOE has the opportunity to accelerate the production of hydrogen that is verifiably clean and realize hydrogen's potential to decarbonize sectors of the economy where urgent progress is needed. Congress recognized this critical role for hydrogen in the Infrastructure Investment and Jobs Act (IIJA) and appropriately tasked DOE with the goal of rapidly building a hydrogen economy. The annual demand for clean hydrogen is expected to grow to as much as 660 million metric tons by 2050.[1] The Clean Hydrogen Production Standard will guide DOE's funding decisions that will jumpstart the clean hydrogen industry. Recognizing the importance of the CHPS, Constellation provides several recommendations for DOE's standard.

First, in funding projects where hydrogen is produced by electrolyzers powered by grid-connected electricity, DOE should require verification that the electricity used to power the electrolyzers is produced on the same electric grid (referred to as the balancing authority area) in the same hour as the hydrogen is being produced. Numerous studies have shown that matching consumption with clean energy production an annual basis is not effective in driving significant greenhouse gas reductions. Precise carbon accounting is necessary to ensure that the relevant portion of a generator's output is directly associated with, and only used for, the hydrogen production. In this vein, DOE should require the retirement of carbon-free energy attribute certificates (EACs), matched in time and location, in an amount equal to the power consumption of the grid-connected electrolyzer to ensure that associated carbon-free electricity is claimed for hydrogen production and cannot be used by anyone else.

Second, as contemplated by the IIJA, DOE should allow power purchases from both existing and new sources of carbon-free energy to be used in the verification of a hydrogen project's carbon

[1] *See* Bernd Heid et al., McKinsey & Company, *Five Charts on Hydrogen's Role in a Net-Zero Future*, https://www.mckinsey.com/capabilities/sustainability/our-insights/five-charts-on-hydrogens-role-in-a-net-zero-future.

intensity from grid-connected electrolyzers. This will allow clean hydrogen production to expand on a timeline that meets the Administration's expectations, including DOE's Hydrogen Shot, and the urgent need for climate solutions. DOE should therefore reject inclusion of an "additionality" requirement in the CHPS, as proposed by some, which would violate multiple provisions of the IIJA, conflict with related provisions of the Inflation Reduction Act (IRA), and undermine the policy goals of both statutes.

Finally, in the interest of efficient deployment of the CHPS, we also recommend that DOE utilize the GREET model to assess lifecycle emissions, in light of its widespread use.

Our Company: Constellation's Contribution to Decarbonization

Constellation[2] is the nation's largest producer of carbon-free energy and a leading supplier of competitive energy supply, including a variety of sustainable energy solutions, to millions of residential, public-sector and business customers, including three-fourths of Fortune 100 companies. Our fleet of nuclear, hydro, wind, natural gas, and solar facilities has the generating capacity to power the equivalent of approximately 15 million homes, producing 10 percent of the nation's emission-free energy. Constellation is helping to accelerate the nation's transition to a carbon-free future with an annual output that is nearly 90 percent emission-free. Our world-class nuclear plants will support decarbonization of other sectors through efforts such as production of clean hydrogen and development of direct air capture technology.

At Constellation, we believe hydrogen is an essential element of a fully carbon-free economy. Thanks to advances in technology, it is now possible to efficiently create hydrogen using carbon-free energy resources. Carbon-free hydrogen can be produced from clean electricity through electrolysis, a long-established technology that splits water molecules to produce hydrogen and oxygen. Unlike fossil fuel processes, electrolysis powered by nuclear energy is pollution-free.[3]

Constellation is heavily focused on the role that hydrogen will play in the decarbonization of the U.S. economy. We are investing in hydrogen production at our nuclear power plants so that we can scale carbon-free hydrogen to meet expected growth in hydrogen demand across all sectors including the aviation, transportation, agricultural and industrial sectors at a competitive price. Thanks to a DOE grant, Constellation's first clean hydrogen technology project is now under construction at our Nine Mile Point Clean Energy Center in New York.[4] This scaled demonstration

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[2] On February 1, 2022, Exelon Corporation separated its competitive generation and customer-facing energy businesses from its regulated utility businesses into an independent, publicly traded company known as Constellation.

[3] For more information on Constellation's work to advance clean hydrogen as a climate solution, please see our website: https://www.constellationenergy.com/our-work/what-we-do/generation/clean-hydrogen.html

[4] Constellation Energy, *Constellation Joins State and Federal Officials to Celebrate Progress on Nation's First Nuclear-Powered Clean Hydrogen Facility* (Sept. 28, 2022), https://www.constellationenergy.com/newsroom/2022/Constellation-Joins-State-and-Federal-Officials-to-Celebrate-Progress-on-Nations-First-Nuclear-Powered-Clean-Hydrogen-Facility.html.

project will be used to conduct additional research that will allow us to deploy hydrogen production at many of our facilities to make the fuels and products that will reduce pollution in all sectors of the economy. With support from NYSERDA, Nine Mile Point will also help demonstrate hydrogen fuel cell technology to provide long-duration energy storage for the electric grid. Our world class fleet of nuclear power plants are well suited to produce clean fuels to use as storage that injects energy onto the grid when intermittent resources are not available.

In addition, Constellation is a participant in the Midwest Alliance for Clean Hydrogen (MachH2), a multistate coalition of public and private entities representing every phase in the hydrogen value chain formed to produce clean, carbon-free hydrogen.[5] The alliance is preparing an application for funding under the IIJA for a regional clean hydrogen production and distribution hub capable of bringing more than 100,000 metric tons of clean hydrogen to the region. The MachH2 partners are united in a shared vision to create an immediately scalable hydrogen hub in the Midwest that uses the region's abundant nuclear and renewable power to create a clean hydrogen economy and reduce emissions across multiple heavy emitting sectors. Constellation also is a participant in two additional hydrogen hubs in the Northeast and Midatlantic.[6] Throughout these initiatives, Constellation is collaborating closely with stakeholders at every level to create new job opportunities while reducing emissions and creating a sustainable, clean hydrogen product for our customers.

Critical Importance of Clean Hydrogen and the CHPS

The CHPS is an essential component of DOE's implementation and funding decisions under the IIJA. This legislation has the potential to put the United States on a path to achieving significant reductions in greenhouse gas emissions and its numerous provisions to advance hydrogen demonstrate the intent of Congress to develop and deploy this technology quickly. The acceleration of clean hydrogen production is essential to tackling the climate crisis. Consistent with the IIJA's funding programs, the White House has recognized that "Hydrogen is expected to become a staple of the new clean energy system."[7] Clean hydrogen is especially promising as a vehicle for reducing the carbon footprint of the industrial sector and manufacturing, which has historically been hard to decarbonize.[8] Industries like steelmaking, aviation, agriculture and long-

[5] https://machh2.com/

[6] *See* https://www.nyserda.ny.gov/About/Newsroom/2022-Announcements/2022-08-25-Governor-Hochul-Announces-Maine-and-Rhode-Island-Join-Multi-State-Agreement; https://www.connecteddmv.org/hydrogen

[7] "Launching A Transformative Decade of Climate Action," Remarks of OSTP Deputy Director for Energy Sally M. Benson (Sept. 20, 2022), *available at* https://www.whitehouse.gov/ostp/news-updates/2022/09/20/launching-a-transformative-decade-of-climate-action/.

[8] Kiran Julin, *Hydrogen Can Play Key Role in U.S. Decarbonization*, News from Lawrence Berkeley National Laboratory (Oct. 8, 2021), *available at* https://newscenter.lbl.gov/2021/10/08/hydrogen-can-play-key-role-in-u-s-decarbonization/ ("We see hydrogen as something that can really help decarbonize hard-to-decarbonize sectors. Such applications include industrial usages such as a

haul transportation cannot easily switch to carbon-free electricity as a power source. The industrial sector accounts for one-third of U.S. greenhouse gas emissions and 30 percent of global emissions[9] and, therefore, accelerating the use of clean hydrogen in the industrial sector is a priority for the Biden Administration.[10]

The IIJA includes $9.5 billion for clean hydrogen research, development, and demonstration programs. It specifically directs $8 billion in funding for hydrogen hubs in order to move beyond R&D to accelerate deployment. The legislation also directs DOE to establish a program for reducing the cost of producing hydrogen through electrolyzers, creates a grant program for hydrogen fueling infrastructure, and sets forth a Clean Hydrogen Manufacturing Initiative to award grants to advance clean hydrogen production, storage, and equipment manufacturing.[11] These provisions support the IIJA's explicit goal for a national strategy "to facilitate widespread production, processing, delivery, storage, and use of clean hydrogen."[12] To complement the IIJA's

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reductant in steel manufacturing or making green ammonia for fertilizers, using its thermal energy for thermal processes, or heavy-duty transportation such as long-haul trucking, maritime, trains, and aviation, to name a few."); Jay Bartlett & Alan Krupnick, Resources for the Future, *Decarbonized Hydrogen in the US Power and Industrial Sectors: Identifying and Incentivizing Opportunities to Lower Emissions* (Dec. 2020), *available at* https://www.rff.org/publications/reports/decarbonizing-hydrogen-us-power-and-industrial-sectors/ ("green hydrogen has broad potential: for long-term energy storage, industrial heat, and as a feedstock for refining, chemicals, and steel").

[9] *See, e.g.*, Bill Gross, *To decarbonize heavy industry, we must focus on industrial clusters*, World Economic Forum (Jan. 17, 2022), https://www.weforum.org/agenda/2022/01/decarbonizing-heavy-industry-industrial-clusters/; Kellie Nault, *Clean Hydrogen: A long-awaited solution for hard-to-abate sectors*, Harvard School of Engineering and Applied Sciences News & Events (Oct. 3, 2022), *available at* https://www.seas.harvard.edu/news/2022/10/clean-hydrogen-long-awaited-solution-hard-abate-sectors.

[10] Fact Sheet: Biden-Harris Administration Advances Cleaner Industrial Sector to Reduce Emissions and Reinvigorate American Manufacturing, White House (Feb. 15, 2022), *available at* https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/15/fact-sheet-biden-harris-administration-advances-cleaner-industrial-sector-to-reduce-emissions-and-reinvigorate-american-manufacturing/ ("Clean hydrogen can reduce emissions in many sectors of the economy, and is especially important for hard-to-decarbonize sectors and industrial processes, such as steel manufacturing."). As National Climate Advisor, Gina McCarthy extolled the importance of rapid deployment of hydrogen production: "We need to get more and more solutions to deploy, so green hydrogen is a big player in both the manufacturing and the heavy-duty vehicle sector right away." *See* https://h2worldnews.com/white-house-promotes-promise-of-green-hydrogen/.

[11] Sec. 815 (Clean Hydrogen Manufacturing and Recycling); Sec. 816 (Clean Hydrogen Electrolysis Program); Sec. 11401 (grants for fueling and charging infrastructure).

[12] 40 U.S.C. 16161b(a)(1) (directing DOE to "develop a technologically and economically feasible national strategy and roadmap" to meet the goals described above).

incentives to increase the supply of clean hydrogen, the federal government is creating demand for zero-carbon industrial products through its procurement power and the Buy Clean task force.[13]

The CHPS will guide DOE's efforts to implement these programs and "ensure that clean hydrogen is developed and adopted as an effective decarbonization tool and for maximum benefits to the United States."[14] To ensure that clean hydrogen is part of the technological solution to meeting ambitious climate goals, DOE should incentivize rapid deployment of the cleanest hydrogen projects through its funding decisions and, in turn, the CHPS.[15]

Recommendations

Constellation provides the following recommendations to ensure that DOE's Clean Hydrogen Production Standard is effective in spurring the development, demonstration, and deployment of hydrogen production utilizing carbon-free generating resources.

I. DOE Should Prioritize Projects With Verifiably Low-Carbon Hydrogen Production

The goal of the CHPS is to establish a lifecycle GHG emissions target for clean hydrogen production that takes into account emissions from upstream and downstream processes. When hydrogen is produced using electrolysis, the electricity used for that production is typically the greatest potential source of GHG emissions; as a result, hydrogen's lifecycle emissions are closely related to the emissions produced by the generating facilities powering its production. The emissions profile of hydrogen produced behind the meter directly from a specified electric generation source is clear: it should be based on the emissions of the specific behind-the-meter generator. If the hydrogen is produced by co-located carbon-free generation[16] including nuclear energy, it can be easily demonstrated that such production does not result in GHG emissions. Experts have observed that "When powered primarily with zero-carbon electricity from renewables or nuclear power, electrolysis-based hydrogen can provide some of the largest GHG

[13] Federal Buy Clean Initiative (https://www.sustainability.gov/buyclean/).

[14] U.S. Department of Energy, National Clean Hydrogen Strategy and Roadmap, Draft (Sept. 2022), https://www.hydrogen.energy.gov/pdfs/clean-hydrogen-strategy-roadmap.pdf

[15] *See, e.g.*, Resources for the Future, *Hydrogen Hubs: Is There A Recipe for Success* (July 1, 2022), *available at* https://www.rff.org/publications/issue-briefs/hydrogen-hubs-is-there-a-recipe-for-success/ ("if the clean hydrogen standard is a minimum qualifying level, then proposals that perform better should be given a higher preference for being selected or moving on to the next funding phase.")

[16] Executive Order 14057 defines "carbon pollution-free electricity" as "electrical energy produced from resources that generate no carbon emissions, including marine energy, solar, wind, hydrokinetic (including tidal, wave, current, and thermal), geothermal, hydroelectric, nuclear, renewably sourced hydrogen, and electrical energy generation from fossil resources to the extent there is active capture and storage of carbon dioxide emissions that meets EPA requirements." Sec. 603(d).

reductions of the pathways we studied."[17] To achieve the same result with hydrogen produced using energy from the grid and thus not directly connected to a specific electricity generator, precise carbon accounting will be necessary to ensure that the relevant portion of a generator's output is directly associated with, and only used for, the hydrogen production.

A production standard that accurately accounts for emissions from input electricity by requiring projects to associate their production with a specific generator's output will drive the advancement of hydrogen technologies that significantly reduce GHG emissions, consistent with the intent of the IIJA and IRA.

A. To Accurately Assess Lifecycle Emissions, DOE Should Require Temporal and Locational Matching of Clean Energy Used For Hydrogen Production Through Electrolysis

In soliciting stakeholder feedback, DOE recognizes that generation of the electricity used to power a hydrogen electrolyzer may not be occurring at the electrolyzer's location. This project configuration is likely to be common and, therefore, the CHPS must clearly delineate how to calculate the carbon intensity of the electricity being used. In the energy industry, it is common practice to use EACs[18] such as renewable or emission-free energy certificates to match electricity consumption with carbon-free electricity production. EACs represent a specified volume of carbon-free electricity produced from a particular carbon-free generator. EACs are tracked through public registries that verify production from the power source and ensure that only one customer is claiming the environmental characteristics associated with the power output. Even in the case of power purchase agreements, where an end-use customer purchases renewable or emission-free energy directly from a generating facility, the attributes associated with that energy will typically be dedicated to the customer by retiring the EACs created when the facility delivers electricity to the grid.

Recognizing this industry practice, DOE asks whether the CHPS should allow use of renewable energy credits, power purchase agreements, or other market structures in characterizing the

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[17] Dane McFarlane, Carbon LLC, *Hydrogen: A Climate Solution*, *available at* https://www.carbonsolutionsllc.com/hydrogen-a-climate-solution/; *see also* Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources, UN Economic Commission for Europe, *available at* https://unece.org/sites/default/files/2022-04/LCA_3_FINAL March 2022.pdf (The report found that across its lifecycle, nuclear power emits less greenhouse gases than the other power sources studied, including all variants of wind and solar.)

[18] An energy attribute certificate, or EAC, is the generic term for technology-specific terms such as renewable energy certificates ("RECs"), solar renewable energy certificates ("S-RECs"), offshore wind renewable energy certificates ("O-RECs"), zero-emission energy certificates ("ZECs"), and emission-free energy certificates ("EFECs"). The more specific terms are often used for various state renewable portfolio standard and other incentive programs and have a number of differing definitions. Use of the more general term EAC is reflective of the broad range of resources that can support GHG emission-reduction claims and avoids confusion with any state-specific program requirements.

intensity of electricity emissions for hydrogen production. If so, DOE questions whether any requirements should be placed on these instruments if they are allowed to be accounted for as a source of clean electricity, such as restrictions on time of generation, time of use, or regional considerations. DOE should allow the use of EACs, including renewable energy certificates and other forms of emission-free energy certificates, in the calculation of lifecycle emissions for hydrogen production. DOE also should require that hydrogen producers retire EACs utilized in the calculation of hydrogen production emissions in order to ensure that the emission characteristics associated with the EACs are not claimed more than once.

It also is critical that the electricity associated with those EACs is being produced at the same time and on the same electrical grid (referred to as the balancing area authority) as the hydrogen production through hourly, rather than annual, matching of EACs with electricity use. There is widespread recognition that annual matching of carbon-free electricity to customer demand does not lead to actual reductions in GHG emissions that match the quantity of carbon-free electricity purchased.[19] When permitted to match annually with no location restrictions, customers face an economic incentive to match 100% of annual demand with attributes from the lowest-cost carbon-free energy, which may be generated and delivered into the grid far from and many hours (or months) away from the place and time of hydrogen production. Meanwhile, the hydrogen production process continues to use energy from the grid, including fossil energy. As a result, an annualized approach to matching energy consumption allows a company to claim zero emissions associated with its electricity use while continuing to rely on fossil fuels for part of the year by buying a large quantity of EACs produced during a few months. Fossil generation, with its associated GHG emissions, simply fills the underproduction gaps.[20] Such an outcome is plainly inconsistent with Congress' intent to incentivize production of hydrogen using clean electricity.

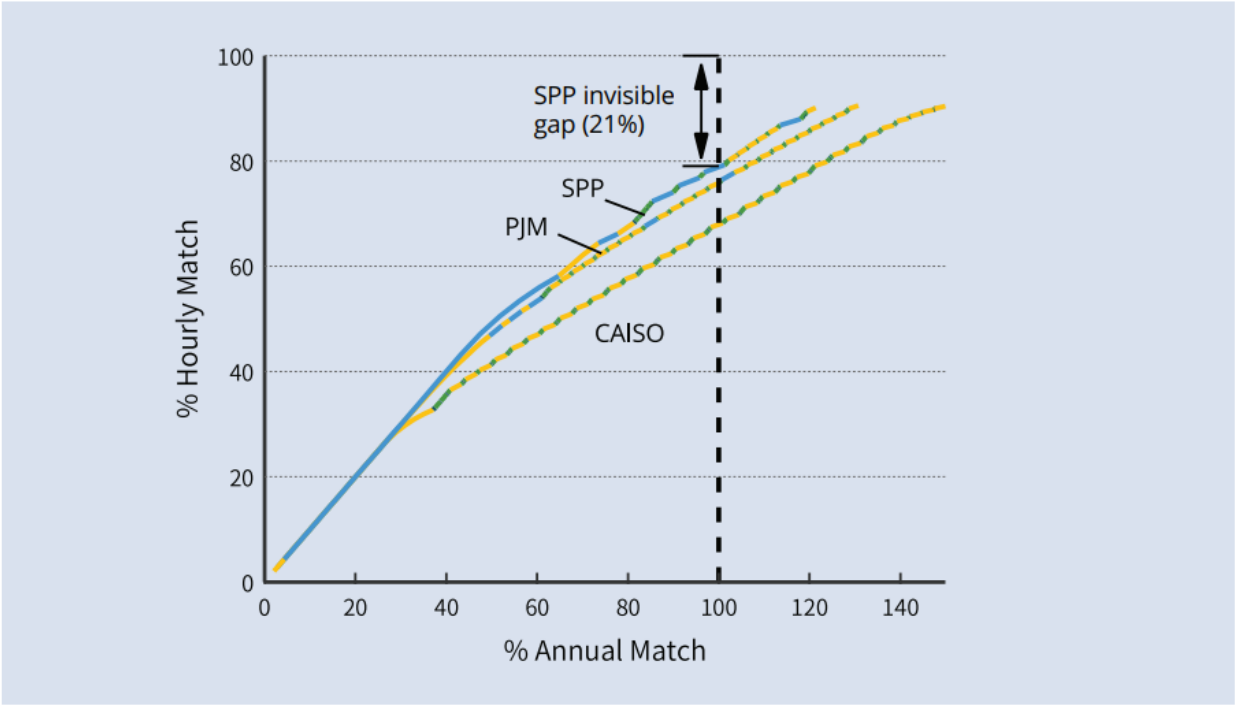
The shortcomings of these annual matching frameworks are well documented. For example, a recent analysis of three regions of the country (PJM in the Northeast, SPP in the Midwest, and CAISO in California) found that procuring carbon-free energy to offset 100% of annual load only

[19] *See, e.g.*, Melissa Lott and Bruce Phillips, Columbia Center on Global Energy Policy, *Advancing Corporate Procurement of Zero-Carbon Electricity in the United States: Moving from RE100 to ZC100* (Dec. 2011), *available at* https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/CorporateProcurement_CGEP_Report_120821.pdf; Jacques A. de Chalendar and Sally M. Benson, *Why 100% Renewable Energy is Not Enough*, Joule 3, 1389-1393 (June 2019), *available at* https://www.sciencedirect.com/science/article/pii/S2542435119302144; Anders Bjorn, et al., *Renewable Energy Certificates Threaten the Integrity of Corporate Science-Based Targets,* Nature Climate Change Vol. 12, 539-546 (June 2022), *available at* https://www.nature.com/articles/s41558-022-01379-5; Quinju Xu, et al., Princeton University Zero Lab, *System-Level Impacts of 24/7 Carbon-Free Electricity Procurement* (Nov. 2021), *available at* https://zenodo.org/record/7082212#.Y0w1tqTMKpc; Rocky Mountain Institute, *Clean Power by the Hour: Assessing the Costs and Emissions Impacts of Hourly Carbon-Free Energy Procurement Strategies* (July 2021), *available at* https://rmi.org/insight/clean-power-by-the-hour/.

[20] EPA provides guidance on the method for calculating customer GHG inventories which are the basis of customer GHG claims. https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance

resulted in 65-80% of hourly load being matched by the carbon-free electricity resources purchased.[21] As shown in the chart below from the Rocky Mountain Institute's "Clean Power by the Hour" report, this resulted in an "invisible gap" that was met by the continued use of fossil generation.

"Invisible gap" between hourly and annual carbon-free energy procurement



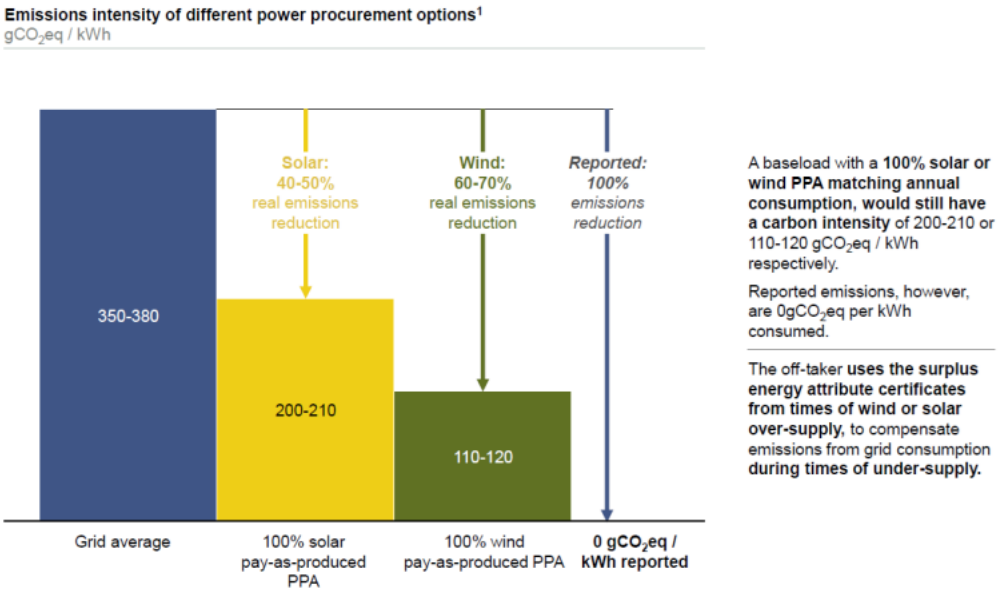
Customers are increasingly realizing that reaching "100% clean" by purchasing annual EACs is not resulting in actual 100% use of carbon-free generation. In contrast, hourly, location-based carbon-free energy requirements, by definition, ensure that clean energy resources are used at the time and in the locations where they are needed.

Other studies have affirmed these conclusions. A report produced by Long Duration Energy Storage ("LDES") Council, with insights and analysis provided by McKinsey & Company, estimates the average carbon intensity of 100% solar or wind claims based on an annual matching methodology.[22] As shown in the chart below, a company matching its entire annual electricity consumption with purchases of solar power across the year in an equal volume would be able to report zero emissions associated with its electricity use even though the actual emissions associated

[21] *Clean Power by the Hour*, *supra* note 19.

[22] Long Duration Storage Council and McKinsey & Company, *A Path Towards Full Grid Decarbonization with 24/7 Clean Power Purchase Agreements* (May 2022), *available at* https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/decarbonizing-the-grid-with-24-7-clean-power-purchase-agreements.

with its electricity consumption are only reduced by approximately 40-50%. Matching annually with wind power yields higher emission reductions of approximately 60-70%, but still far below the claimed 100%.



1. Based on 2021 average grid emissions and RES generation data for Germany and California. Emissions intensity of the grid and wind PPA: lower range applies to Germany (offshore wind), and upper range to California (onshore wind). Emissions intensity of solar PPA: lower range applies to California, upper range to Germany.

In addition, an analysis from Columbia's Center on Global Energy Policy found that the mismatch between the profile of renewable supply and energy demand created "an opportunity for companies to align their goals with pathways to achieve deep decarbonization of the power sector" and recommended hourly time matching as a logical next step.[23]

To overcome the shortcomings of annual EAC frameworks, companies and policymakers are implementing structures that match consumption to the time and location of clean power production, commonly referred to as 24/7 carbon-free energy. In September 2021, Constellation joined a group of energy consumers, suppliers, and governments, in partnership with the United Nations, in signing a set of principles known as the 24/7 Carbon-Free Energy Compact.[24] The Compact is intended to accelerate the decarbonization of electricity grids by adopting, enabling,

[23] *Advancing Corporate Procurement of Zero-Carbon Electricity in the United States: Moving from RE100 to ZC100*, *supra* note 19.

[24] UN Energy, 24/7 Carbon-Free Energy Compact, https://www.un.org/en/energy-compacts/page/compact-247-carbon-free-energy.

and advancing 24/7 carbon-free energy. Aligned with the Compact's goals, companies[25] and municipalities[26] are committing to 24/7 carbon-free energy in order to ensure their procurement activity is aligned with emission reductions. President Biden recognized the importance of matching carbon-free energy needs on an hourly and regional basis in Executive Order 14057: "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability," issued on December 8, 2021.[27] This Executive Order establishes that the Federal Government will lead by example to achieve a carbon pollution-free electricity sector by 2035 and includes an interim goal of procuring 100 percent carbon pollution-free electricity on a net annual basis to power all federal installations by 2030, including 50 percent 24/7 carbon pollution-free electricity.[28]

Increased utilization of hourly and locational matching will have other beneficial effects that align with key legislative objectives. Along with driving deep reductions in carbon dioxide emissions associated with a buyer's electricity consumption, 24/7 carbon-free electricity procurement will accelerate the power sector transition to cleaner energy production by "driv[ing] early deployment of advanced, 'clean firm' generation and / or long-duration energy storage, creating initial markets for deployment, innovation, and cost-reductions that make it easier for societ[y] at large to follow

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[25] *See, e.g.*, Sundar Pichai, *Our third decade of climate action: Realizing a carbon-free future,* Google Blog (Sept. 14, 2020), https://blog.google/outreach-initiatives/sustainability/our-third-decade-climate-action-realizing-carbon-free-future/ (commitment to operate on 24/7 carbon-free energy by 2030); Lucas Joppa and Noelle Walsh, *Made to measure: Sustainability commitment progress and updates*, Microsoft Blog (July 14, 2021), https://blogs.microsoft.com/blog/2021/07/14/made-to-measure-sustainability-commitment-progress-and-updates/ (commitment to have 100 percent of Microsoft electricity consumption, 100 percent of the time, matched by zero carbon energy purchases by 2030); *Iron Mountain Data Centers Among the First to Track, Renewable Energy by the Hour* (Apr. 14, 2021), https://www.ironmountain.com/about-us/newsroom/press-releases/2021/april/iron-mountain-data-centers-among-the-first-to-track-renewable-energy-by-the-hour (commitment to source 100% renewable energy aimed at matching the hourly usage of all of its facilities in Pennsylvania and New Jersey (over 60 buildings), including two data centers).

[26] *See, e.g.,* Shelby Fleig, *Des Moines sets ambitious targets to lower greenhouse gas emissions, go carbon-free by 2035*, Des Moines Register (Jan. 12, 2021), https://www.desmoinesregister.com/story/news/2021/01/12/des-moines-sets-ambitious-goals-lower-greenhouse-gas-emissions-climate-sustainability/6637271002/ (City of Des Moines, Iowa plans to achieve 100%, 24/7 carbon-free electricity by 2035).

[27] https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/; Statement by Secretary Granholm on the President's Executive Order Catalyzing America's Clean Energy Economy Through Federal Sustainability (Dec. 8, 2021), https://www.energy.gov/articles/statement-secretary-granholm-presidents-executive-order-catalyzing-americas-clean-energy (expressing DOE's "full support of the Administration's whole-of-government strategy.").

[28] Section 603(a) of the Executive Order defines 24/7 carbon pollution-free electricity as "carbon pollution-free electricity procured to match actual electricity consumption on an hourly basis and produced within the same regional grid where the energy is consumed."

the path to 100% carbon-free electricity."[29] It will also support one of the IRA's central goals of reducing localized pollution that disproportionately impacts overburdened environmental justice communities.[30] DOE's National Clean Hydrogen Strategy and Roadmap similarly recognizes the importance of "promoting energy and environmental justice."[31] Without location and time matching, hydrogen production could be considered "clean" even if it is still powered by local polluting generators, so long as the hydrogen producer buys carbon-free power generated somewhere else in the country at another time during the year. Accounting for the time and location of electricity generation would ensure that DOE meets the statutory objective of ensuring that hydrogen is produced from clean electricity, while allowing all sources of clean energy to appropriately contribute to the goal of accelerating hydrogen production.[32]

B. Hourly And Location-Based Matching Technology Is Available, Rapidly Advancing, And Will Be Accelerated By Policy Leadership

DOE may hear from some commenters that the technology is not yet ready to track hourly EAC matching. While there are price implications to locational and temporal matching, the purpose of the IIJA and IRA funding is to drive investments in technologies that will catalyze the production of clean hydrogen. Given the amount of hourly matched clean energy currently on the system, early movers will have far more modest costs of compliance. As demand for clean energy increases, trading systems can be implemented to drive efficiencies and lower costs for consumers.[33] DOE setting an expectation of hourly matched clean energy will provide a market signal for the clean energy investments needed to further drive decarbonization in the power sector.

Regarding tracking capabilities, Constellation agrees that accurate emissions accounting will be critical in ensuring the effectiveness of regulatory efforts.[34] It is true that historically EACs have

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[29] Qingyu Xu and Jesse Jenkins, Princeton University Zero Lab, *Electricity System and Market Impacts of Time-based Attribute Trading and 24/7 Carbon-free Electricity Procurement* (Sept. 15, 2022), *available at* https://acee.princeton.edu/24-7/.

[30] FACT SHEET: Inflation Reduction Act Advances Environmental Justice, White House, Aug. 17, 2022, *available at* https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/17/fact-sheet-inflation-reduction-act-advances-environmental-justice/ ("Most Significant Climate Legislation in U.S. History Delivers for Overburdened Communities").

[31] National Clean Hydrogen Strategy and Roadmap, *supra* note 14, at pg. 40.

[32] See 42 U.S.C. 16166(c) ("The standard developed under subsection (a) shall apply to clean hydrogen production from renewable, fossil fuel with carbon capture, utilization, and sequestration technologies, nuclear, and other fuel sources using any applicable production technology.").

[33] *Electricity System and Market Impacts of Time-based Attribute Trading and 24/7 Carbon-free Electricity Procurement*, *supra* note 29.

[34] Gregory Miller, Kevin Novan, and Alan Jenn, *Hourly accounting of carbon emissions from electricity consumption*, Environmental Research Letters (Apr. 8, 2022), *available at* https://iopscience.iop.org/article/10.1088/1748-9326/ac6147

been tracked and used on an annual basis and that most state clean energy programs and corporate procurement structures are currently built around annual compliance frameworks. That reinforces, rather than undermines, the reason why DOE should incorporate temporal and location matching in the CHPS, to ensure that hydrogen characterized as clean actually meets the target level of lifecycle emissions. As discussed above, policymakers and customers are adopting 24/7 carbon-free energy goals and the systems and compliance frameworks needed to realize those goals are being implemented. EAC registries covering most of the electrical grids in the U.S. are already tracking, or will soon be tracking, carbon-free electricity production on an hourly basis. M-RETS, a widely-used EAC tracking platform, developed technical tools to collect hourly data in January 2019 and has used them to facilitate hourly EAC claims since January 2021.[35] Another widely-used EAC registry, PJM GATS, anticipates implementing hourly functionality by the end of this year. M-RETS covers 15 middle-America states[36] and is expanding to host the registry for the entire West,[37] and PJM GATS covers 13 states and the District of Columbia.

To be sure, more work needs to be done to perfect these hourly EAC tracking systems. Many of the automated systems available for annual EAC tracking and reporting are not yet in place for hourly tracking. Additional EAC registries are evaluating the potential implementation of hourly tracking, and customers are exploring their own tracking and compliance systems. Incorporating temporal and location matching into the CHPS will spur the improvement of these systems and provide a catalyst for their harmonization with broader industry practices, including achievement of the U.S. government's own 24/7 carbon-free electricity procurement goal. On the other hand, waiting to require real clean energy usage in the production of hydrogen until all the systems are developed will greatly delay the emissions impact of the IIJA and IRA, contrary to Congress' intent.

C. Requests for an "Additionality" Requirement for Grid-Connected Electricity Should Be Rejected

Some commenters have asked that DOE only permit the purchase of grid-connected carbon-free electricity for hydrogen production if the electricity comes from new "additional" clean generation and not existing clean generation. This approach is plainly inconsistent with the IIJA, but even if it were permissible, it would not be rational or feasible for implementing the IIJA or meeting the Administration's goals of developing a domestic clean hydrogen economy.

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[35] Ben Gerber, M-RETS, *A Path to Supporting Data-Driven Renewable Energy Markets*, March 2021, *available at* https://www.mrets.org/wp-content/uploads/2021/02/A-Path-to-Supporting-Data-Driven-Renewable-Energy-Markets-March-2021.pdf.

[36] https://www.mrets.org/about/tracking/

[37] Environmental Markets Association, *WECC Signs Multi-Year Agreement With M-RETS for Software Services* (Apr. 4, 2022), *available at* https://www.enviromarkets.org/news/12693765.

i. An Additionality Requirement Would Violate the IIJA

The text of the IIJA[38] directs DOE to develop a "standard for the carbon intensity of clean hydrogen production."[39] While the statute does not define "carbon intensity," the term is defined by the U.S. Energy Information Administration as "the amount of carbon by weight emitted per unit of energy consumed."[40] Whether the electricity powering electrolytic hydrogen production is produced by a new or existing generator is irrelevant to the carbon intensity of the electrolyzer's operation, which is the statute's focus. If the electricity powering the electrolyzer is time- and location-matched with production from a carbon-free generator, verified through the retirement of EACs, no carbon emissions are associated with that electricity. This is true whether the carbon-free generator powering the electrolyzer is existing or new: both have the same carbon intensity in producing hydrogen and, therefore, must be treated the same under the statute. An agency may not introduce a limitation not found in the statute.[41]

The IIJA also specifies that, along with setting a specific carbon-intensity level, the CHPS should accomplish two objectives—both of which run counter to an additionality requirement for carbon-free generation to power hydrogen production. First, the statute requires that DOE's standard shall "support clean hydrogen production from *each source* described in section 16154(e)(2) of this title,"[42] which in turn directs DOE to engage in research and development activities regarding the production of hydrogen from diverse energy sources including, among others, nuclear energy. Adopting a standard that could be satisfied only by new sources would effectively exclude hydrogen production from nuclear energy because new nuclear plants cannot come online within the funding period of the IIJA. DOE cannot read an implied limitation into the statute when doing so would frustrate the statute's express directives. If Congress wanted to exclude hydrogen production using nuclear energy, it would have done so—but instead Congress not only expressly included nuclear energy on the list of sources, but directed that the standard shall support production from "each" source.

Second, the IIJA requires that the CHPS "take into consideration technological and economic feasibility."[43] Adopting a standard that would have the effect of excluding nuclear energy would fail to take into consideration the technological infeasibility of developing new nuclear plants

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[38] "Statutory interpretation … begins with the text," *Ross v. Blake*, 578 U.S. 632, 638 (2016), and courts "presume that [the] legislature says in a statute what it means and means in a statute what it says there." *Conn. Nat. Bank v. Germain*, 503 U.S. 249, 253–254 (1992).

[39] 42 U.S.C. § 16166(a).

[40] https://www.eia.gov/tools/glossary.

[41] *See, e.g.*, *Little Sisters of the Poor Saints Peter & Paul Home v. Pennsylvania*, 140 S. Ct. 2367, 2381 (2020).

[42] 42 U.S.C. § 16166(b)(1) (emphasis added).

[43] 42 U.S. Code § 16166(b)(2).

within the relevant time frame, once again contravening the statute's express directions. DOE may not read this statutory directive out of existence by adopting an additionality requirement in the CHPS. Indeed, the statute explicitly directs DOE to "focus on" clean hydrogen production from a variety of sources including nuclear in its statutorily-required National Clean Hydrogen Strategy and Roadmap.[44]

Including an additionality requirement in the CHPS also would contradict the statutory mandate to fund hydrogen hubs under the IIJA.[45] The express purpose of these hubs is to create networks of clean hydrogen producers, consumers, and connective infrastructure. To that end, the IIJA requires consideration of at least one hub demonstrating the production of clean hydrogen from nuclear energy.[46] An additionality requirement would make it impossible for existing nuclear plants to power grid-connected electrolyzers in a hydrogen hub, imposing a severe restriction that would conflict with the statutory directive to use IIJA funding to demonstrate clean hydrogen production from nuclear energy through a hub with both end-use and geographic diversity.

As DOE has rightly recognized, the CHPS will operate alongside other federal programs supporting the development of clean hydrogen, and alignment with other programs is therefore essential.[47] The definitions provided by related provisions in the IRA reinforce the inconsistency of an additionality requirement with the statutory text. Section 45V – titled "Credit for Production of Clean Hydrogen" – defines "qualified clean hydrogen" as "hydrogen which is produced through a process that results in a lifecycle greenhouse gas emissions rate of not greater than 4 kilograms of CO2e per kilogram of hydrogen."[48] As in the IIJA, the IRA does not ask whether the sources that generated those emissions predated the tax credit. Furthermore, the IRA definition of

[44] 42 U.S. Code § 16161b(a)(2)(B)(i) ("The national clean hydrogen strategy and roadmap developed under paragraph (1) shall focus on clean hydrogen production and use from natural gas, coal, renewable energy sources, nuclear energy, and biomass.")

[45] 42 U.S. Code § 16161a.

[46] 40 U.S.C. 16161(c)(3)(A)(iii).

[47] The CHPS Draft Guidance notes that its proposed lifecycle target is intended to align with Section 13204 of the Inflation Reduction Act, which creates a new 10-year production tax credit (the 45V Credit) for "qualified clean hydrogen." The U.S. Department of Treasury's Request for Comments on Credits for Clean Hydrogen and Clean Fuel Production also has a heading about "alignment" for DOE's CHPS.

[48] 26 U.S.C. § 45V(c)(2)(A). Proponents of an additionality requirement argue that a colloquy between Senator Carper and Senator Wyden during floor debate of the IRA indicates congressional intent to prohibit the use of EACs when determining the lifecycle emissions of grid-connected electrolyzers. RMI/NRDC/CATF/UCS comments on Treasury IRS Notice 2022-58 at pages 5-7. That exchange merely confirms that Treasury may "consider" indirect EAC-related factors that reduce GHG emissions when determining lifecycle emissions. Such consideration cannot result in an interpretation of the statute that conflicts with its plain language. A better reading of this exchange is that hourly matching of electricity consumption with EACs from carbon-free electricity production would be permitted under the IRA.

"qualified clean hydrogen production facility" indicates that Congress knows how to legislate a time limitation in its definition when it wants to – and there it does so only to limit the credit to production at facilities that are built *before* 2033, not at facilities built *after* passage of the IRA.[49] Moreover, Section 45U of the IRA–titled Zero-Emission Nuclear Power Production Credit–specifically authorizes existing nuclear plants to receive both the 45V and 45U tax credit when output from the nuclear plant is being used to produce hydrogen, a provision that would been unnecessary if existing nuclear plants are not eligible to receive 45V credits. The IRA also creates a separate 45Y tax credit for new nuclear plants, again demonstrating that Congress knew how – and chose not – to distinguish between existing and new resources in its CHPS directives. An additionality requirement would create direct conflicts between the CHPS and related provisions in the IRA.

As discussed above, it is appropriate for DOE to require hydrogen producers to retire EACs to ensure that carbon-free energy is not counted more than once in meeting clean energy programs. As long as EACs are retired and not used more than once, further "additionality" requirements that discriminate between new and existing resources are unnecessary and redundant because, by using the attribute only once, clean generation supply is effectively removed for the purposes of supplying clean energy programs, requiring that additional clean attributes be produced to cover for the shortfall. The EAC reflects the emissions profile of the actual generator that is producing the credit. It does not reflect the emissions impact of the energy on the electrical grid. In other words, it is consistent with the IIJA for all clean resources, both new and existing, used in hydrogen production to qualify so long as their clean energy attributes have not already been dedicated for another purpose. Such a system should be straightforward to implement given that it follows standard practice used in most credit-based clean energy programs in existence today.

To be clear, an approach requiring that electricity consumption be matched on an hourly basis with carbon-free electricity production does not require that the carbon-free generator be newly installed. Proponents of an additionality requirement in the CHPS confuse this point by suggesting that a 24/7 carbon-free electricity framework requires additionality.[50] This is untrue. While the principles governing the United Nation's 24/7 Carbon-Free Energy Compact do include a goal of enabling new clean electricity generation, they do not impose any restrictions on the ability of existing clean electricity generation to participate in hourly matching programs.[51] This is because

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[49] 26 U.S.C. § 45V(c)(3). *See Rotkiske v. Klemm*, 140 S. Ct. 355, 361 (2019) ("Atextual judicial supplementation is particularly inappropriate when, as here, Congress has shown that it knows how to adopt the omitted language or provision.").

[50] RMI/NRDC/CATF/UCS comments, *supra* note 48, at pg. 16 ("The 24/7 CFE approach requires that electrolyzer load be matched with additional clean electricity supply on an hourly basis throughout the year, with tight regionality requirements.").

[51] *See* https://www.un.org/sites/un2.un.org/files/2021/09/principles_-_updated.pdf. Clean Air Task Force, a signatory to the joint comments claiming that 24/7 carbon-free electricity framework includes an additionality requirement, is a signatory to the United Nation's 24/7 Carbon-Free Energy Company. See https://gocarbonfree247.com/our-partners/.

all forms of carbon-free energy will be needed to achieve the goal of clean electricity being delivered to customers every hour of every day.

ii. An Additionality Requirement Would Undermine the Policy Goals of the IIJA and IRA

Proponents of an additionality requirement for clean hydrogen production point to a study performed by researchers at Princeton University.[52] However, the modeling underlying that study is based on modest levels of hydrogen production for the remainder of this decade, insufficient to meet the Administration's goals. Specifically, the Princeton model evaluated scenarios of 1 and 5 GW of electrolyzer capacity in Southern California in 2030, while 10 GW would be needed to meet the goals of DOE's Hydrogen Shot.[53] The very modest expansion of hydrogen production targeted by this analysis makes it of limited use to DOE in light of the importance of accelerating the hydrogen economy.[54] At higher hydrogen production levels, an additionality requirement would make it impossible to meet hydrogen demand in addition to meeting other clean energy needs such as state programs and corporate demand. A vintage-based additionality requirement is likely to greatly limit the deployment of hydrogen in the near and medium term.

To support the development of the clean hydrogen economy in time to meet the 2050 emissions reductions goals envisioned by the IIJA and IRA, we need to begin deploying clean hydrogen production technology immediately, powered by both existing and new sources of carbon-free generation, in order to be ready to meet future hydrogen demand.[55] The IRA will spur the continued growth of renewables, but there is wide recognition of significant barriers to quickly bringing new sources online. In particular, the multi-layered permitting process – which can include multiple federal agencies implementing different statutory objectives along with state, local, and interstate

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[52] Wilson Ricks, Qingyu Xu, and Jesse D. Jenkins, *Enabling grid-based hydrogen production with low embodied emissions in the United States* (Oct. 10, 2022), available at https://zenodo.org/record/7183516#.Y2AY3-wpA0E

[53] In contrast, DOE's Hydrogen Shot has an ambitious goal of producing 10 MMT of clean hydrogen nationally by 2030. Conservative assumptions (half of that goal met by electrolyzer rather than SMR hydrogen, and early demand in California driving 1/3 of electrolyzer buildout to that location) would translate to approximately 10GW of electrolyzer capacity in Southern California by 2030, which is 2-10 times the level modeled by the Princeton team.

[54] National Clean Hydrogen Strategy and Roadmap, *supra* note 14, at pg. 2 ("Pathways for clean hydrogen to decarbonize applications are informed by demand scenarios for 2030, 2040, and 2050 – with strategic opportunities for 10 million metric tonnes (MMT) of clean hydrogen annually by 2030, 20 MMT annually by 2040, and 50 MMT annually by 2050.")

[55] Constellation has already begun investing in clean hydrogen production at our nuclear plants. *See supra* note 4, https://www.constellationenergy.com/newsroom/2022/Constellation-Joins-State-and-Federal-Officials-to-Celebrate-Progress-on-Nations-First-Nuclear-Powered-Clean-Hydrogen-Facility.html; https://www.constellationenergy.com/newsroom/2021/exelon-generation-receives-doe-grant-to-support-hydrogen-production-project-at-nine-mile-point.html

authorities – can take several years in addition to subsequent delays from litigation.[56] Furthermore, supply chain constraints are delaying renewable growth.[57] For similar reasons, the European Union Parliament recently voted to reject additionality requirements for renewable hydrogen in light of "concerns that overly strict regulations would hinder the development of this crucial market."[58] Even if new projects are able to be permitted and built, transmission is another constraint on the pace of renewable electricity expansion. While modeling based primarily on economic incentives suggests that electricity transmission could more than double its historic rate, "current transmission planning, siting, permitting and cost allocation practices can all potentially impede the real-world pace of transmission expansion."[59] Existing generators face none of these barriers and therefore can immediately be deployed to support the hydrogen objectives of the IIJA and IRA so that enabling technologies are available as more renewables come online over time.

Moreover, system-wide emissions associated with any use of electricity (whether for hydrogen production or other otherwise) will be dependent on a number of factors given the interconnected nature of the electric grid. Transmission limitations are an important factor given that bottlenecks on the transmission system can prevent some generators from being able to deliver their output.[60] In those instances, carbon-free generators (often remote wind and solar resources) are ramped down. This is already occurring at times in Northern Illinois, where a number of Constellation's nuclear plants are located, and it is projected to become a more frequent occurrence by 2030 as new wind and solar resources come online to meet the state's aggressive decarbonization goals. Redirecting output from one or more of Constellation's nuclear plants to produce hydrogen behind-the-meter would relieve congestion on the transmission system and could reduce the growing curtailment of wind and solar generation. While this scenario may not be present everywhere, it

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[56] Rayan Sud and Sanjay Patnaik, *How does permitting for clean energy infrastructure work?*, Brookings, Sept. 28, 2022, *available at* https://www.brookings.edu/research/how-does-permitting-for-clean-energy-infrastructure-work/

[57] Peter Hannam, *Supply chain delays and steel costs are part of 'perfect storm' stalling renewable energy growth*, The Guardian (May 23, 2022), *available at* https://www.theguardian.com/environment/2022/may/24/supply-chain-delays-and-steel-costs-are-part-of-perfect-storm-stalling-renewable-energy-growth; Clean Power Quarterly Market Report | Q3 2022, American Clean Power, *available at* https://cleanpower.org/resources/clean-power-quarterly-market-report-q3-2022/ ("In total, 14 GW of clean power capacity was delayed this quarter, adding to a growing backlog of delayed projects that totals 36 GW – 63% of which are solar projects.")

[58] Scrapped | EU's controversial 'additionality' rules for green hydrogen are history after European Parliament vote (Sept. 14, 2022), *available at* https://www.rechargenews.com/energy-transition/scrapped-eus-controversial-additionality-rules-for-green-hydrogen-are-history-after-european-parliament-vote/2-1-1299195

[59] Princeton University Zero Lab, *Electricity Transmission is Key to Unlock the Full Potential of the Inflation Reduction Act* (Sept. 2022), *available at* https://repeatproject.org/docs/REPEAT_IRA_Transmission_2022-09-22.pdf

[60] *Id.*

demonstrates that the modeling relied on by proponents of additionality is specific to a particular set of circumstances and assumptions that do not apply everywhere.

An additionality requirement also would make IIJA implementation burdensome for potential hydrogen producers and administratively infeasible for DOE. Proponents of additionality argue that purchases from generation resources should qualify only if the generation resource would not have been built but-for the demand for clean hydrogen production, but do not explain how hydrogen producers would make that showing or the criteria by which DOE would make that determination.[61] Even proponents of vintage-based additionality recognize that exceptions should be made for existing plants that are under threat of economic retirement or would be forced to curtail their generation without offtake from hydrogen producers.[62] Roughly two-thirds of Constellation's nuclear plants are operating under state support programs implemented to prevent premature retirement of the plants for economic reasons, and the 45U tax credit was enacted to address economic challenges faced by the nation's entire nuclear fleet. Preventing nuclear plants from participating in hydrogen production through a "new-only" requirement flies in the face of these state and federal programs.

At the same time, it is essential for DOE to require the retirement of EACs for any carbon-free electricity used to power hydrogen production in order to ensure that carbon-free electricity is not being used for any other use. Many resources, like a number of Constellation's nuclear plants, already have dedicated their EACs to state and other clean energy procurement programs and thus their output is not available for clean hydrogen production. To the extent that existing carbon-free resources have not yet dedicated their output to a particular use, it is sensible for them to be available for hydrogen production. Once their EACs are spoken for, new clean resources will be

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[61] Renewable portfolio standards ("RPS") in many states require that customers are supplied with an increasing percentage of renewable energy over time. Meeting these requirements will call for the installation of significant quantities of new renewable capacity between now through 2030 and beyond. With the availability of tax credits for hydrogen production, new renewable capacity that would have supplied RPS demand may choose to supply hydrogen production. If future state RPS targets are not achieved, it will be impossible to know how much of the shortfall would have been satisfied but for the hydrogen production. (Most RPS programs allow for a penalty payment known as an alternative compliance payment ("ACP") as a substitute for retirement of RECs to satisfy the regulatory obligation. https://njcleanenergy.com/files/file/1A_ACP_order.pdf) Further, with high levels of renewable penetration, producing hydrogen in one location can reduce the curtailment of renewables at other locations. So, an accurate assessment of the net amount of carbon-free electricity removed from the grid would require detailed congestion modeling to determine the grid impacts of producing hydrogen at every single location.

[62] *See* Ricks, Wu & Jenkins paper, *supra* note 52, at pg. 12. Existing renewables could also be at risk of going offline without access to new revenue streams. *See, e,g.*, *The CFE Manager: A New Model for Driving Decarbonization Impact*, Google, Sept. 16, 2022, *available at* https://www.gstatic.com/gumdrop/sustainability/2022-carbon-free-energy-manager.pdf (providing an example of a German wind farm whose new Google CFE Manager "contract provides additional guaranteed revenue streams, without which these projects may be dismantled due to their high operating and maintenance expenses").

needed to serve the additional hydrogen production needs and will be encouraged organically through market forces. In the interim, an exclusive focus on new resources – before they have sufficient time to come online – will interfere with the ability to rely on location-matched power.

Finally, an additionality requirement would severely impair the efficiency of producing clean hydrogen. The practical implication of relying exclusively on new resources is that most electrolytic hydrogen would be produced by renewable power, which has output that varies by hour, month, and season. This would result in a mismatch between supply and demand profiles given that electrolyzers perform best with a predictable power supply. Economic incentives are vital to ensuring that the gaps in renewable output are filled by firm carbon-free resources, reinforcing the need for time and location matching discussed above.[63]

DOE occupies an important role in setting the table for a standard that will jumpstart a hydrogen economy: it is the first agency to establish guidance on this score, and it is therefore all the more important that it get the answer right. To meet the Administration's decarbonization goals, in line with the U.S. commitment under the Paris Agreement, all sources of carbon-free electricity are needed to deploy and accelerate hydrogen production, including clean resources that are available and ready today and other resources that will be built over time. Modeling that is limited to the emissions impact of hydrogen production on the power sector does not capture the climate benefits of using hydrogen to decarbonize other sectors of the economy.[64] In that decarbonized power system, nuclear plants and hydroelectric dams, along with storage facilities like batteries, will be needed to balance the variable output from renewables, like wind and solar resources, which fluctuate both daily and seasonally. Waiting for new, additional clean resources to come online will delay and reduce the benefits of both the IIJA and IRA.

II. The Widely Used GREET Model Is Best Suited to Accurately Assess Lifecycle Emissions From Hydrogen Production

DOE appropriately relied on the "Greenhouse gases, Regulated Emissions, and Energy use in Technologies" ("GREET") model to conduct lifecycle analysis and develop the targets in the Draft Guidance. The GREET lifecycle analysis model was developed by the renowned Argonne National Laboratory in 1995 and has been continually refined through annual updates and expansions.

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[63] *See also* Hydrogen Production From Carbon-Free Nuclear Energy, Nuclear Hydrogen Initiative (July 2022), *available at* https://cdn.nuclear-hydrogen.org/wp-content/uploads/2022/07/25201728/NHI_NHProduction_Report_07.25.22.pdf (noting that nuclear has "benefits not available from any other energy source" for clean hydrogen production, including "operat[ion] at capacity factors above 90%").

[64] *See, e.g.*, U.S. Innovation to Meet 2050 Climate Goals, White House, Nov. 2022, *available at* https://www.whitehouse.gov/wp-content/uploads/2022/11/U.S.-Innovation-to-Meet-2050-Climate-Goals.pdf ("Net-zero hydrogen and ammonia can support decarbonization of a wide range of transportation, buildings, agriculture, and industrial systems.")

The GREET model appropriately considers the full lifecycle emissions of various hydrogen production pathways, including not just emissions at the point of hydrogen production but also emissions upstream from that point. Further, GREET fittingly considers all GHGs in addition to carbon, such as methane and N_2O. Both these features are essential to accurately describing the lifecycle emissions of any type of hydrogen production. GREET also accurately calculates the emissions associated with directly connected, behind-the-meter electrolytic hydrogen production by utilizing the lifecycle emissions of the directly connected electricity source to calculate the emissions of the hydrogen produced in this manner.

Argonne National Laboratory has made GREET available online for free download and use, and its website has over 50,000 registered users including many private sector companies along with other government agencies.[65] GREET covers hundreds of pathways and provides a suite of tools with many derivatives for specific applications, and numerous applications by state, federal, and international agencies.[66] GREET "is now used by tens of thousands of stakeholders worldwide to conduct emissions evaluation of hydrogen as well as many other pathways" and DOE's use of GREET in implementing the CHPS will provide predictability and reduce administrative burdens.

Some commenters may suggest that DOE needs to move to a different framework. However, to implement the IIJA quickly and accurately, accelerate innovation and deployment on the timeline envisioned by the IIJA, and realize critical GHG reductions in the short-term, DOE should continue to utilize the GREET model. The challenge of tackling climate change is too urgent to delay policy signals and funding decisions from the federal government. President Biden has emphasized that "The United States is not waiting, the costs of delay are too great, and our nation is resolved to act now."[67] As a result, it is critical that DOE move expediently in encouraging the development and deployment of hydrogen as part of the climate solution. DOE has recognized the importance of "spurring momentum towards achieving the benefits of clean hydrogen" because "[a]cceleration is key to meeting our climate goals."[68]

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[65] Amgad Elgowainy, Argonne National Laboratory, *GREET Model for Hydrogen Life Cycle GHG Emissions*, June 15, 2022, *available at* https://www.energy.gov/sites/default/files/2022-06/hfto-june-h2iqhour-2022-argonne.pdf.

[66] U.S. Department of Energy, H2IQ Hour: Learn to use the GREET Model for Emissions Life Cycle Analysis, June 15, 2022, https://www.energy.gov/sites/default/files/2021-11/h2iq-hour-10282021.pdf (Slides 5-7).

[67] FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies, Apr. 22, 2021, *available at* https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

[68] National Clean Hydrogen Strategy and Roadmap, *supra* note 14, at pg. 9.

Conclusion

The Clean Hydrogen Production Standard provides an important opportunity for DOE to drive the largest possible GHG reductions in line with the goals of the Infrastructure Investment and Jobs Act and the Inflation Reduction Act. The CHPS will serve as a benchmark for disbursing significant and impactful federal funds and may be viewed as an informative precedent by other agencies in future regulatory implementation. The recommendations above will strengthen the CHPS and we appreciate the opportunity to submit comments on the Draft Guidance. We would be pleased to discuss our perspectives on these issues with you at any time.

Thank you for your consideration of these comments.

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