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RE: Section 45V Credit for Production of Clean Hydrogen, IRS REG-117631-23

BP America, Inc. ("bp") is pleased to submit a response to REG-117631-23: "Section 45V Credit for Production of Clean Hydrogen".

Introduction

bp is investing in America's energy system as we transition from an international oil company to an integrated energy company.[1] With $150 billion invested in the US since 2005, we employ more than 30,000 Americans and support more than 275,000 jobs. We have a bigger footprint here than anywhere else in the world, and we're proud to be a trusted partner for secure, affordable and reliable energy.

We're transforming bp so we can deliver the secure, affordable, lower carbon energy the world increasingly wants and needs. bp's purpose is to reimagine energy for people and our planet. Our ambition is to become a net zero company by 2050 or sooner; and to help the world get there, too. We aim to dramatically reduce carbon in our operations and in our production, and grow new low carbon businesses, products and services.

As a consumer of hydrogen in our refineries, clean hydrogen will play a critical role in our efforts to reach net zero. Hydrogen will be a complementary source of energy to electrification, particularly when considering the decarbonization of hard-to-abate industrial sectors where electrification is too expensive or infeasible. bp is planning to develop clean hydrogen produced both through renewable electricity and natural gas paired with carbon capture and storage in the US and around the world.

[1] "bp" is used interchangeably herein to refer to BP America, Inc., BP p.l.c. or any subset of the BP group of companies.

bp is poised to develop low carbon hydrogen production facilities in key regions around the world including the US, Europe, UK and Australia. In the US, bp has several blue and green hydrogen projects at various stages of development. bp is a committed member of the Midwest Alliance for Clean Hydrogen ("MachH2"), which was recently selected for a $1 billion grant from the US Department of Energy ("DOE") to develop a hydrogen hub in the Midwest. Our key role in MachH2 demonstrates how committed we are to pursuing low carbon hydrogen. This clean hydrogen hub has the potential to decarbonize bp's Whiting, Indiana refinery and enable decarbonization of key industries in the vicinity. MachH2 projects have the potential to avoid as many as 3.9 million metric tons of CO_2 per year.[2] In the UK, bp is progressing the H_2Teesside project, which could become one of the world's largest blue hydrogen production facilities. In Germany, bp aims to develop the Lingen Green Hydrogen project. The company is well-positioned to play a leading role in the development of this important energy source with our experience in both fuel processing and transport and renewable energy facilities. Given our recent announcement of agreement to take full ownership of Lightsource bp[3] and the Beacon offshore wind energy project,[4] we are continuing our evolution into an integrated energy company.

bp appreciates the Administration's clean energy leadership, as shown by the enactment of the Inflation Reduction Act ("IRA") and the Bipartisan Infrastructure Law ("BIL"), and other executive actions that are encouraging energy transition investments. The establishment of the 45V tax credit reflects the interest of Congress in incentivizing a robust clean hydrogen industry in the US. As noted by Senator Tom Carper, Chair of the Senate Committee on Environment and Public Works, "**If implemented as intended by its authors**, the 45V credit offers the United States an invaluable opportunity to reduce greenhouse gas emissions, enhance energy security, and expand U.S. competitiveness while strengthening our economy and creating jobs."[5] [Emphasis added.] If implemented with measures that are conducive to scalable and substantial growth of the US clean hydrogen market, the 45V tax credit can make the US the most competitive market in the world. However, as the proposed guidance risks eroding the value of the tax credit itself, it also erodes the competitive advantage it would bring to a clean hydrogen market in the US.

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[2] Department of Energy, Office of Clean Energy Demonstration, "Regional Clean Hydrogen Hubs Midwest Regional H2Hub Community Briefing." November 1, 2023. https://www.energy.gov/sites/default/files/2023-11/H2Hubs_Midwest_Community_Briefing.pdf

[3] https://lightsourcebp.com/news/bp-agrees-to-take-full-ownership-of-lightsource-bp/

[4] https://www.bp.com/en_us/united-states/home/news/press-releases/bp-to-take-full-ownership-of-beacon-wind-us-offshore-projects-and-transfer-interest-in-empire-wind-to-equinor.html

[5] Letter from Senator Tom Carper to Treasury Secretary Janet Yellen, Secretary of Energy Jennifer Granholm, and Senior Advisor for Clean Energy Innovation and Implementation John Podesta. November 9, 2023

Recognizing the nascency of the clean hydrogen industry, Congress provided a technology neutral and feedstock neutral approach to spur investments and drive costs down. With this approach, the 45V tax credit has the potential to be a complementary policy to support the development of regional clean hydrogen hubs and assist in reaching the DOE Hydrogen Energy Earthshot goal of reducing the cost of production to $1 per kilogram by 2031.

bp is seeking six principal revisions to the proposed rule and other clarifications/recommendations. We believe these revisions closely align with the vision of establishing a strong clean energy economy that strengthens energy security, bolsters domestic manufacturing, and delivers jobs and economic opportunities across the nation. These proposed revisions will help stand-up and sustain a nascent clean hydrogen economy in the US.

Below, we are providing recommendations regarding:

1. Use of renewable natural gas without a direct connection, per Treasury's request for feedback;
2. An opportunity to improve the accuracy of the 45VH2-GREET model with respect to methane loss rates from natural gas and to drive further reductions across industry;
3. An opportunity to incentivize innovative approaches to the production of clean hydrogen by enhancing the flexibility of the 45VH2-GREET model;
4. An approach to use of Energy Attribute Certificates ("EACs") for electricity that aligns more closely with the intent of Congress while continuing to drive net reductions in greenhouse gas emissions;
5. An approach to petitioning for a provision emissions rate that protects investment while guarding against overburdening the DOE; and,
6. Use of the 45VH2-GREET model without challenging initial financing decisions.

Additionally, we have requested clarity and certainty on specific aspects relating to the use of EACs for electricity. bp is pleased to provide these comments in support of the development of a sound, workable final rule that reflects the intent of Congress to spur the development of a technology and feedstock neutral clean hydrogen economy oriented towards greenhouse gas emission reductions.

1. **Mass balancing should be allowed for use of renewable natural gas in the final rule. Failure to provide complete renewable natural gas regulations is a major impediment to successful deployment of clean hydrogen, could prevent achievement of the $1 per kg in 1 decade ("1-1-1" objective[6]), and may cause significant reductions in US clean hydrogen development.**

bp supports the inclusion of mass balancing for processes that use renewable natural gas ("RNG") in the final 45V rulemaking.[7] As reflected in the colloquy between Senator Ron Wyden, Chair of the Senate Committee on Finance and Senator Tom Carper, Chair of the Senate Committee on Enivronment and Public Works, legislative intent included pathways for use of thermal and biogas credits, in addition to electricity credits.[8] Failure to offer a mass balancing approach for RNG would be inconsistent with the intent voiced during the colloquy, and with the intent to establish a technology and feedstock agnostic tax credit. Similar to the approach provided for clean electricity, bp urges Treasury to include a system that enables the creation of carbon intensity representative certificates by RNG producers and retirement of those certificates by hydrogen producers.

40 years of operational experience across the RNG industry has precipitated a broad consensus on monitoring, reporting, verification and emissions calculations. As such, robust and transparent systems are already in place that should serve as models for use of RNG within the 45V tax credit. The Environmental Protection Agency ("EPA") has administered the Renewable Fuel Standard ("RFS") program for nearly 20 years, which enables the transportation market to mass balance RNG through the EPA Moderated Transaction System ("EMTS").[9] This system creates a record for traceability and reporting of transactions from the RNG source to user and would serve as a good model to allow the mass balancing of RNG into hydrogen production facilities on a "well-to-gate" basis. EMTS is used by a diverse group of companies and utilities across the country and tracks billions of transactions each year.[10] In addition to the EMTS, the California Air Resources Board administers the Low Carbon Fuel Standard ("LCFS") Reporting Toll and Credit Bank & Transfer System ("LRT-CBTS") which

[6] US DOE, Hydrogen and Fuel Cell Technologies Office, "Hydrogen Shot." https://www.energy.gov/eere/fuelcells/hydrogen-shot

[7] bp refers to a mass balancing approach for RNG in contrast to the "book-and-claim" language used by Treasury in this proposal. A mass balance accounting system utilizes third-party meters to measure the volumes injected into the pipeline system by an RNG producer and withdrawn by the pipeline system by an RNG consumer. This approach to custody transfers has a long history in the natural gas market. So-called "book-and-claim" approaches, that rely on a mass balancing accounting system, have been used in several regulatory programs without identified cases of fraud or double-counting.

[8] S4165-4166 Congressional Record, August 6, 2022

[9] US EPA, "Renewable Identification Numbers (RINs) under the Renewable Fuel Standard Program." Last updated January 23, 2024. https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-numbers-rins-under-renewable-fuel-standard

[10] US Environmental Protection Agency, "Reporting RFS RIN Transactions in the EPA Moderated Transaction System." Last updated August 24, 2023. https://www.epa.gov/fuels-registration-reporting-and-compliance-help/reporting-rfs-rin-transactions-epa-moderated

can also be referenced as a model that tracks carbon intensity. It has served as a model for the Oregon Clean Fuels Program (Oregon Fuel Reporting System) and Washington Clean Fuel Standard (Credit Bank & Transfer System).[11]

These electronic tracking systems are regulated and audited to provide necessary assurance. In addition, the existing EMTS is widely accepted by the industry and provides an immediately available solution with EPA positioned to verify the volume and carbon intensity of any RNG used by a hydrogen producer. Similar to use of EACs for electricity, the mass balancing approach used in the EMTS would provide a sound mechanism to establish contractual claims of RNG purchases. This would enable hydrogen producers to verify the purchase of RNG and the corresponding carbon intensity as part of the lifecycle greenhouse gas emission calculation for production of clean hydrogen via 45VH2-GREET.

Similar systems are in place today for the tracking of other energy commodities which could also be adapted for the purposes of RNG use in 45V. The "MiQ Registry"[12] provides a transparent, publicly accessible digital ledger for the tracking of certificates for natural gas with low methane intensity. With appropriate technical modifications, the MiQ Registry could serve as an alternate model for the administration of RNG mass balancing for 45V.

Treasury may prefer a system which is publicly accessible at the participant level (similar to how electrical power renewable energy certificate registries publish participant data). We suggest this is not necessary, provided that an established third party administers the process. However, if participant level information is required, we would suggest this should be a future extension of an existing system (like hourly tracking for electricity EACs) so that development of the clean hydrogen market is not delayed while waiting for these details to be established.

Treasury has expressed concerns that use of RNG, either directly or via mass balancing, will lead to unintended consequences, such as the production of additional waste to generate more RNG or loss of greenhouse gas reduction benefits via diversion of RNG from other productive uses. Both of these concerns are unfounded.

Demand for RNG already exists through the LCFS and RFS markets and has not been found to impact waste generation. Existing Federal, state, and local regulation provide robust governance and regulation of waste processing. These regulations serve as barriers to the generation of additional waste for the production of RNG. Importantly, it is not the role of Treasury to establish or enforce any such rules on or relating to the generation of waste as a component of the 45V tax credit. The use of RNG in hydrogen is a mechanism to capture the emitted methane from landfills and prevent it from reaching the environment. The capture of emissions derived from waste are critical to the reduction of

[11] https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/resources

[12] https://miq.org/

greenhouse gas emissions and the imposition of restraints on the sources of waste would not be aligned with the intent of the IRA.

The proposed rule seeks to impose a "first productive use" requirement on the ability for RNG to receive an accurate carbon intensity value from 45VH2-GREET for use of the product. This requirement is not necessary and is not justified by existing data or research. Treasury has not presented evidence or credible study data that suggests "first productive use" of RNG is a benchmark that is required to mitigate any particular adverse or indirect negative carbon intensity issue relating to hydrogen production. Limiting hydrogen production to use only new RNG facilities would not prevent existing facilities from contracting with other users in the future. The concern that emission reductions resulting from use of RNG will shift from an existing productive use to hydrogen production is unfounded in the context of the 45V tax credit, provided that any certificates generated by the RNG facility and sold to the hydrogen producer are retired only by the hydrogen producer. Appropriate generation and retirement of certificates will avoid any risk of double counting. RNG is a flexible tool that can support decarbonization in a number of different end-uses. We encourage Treasury to avoid prescribing specific use-cases for RNG, and instead provide fair, reasonable and transparent rules that allow RNG the opportunity to be used in as many markets as possible, including hydrogen production. Arbitrary limitations on use of existing sources will lead to market distortions that may inhibit further growth of the RNG market, rather than spurring additional activity and capture of methane from landfills, wastewater treatment plants, and livestock farms.

bp does not support the inclusion of any additional "incrementality requirement" for RNG given the reasons stated below. However, if Treasury decides to include such a requirement for the use of mass balancing for RNG, we recommend that it should be consistent with the requirements applied to EACs for electricity. In this context, the first injection of on-spec RNG[13] into the natural gas pipeline system should be the trigger for commencement of operations of an RNG project ("RNG startup date").

It is important that Treasury recognizes the unique properties of RNG that remove the need for any additional requirements, along the lines of those provided for electricity EACs, to account for delivery and use of RNG. RNG production is based on the steady state generation of gas from a waste product and is not temporal, in contrast to electricity generated from wind or solar resources, for example. Further, RNG can be safely and easily stored in existing co-mingled natural gas

[13] Raw biogas is generated from the decomposition of organic materials and consists of a mixture of various gases including carbon dioxide ("CO_2"), methane ("CH_4"), oxygen and other trace gasses such as hydrogen sulfide ("H_2S"), nitrogen ("N_2"), ammonia ("NH_3") and hydrogen ("H_2"). In this state it cannot be safely stored, compressed, blended with other gases, transported, or used as a direct substitute for natural gas. For biogas to support large scale hydrogen production, RNG must be transported via pipeline and therefore must meet all required standards to be blended into the national natural gas pipeline system, requiring cleaning and conditioning to remove the above noted contaminants.

storage facilities. US natural gas storage capacity is greater than 9 trillion cubic feet, across more than 400 locations nationwide, equivalent to nearly 300,000 GWh of energy. In this context, with storage so prevalent, there should be no requirement to match discrete units of production with consumption in a hydrogen plant except in the case of extended storage. We propose that for storage beyond one month duration, hydrogen producers should be required to show proof of physical co-mingled storage inventory.

Similarly, a deliverability requirement would be inappropriate for use of RNG. The US has a national natural gas pipeline system that allows for the flow of gas throughout the country. The interconnected nature of the natural gas transmission and distribution system allows a cubic foot of gas produced in an area to offset production elsewhere. A tracking system for RNG would identify the origin and carbon intensity of a unit of RNG along with the buyer of that same RNG without the risk of double counting. The actual physical flow of the natural gas system may not directly place that unit with the hydrogen producer, but it will demonstrably offset the use of a physical natural gas molecule somewhere within the country. This approach is consistent across applications of RNG.

While the 45VH2-GREET model published in 2023 includes only one source and accompanying carbon intensity for RNG, bp supports the use of the 45VH2-GREET model to estimate varying emissions associated with different methods of transportation of RNG. Further, the 45VH2-GREET model should be expanded to include other sources of RNG, and taxpayers should be given the ability to input volumes of any sources of RNG into the model for carbon intensity calculation provided the taxpayer can verify purchase of associated certificates. A large-scale clean hydrogen project is likely to require RNG gathered from multiple sources of supply. The 45VH2-GREET model should be modified to allow a hydrogen producer the ability to enter different sources of RNG (and corresponding carbon intensities), which would be averaged along with other feedstocks to provide an aggregate input feedstock carbon intensity. Landfill gas is only one type of RNG, and the 45V rules should not exclude other sources of RNG. Instead, the model should include the appropriate carbon intensity values for each source of RNG, as they could and will likely differ. The aggregation calculation should be completed within the 45VH2-GREET model, based on volumes and feedstock type selections made by the taxpayer. Such entries will be verifiable back to renewable certificate retirement as administered by the EPA and the third-party verifier. Following this approach would be consistent with the intent of the tax credit to be technology and feedstock agnostic.

2. **The 45VH2-GREET model should be enhanced to enable user specific values for methane carbon intensity to ensure the most accurate calculation of the carbon intensity of produced hydrogen, and to further incentivize the reduction of methane loss from upstream and midstream natural gas operations.**

bp supports use of the MiQ standard for Responsibly Sourced (certified) Natural Gas and the generated certificates to confirm the veracity of these claims. This program has been utilized for over three years, certifies a large portion of current US production, and has a robust registry that already manages the same capabilities sought by Treasury.

"The MiQ Standard for Methane Emissions Performance (the Standard) combines several Standard elements – (1) a calculated Methane Intensity, (2) Producer policies and procedures focused on methane emissions prevention, detection, and abatement (Company Practices), and (3) detection and mitigation of methane emissions through Monitoring Technology Deployment – to provide a robust and reliable method to certify natural gas production according to its methane emissions performance. The Standard is designed to incentivize continuous improvement in methane emissions monitoring and abatement."[14]

Due to the large variations from producer to producer, and basin to basin, there is no one-size-fits-all figure to accurately represent methane loss from natural gas production. Utilizing a single figure may dramatically over- or under-represent the actual life cycle emissions of hydrogen production, undermining the intention of the 45V tax credit's threshold mechanisms.

The Evident Registry ("I-REC") is used for the retirement or trading of the MiQ certificates. It manages the capabilities sought by Treasury to ensure fidelity of the system, including the use of unique identification numbers for each MMBtu issued, geographical and facility source information and timestamping. Retirement statements generated by the I-REC from retired natural gas emission certificates can be used as credible and direct evidence for foreground inputs into 45VH2-GREET and verified by a third-party. These certificates have accompanied bilateral contracts, single trade agreements, as well as transactions on marketplace platforms for certified gas. All certified facilities and the valid period of their certification may be found on a transparent dashboard on the MiQ Registry, complete with unique details and geographical information so that any user or purchaser of certificates can properly cross reference their information.

The MiQ Certificates expire after three years to encourage the use of the attributes and continuous improvement from the facility. To meet the timeliness standards around hydrogen production, an active certificate would be retired to prove the upstream gas methane leakage rate is lower than the assumption

[14] https://miq.org/document/miq-standard-onshore/

within the 45VH2-GREET model. Because the intention of the IRA is not to initiate additional hydrocarbon production, there should be no additional provisions to the production of certified gas. Due to the nature of the gas market, the individual molecule cannot be tracked, further justifying the usage of a mass balancing system similar to EACs already included in the 45V program and the use of certificates for RNG discussed above. The MiQ certificates require no further technical development to meet the 45V standard.

3. **The 45VH2-GREET model should not pre-suppose technology solutions that developers may deploy for the production of clean hydrogen by reformation. Restrictions will limit deployment to a small number of fixed technology solutions and remove the incentive to innovate.**

If a blue hydrogen producer is using an advanced technology, it should be credited with the advantages of that technology. This should be addressable via request for a provisional emissions rate ("PER"), but the limitations asserted by Treasury for taxpayers seeking a PER give bp reason for concern. bp fully recognizes a desire to limit the burden on DOE and cost to Treasury of reviewing countless PER requests. Increasing the flexibility of the 45VH2-GREET model, rather than limiting requests based on feedstock or technology, would be a superior approach to avoiding excessive requests.

One area to which additional flexibility should be enabled is the use of co-produced steam when a carbon capture process is deployed. The most recently published iteration of the 45VH2-GREET model allows credit for co-produced steam only when carbon capture is not deployed, on the basis that an efficient carbon capture process would consume any available steam, and therefore any steam export would be "gaming". Treasury has applied this limitation in the interest of avoiding abuse of the tax credit. bp recognizes this concern but argues that this limitation is too broad.

The technical basis for hydrogen reforming with and without carbon capture and sequestration ("CCS") arises from a National Energy Technology Laboratory ("NETL") study that provides a reasonable benchmark for these pathways.[15] However, advances in technology, especially carbon capture technology, are being integrated into the engineering designs of planned hydrogen projects and will bring higher overall energy efficiency with lowered carbon intensity. The limitation in the proposed 45V rule that disallows a steam export credit for reforming with CCS pathways is not reflective of these advancements in technology, given these new plants will result in excess steam that is not utilized in the process and, as a result, is available for export. Therefore, bp suggests adjusting the 45V proposed rule to allow for limited steam export from

[15] National Energy Technology Laboratory. Comparison of Commercial, State-of-the-Art, Fossil-Based Hydrogen Production Technologies. DOE/NETL-2022/3241. Pittsburgh, PA: National Energy Technology Laboratory, 2022. Technical Report.

reformation with CCS that will encourage more efficient project design, maximizing waste heat integration and utilization of any excess steam.

The NETL design that underpins the autothermal reforming ("ATR") with CCS pathway in the 45VH2-GREET model assumes a methyldiethanolamine ("MDEA") Acid Gas Removal ("AGR") carbon capture process. In this process, all the low-pressure steam generated in the ATR process is consumed in the MDEA Regenerator reboiler, and therefore no steam is available for export. While there is only limited information available from the NETL study to evaluate the assumed energy flows in the MDEA process, the consumption rate of steam in the MDEA process is high when coupled with large unrecovered heat loads sent to the cooling tower (e.g., in the NETL study's ATR with CCS pathway, approximately 33% of the input natural gas energy is lost in the cooling tower).[16] These NETL assumptions appear to be missing opportunities for heat integration, e.g. recovery of lower grade heat from steam condensate; optimizations that are already being reflected in more efficient real world project designs. In reforming plants with CCS using MDEA regeneration, this optimization could lead to lower overall heat inputs for the carbon capture unit, freeing up steam for export, in contrast to the NETL study assumption.

There are also increasingly mature carbon capture technologies that operate using electricity, eliminating the need to use steam. Large-scale projects are already being designed with these technologies. As an example, cryogenic fractionation for carbon capture is stated to "consume minimal energy due to the high amount of heat integration. Nearly all of the sensible heating and cooling is provided via recuperation, leaving only the energy of separation and phase change to be provided by the process".[17] The energy required for separation and phase change can optimally be achieved via electricity input. Several new and promising technologies for carbon capture based on ionic liquids, membranes and hybrid systems are evolving which are recognized as less energy intensive alternatives to standard solvent-based technologies, with the potential to operate at equivalent or higher carbon capture rates but with lower heat requirements than in the NETL paper.[18,19,20] Cryogenic fractionation is already available as a carbon capture technology option within R&D GREET[21], and it would appear to be viable to include this technology (and other carbon capture technologies from R&D

[16] NETL ATR with CCS case assumes 1,597 MMBtu/hr cooling tower load to produce 3,636 MMBtu (HHV)/hr H_2 from 4,804 MMBtu (HHV)/hr natural gas.

[17] Hoeger, C. et al. "Cryogenic Carbon Capture™ Technoeconomic Analysis". GHGT-15, 15-18 March 2021.

[18] Goren et al., "Comprehensive review and assessment of carbon capturing methods and technologies: An environmental research", Environment Research, 240, 2024, 117503.

[19] Dubey A. and Arora A., "Advancements in carbon capture technologies: A review", Journal of cleaner production, 373 (1), 2022

[20] Silvio V.J. et al., "Technologies of carbon dioxide capture: A review applied to energy sectors", Cleaner Engineering and Technology, 8, 2022

[21] Argonne National Laboratory, "R&D GREET Model." https://greet.anl.gov/

GREET) within the next version of 45VH2-GREET to allow for more accurate accounting of a hydrogen project's lifecycle carbon intensity.

In light of these different technologies and process configurations for carbon capture, a steam export credit should be allowed for reforming with CCS pathways in 45VH2-GREET but restricted to the amount of steam that is not required within the carbon capture unit and within an appropriate overall limit, as discussed below.

There is no precedent in relevant GHG emission methodologies (e.g., R&D GREET, ISO 14067, ISO/TS 19870, IPHE, GHG Protocol's Product Life Cycle Accounting and Reporting Standard) for preventing or setting a limit on the amount of excess steam that can be claimed as a co-product from hydrogen production or similar fuel production processes. However, bp acknowledges that Treasury is seeking to set a limit on the export steam credit in the 45V rule to avoid projects designing inefficient reforming plants or oversizing gas boilers, thereby over-generating steam only for export and artificially reducing the lifecycle carbon intensity of a hydrogen project. These risks apply to reforming plants with and without CCS. While these risks could be partly mitigated by sufficient technical and lifecycle analysis expertise on the part of auditors, this is still a complex area, and the use of a readily explainable metric for any limit has advantages.

The DOE proposed 17.6% steam export limit (as a percentage of the total energy content of steam exported plus the lower heating value of hydrogen produced) is derived from the NETL study for reforming plants without CCS. This limit acts as an upper bound on the steam credit that can be claimed by reforming without carbon capture in 45VH2-GREET, provided the steam is produced from processes integral to the hydrogen production process.[22] bp agrees that the 17.6% maximum available limit for claiming steam export credit is a reasonable benchmark to avoid unintended consequences. Given that carbon capture technologies and process plants can be chosen and optimized to minimize or avoid steam demands, bp proposes that the same upper bound limit of 17.6% for steam export should also apply to reforming pathways with CCS.

Although the steam export amount would exclude any steam utilized in the carbon capture process (and any other process in the plant), a further safeguard could be the inclusion of the process-generated steam that is consumed in the carbon capture plant as a required input parameter. As such, the 45VH2-GREET model could be modified to include an additional user input box for the process-generated steam that is utilized in the carbon capture plant, to ensure that the sum of the steam exported and the steam utilized in the carbon capture plant collectively does not exceed the 17.6% limit.

[22] US DOE, "Guidelines to Determine Well-to-Gate Greenhouse Gas (GHG) Emissions of Hydrogen Production Pathways using 45VH2-GREET 2023." December 2023.

This proposed change would mean that reformers that use a large amount of steam in the carbon capture unit, similar to the NETL design, will not be able to claim any steam export credit. Plants with more thermally efficient carbon capture technologies will be able to claim some credit for any export steam, and those plants that entirely avoid the use of steam for carbon capture will have the same 17.6% upper limit as reforming plants without carbon capture but could only claim the minimum of either the actual amount or the 17.6% limit of steam exported. This would incentivize greater heat integration, deployment of more advanced carbon capture technologies, and valorization of steam for those reforming plants with CCS where there is no further onsite use and export is necessary.

4. **For green hydrogen, the three pillars in the proposed rulemaking, crafted to minimize lifecycle greenhouse gas emissions from electricity powering electrolysis, are more restrictive than justified and erode the value of the tax credit, reducing the likelihood that clean hydrogen will be able to compete with unabated hydrogen.**

bp recognizes the need to ensure that electrolytic pathways to produce clean hydrogen use low- or zero-emission electricity and do not result in significant increases in induced grid emissions. However, application of the requirements proposed by Treasury on qualifying EACs for grid-connected electrolyzers will likely lead to significantly increased cost of production. This erodes the value of the tax credit and reduces the likelihood that clean hydrogen will be able to compete with traditional, unabated hydrogen production methods. As there are minimal policies in place to drive demand for clean hydrogen, producers will likely need to reach cost-parity to secure offtake agreements with consumers. Maximizing the value of the 45V tax credit will be critical to moving toward cost parity.

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 heavy-duty transportation and chemical, steel, and cement manufacturing. Targeted investments in these areas can help reduce costs, make new breakthroughs, and create and support jobs for engineers, manufacturing workers, construction workers, and others. However, in order for a clean hydrogen economy and market to launch in a meaningful way, the product needs to compete on price versus its alternatives. If 45V were finalized as proposed, the price gap between clean hydrogen and the current unabated hydrogen incumbent is still considerable. Without meaningful investments in this nascent industry, the formation of an enduring supply chain that is urgently needed to advance technologies, increase confidence, and bring down costs to where they can compete with traditional production remains at risk.

Recent industry articles acknowledge that clean hydrogen is farther from cost-competitiveness than previously understood. Hydrogen Insights recently stated:

"The US aim of producing green hydrogen for $1 per kilo by 2031 now seems more like wishful thinking than an achievable goal… developers have admitted that not only are the expected costs due to be far higher by 2031 — but the cost of green hydrogen is actually rising today, due to inflation on the cost of not only electrolysers, but the wind turbines and solar panels supplying electricity to projects, which represents around 60-75% of the levelised cost of H_2. And, according to a peer-reviewed scientific study published in September, the EU's (and soon-to-be US's) requirement for hourly correlation is expected to increase the cost of producing hydrogen by 27.5% compared to more lenient matching on an annual basis."[23]

As Treasury continues to work to implement the 45V tax credit to promote the production and use of clean hydrogen, extreme care must be taken not impose policies that will unnecessarily restrict or preclude innovation and the ability of a clean hydrogen industry at scale. The transition to clean hydrogen can only be compelled by a commercially competitive alternative or improved incentives. Accordingly, we strongly encourage Treasury to consider the details and requirements behind the proposed rulemaking in context of actual current clean hydrogen costs of production. The additional costs and potential inefficiencies from policies restricting the location and timing of clean hydrogen production will inevitably reduce the competitiveness of clean hydrogen and subsequently the availability of offtake agreements compared to less restrictive policies.

bp offers the following recommendations to avoid approaches that will inhibit the development of this essential decarbonization tool:

A. *To incentivize inaugural investment by reducing risk, Treasury should allow for grandfathering of early mover projects from following stricter incrementality, temporal matching, and regionality requirements for the life of the tax credit. To define an early mover, a beginning of construction measure is most appropriate.*

Early-mover clean hydrogen production facilities are needed to catalyze capital investment in the domestic supply chain which is critical to lower costs and allow the market to mature. Beyond the production facility itself, first mover projects will carry the burden of enabling critical and significant investments in new equipment manufacturing such as electrolyzers to produce clean hydrogen, additional transportation infrastructure such as new pipelines or modifications to existing pipelines, and modifications at existing industrial facilities to reconvert or use clean hydrogen derivatives. Industry is unlikely to make such material investments until there are demonstrated market end-uses that can be

[23] Polly Martin, and Leigh Collins. "Review of 2023: The Key Developments and Trends in the Global Hydrogen Sector (Part 1: Production)." Hydrogen News and Intelligence | Hydrogen Insight, 28 Dec. 2023, www.hydrogeninsight.com/analysis/review-of-2023-the-key-developments-and-trends-in-the-global-hydrogen-sector-part-1-production-/2-1-1574671.

underpinned by long-term offtake agreements that will drive the return on the full supply chain of investments.

Project execution and delivery risks are real and probably not fully understood in this emerging space, especially those that are beyond a developer's control including, but not limited to, interconnection, supply chain, and equipment defects. Significant investment could be marginalized by a minor slip to the commercial operations date ("COD"), which is not uncustomary on early mover large-scale projects. In fact, the International Energy Agency's "Renewables 2023" report states that "project development in several markets has been affected by delays in electrolyser shipments due to backlogs in manufacturing plant orders and, in some cases, by malfunctioning equipment."[24]

Current clean hydrogen production is negligible, and no tradable "commoditized" market exists. Nearly half of current unabated hydrogen output is consumed "inside the fence" at adjacent facilities while the remainder is sold to end users through bilateral contracts and delivered by pipeline or truck. Early mover projects will be required to originate new-market bilateral long-term contracts that will likely be strained on price while requiring significant new bespoke infrastructure to deliver. As a result, framing such agreements will be unique, agreements will take more time to negotiate, and likely they will only be with a finite set of interested customers ahead of market formation. When overlayed with typical project development timelines, which can take 2-3 years moving at pace, cost-competitive projects in development today would not likely reach its Financial Investment Decision ("FID") milestone until 2026 or 2027. Moving to a start of construction date of January 1, 2028 should be viewed through the lens of the nascency of this market, lack of demand at current prices, few framework agreements, and lack of infrastructure, and in consideration of affording some relief to first-movers in helping to launch this critical industry.

B. bp encourages Treasury to change the transition rule applied for temporal matching to a "beginning of construction" date of on or before January 1, 2028 and placed in service within four years of that start of construction year under the continuity safe harbor similar to the treatment of existing tax credits for renewables.[25]

A rush to hourly time-matching without grandfathering will reduce viability of projects and lead to significantly increased cost of production, reducing the competitiveness of electrolytic hydrogen. Moving to a "beginning of construction" date on or before January 1, 2028 with a four year safe harbor should allow developers the necessary time to develop, permit, secure long-term

[24] IEA (2024), Renewables 2023, IEA, Paris https://www.iea.org/reports/renewables-2023, Licence: CC BY 4.0

[25] See generally IRS Notice 2021-41.

offtake, and finance inaugural pioneering projects with the added clarity and certainty in making investment decisions for clean hydrogen projects.

The proposed beginning of construction metric is already adopted in practice today.[26] Begin construction structures (i.e. Physical Work Test or the 5% Safe Harbor) should be allowed for clean hydrogen to preserve grandfathering and certainty through the entire lifecycle of the tax credit, especially with the level of investment and risk being accepted at FID. FID is when the largest monetary commitments are made on a given project. Being unable to secure and grandfather certainty ahead of FID on time-matching requirements (because it is based on an online date) will create unmanageable risk for a developer given all the unforeseen execution risks on major projects.

With respect to cost-competitiveness, spatial and temporal patterns of renewable production are highly variable, especially at hourly granularity, posing a challenge to cost management. Managing hydrogen production to such fine fidelity will be difficult and require redundancy and buffering systems combined with reliable back-up grid power to help smooth production, which is necessary to increase certainty and maintain project utilization factors to a sufficient level for reliable offtake. These additional systems will lead to increased cost of production and require projects to manage a pool of excess green electrons during high renewable output.

Furthermore, certain hydrogen technologies and derivatives are less amenable to ramping, which can increase wear and tear, and even introduce process safety challenges. Additionally, most industrial facilities are designed to start up and operate at a steady state (temperatures, pressures, liquid levels, RPMs, etc.) and limit any unnecessary ramping of equipment. This requires upstream and downstream systems to load follow, though they may not be able to ramp at the same rates. Ramping will require excess buffering, sophisticated control systems, instrumentation and automation, additional maintenance to manage equipment degradation, and, importantly, increased process safety operational procedures, all of which will increase cost of production.

The instrumentation, control systems and metering sophistication combined with the administrative overhead, accounting, verification, reporting, and auditing associated with hourly bookkeeping itself will be significant and add cost. The survey of tracking systems cited by the Department of Energy reflects concerns about making significant changes to systems to benefit only a small number of users.[27]

For all these reasons, bp recommends that Treasury consider the later phase-in of increased time-matching fidelity, as referenced above. bp strongly encourages

[26] See generally IRS Notice 2021-41.

[27] Terada, R. 2023. *Readiness for Hourly: U.S. Renewable Energy Tracking Systems. San Francisco, CA: Center for Resource Solutions*

that the final rule allows for first-mover projects to be afforded full flexibility of the initial position for the life of the credit. This creates incentives and reduces some of the risks to first-of-a-kind projects trying to achieve offtake, commercialization, and investment necessary to scale-up the hydrogen ecosystem.

C. Treasury should increase the sourcing of electricity from incremental resources that have come online prior to the date of the hydrogen facility from "no more than 36 months" to "no more than 60 months."

bp appreciates that incrementality is, by some arguments, a critical factor to protect against induced grid emissions. However, limiting access to only those facilities brought online within the previous 36 months is arbitrarily restrictive and not consistent with other policies.[28]

bp proposes an extension of the 36-month restriction to 60 months. There is a finite amount of renewables that will be brought on in any period, and for markets that are already mature (i.e., ones with the most robust resources), growth may not continue at the pace and scale previously enjoyed over a 3-year window. Follow-on projects could become increasingly difficult at less advantaged sites. Furthermore, with the ultimate goal to get to hourly matching, additional wind generation will be imperative over solar generation, and the timeline to develop a wind project can be years longer than solar development.[29]

For example, in ERCOT, which has a historically efficient interconnection process, wind deployments have trended downward over the past 3 years with 3.1 GW installed in 2021, 2.7 GW installed in 2022, and only 1.8 GW installed in 2023. Established industry consultants have projected roughly 4 to 5 GW of new wind growth in ERCOT in the three-year period between 2027 and 2030.[30] Historical generation profiles signal that only about 33% of nameplate capacity is generated, which suggests this might be able to support up to 1.5 GW of new electrolytic hydrogen if all new generation was dedicated, and likely less under an hourly temporal matching requirement. However, if this were expanded to a five-year 2025 to 2030 window, projected wind growth increased to 6 to 9 GW, which

[28] EPA's Greenpower Partnership guidelines, cited as a source for the DOE's recently developed draft definition of a zero emissions building, defines "new" renewable energy facilities as those "put into service within the last 15 years." https://www.energy.gov/sites/default/files/2024-01/bto-national-definition-zero-emissions-building-122023.pdf; https://www.epa.gov/sites/default/files/2016-01/documents/gpp_partnership_reqs.pdf

[29] A survey of project developers found that 25% of solar respondents were able to bring a project to COD within 4 years, whereas only 17% of wind respondents were able to bring a project to COD within 4 years. Additionally, the authors found "Most developers expect wind to be somewhat more difficult to site and experience more delays than solar in the future." Robi Nelson, Ben Hoen, and Joe Rand, "Survey of Utility-Scale Wind and Solar Developers Report." Lawrence Berkeley Laboratory, January 2024.

[30] WoodMackenzie North America Power & Renewables Tool; S&P Connect North American Market Dashboard

could support up to 2.5 GW of electrolytic projects under similar aspirational assumptions.[31]

Moreover, in power markets where interconnection queue wait times are increasing (now taking 60 months or more from request to commercial operation),[32] coordinating hydrogen delivery with renewables delivery will be increasingly challenging. Permitting uncertainties and project delays will exacerbate project-on-project risk that will need to be managed. This may favor additional behind-the-meter renewables development, although those will struggle to fulfill hourly matching requirements as proposed. Having more access to a broader window of developments will help alleviate uncertainties and challenged renewable power deployment timelines. These increasing queue durations and integrated project delivery coordination is also another reason to encourage a January 1, 2028 "start of construction" transition date as schedules continue to change.

5. bp recommends that Treasury allow for the application of a Provisional Emissions Rate (PER) earlier in the project development process.

Project developers are not likely to use the PER process if a FEED study is a required input because of the extremely high costs to complete a FEED study. This would severely restrict the opportunity for innovation and limit the scope and scale of the future clean hydrogen industry.

Completion of a FEED study is typically an onerous activity. In terms of cost, it is likely a project sponsor will have spent upwards of $100 million, which could include land purchase, technology license payments, extensive engineering studies, feedstock connection studies, power supply studies, and power transmission studies. Additionally, to make key design decisions, such as capacity and hydrogen offtake disposition, customers are likely to have been approached and may have executed preliminary agreements. Customers may have even begun to complete studies to prove the acceptance of hydrogen for new use cases. All of this work will likely have been completed on the basis of an assumed hydrogen lifecycle carbon intensity, affecting awardable value of the 45V tax credit and subsequent purchase cost of clean hydrogen. Requiring such a level of expenditure and oversight is likely to prevent use of the PER process for all but the simplest projects with no innovative features – projects that are less likely to need the PER process.

bp recognizes that without any barriers a PER process may become overburdened with nuisance requests. A compromise position must be sought to balance PER burden, with the opportunity to allow innovation. It is typically

[31] WoodMackenzie North America Power & Renewables Tool; S&P Connect North American Market Dashboard

[32] Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection (https://emp.lbl.gov/queues)

challenging to set a project development benchmark as a requirement for PER because it is not trivial to assess if a project has truly achieved it or not. It is unlikely DOE will be able to effectively discern that a project has completed pre-FEED or FEED studies.

As suggested in bp's response to Treasury Notice 2022-58,[33] we propose that the taxpayer should be able to file a petition for a PER as soon as the taxpayer has sufficient engineering definition to produce a Class 4 estimate, as defined by AACE International Recommended Practice No. 18R-97.[34] A Class 4 cost estimate typically requires a project to have completed a feasibility study, and therefore sufficient technical detail to generate a high quality petition. Including this standardized metric as the qualifier to petition for a PER would reduce risk to investment capital and of speculative filings that could create an unnecessary backlog and delays.

Further, after completing the PER process, a project sponsor should have the opportunity to amend its petition based on further project development, but be limited to formulaic inputs only, where only simple numerical inputs could be varied.

6. **bp recommends that Treasury provides greater certainty to project developers by allowing for the continued reliance on the initial version of the 45VH2-GREET model used to determine the lifecycle carbon intensity for the project. Requiring use of an annually updated model without stakeholder consultation and engagement, and without opportunity to make adjustments prior to claiming the credit under a new model, will limit the ability of project sponsors to reach final investment decision.**

To provide certainty to developers, and allow hydrogen projects to reach FID, a project should be able to "lock" the version of 45VH2-GREET, or a PER assessment, at the point of the formal "begin construction" date for the project. This provides a balance of requiring the use of the latest model for new projects, while allowing advanced projects to continue with a stable and known set of rules.

There is a track record of GREET model updates that have the potential to create dramatically different outcomes.[35] Since the statutory design of the 45V tax credit creates a significant loss of value at a threshold carbon intensity, investors will be concerned about the uncontrollable issue of unexpected 45VH2-GREET updates

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[33] https://downloads.regulations.gov/IRS-2022-0029-0040/attachment_1.pdf

[34] 18R-97: Cost Estimate Classification System - As Applied in Engineering, Procurement, and Construction for the Process Industries [August 7, 2020] | AACE (pathlms.com)

[35] See, for example, Michael Wang, et al. "Summary of Expansions and Updates in GREET 2022," System Assessment Center, Energy Systems and Infrastructure Analysis Division, Argonne National Laboratory. October 2022. https://greet.anl.gov/files/greet-2022-summary

invalidating or lowering the value of tax credits in future years. It is likely that project financiers will not accept this risk, which will create issues in securing project finance.

Further, changes to future versions of 45VH2-GREET should follow a consultation period and appeals process to provide transparency to expected future updates and ensure decision making is robust. The carbon intensity values of grid power in 45VH2-GREET, for example, need to reflect the most recent data possible, rather than lagging by several years, in the face of a rapidly decarbonizing grid. An official consultation period could help drive accurate updates.

bp requests that Treasury provide clarity and certainty on specific aspects of EAC eligibility in the proposed rule: incrementality of repowered or uprated facilities; energy storage; and, avoided retirements.

A. bp is seeking clarification on uprates and repowers. The proposed rulemaking only points to the incremental increase in output stating "Electrolyzers must source electricity via PPAs from updated clean energy facilities, limited to only the new margin of power output."[36] If a facility is being repowered specifically for the purposes of servicing clean hydrogen, bp suggests that the entire facility should count as new for the purpose of satisfying the incrementality requirement. In this case, if not for the purpose of servicing clean hydrogen production, the uprate or repower may not have otherwise been done at this particular time and may alternatively have been a "run-to-failure" asset. As a pure play power asset, a repower or uprate may not have been financially justified depending where it sits in the market, but when integrated with clean hydrogen production could be justified on an accelerated timeline. Serious considerations should be made to include the entire asset as new when motivated by clean hydrogen. Otherwise, instead of leveraging, maintaining, refurbishing, repurposing, and reinvigorating the aging infrastructure already in place (and its previously disturbed footprint), developers may only look toward "new" projects that could disturb new areas and otherwise strand renewable assets that could have been a good candidate for clean hydrogen if not limited by the proposed narrow definition. In addition, the calculation of the new margin of power output is not as straightforward as it seems, with shifting technologies, power curves, wake impacts, and potential curtailment changes. This administrative burden will further increase overall project costs.

[36] 88 Fed. Reg. 89299 (Dec. 26, 2023).

B. bp is seeking clarification on energy storage and time shifting of EACs. Strong consideration should be made for allowing intentionally deployed energy storage for clean hydrogen to be able to change the time stamp of the EAC when it can be shown that it was charged with clean energy, such as behind-the-meter wind or solar. Industry consultants have forecast a range of storage capacity that could be built across the US in the near future. It is essential that these storage resources are built in a manner that aligns with the needs of clean hydrogen producers. If a significant portion of the forecasted storage is built and allowed to shift the time stamp of EACs, costs for clean hydrogen production could be reduced.

   Tracking systems for hourly EACs are yet to be developed and therefore will be shaped by the requirements of the users. It is important that Treasury establishes in this rulemaking how electricity storage will be treated in the lifecycle emissions calculations of clean hydrogen production. Without this information, EAC tracking systems may not be designed to provide the required information. Clarity on the allowed role of electrical storage is needed to optimize planned hydrogen facilities to provide the most economical source of low-carbon hydrogen. Without such a clarification, deployment of systems to buffer hourly time-matching with more consistent hydrogen production may not be pursued. Maintaining high capacity factors is important to hydrogen economics; consequently, a clear rule from the Treasury to establish how electrical storage will be accounted for has material consequences for the commercial viability of clean hydrogen facilities that rely on renewable electricity. Current policy fails to enable a critical tool that developers may use to help manage the hourly time-matching requirement, which could otherwise allow operators to time-shift electron production from periods of excess renewable output to periods of low renewable output. This both helps to smooth out clean hydrogen production and supports the electric grid itself.

C. bp suggests that demonstrated avoided retirements of zero emission assets should qualify as incremental new generation. bp also recommends that the interpretation should not acutely focus on a publicized announced retirement date as the date it qualifies as being incremental. Many assets could be put on a "run-to-failure" program at some point near their end-of-life life-cycle. If an aging asset is identified for support of clean hydrogen and therefore maintained in a way to extend its life, the point at which such life extension investment is initiated should be when incrementality should qualify, not when it would have otherwise retired. Without such provision and demonstration of sustained investment, extending life of these assets for hydrogen will be much more difficult, and we may miss the opportunity to leverage our existing infrastructure in a sensible way.

Conclusion

Ensuring that the implementation of the 45V tax credit reflects the intent of Congress, to advance a clean hydrogen economy in the US, is critical. For hard-to-abate industries, including refining, clean hydrogen is a key component of future decarbonization plans. Without cost competitive clean hydrogen, hard-to-abate industries may not be able to decarbonize without incurring significant and ongoing costs, damaging their competitiveness. Industries like refining, ammonia production and steel production are essential to fueling, feeding, and building the future of the US.

We appreciate the opportunity to submit these comments. Our comments are intended to provide Treasury with investor- and developer-based insights on the costs of entering a nascent industry. These comments will help Treasury meet the intent and value of the 45V tax and further efforts to reduce greenhouse gas emissions and the impacts of climate change. We look forward to Treasury's consideration of our suggested changes and requested clarifications.

Sincerely,

/s/ Isabel Mogstad

Isabel Mogstad
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