Air Liquide

Internal Revenue Service
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Room 5203, P.O. Box 7604
Ben Franklin Station
Washington, DC 20044
VIA Federal eRulemaking Portal at www.regulations.gov

February 26, 2024

RE: Air Liquide Comments on IRS section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property (REG–117631–23)

To Whom It May Concern:

American Air Liquide Inc. ("Air Liquide" or "the Company") welcomes the opportunity to submit the following comments in response to the proposed regulations (the "Proposed Regulations") published by the Internal Revenue Service ("IRS") and the U.S. Treasury Department ("Treasury") regarding Internal Revenue Code ("IRC") section 45V, clean hydrogen production credit ("45V Credit"), as enacted under the Inflation Reduction Act ("IRA"), Public Law 117-169, 136 Stat. 1936, 1938, 1939 (August 16, 2022).

Background

A world leader in gases, technologies and services for industry and health, Air Liquide has a presence in all 50 states, employing more than 20,000 people in the U.S. at more than 1,400 locations and plant facilities, offering industrial gases and related services to customers in a range of industries, including oil and gas, chemicals, steel, construction, food and beverage, research and analysis, electronics, and healthcare. Hydrogen has been, and continues to be a core growth area for our business in the U.S.

Air Liquide has more than 60 years of expertise across the entire hydrogen value chain. From production and storage to distribution and the development of applications for end users, Air Liquide is focused on hydrogen as a key molecule for investment, research, and technology development. As a global leader in clean hydrogen development, Air Liquide has made significant investments worldwide, exceeding more than $1 billion dollars invested in hydrogen in the U.S., and has a commitment to invest nearly $10 billion dollars more globally in low-carbon hydrogen by 2035. With Air Liquide's significant presence in the U.S. and the acceleration of hydrogen, we would like to see as much of that $10 billion dollars invested in the U.S., helping the nation achieve its decarbonization goals while creating more clean energy careers.

Air Liquide is deeply convinced that hydrogen will play a major role in the energy transition, and is a proud partner in six of the seven Hydrogen Hubs led by the Department of Energy ("DOE") to accelerate low-carbon hydrogen development in the U.S. Air Liquide's participation in these regional hubs supports our ambition to create a reliable hydrogen network across industry and bring it to scale. In addition to our strong leadership in clean hydrogen development, Air Liquide is a key leader and contributor in the

National Petroleum Council study on the deployment of low-carbon intensity hydrogen at scale through the entire value chain, requested by the Department of Energy.

Executive Summary

The clean energy transition is a once in a lifetime opportunity–reimagining our energy future and doing so in a way that drives economic development and job creation in a sustainable way. In 2022, under President Biden's leadership, Congress passed the landmark Inflation Reduction Act (IRA) introducing hydrogen-related incentives, including IRA section 45V (REG–117631–23), the credit for production of clean hydrogen.

As a long-time partner of the U.S. government, Air Liquide strives to be solutions-based, and the Company has very real concerns with regards to the proposed implementation of the 45V Credit. Section 45V has the potential to catalyze the hydrogen economy and further cement U.S. global energy leadership. However, the regulations in their current form would undermine the Administration's goals to lower greenhouse gas emissions while creating clean energy careers.

Grouping them into three primary areas of concern, below, Air Liquide has summarized its response to the proposed regulations REG–117631–23 for production of clean hydrogen (clean hydrogen production credit, section 45V). Air Liquide's detailed comments follow, and we would welcome the opportunity to meet in person at your convenience to walk you through the more detailed project specific information as needed.

1. Need for flexibility and certainty in implementing the "three pillars" - temporality, incrementality, deliverability. Our recommendations are as follows:

1.1. Locking in, or "grandfathering," facilities that commence construction before 2030 into the same set of requirements for the duration of the applicable tax credit period.

1.1.1. The cutoff of beginning construction before 2030 was identified to align with DOE Hydrogen Hubs. This would allow these first mover projects to qualify for the section 45V Credit thereby ensuring that Hydrogen Hubs are given flexibility to help them advance.

1.2. Temporality - Quarterly matching for the lifetime of projects which began construction before 2030, then hourly matching for projects beginning construction on or after January 1, 2030.

1.3. Incrementality - Exemption from incrementality requirements for projects which began construction before 2030. Projects beginning construction beginning on January 1, 2030, would be required to comply with a 36-month lookback rule with flexibility allowed for project delays.

1.4. Deliverability - For projects which begin construction before 2030, Energy Attribute Certificates (EACs) for electricity must be generated and retired within one of the six North American Electricity Reliability Corporation (NERC) regions. For projects beginning construction on or after January 1, 2030, EACs must be generated in the same geographic regions used in DOE's National Transmission Needs Study.

1.5. Once the three pillars take effect, we also seek the ability to claim partial credits for partial compliance. For example, producing hydrogen with qualified renewable power during 70% of the year will enable full $3/kg PTC during those 70% of the hours. This will encourage companies to continually seek additional hourly matched clean power.

2. Clarify the applicability of renewable natural gas (RNG) usage as a feedstock for clean hydrogen production.

2.1. Expand the regulatory language to ensure additional sources of RNG outside of landfill-derived renewable natural gas (LFG) are fully eligible. As a basis, we recommend expanding the eligibility to all sources including landfill, agricultural waste, and anaerobic digesters including the methane avoidance credit allowed in previous versions of the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model.

2.2. Working in tandem with credits for partial compliance under the three pillars of the PTC, allow pathways for RNG-to-hydrogen on portions of production at a hydrogen facility (i.e., "partial pathways"), with a separate 10-year crediting window enabled on each pathway, in light of the "first productive use" requirement on RNG sources.

2.3. Allow for an investment in a new RNG-production facility, from which RNG is dedicated either via direct-connection or via a book-and-claim mechanism to an existing hydrogen-production facility to satisfy the requirements of a qualifying capital modification for a qualified clean-hydrogen facility.

2.3.1. Under the proposed guidance, an H_2 production facility which currently does not qualify for 45V can qualify for 45V tax credits if the facility makes modifications "properly chargeable to the taxpayer's capital account." Notably, the guidance states, "Changing fuel inputs to the hydrogen production process, such as switching from conventional natural gas to renewable natural gas, would not qualify as a facility modification."

2.3.2. Our comments clarify that placing in service a new biogas facility which is intended to be dedicated to a hydrogen production facility should satisfy the statutory test which states that the modification must be "properly chargeable to the taxpayer's capital account."

2.4. Clarify the applicability of temporality and deliverability of RNG with the understanding that there are fundamental differences in the infrastructure when compared to electricity.

2.4.1. As the pipelines used by RNG are national, the deliverability issue described for electricity is not relevant. The California Low Carbon Fuel Standard (LCFS) requirement for "plausible deliverability" should be used here.

2.4.2. As biogas facilities continuously produce RNG, the temporal restriction is inherently met.

3. Concerns around the lifecycle analysis and facility eligibility, specifically associated with the new 45VH_2-GREET model.

3.1. Take into account natural gas with lower carbon intensity than average to incentivize deeper upstream decarbonization.

3.1.1. Currently, natural gas is a background parameter in the 45VH_2-GREET model. As a result, companies are not incentivized in 45V to invest in technologies and processes that reduce the carbon intensity of natural gas being used as a feedstock to produce hydrogen.

3.1.2. Incentivizing the reduction of greenhouse gas emissions from natural gas production will encourage the adoption of new technologies to avoid methane leakage, leading to greater overall greenhouse gas reductions.

3.2. Clarify the definition of "clean hydrogen" (i.e., point of production, purity, etc.)

3.2.1. We suggest a definition of produced hydrogen as: hydrogen is considered "produced" when it has market value and is in a state that is ready for final use requiring no further upgrading or purification.

3.3. Account for emissions associated with captured carbon that has been utilized similar to the treatment of CO_2 under Internal Revenue Code section 45Q.

3.3.1. The NPRM and the associated Argonne Labs 45VH_2-GREET model are inconsistent regarding utilized CO_2.

3.3.1.1. Prop. Reg. §1.45V-6(c)(3) provides an example of a qualified facility which is modified to "capture, process, and prepare carbon dioxide for transport for disposal, injection, or utilization."

3.3.1.2. Conversely, 45VH_2-GREET only models sequestered CO_2 and not utilized CO_2.

3.3.2. Air Liquide proposes similar treatment to section 45Q which does allow for utilized CO_2 to qualify for the credit.

3.4. Provide additional detail with respect to Provisional Emissions Rate (PER) pathway evaluations.

3.4.1. The clean hydrogen production facility investments being considered have long-term economic ramifications. Businesses need to understand whether or not pathways (or a new pathway) would qualify before making major investment decisions.

3.5. Clarify that 45VH_2-GREET model calculations made for a given facility at the time of claiming the credit can be "locked in" for the duration of a project.

3.5.1. This is consistent with how the California LCFS applies the GREET model and will provide companies with the clarity needed to forecast returns and make investment decisions.

3.6. Clarify how EAC's associated with battery storage are used under the hourly temporal requirements.

3.6.1. We recommend that energy stored qualify under the guidance based on when the power is used to produce hydrogen, and not when it was originally produced.

3.7. Clarify the 45VH_2-GREET "system expansion" approach for allocating emissions to various co-products.

3.7.1. The flexibility to choose an approved GREET methodology based on what makes the most sense in the context of the particular pathway is recommended (energy content, mass, etc.).

3.8. In the case of hydrogen produced by an AutoThermal Reformer (ATR), we recommend that the oxygen supplied to the ATR be treated as a feedstock. The current 45VH_2-GREET model does not have oxygen as a feedstock to an ATR, as it appears to assume that an Air Separation Unit (ASU) and ATR comprise a single integrated system. In practice, ATR operators very often choose to purchase their oxygen from a supplier, which can be supplied from a standalone ASU, oxygen co-produced from an electrolyzer, or a pipeline network system with a mix of oxygen production pathways.

3.9. Clarify the eligibility requirements for pre-existing facilities claiming PTC based on originally placed in service date.

Air Liquide's Detailed Comments

1. Need for flexibility and certainty in implementing the "three pillars" - temporality, incrementality, deliverability (Proposed Reg. §1.45V-4(d)(3)).

Overview:

Air Liquide supports a phased approach for the three pillars provided in Proposed Reg. §1.45V-4(d)(3), providing flexibility at an early stage to allow the hydrogen economy to develop and scale in the short term as a transition period before restricting them in parallel to the grid decarbonization. This type of approach would allow the twin objectives of advancing the hydrogen economy and achieving our environmental goals to be fully realized. The nascent industry faces two major challenges - access to low cost, high capacity factor renewable power and high engineering, procurement, and construction (EPC) costs (which will be addressed as scale builds). While the three pillars could eventually provide a regulatory framework that allows industry to grow and supports environmental goals, the strictest implementation immediately could imperil the construction of the first generation facilities and delay industry growth, hydrogen production, and make the widespread deployment of hydrogen cost-prohibitive for the customers who need it the most. This would directly undermine the essential goals of the hydrogen production tax credit. We also note that CO_2 savings that result when EACs are generated (renewable power displacing fossil power) should be offset against CO_2 emissions when fossil power is consumed for hydrogen production when considering the net impact on systemic emissions of electrolytic hydrogen.

1.1. Locking in, or "grandfathering", facilities that commence construction before 2030 into the same set of requirements for the duration of the applicable tax credit period:

It is imperative that to enable the desired environmental, economic, and equity goals of the IRA, private investment in hydrogen production must advance at scale and at an accelerated pace. Hydrogen project investments require stable market projections and assurance of regulatory stability to ensure the economics of the long term projects. Should Treasury move forward with the three pillars approach, Air Liquide recommends the implementation of a grandfather rule for first mover facilities to encourage early development and adoption of this technology. Therefore, Air Liquide requests that the IRS and Treasury consider locking, or "grandfathering" a project into the requirements in place when construction commences for the duration of the tax credit. Implementation of a grandfather rule, will give the private sector the certainty needed to commit the investment required to properly scale the clean hydrogen economy and build the requisite renewable infrastructure for achieving net-zero ambitions.

Companies are looking at investing billions of dollars to grow these hydrogen ecosystems, notably the Hydrogen Hubs. As responsible stewards of shareholders' funds, companies must be able to develop financial models to have these investments approved, and without grandfathering it is difficult to accurately model costs and provide the certainty needed to have investments approved. Therefore, the implementation of a grandfather rule would incentivize first movers to move quickly without adding undue financial uncertainty on the level of the credit that a project will get, in addition to linking hydrogen deployment with new renewable power generation – which in our experience will cause delays due to interconnection queues and permitting.

Grandfathering would establish the requisite long term certainty needed for first mover projects to advance, such as the Hydrogen Hub projects. This mechanism would allow for the buildout of critical infrastructure needed to transition to stricter temporal, incremental, and geographic requirements over time.

Air Liquide recommends the following addition to Prop. Reg. §1.45V-4(d)(3):

- Grandfathering first mover projects as outlined in the subsequent recommendations.

1.2. Temporal Matching (Proposed Reg. §1.45V-4(d)(3)(ii)):

For the clean hydrogen economy to reach its full potential, companies will need to invest significantly. To do so, they need long term certainty. Proposed Reg. §1.45V(d)(3)(ii)(A) proposes that the taxpayer's hydrogen production facility be required to match the renewable electricity used to produce hydrogen on an hourly basis. Furthermore, the proposed Reg. §1.45V(d)(3)(ii)(B) provides a transition rule to allow renewable energy generated before January 1, 2028 to satisfy the temporal matching requirement[1] if the renewable electricity used to produce hydrogen is generated in the same calendar year. Should Treasury move forward with this proposed regulation, companies will have to determine how to purchase hourly matched clean electricity starting in 2028 to justify their projects. In some markets, this option is not yet available and in those where it is, this is often cost prohibitive.[2]

Strict temporal matching requirements at the outset, hourly set to commence in 2028, is not compatible with the practical realities of the renewable energy market and its existing infrastructure, effectively stifling the development of the clean hydrogen market. Furthermore, the unpredictability of renewable energy poses a risk of availability on an hourly basis. Power from wind and solar has a typical capacity factor between 15 and 50%.[3] While, theoretically, electrolytic hydrogen production can similarly follow such power fluctuations, downstream customers require supply of hydrogen 24/7/365. This requires significant onsite storage of renewable electricity and/or 2-3X overbuild of the electrolysis capacity with hydrogen storage to meet these requirements in order to prevent the need for additional low-carbon power in the off hours. This would result in significant cost increases for clean hydrogen projects.

To spur the large scale investments needed for liftoff of the clean hydrogen economy, companies need predictability on their inputs. As the renewable energy market grows alongside the clean hydrogen market, it may be possible for the sector to comply with stricter temporal requirements. However, to incentivize first movers and ensure continued growth of the clean hydrogen market, Air Liquide recommends extending the transitional rule to projects that start construction before 2030, and the implementation of a grandfathering rule for said projects. Furthermore, should a transitional rule be implemented, Air Liquide recommends the transitional rule of quarterly matching to satisfy the temporal requirement, with increasing requirements for projects which begin constructions at later dates. This allows companies to make large scale financially viable investments to grow the hydrogen economy while also ensuring that renewable power continues to play a key role in clean hydrogen production.

[1] §1.45V(d)(3)(ii)
[2] https://media-publications.bcg.com/Green-Hydrogen-assessment-of-near-term-power-matching-requirements.pdf
[3] https://www.nrel.gov/docs/fy15osti/63038.pdf

Air Liquide recommends the following revisions to Prop. Reg. §1.45V-4(d)(3)(ii):

- Transitional rule of quarterly matching for projects which began construction before 2030.
- Implementation of a grandfathering rule for projects commencing before 2030.
  - When a project commences construction, they are locked into that level of temporal matching for the 10 year duration in which they claim the tax credit.
- Hourly matching for projects beginning construction on or after January 1, 2030.

1.3. Incrementality/Additionality (Proposed Reg.§1.45V-4(d)(3)(i)):

The development of renewable energy projects, storage, and transmission, are required to properly scale the clean hydrogen economy and build the requisite renewable infrastructure for achieving net-zero ambitions. Proposed Reg. §1.45V-4(d)(3)(i) proposes renewable energy generated for a hydrogen production facility must represent an incremental source, such as renewable energy generated from a renewable energy source that has a recent commercial operations date ("COD") or uprate no more than 36 months before the hydrogen production facility for which the renewable energy is used was placed in service. However, the limitation of only the use of new renewable energy could create a temporary supply/demand imbalance, which would have a significant impact on the immediate development of a clean hydrogen economy. Therefore, the IRS and Treasury should defer the implementation of an incrementality rule to projects commencing construction beginning on January 1, 2030, complying with a 36-month lookback rule with flexibility allowed for project delays. A phased approach (flexibility for incrementality early on) would help to smooth any supply/demand imbalance by allowing more supply initially and more time for new renewable energy production and storage projects to come online. Storage will be especially important when high proportions of renewable power are required under tighter temporal matching.

Air Liquide recommends the following revisions to Prop. Reg. §1.45V-4(d)(3)(i):

- Exemption from incrementality requirements for projects which began construction before 2030.
- Projects beginning construction beginning on January 1, 2030, would be required to comply with a 36-month lookback rule with flexibility allowed for project delays.
- Electricity generating projects retrofitted sufficiently to satisfy the so-called"80/20" rule should be considered "new build" under Prop. Reg. §1.45V-4(d)(3)(i)(A).
- Flexibility should be provided for projects in the event of delays which can occur between the launch of a project, interconnection and permitting timelines, the effective production date, and Power Purchase Agreement (PPA) signature dates.

1.4. Deliverability/Geographic (Proposed Reg. §1.45V-4(d)(3)(iii)):

CO_2 emissions are not a regional issue, but rather a global issue. The Proposed Reg. §1.45V-4(d)(3)(iii) proposes that companies be required to use renewable electricity generated within the same region as the hydrogen production. However, excessively difficult geographic limitations have the potential to impede the buildout of the national clean hydrogen market. As renewable energy production

proliferates, it will be possible to limit the physical distance between electricity generation and hydrogen production. In the short term, flexibility must be given to ensure the development of the clean hydrogen economy.

The biggest risk associated with deliverability restrictions is that projects will be less likely to be built in markets where the supply of renewable power is low or transmission infrastructure is constrained relative to other regions of the country. This could add additional costs to projects within regions without abundant clean power resources, causing missed opportunities on a national scale and an uneven distribution of investment and clean energy jobs.

Most utilities are in the early stages of adding renewable energy to their supply mix and due to the extensive regulatory timelines, lack the requisite capacity to meet industry's projected demand. This, together with siting and long interconnect queues, leads to pricing uncertainty that challenges project development which needs price and supply certainty in the early stages of development and siting. Strict regional requirements will lead to uneven development and buildout of renewable energy infrastructure, including clean hydrogen production. Tying back into initial flexibility, a phased approach to geographic restrictions is critical - starting broad as we allow energy infrastructure to develop then transition to stricter requirements. This will allow more clean hydrogen projects to develop and achieve greater CO_2 abatement.

Air Liquide recommends the following revisions to Prop. Reg. §1.45V-4(d)(3)(iii):

- For projects which begin construction before 2030, Energy Attribute Certificates (EACs) for electricity must be generated and retired within one of the six North American Electricity Reliability Corporation (NERC) regions.
- For projects beginning construction on or after January 1, 2030, EACs must be generated in the same geographic regions used in DOE's National Transmission Needs Study.

1.5. Once the three pillars take effect, we also seek the ability to claim partial credits for partial compliance. For example, producing hydrogen with qualified renewable power during 70% of the year will enable full $3/kg PTC during those 70% of the hours. This will encourage companies to continually seek additional hourly matched clean power.

The proposed annual aggregation of a production facility fails to address the complex markets, customer requirements, and efficient operation and utilization of production assets. Operational flexibility is a key to optimizing energy usage and market demands. In order to address this we request that Treasury allow taxpayers to claim the PTC for any duration of clean hydrogen production – not just an annualized aggregate.

The hydrogen credit should be determined with regard to each unit of hydrogen produced by a taxpayer, not with regard to all units of hydrogen produced in a given year as described in the proposed regulations. Hydrogen producers should be able to produce hydrogen with varying carbon intensities throughout the taxable year to optimize operations, accommodate customer requirements, and adjust to input availability, price, and quality. Particularly in light of the proposed hourly temporal matching requirements for EACs, clean hydrogen producers should be given the ability to bifurcate their clean hydrogen production into qualified and nonqualified quantities for purposes of claiming the tax credit. Clean hydrogen producers should not have to average the two to claim the credit.

Similarly, if annual matching is the requirement for clean hydrogen production claimed as qualifying in a given year, it should only need to be matched with the EACs acquired in that year, regardless of how well the production matches EAC acquisition. That same view should be held if, or when, an hourly matching requirement comes into effect.

Air Liquide recommends the following addition to Prop. Reg. §1.45V-4(d)(3)(ii):

- Once the three pillars take effect, allow for partial credit for partial compliance of the PTC. For example, producing hydrogen with carbon free power during 70% of the year will enable full $3/kg PTC during those 70% of the hours.

2. Clarify the applicability of renewable natural gas (RNG) usage as a feedstock for clean hydrogen production.

Overview:

Air Liquide applauds the Treasury's recognition of renewable natural gas (RNG) as a tool to decarbonize hydrogen production, and emphasizes that RNG will be an indispensable, "drop-in" solution to the nation's short-term, large-scale production of low-carbon hydrogen.

The DOE and Energy Information Administration (EIA) indicate that over 95% of the USA's commercial hydrogen production today is from established technologies that reform natural gas (fossil fuel) into hydrogen (i.e., steam methane reformers (SMR), autothermal reformers (ATR)[4]). RNG is physically identical to the natural gas fed to these reformers, and is injected at pipeline-specifications into the nation's distribution system. Importantly, on a lifecycle basis (i.e., from source to production), RNG carries negative-CO2-emissions (i.e., a negative carbon intensity) due to the fact it is captured and purified from waste sources and thus credited with avoided emissions of methane into the atmosphere. As such, negative-carbon RNG is a "drop-in" solution for the decarbonization of hydrogen production at reforming plants, in that it directly displaces emissions associated with the use of fossil-based natural gas. Furthermore, Air Liquide is participating in several of the DOE's Hydrogen Hubs, which intend to use RNG for decarbonization of reformer-based hydrogen production.

Today, the proposed guidance raises important issues on key matters for the use of RNG in hydrogen decarbonization. We urge that the guidance is developed in a way that does not restrict the potential for RNG to provide the immediate impact to hydrogen decarbonization in the U.S. described above. Unfortunately, this lack of clarity will also slow investment in new sources of RNG in the U.S. Air Liquide is pleased to see the inclusion of 12 questions by the Treasury specifically around RNG, which allow the RNG-community to provide key information that should ensure the final guidance is flexible enough to realize the full potential of RNG as an effective tool for the decarbonization of hydrogen. Several key topic areas and recommendations are summarized below for consideration by the Treasury.

[4] https://www.energy.gov/eere/fuelcells/hydrogen-fuel-basics

2.1. Expand the regulatory language to ensure additional sources of RNG outside of landfill-derived renewable natural gas (LFG) are fully eligible.

In Proposed Reg. §1.45V(c)(1)(B) the 45VH_2-GREET model includes eight hydrogen production pathways, including: (i) steam methane reforming ("SMR") of natural gas with potential carbon capture and sequestration ("CCS"), (ii) autothermal reforming ("ATR") of natural gas with potential CCS, (iii) SMR of landfill gas with potential CCS, (iv) ATR of landfill gas with potential CCS, (v) coal gasification with potential CCS, (vi) biomass gasification with potential CCS, (vii) low-temperature water electrolysis using electricity, and (viii) high-temperature water electrolysis using electricity and/or heat from nuclear power plants. However, the 45VH2-GREET model is silent on RNG derived from sources beyond landfills (e.g., dairy/swine/beef/poultry manure), which are significantly more potent in reducing carbon emissions.

Instead, the Treasury should leverage existing models already published by the DOE (Argonne Lab) that consider RNG from other waste sources, especially RNG derived from anaerobic digestion of agricultural waste (e.g., dairy, swine, beef, poultry manure), which carries the most negative carbon-intensities on a lifecycle basis, owing to recognition of avoided emissions for capturing methane released into the atmosphere by these sources. Such models include the parent GREET-1 model, of which a subset is the CA-GREET model currently utilized by California in its Low Carbon Fuel Standard ("LCFS").

While under Proposed Reg. §1.45V-4(c) the guidance contemplates a Provisional Emissions Rate (PER) for non-landfill RNG sources, it does not provide additional information needed for taxpayers to understand how the process will work or how the quantitative assessment of the PER will be made. This uncertainty makes it very difficult for long term investments in major clean energy projects, like RNG. Therefore, Air Liquide recommends that the final regulations expand the hydrogen production pathways in the 45VH_2-GREET model to include common technologies and feedstocks used to produce qualified clean hydrogen.

<u>Air Liquide recommends the following revisions to Prop. Reg. §1.45V:</u>

- Leverage precedent DOE-GREET models (e.g., CA-GREET used under CA's Low Carbon Fuel Standard program, or Argonne's R&D GREET1 Model for Hydrogen Production Pathways) to accommodate sources of RNG beyond landfills, given the chosen 45VH_2-GREET only explicitly contemplates landfill sources.
    - The Argonne's GREET1 Model for Hydrogen Production Pathways significantly expands the potential feedstocks beyond those acknowledged in CA-GREET, enabling more investment and rapid development of sources of RNG to support H_2 decarbonization. Notably, these include waste from beef and poultry.

2.2. Working in tandem with credits for partial compliance under the three pillars of the PTC, allow pathways for RNG-to-hydrogen on portions of production at a hydrogen facility (i.e., "partial pathways"), with a separate 10-year crediting window enabled on each pathway, in light of the "first productive use" requirement on RNG sources.

To decarbonize, a typical H_2 production facility (SMR, ATR) requires RNG production from several typical RNG facilities. The "first productive use" requirement imposes incrementality on RNG (i.e., that the RNG facility be new, in that the first productive use of the RNG will be the decarbonization of the hydrogen facility). These new RNG facilities each typically require 1-3 years to develop, build and bring online.

Therefore, the required number of RNG facilities would come online in a staged fashion over years. Those brought online in earlier years must monetize the RNG production to justify their respective investments, and given the "first productive use" rule proposed by Treasury, should be allowed to send the RNG to the hydrogen facility.

Air Liquide recommends the following revisions to Prop. Reg. §1.45V:

- Final guidance should allow an RNG facility to decarbonize a corresponding percentage of the total hydrogen production at a hydrogen facility (i.e., the total hydrogen production at a given facility will include a volume of clean hydrogen with 0.45 $kgCO_2e/kgH_2$ and a remaining volume of hydrogen that is not decarbonized, at for example 12 $kgCO_2e/kgH_2$, until the remaining RNG facilities are online and the RNG may be procured).
- Moreover, final guidance should allow a separate 10-year crediting window to apply for each RNG-to-hydrogen pathway that produces qualified clean hydrogen, even if on a portion of the total hydrogen production at a hydrogen facility.
- Final guidance should continue to allow blending of RNG with natural gas in a given RNG-to-H_2 pathway (i.e., the carbon intensity of the hydrogen should account for the carbon intensity of the percentage of the feedstock which is RNG).

2.3. Allow for an investment in a new RNG-production facility, from which RNG is dedicated either via direct-connection or via a book-and-claim mechanism to an existing hydrogen-production facility to satisfy the requirements of a qualifying capital modification for a qualified clean-hydrogen facility.

Section 45V(d)(4) provides that for purposes of Proposed Reg. §1.45V–6(a)(1), in the case of any facility that (A) was originally placed in service before January 1, 2023, and, prior to the modification described in section 45V(d)(4)(B), did not produce qualified clean hydrogen, and (B) after the date such facility was originally placed in service (i) is modified to produce qualified clean hydrogen, and (ii) amounts paid or incurred with respect to such modification are properly chargeable to the capital account of the taxpayer, such facility is deemed to have been originally placed in service as of the date the property required to complete the modification described in section 45V(d)(4)(B) is placed in service. Section 45V(d)(4) is effective for modifications made after December 31, 2022.

Proposed Reg. §1.45V–6(a)(2) would provide that an existing facility will not be deemed to have been originally placed in service as of the date the property required to complete the modification is placed in service unless the modification is made for the purpose of enabling the facility to produce qualified clean hydrogen and the taxpayer pays or incurs an amount with respect to such modification that is properly chargeable to the taxpayer's capital account for the facility. Proposed Reg. §1.45V–6(a)(2) would also provide that a modification is made for the purpose of enabling the facility to produce qualified clean hydrogen if the facility could not produce hydrogen with a lifecycle GHG emissions rate that is less than or equal to 4 kilograms of CO2e per kilogram hydrogen but for the modification. Proposed Reg. § 1.45V–6(a)(2) further states that changing fuel inputs to the hydrogen production process, such as switching from conventional natural gas to renewable natural gas, would not qualify as a facility modification for purposes of section 45V(d)(4)(B).

Air Liquide requests further guidance related to the modification provision, including expansion of the limitation provided in Proposed Reg. § 1.45V–6(a)(2). As mentioned above, Air Liquide applauds the Treasury's recognition of RNG as a tool to decarbonize hydrogen production, and emphasizes that RNG will be an indispensable, "drop-in" solution to the nation's short-term, large-scale production of low-carbon hydrogen. Overly restrictive regulations related to changing fuel inputs would stifle an important pathway for decarbonizing the most common form of domestic hydrogen production and would reduce critically needed investment in RNG. Also, there are existing hydrogen facilities where carbon capture investments are not economically feasible.These RNG investments assist in the ability for these existing hydrogen facilities to reduce their GHG emissions. As mentioned before, this capital investment will be significant as it typically takes more than one biogas/RNG facility to allow an existing hydrogen plant facility to qualify as a clean hydrogen facility.

Air Liquide recommends the following revisions to Prop. Reg. §1.45V:

- Adopt a rule to allow a taxpayer's capital expenditures on newly constructed RNG systems that feed either directly to a facility or into a natural gas pipeline, ultimately providing the fuel input to a hydrogen production facility, to qualify as a modification to the hydrogen production facility under section 45V(d)(4)(B).
    - This provision would also be similar in nature to previous provisions adopted by the IRS and Treasury on related sustainability incentives. For example, in the Treasury Regulations for section 45Q, the Treasury and the IRS adopted a provision under Treas. Reg. §1.45Q-2(g)(5) to allow a taxpayer to elect to include the cost of expenditures on a new carbon oxide pipeline solely for the purposes satisfying the 80/20 Rule on an existing carbon capture facility. Although the provision in Treas. Reg. §1.45Q-2(g)(5) applies to the 80/20 Rule rather than a mere modification to a carbon capture facility, it helps drive needed investments on existing carbon capture facilities by allowing a special-purpose broadening of eligible capital expenses beyond the traditional boundaries of a carbon capture facility.
    - A similar narrowly-tailored expansion of the capital expenditures eligible to constitute a modification of an existing hydrogen production facility would help drive similar investments intended to decarbonize existing hydrogen production facilities.

2.4. Clarify the applicability of temporality and deliverability of RNG with the understanding that there are fundamental differences in the infrastructure when compared to electricity.

The IRS and the Treasury state they intend to apply conditions that are "logically consistent with, but not identical to, the incrementality, temporal matching, and deliverability requirements for electricity derived EACs" for hydrogen production pathways that use RNG. However, the concern regarding induced emissions driving the incrementality, temporal matching, and deliverability requirements for EACs does not directly apply to the use of RNG certificates. The use of RNG to produce qualified clean hydrogen would simply induce more demand and production of RNG, which can be generated much faster than building additional renewable energy capacity.

Furthermore, imposing incrementality, temporality, and regionality restrictions on RNG sources disincentivizes use of relatively expensive RNG and fugitive methane in favor of fossil natural gas because of its lower cost and lesser administrative burden. The unintended result of extending the three

pillars to RNG would be to increase GHG emissions and decrease the feasibility of methane abatement through low-carbon RNG production.

Temporal regulations for RNG would add tremendous costs and project timeline delays. Unlike certain renewable electricity production facilities, RNG facility production is not intermittent in production (e.g. renewable electricity from wind turbines can only occur when there is wind, but landfill RNG facilities continuously produce RNG). The IRS and the Treasury should review how current markets are managed. RNG production does not change with day-to-day, much less hour-to-hour variations in demand, and so it does not face the same intermittency issues as wind and solar. As a result, the temporal restriction is inherently met. Moreover, the gas utility industry today already balances on a regular basis (e.g., monthly).

Given where typical waste-sources for negative-carbon RNG (e.g., especially from agricultural waste) are located throughout the country, any requirements on deliverability (regionality) will significantly limit the strong potential of RNG to decarbonize U.S. hydrogen. The RNG pipeline system is significantly different from the electric grid. Pipelines are fully integrated across the country. Furthermore, the RNG system is endowed with significant physical storage capacity, both through dedicated storage infrastructure as well as line packing – these infrastructure elements work in tandem to ensure robustness and deliverability against the seasonal and variable RNG demand throughout the country. Accordingly, it is "logically consistent" with EAC provisions to treat the entire U.S. pipeline system as a single region for book and claim eligibility. In addition, the appropriate region for book and claim should be defined as the North American interconnect pipeline grid.

Air Liquide supports the use of a book-and-claim system, as called out in the proposed guidance, which allows environmental attributes generated from remote RNG-production facilities to be retired at hydrogen facilities drawing natural gas from their local pipeline interconnects. The IRS and the Treasury should leverage the California LCFS requirement for "plausible deliverability" for purposes of determining "deliverability" under the final regulations.

Air Liquide recommends the following regulations for RNG used to produce qualified clean hydrogen under IRC 45V:

- Similar deliverability requirements be put in place as the California Low Carbon Fuel Standard's "plausible deliverability" model.
- No requirements for temporality as this is inherently met.

3. Concerns around the lifecycle analysis and facility eligibility, specifically associated with the new 45VH2-GREET model.

3.1. Take into account natural gas with lower carbon intensity than average to incentivize deeper upstream decarbonization.

Certain parameters in the GREET model are fixed assumptions (or "background data"). Examples of background data include upstream methane loss rates, emissions associated with power generation from specific generator types, and emissions associated with regional electricity grids. According to the Preamble, the IRS views such background data as parameters for which bespoke inputs from hydrogen producers are unlikely to be independently verifiable with high fidelity, given the current status of verification mechanisms. All other parameters are 'foreground data' and must be input by the user.

By categorizing upstream methane loss rates as "background data," low emissions intensity natural gas will not be recognized as a reduction to the lifecycle GHG emissions rate. Without the capability to account for upstream emissions the incentive for deeper decarbonization is removed, which would stymie the adoption of new technologies to avoid methane leakage from being adopted. Such a result will create a significant economic risk for many natural gas-based clean hydrogen production facilities, as well as create a substantial increase in the cost of the hydrogen production.

Upstream methane emissions can be an important contributor to the total carbon intensity of natural gas based production and needs to be appropriately accounted for in the pathway assessments. Process owners who can demonstrate that their feedstocks are sourced with lower carbon intensity than the 45VH_2-GREET model defaults should be eligible to credit this activity by enabling it as foreground data in the models. A certification process for such pathway improvements could be developed or, as in the case for other processes that fall outside of the GREET model defaults, a provisional (PER) pathway evaluation covering such activities should be enabled. Furthermore, congressional intent was clear that "indirect book accounting factors, also known as book and claim[5]" be applicable to both renewable power and biogas credits. It is important that final guidance creates consistency across all eligible energy feedstocks.

Air Liquide recommends the following revisions to 45VH_2-GREET Model:

- Allow for natural gas that is certified to be at a lower carbon intensity than the grid average to use that feedstock carbon intensity for the purposes of calculating their hydrogen carbon intensity.

3.2. Need for clarity on definition of "qualified clean hydrogen" (i.e., point of production, purity, etc.).

There is not a clear definition for "qualified clean hydrogen." This is particularly unclear for syngas and offgas hydrogen and needs to be addressed in the model. As an example, low-carbon syngas (a blended stream produced by an SMR or ATR consisting primarily of hydrogen as well as carbon oxides) can be used to synthesize low-carbon products such as methanol and acetic acid. Air Liquide suggests the hydrogen in such syngas be eligible for 45V, provided that the carbon dioxides in the syngas are indeed utilized rather than emitted (whereas the 45VH_2-GREET model assumes all such carbon oxides are emitted).

Air Liquide recommends the following revisions to Prop. Reg. §1.45V:

- We suggest a definition of produced hydrogen as: hydrogen is considered "produced" when it has market value and is in a state that is ready for final use (for instance as a process feedstock or transportation fuel) requiring no further upgrading or purification.

[5] 168 Cong. Rec. S4165-S4166 (Aug. 6, 2022) - https://www.govinfo.gov/content/pkg/CREC-2022-08-06/pdf/CREC-2022-08-06-pt1-PgS4165-3.pdf

3.3. Similar to the treatment of CO_2 under Internal Revenue Code 45Q, emissions associated with carbon which has been utilized should be accounted for.

Regarding carbon capture and utilization, there is inconsistent messaging on utilization of CO_2 between the tax guidance and GREET manual. Specifically, Prop. Reg. §1.45V-6(c)(3) provides an example of a facility which qualifies for 45V by making a modification to capture and utilize CO_2:

"Facts. Facility Y, a hydrogen production facility that was originally placed in service on February 1, 2020, could not previously produce qualified clean hydrogen as described in section 45V(c)(2). On February 1, 2026, Facility Y was modified to produce qualified clean hydrogen by adding new CCE to allow Facility Y to capture, process, and prepare carbon dioxide for transport for disposal, injection, or utilization."

Conversely, footnote 12 on page 11 of the GREET manual states that "45VH_2-GREET 2023 only models the permanent sequestration of carbon dioxide, as in Class II or Class VI injection wells. 45VH_2-GREET 2023 does not model other forms of carbon dioxide utilization (e.g., production of synthetic fuels)."

Allowing the utilization pathway in the GREET model would also be logically consistent with the 45Q program, which incentivizes disposal of CO_2 via industrial utilization (in addition to permanent storage). Alternatively, if CO_2 is utilized (rather than permanently stored) it would make sense to valorize it as a co-product to hydrogen production and allocate emissions accordingly by inputting the mass of the CO_2 utilized into the GREET model. The GREET manual states that impurities in hydrogen are assumed to be emitted, however, in practice this is not always the case as some processes utilize the CO_2 (or CO) impurities.

Air Liquide recommends the following revisions to 45VH_2-GREET Model:

- The GREET model be updated to be consistent with the tax guidance by allowing the user to model disposal of CO_2 via utilization.
    - Specifically, we recommend the following changes to the GREET manual (**suggested changes in red**):

      "In practice, hydrogen production facilities are likely to produce gas streams that are not 100% hydrogen because they contain ~~traces of~~ impurities (i.e., gases that are not hydrogen). To account for these impurities, 45VH_2-GREET 2023 requires users to input the chemical composition and quantity (mol%) of each impurity in the hydrogen product gas stream (after any purification that occurs at the hydrogen production facility), including the quantity of hydrogen (mol%). While the model is populated with several common impurities for users to select, if a user's hydrogen product gas stream contains an impurity not displayed, they must input the molar mass of that impurity next to the "All Others" category and then the respective molar concentration to ensure that it is accounted for in the well-to-gate analysis.
    - *45VH_2-GREET 2023 then levelizes the well-to-gate GHG emissions of the hydrogen production over only the kilograms of 100% pure hydrogen produced. Additionally, to complete the accounting of carbon life cycle, 45VH_2-GREET 2023's base assumption ~~assumes~~ is that any carbon-containing impurities in the gas stream will be eventually converted by the end user(s) to form CO_2e emissions, and accounts for these CO_2e emissions in the well-to-gate GHG emissions of hydrogen production, unless the user can demonstrate that such CO_2e impurities are not emitted to the atmosphere (i.e., either via*

industrial utilization or carbon capture capture and underground storage). ~~(The assumption that carbon-containing impurities will be converted to CO2 is based on current practices at industrial facilities that consume hydrogen, such as petroleum refineries and ammonia plants,5,6 as well as expected practices at potential future industrial facilities such as iron and steel making plants.7,8)~~"

- Allow hydrogen producers to specify in 45VH_2-GREET if impurities in the hydrogen are indeed utilized so they can be accounted for as an avoided emission for purposes of the hydrogen qualifying for 45V.

3.4. More detail needed on Provisional Emissions Rate (PER) pathway evaluation.

The investments being considered are long-term, multi-decade in length. Businesses need to understand whether or not pathways (or a new pathway) would qualify before making major investment decisions. Flexibility is needed to petition for a PER even if the technology and feedstock are already included in 45VH_2-GREET, as 45VH_2-GREET currently has substantial coproduct valorization limitations and an inability to account for CO_2 disposed of via industrial utilization.

Air Liquide recommends the following revisions to 45VH_2-GREET Model:

- Provide additional details on how the Provisional Emissions Rate pathway evaluation can be used.
- Allow for the usage of the PER even if there is an approved pathway available.

3.5. Clarification needed that GREET model calculations at the time of claiming the credit apply for the duration of a project.

A change in the GREET model halfway through a project's life has the potential to negatively impact the carbon intensity calculation and credit amount received. Given the scale of investment being considered and the major implications this could have on project economics, some sort of safeguard or mechanism should be put in place to allow for long-term certainty. This would be consistent with the California LCFS model.

Air Liquide recommends the following revisions to 45VH_2-GREET Model:

- 45VH_2-GREET model calculations made for a given facility at the time of claiming the credit can be "locked in" for the duration of a project.

3.6. Clarifying how EAC's associated with battery storage be used under the hourly temporal requirements.

Flexibility is needed in the timing by which hourly EAC's can be acquired for a given hour of generation/consumption matching. Storage in battery, should by definition convert "as available" power to 'on demand' power, effectively storing the renewable attribute.

Air Liquide recommends the following revisions to 45VH_2-GREET Model:

- Energy stored should qualify under the guidance based on when the power is used to produce hydrogen, and not when it was originally produced.

3.7. Comments on 45VH$_2$-GREET "system expansion" approach for allocating emissions to various co-products.

The initial 45VH$_2$-GREET is severely restrictive in terms of co-product allocations, only allowing for minimum options (such as oxygen co-produced via electrolysis and steam co-produced via SMR/ATR). Air Liquide recommends expanding the range of co-products that can be valorized in 45VH$_2$-GREET, particularly to include carbon-based co-products for SMR/ATR pathways such as CO, CO2, among others, as there are many industrial utilization applications for these co-products that prevent the carbon oxides from being emitted to the atmosphere. As these carbon oxides can have a market value (i.e. as products) and are not emitted, the 45VH$_2$-GREET model should have the flexibility to valorize them as co-products, which would be consistent with the intent of the legislation to minimize carbon oxide emissions, and logically consistent with the 45Q utilization incentive. As many potential co-products do not have an energy content, other methodologies such as a mass allocation should be allowed.

Air Liquide recommends the following revisions to 45VH$_2$-GREET Model:

- The final regulations provide flexibility to choose an approved GREET methodology based on what makes the most sense in the context of the particular pathway (energy content, mass, etc.).

3.8. Comments on 45VH$_2$-GREET ATR feedstock limitations.

We seek clarity on the treatment of the oxygen supply in the case of hydrogen production with an ATR. In this case, oxygen production should not be considered part of the qualified clean hydrogen production facility as the oxygen production and supply to the ATR is not functionally interdependent with the ATR hydrogen production. In practice, ATR operators usually purchase their oxygen from a supplier (i.e. as a feedstock), rather than vertically integrating to own and operate the ASU. In these cases, oxygen is produced in a standalone facility, owned and operated offsite, often fed by pipeline from multiple production facilities, may deploy a variety of oxygen production technologies, and shares no operational dependence with the ATR other than as its offtaker.

Accordingly, Air Liquide recommends that oxygen is treated as a feedstock similarly to electricity or natural gas with similar treatment in the lifecycle assessment of an ATR, or similarly to water as a feedstock to an electrolyzer. The current 45VH$_2$-GREET model does not have oxygen as a feedstock to an ATR, as it appears to assume that an air separation unit (ASU) and ATR comprise a single interdependent system. Specifically, the 45VH$_2$-GREET model should be updated to allow for a third party oxygen supplier to evaluate the carbon intensity of the oxygen supplied.

Flexibility in accounting for oxygen production carbon intensity would incentivize oxygen suppliers to minimize carbon intensity through a range of production technologies, specifying the energy sourcing mix, co-producing nitrogen and argon (valorized via an allocation methodology such as mass, displacement, etc), electricity, or other products. As an example, oxygen produced via an air separation unit versus oxygen produced via electrolysis (as a coproduct to hydrogen) could have very different carbon intensities.

Air Liquide recommends the following revisions to 45VH$_2$-GREET Model:

- We recommend that the oxygen supplied to the ATR be treated as a feedstock.

3.9. Clarify the eligibility requirements for pre-existing facilities claiming PTC based on originally placed in service date.

The initial guidance limits the construction of qualified clean hydrogen production facilities to before 1/1/2033. It is not clear on how existing facilities are treated and the date under which such facilities become eligible for the 10 year PTC term. Some guidance on existing facilities is referenced in the "amount of credit" section where it is set forth that credit amounts are calculated based on the kilograms of qualified clean hydrogen produced by the taxpayer during such taxable year at a qualified clean hydrogen production facility during the 10-year period beginning on the date such facility was originally placed in service.

It is clear that for existing facilities not producing clean hydrogen before 2023 and hoping to achieve a full 10 year PTC term, the facility will need to go through facility "modification". However, it is not clear as to how this applies to existing facilities that are NOT seeking a full 10 year term but rather looking to claim the tax credit for the remaining years of a 10 year window from when the facility was first placed in service.

Air Liquide recommends the following revisions to Prop. Reg. §1.45V:

- We seek clarity on existing facilities originally placed in service before 1/1/2023 that are eligible for claiming PTC without a “modification” for the remainder of the 10 year term based on the originally placed in service date.

Conclusion

Thank you for your time and consideration of this comment letter. The concerns identified above have direct impacts on Hydrogen Hubs. Air Liquide is concerned that if the proposed guidance goes into effect as is, then the Hydrogen Hub program and other clean hydrogen projects will not develop at the scale needed to meet the President’s goals for clean hydrogen.

With our expertise in domestic and global hydrogen markets, our technology offerings in the areas of hydrogen production, gas distribution, and carbon capture, and our history of establishing strong partnerships with the DOE and energy market stakeholders, we offer our assistance to the Department of Treasury as final guidance for 45V is considered. For more information and follow-up please contact me or our Vice President of Government Affairs, Joe Fawell at Joe.Fawell@airliquide.com.

Respectfully,

Anh Kim
Vice President, US Tax