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Comments on the Proposed Rule: Section 45V Credit for Production of Clean Hydrogen

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I. Treasury can make a profound impact on America's net zero trajectory by facilitating the growth of environmentally responsible RNG through its 45V regulations.

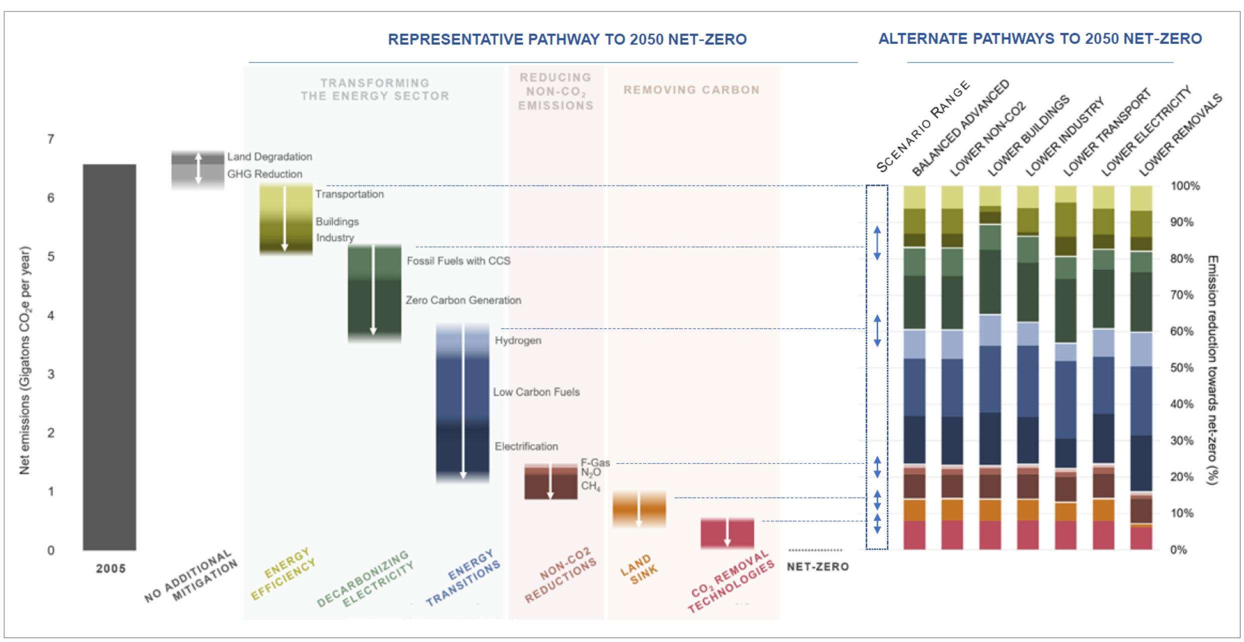
A. The U.S. roadmap to a zero-emissions future by 2050 is based on five key strategies: enhancing energy efficiency, decarbonizing electricity, transitioning energy uses, reducing non-CO2 gases, and increasing CO2 removal.

The "Long Term Strategy of the United States - Pathways to Net-Zero Greenhouse Gas Emissions by 2050" (the "Long-Term Strategy") lays out how the United States can deliver net-zero emissions across all sectors and GHGs through multiple pathways, but all viable routes to net-zero involve five key transformations:

- *Energy efficiency*: cutting energy waste through efficiency improvements,
- *Decarbonizing electricity*: decarbonizing the electricity sector with a goal of 100% clean electricity by 2035,
- *Energy Transition*: electrifying end uses while switching to clean fuels for hard-to-electrify sectors,
- *Non-CO2 reductions*: reducing methane and other non-CO2 emissions with a commitment to significant cuts by 2030, and
- *CO2 removal*: scaling up land carbon sinks as well as CO2 removal techniques to address residual emissions.

This multifaceted approach combines advancements in renewable energy, energy efficiency, cleaner fuel alternatives, and carbon removal technologies to address climate change comprehensively.

Figure ES-2 from the Long-Term Strategy, reproduced below illustrates how the five key transformations can combine in different pathways to achieve net zero emissions by 2050.



The Long-Term Strategy makes clear, that although the exact pathway will depend on how quickly change occurs across different sectors:

> "some broad patterns are clear. For example, energy system transformations contribute roughly 4.5 gigatons of CO2 equivalent per year (Gt CO2e/yr.) of overall emissions reductions, or about 70% of overall reductions. These energy emissions reductions are delivered by cutting energy waste, decarbonizing electricity, and transitioning energy sources including through fuel switching and electrification. Addressing non-CO2 gases, including methane, nitrous oxide, and fluorinated gases, reduces another 1 Gt of annual emissions. Enhancing land sinks and scaling up CO2 removal technologies also deliver about 1 Gt of negative emissions. While these figures are a helpful rough guide, the exact contribution from each area varies between pathways (as shown in Figure ES-2). The eventual U.S. pathway to net-zero emissions will depend on the evolution of technologies, the specifics of policy and regulatory packages, and factors such as economic growth, sociodemographic shifts, and market prices for commodities and fuels across the next three decades."

B. Bioenergy plays a crucial, multi-faceted and ambitious role in America's net-zero strategy, driving 25% of emissions reductions through low-carbon fuels, biogenic carbon supply, and CO2 removal.

Bioenergy based processes play a pivotal role in America's plans for net zero through three distinct pathways:

- Generating bio-based low carbon fuels, especially for hard to abate applications;
- Supplying biogenic carbon for additional production of low carbon fuel; and
- Delivering atmospheric CO2 removal– where bioenergy carbon capture and storage (BECCS) and biomass carbon removal and storage (BiCRS) represent the most cost-effective routes for engineered carbon dioxide removals.

Collectively, these strategies underpin roughly 25% of the reductions outlined in the Long Term Strategy, surpassing the average contributions from decarbonizing electricity (~22%), energy efficiency (~17%) and hydrogen and hydrogen based fuels (~14%).

These goals are very ambitious: requiring over 80% of America's billion tons of potentially available cellulosic biomass to be used for producing low carbon fuels for hard to abate sectors (~7 EJ/yr) together with capturing almost all of the waste CO2 generated from this low carbon fuel production for delivering biogenic carbon for hydrogen based fuels and carbon dioxide removal (~1 Gt/yr).

C. By ensuring its 45V regulations bolster environmentally responsible RNG, Treasury will significantly advance America on its path to net zero.

For America to meet its net zero targets, it must pivot its bioenergy production away from food and feed-based crops toward cellulosic biomass, the sole resource capable of providing the necessary scale for net zero ambitions. The question arises: what technologies will facilitate the conversion of this biomass into low-carbon fuels? Currently, RNG stands out, comprising more than 99% of the nation's cellulosic biomass fuel production and primarily made from landfill gas and manure. RNG also provides a platform for converting the most abundant cellulosic materials, such as corn stalks and wheat straw, into hydrogen and other low-carbon fuels essential for tackling the toughest sectors to decarbonize.

The Inflation Reduction Act, with its 45V clean hydrogen credits, promises to be a catalyst for this crucial shift. We urge Treasury to craft the final rule for clean hydrogen in a way that supports the scalable, practical, and entirely environmentally responsible expansion of biomass-based RNG. This approach represents one of the most significant levers Treasury can use to steer America towards its net zero objectives.

II. Treasury can and must develop an entirely environmentally responsible way to track and verify RNG transfers via existing natural gas pipelines.

A. The use of existing natural gas pipelines for RNG transfer is critical to its efficient and environmentally friendly nationwide deployment.

Leveraging existing common-carrier natural gas pipeline infrastructure for transporting RNG is essential for its widespread deployment. This approach not only ensures a smooth and cost-efficient integration of RNG into the national energy portfolio, it also avoids the financial and environmental costs associated with constructing new infrastructure or resorting to less efficient transport methods. Without access to this network, it would be essentially impossible, for example, to build an RNG plant in Minnesota to supply a clean hydrogen facility in Texas.

The pre-existing network of natural gas pipelines offers a direct link between RNG producers and clean hydrogen facilities, facilitating a rapid, geographically broad market entry for RNG while still delivering legitimate incremental carbon reductions for clean hydrogen producers. With access to the national pipeline network, RNG can generate economic benefits around the country, enabling regions without clean hydrogen facilities to engage in the clean hydrogen economy. Moreover, leveraging existing pipelines minimizes RNG's environmental footprint by eliminating the need for new construction and reducing reliance on less eco-friendly transportation options.

The strategic use of current pipeline infrastructure is, therefore, a crucial factor in advancing RNG's role in helping deliver net zero, in line with the Inflation Reduction Act's environmental objectives.

B. Treasury has proposed to implement a book-and-claim system for tracking RNG environmental claims, yet has expressed concerns about whether the system is effective enough to be used for RNG transported via the existing natural gas pipeline network.

Treasury has indicated its intention to use a book-and-claim system for tracking and verifying environmental claims for RNG, which would apply for both RNG transferred to a hydrogen plant via a "direct" dedicated pipeline as well as via a "non-direct" use of the existing natural gas pipeline network. But Treasury has also expressed a number of concerns about whether a book-and-claim system is adequate for tracking RNG transported over the existing natural gas pipeline network. These include uncertainty relating to:

- pipeline leakage;
- tracking; and
- verification

This puts the entire viability of using RNG for clean hydrogen production in a precarious position. Treasury is committed to the use of a book-and-claim system but is still considering whether it will even permit this system to be used for tracking and verifying the environmental benefits of RNG transported by the existing natural gas pipeline network. In fact, Treasury has put consideration of pathways using that network on hold until final rules are issued, indicating that:

> While it will allow taxpayers to *"determine a lifecycle GHG emissions rate for hydrogen production pathways using landfill gas by using 45VH2–GREET in cases in which the hydrogen production facility is receiving RNG through a* *<u>direct dedicated pipeline connection</u>* *and measurement using a revenue grade meter. The PER process will* *<u>not address other hydrogen production pathways</u>* *using biogas and RNG until after the final regulations are issued."*

C. Even if Treasury concludes a book-and-claim system cannot adequately track and verify the environmental benefits for RNG transported via the existing natural gas pipeline network, there are other approaches that have proven to be effective and are in operation in the U.S. and abroad today.

The book-and-claim system Treasury intends to deploy is only one of many "chain of custody" models for tracking renewable energy transfers. These models offer different approaches to tracking and verifying sustainability claims in renewable fuel supply chains including, from least to most robust: book-and-claim, mass balance and identity preservation. Each model provides a different level of traceability, flexibility, and potential for credible sustainability claims:

> *<u>Book-and-claim model</u>*. The book-and-claim model (typically used for electricity) enables companies to generate certificates for the sustainable materials they produce upon entry into the commercial grid, and then trade the certificates through a registry. Neither traceability nor physical connection between certified sustainable supplies and final products are required. Sustainable certificate are traded completely independently of the energy commodity, rewarding producers of sustainable materials while allowing corporations to make sustainability claims regardless of actual sustainable material content or even physical purchases. This approach offers the lowest barrier to entry and maximum flexibility but is broadly believed to have the highest risks of allowing false or misleading environmental claims. It is often denigrated as a means by which polluters can buy their way out of compliance with nebulous offsets.
>
> *<u>Mass balance model</u>*. A mass balance model keeps the physical energy commodity and its environmental attributes bundled. It also allows certified sustainable supplies to be mixed with fungible fossil-based materials during production, storage and transportation. Detailed bookkeeping tracks the specific amount of sustainable material (with attributes) injected into an overall "mass balance system" (which, for example, might be a connected natural gas pipeline network) and requires that this injected physical quantity (with attributes) match the physical quantity (with attributes) of any material withdrawn from the mass balance system for which sustainability claims are made. Certificates are typically generated after delivery of the physical commodity (with attributes) to its targeted end us following verification of all the applicable paperwork – but can also be generated earlier in the process.
>
> This enables gradual sustainability transitions that can take advantage of existing infrastructure and offers flexibility in sourcing; but it requires more demanding direct one-to-one physical transactions of material that must be coupled with matching exchanges of environmental attributes. Ultimately companies can identify the specific source of the "sustainable material"

they receive along with the path that is has travelled, enhancing integrity. But this "sustainable material" is not the actual physical product that was injected into the mass balance system. Rather, it is a matching amount of an identical physical product.

The mass balance model, because it offers both physical integrity and an ability to use existing infrastructure, has become the standard way of tracking RNG transactions and is used in North America for transactions under both the Federal Renewable Fuel Standard (administered by EPA) and the California Low Carbon Fuel Standard (administered by CARB)[1], as well as globally for transactions under the European Renewable Energy Directive (administered by Member States, approved certification systems and 3rd party auditors) and the U.K.'s Renewable Transport Fuel Obligation (administered by the UK Department for Transport, approved certification systems and 3rd party auditors).

Identity preservation. The identity preservation model uniquely tracks actual sustainable molecules without allowing any mixing from source through final product. This enables the most robust claims and inspires the greatest trust but also demands the strictest separation controls and extensive monitoring at all chain stages, limiting flexibility and requiring higher costs – making many potential transactions impossible. Treasury's current short-term approach of only considering RNG that has been transported via a direct dedicated pipeline between an RNG supplier and its clean hydrogen customer is a functional identity preservation system. This system has the disadvantage that it is impractical often and limits adoption of real GHG-savings solutions.

Of these systems, the mass balance system is the most widely used and has proven to be an effective way to verify the integrity of environmental claims around RNG, while still enabling industry growth.

More information on chain of custody models is available here, here, here, here, here and here

D. The benefits of the direct, dedicated pipeline model that Treasury believes is acceptable for RNG transfers can be replicated using the existing natural gas network.

Treasury has indicated its comfort with cases where a clean hydrogen facility is receiving RNG through a direct dedicated pipeline connection with measurement using a revenue grade meter. At the same time, it put a hold on consideration of hydrogen production pathways that use RNG transferred through the existing natural gas pipeline network. Based on the NPRM, this choice has been driven by concerns about whether book-and-claim systems can successfully track and verify the environmental benefits of RNG transferred over the existing natural gas pipeline network – whereas for a direct dedicated pipeline connection, it's crystal clear who both the supplier and user of RNG are, these parties' operations can be

[1] While CARB refers to its LCFS practices for RNG as "book-and-claim accounting", they can more properly be described as following a mass balance model. Their system does not keep a registry of injected RNG like there is for electricity but does have a reconciliation of volumes on the physical pipeline network, credits are generated after use, and there is chain of custody integrity across the supply chain because of its coupled with the RFS system, which requires chain of custody control using a mass balance system.

audited and the exact production of RNG can be measured and matched to the intake of RNG at the clean hydrogen facility. [2]

But all of these advantages can be replicated using the existing natural gas pipeline network through a simple arrangement between an RNG supplier and a clean hydrogen producer, illustrated as follows:

- a clean hydrogen producer acquires RNG, together with a right to all its environmental attributes, from an RNG facility at that RNG facility's site;
- the clean hydrogen producer then injects the RNG into an existing natural gas pipeline network, measuring the injection with a revenue grade meter;
- the clean hydrogen producer then withdraws a matching amount of gas from a connected part of the same natural gas pipeline network, measuring the withdrawal with a revenue grade meter;
- the clean hydrogen producer also attests that it has only used the environmental attributes acquired from the RNG producer for use with the measured amount of gas it withdrew from the connected pipeline system, and that attestation is confirmed by a third-party auditor.

Just as in the case of a direct dedicated pipeline connection, it's now crystal clear who both the supplier and user of RNG are, these parties' operations can be audited and the exact production of RNG can be measured and matched to the intake of RNG at the clean hydrogen facility.

As a result, if Treasury is willing to permit direct dedicated pipeline transfers of RNG, it should, at minimum, also permit a clean hydrogen producer to purchase RNG (with all its environmental attributes) at the producer site and then manage transportation using the interconnected natural gas infrastructure as a "mass balance system" to transfer the RNG between the injection and withdrawal points. Such a limitation, while not ideal, would still be workable given that it mimics a common approach for current RNG transactions

This direct point to point, mass balance approach offers a backstop that could still permit use of the existing natural gas pipeline system even if Treasury concludes that book-and-claim systems are not ready to be generally applied to tracking non-direct use of RNG.

E. If Treasury concludes the book-and-claim system it is considering cannot adequately track and verify the environmental benefits of RNG, its concerns may be resolvable by adding robust "mass balance" requirements

Adding a mass balance requirement for RNG to the planned EAC system would: significantly strengthen the integrity of tracking and verification and align the 45V system with the most common approach for managing RNG chain of custody. The following is an illustration of some of the types of modifications to the proposed rule that might be useful:

[2] Treasury also noted a concern in the NPRM about uncertainty of pipeline leakage for RNG transfers over the existing natural gas pipeline network. We address this point in more detail under Sec III, but suffice to say here that uncertainty about methane leakage from the natural gas pipeline system: is equally applicable important to the use of natural gas for clean hydrogen as it is to RNG; and has been reviewed and assessed by the Argonne National Laboratory and accounted for in the background data of the existing 45VH2-GREET model. There should be no reason why uncertainty about potential regional differences in pipeline leakage over the existing natural gas pipeline grid should disqualify RNG without also disqualifying the use of natural gas delivered over the same grid, which faces the same uncertainty.

- An EAC for RNG (representing the environmental attributes[3] of an amount of RNG) may only be traded with the underlying RNG it represents.

- An Eligible EAC for RNG might also include requirements for:

(A) A third-party engineering review of the biogas production and RNG production facilities in conformance with RFS regulations for Biogas derived Renewable Fuel, 40 CFR Part 80 Subpart E: 80.135(b)(3), and 80.135(c),(d),(e), and (f) (link: eCFR :: 40 CFR Part 80 Subpart E -- Biogas-Derived Renewable Fuel)

(B) A supplement to the third-party engineering review in item (A), including the following information from operating data:

a. The COD of the RNG production facility
b. The amount of electricity used per MMBtu of production;
c. The amount of natural gas used per MMBtu of RNG production;
d. The amount of un-combusted methane released to the atmosphere;
e. Quantities of carbon dioxide captured and sequestered; and
f. Any other data that is specific to the RNG production facility's provisional emissions rate (PER), if separately issued.

(C) Information, including attestations subject to third party verification, relating to the RNG represented by the EAC:

a. The quantity of RNG, in MMBtu, of such consignment
b. Injection information:
    i. The facility that produced the RNG
    ii. The starting and finishing date range during which the consignment of RNG was injected into the commercial distribution system
    iii. Third party meter readings, in MMBtu, equalling the sum of the RNG and any fossil fuel injected between such starting and finishing date range
c. Matching withdrawal information
    i. The starting and finishing date range during which the consignment of RNG was withdrawn from the commercial distribution system
    ii. Third party meter readings, in MMBtu, equalling the sum of all RNG and any fossil fuel withdrawn between such starting and finishing date
d. Storage information:
    i. If the injection and withdrawal are not in the same month, then records demonstrating that an equal quantity of gas was stored in a gas storage facility connected to the commercial distribution system.
    ii. and the taxpayer, including the name, the [IRS registration number]
e. Confirmation of no double claiming, subject to attestations and third party verification.

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[3] The term ***environmental attributes*** means, in respect of RNG, any credits, benefits, offsets or allowances, howsoever entitled, that are attributable to the renewable nature or lifecycle emissions of RNG and are transferable, including Renewable Identification Numbers (RINs) as described in 40 CFR 80.1401.

III. Methane leakage from pipeline transfers of natural gas and RNG should be assessed consistently and in accordance with GREET.

A. GREET uses the best available scientific data to quantify methane leakage in natural gas pipelines – this reflects national averages without site specific differentiation.

Under the provisions of 45V, the GREET model is utilized to determine the lifecycle emissions rates of clean hydrogen production, establishing a standardized approach for assessing various hydrogen production processes.

Within the current framework of the 45VH2-GREET model, methane leakage rates from upstream natural gas production and pipeline transmission are set as fixed background parameters. These background parameters are based on extensive investigation by the Argonne National Laboratory and its numerous collaborators. Nonetheless, they reflect national averages, without site specific differentiation. The estimates for pipeline transmission, for example, are fixed amounts per MMBtu and do not depend on "distance between injection and withdrawal points".

This approach to quantifying methane leakage rates is physically reasonable, practical and the best that is possible with currently available information.

B. Determining site-specific methane leakage from new gas injections into the North American will be a daunting challenge.

Given the complexity of North America's integrated natural gas transmission network, there is no easy answer for how to determine the specific amount of incremental methane leakage that might be caused by new gas being injected into the grid in one location and a matching amount of gas being withdrawn for a new use in a separate location. This will depend on numerous factors including:

- How gas flow rates in the grid will rebalance based upon injection in one location (where the actual gas injected will tend to serve nearby users) and withdrawal in another location (where the actual gas withdrawn will tend to be supplied by nearby gas sources); and
- The marginal leakage rates on each segment of the grid in which flows have been affected by this rebalancing.

As a result, there is no reason to think that the "distance between injection and withdrawal points" will be correlated with the marginal amount of methane leakage. For example, if new gas is injected in a region far from natural gas production sites and a matching amount of gas is withdrawn for a new use a long way away in an area of plentiful gas production, the average methane leakage on the natural gas grid might decrease, rather than increase. This could occur because the amount of long-distance transmission required of the grid would be reduced, even though the distance between injection and withdrawal sites is very large. Under these circumstances, it is entirely possible that such new gas injection and withdrawal could reduce, rather than increase the grid's net methane leakage rate.

To make matters even more complex, one should not expect these factors to remain static. As the structure of the grid and its sources and uses of gas shift over time, the nature of grid rebalancing will shift, changing marginal methane leakage rates. Furthermore, we should expect leakage on different parts of the grid to reduce over time as various methane abatement measures are implemented.

C. Treasury is right to ask for public input on verification methods that could allow methane leakage rates to become foreground date in future iterations of the GREET model.

Nonetheless, the NPRM rightly recognizes that GREET could potentially take variances in emissions across the grid into account in determining life cycle GHG emissions. Consequently, Treasury has sought public input on the development and readiness of verification mechanisms that could enable certain background data, like methane leakage rates, to be made foreground data in future iterations of the model. Such a shift would not only recognize the efforts of operators achieving below-average methane emissions through responsibly sourced natural gas but also ensure the model's adaptability to evolving verification standards.

D. The risk of variation in methane leakage across the existing natural gas grid is the same for RNG and natural gas

The problem of estimating methane leakage rates for site specific RNG use is absolutely 100% identical to the problem of estimating methane leakage rates for site specific natural gas use.

In addition, there is also no basis to consider a unit of methane leakage resulting from transmission of RNG over the grid to be any more or less consequential than that of a unit of methane leakage from the transmission of natural gas over the grid. In each case, given the identical yield of hydrogen from RNG and natural gas feedstocks, a gram of CH_4 emissions per million Btu of either RNG or natural gas will have exactly the same impact on the life cycle GHG emissions rate of hydrogen produced, measured in kilograms of CO2e per kilogram of hydrogen.

Since GREET uses a national average baseline for methane leakage, variations in methane leakage across the natural gas grid could mean that the actual site-specific emissions from transporting a fixed amount of RNG or grid natural gas might be higher or lower than the GREET numbers. But the risk is identical, the consequences are identical and the GREET background data is the best we have.

E. Treasury's questions about assessing methane leakage associated with RNG hint at the possibility that it would treat low emission RNG less favorably than baseline natural gas. This would be entirely inappropriate.

Treasury has asked the following question relating to the transmission of RNG:

> *(10) How should variation in methane leakage across the existing natural gas pipeline system be taken into account in estimating the emissions from the transportation of RNG or fugitive methane or establishing rules for RNG or fugitive methane use? How should methane leakage rates be estimated based on factors such as the location where RNG or fugitive methane injected and withdrawn, the distance between the locations where RNG or fugitive methane is injected and withdrawn, season of year, age of pipelines, or other factors? Are data or analysis available to support this?*

In answer to each sub-question:

How should variation in methane leakage across the existing natural gas pipeline system be taken into account in estimating the emissions from the transportation of RNG or fugitive methane or establishing rules for RNG or fugitive methane use?

When adequate verification methods are available, the potential for variation in methane leakage across the existing natural gas pipeline system should be addressed through updates of the 45VH2-GREET model that permit the current background data for transmission leakage of methane to be made foreground data. Until such verification methods are available, methane leakage estimates should be based on the applicable 45VH2-GREET background data. The same methodology should be used for natural gas, RNG and fugitive methane transmission.

How should methane leakage rates be estimated based on factors such as the location where RNG or fugitive methane injected and withdrawn, the distance between the locations where RNG or fugitive methane is injected and withdrawn, season of year, age of pipelines, or other factors?

This should be the subject of future research by the Argonne National Laboratory and its collaborators. At this juncture, the 45VH2-GREET model's applicable background data offers the best scientific assessment of methane leakage rates.

Are data or analysis available to support this?

Subject to any new information Treasury may receive through public comment, we believe the work of the Argonne National Laboratory and its collaborators represents the best overall scientific assessment of the current state of knowledge on methane leakage rates in the natural gas pipeline system.

IV. The risk of undesirable indirect emissions effects from geographic or temporal mismatches between sources and uses is very low for RNG because the marginal source of methane is the same at all times of the day, in all seasons of the year and in all regions of North America. It is natural gas.

A. Aligning the supply and use of renewable electricity both geographically and temporally is crucial for preventing indirect emissions, which arise from differences in the emissions profile of the marginal power displaced by the renewable electricity supply versus that drawn by the clean hydrogen use.

Treasury has rightly identified the risk that geographic or temporal mismatches between sources of renewable electricity and unmatched uses of electricity in hydrogen production could lead to significant "unanticipated" indirect emissions.

<u>*Geographic matching for electricity:*</u> Geographic matching, for example, is critical for accurately accounting for the emissions impact of grid-connected electrolyzers under the 45V clean hydrogen production tax credit. This is because of the inherent differences in marginal emissions rates across the U.S. power grid. The fundamental issue is that changes in electricity supply and demand have differing emissions outcomes depending on where they occur on the grid.

Consider an electrolyzer built in Colorado that contracts with a new wind farm in wind-rich Texas to meet its power needs. On the surface, this appears like a clean arrangement. However, due to transmission constraints, the electrolyzer's new demand in Colorado might compel local coal or gas plants to ramp up to meet it. Conversely, additional wind generation in Texas might actually fail to displace fossil fuels because of the surplus of local renewable electricity. The net outcome would be an increase in fossil generation and emissions, contrary to the intent of 45V.

This emissions "leakage" can happen between any two grid regions with limited transmission connectivity because marginal emissions rates inherently differ - coal still sets the marginal rate sometimes in the Midwest while gas does so in California. Negating these regional differences requires adherence to regionality principles under 45V guidance. Bounding project pairings within smaller balancing areas or zones ensures the clean power is truly incremental and helps guarantee emissions reductions.

Put simply, if marginal emissions rates were uniform nationally, electrolyzers could source electricity from anywhere without emissions increases. But with current regional variability, alignment is essential for emissions integrity. Localized matching provides the guardrails for ensuring additional clean electricity displaces fossil generation rather than other clean power because of congested interfaces. Regionality principles thus uphold 45V's aim to grow low-carbon hydrogen without increasing grid emissions.

Temporal matching for electricity: Similarly, time matching principles are also critical for accurately accounting for the emissions impact of grid-connected electrolyzers under the 45V clean hydrogen production tax credit. Fundamentally, this is because of inherent differences in marginal emissions rates across different times of the day on the U.S. power grid. The key issue is that changes in electricity supply and demand have vastly differing emissions outcomes depending on when they occur as the grid mix fluctuates.

Consider an electrolyzer that contracts with a solar farm sized to match its annual power consumption but runs continuously around the clock. During daylight hours when solar is generating, the excess solar electricity from the solar farm, over and above the electrolyzer's needs, may displace some fossil fuels, but it may also some other renewable power. During the evening and overnight when solar switches off and the electrolyzer keeps operating, grid operators will have to ramp up fossil fuel plants to compensate for 100% of the continued electrolyzer load.

This means the emissions savings from the solar farm's excess capacity during the day (when the emissions of the marginal electricity supply are low because the grid may, on the margin, be supplying renewable power) will not be able to offset the emissions attributable to the electrolyzer's electricity demand during solar off-peak times (when the emissions of the marginal electricity supply are much higher because the grid is supplying 100% fossil based electricity). As a result, without the time-matching principle, grid-connected hydrogen production could significantly increase GHG emissions even with arrangements for annually matched renewable electricity contracts.

Essentially, marginal emissions rates of power vary widely across hours of the day as the composition of grid generation fluctuates. Ensuring emissions integrity thus requires matching electrolyzer operations to contracted renewable generation on an hourly basis. This time-based linkage makes sure emissions reductions directly result when renewable electrons power electrolysis.

If time differences in marginal rates did not exist, then time boundaries would not matter. But given today's reality, temporal matching principles are foundational for responsible 45V deployment.

B. Unlike electricity, RNG benefits from there being a stable source of marginal gas on the natural gas grid—natural gas—making geographic and temporal matching less critical for emissions

Geographic and temporal matching for RNG: The situation for renewable natural gas is completely different. Unlike the electricity grid, where both the source and emissions intensity of marginal electricity supply varies across time and geography, the natural gas grid has only one source of marginal gas – that is natural gas. Natural gas is and will continue to be the sole source of marginal gas supply on the natural gas grid for the foreseeable future because:

- Unlike any individual source of power on the electric grid, natural gas plays an absolutely dominant role in the supply of gas to the natural gas grid;
- Unlike electricity, natural gas can be stored at relatively low cost for even months at a time; and
- RNG, the only other source of gas on the grid, serves dedicated specialty users of gas (such as CNG distributers, hydrogen producers and green purchasers) who use it because of its environmental attributes, not because it is a marginal competitor with natural gas.

Consider, for example, a hydrogen plant built in Texas that contracts to meet its methane needs with a new RNG facility in Colorado. Like the electrolyzer example above, this appears like a clean arrangement, with new clean supply matching clean demand … but unlike the electrolyzer example, on closer examination, it remains a clean arrangement. While the hydrogen plant's new demand in Texas would result in an increase in natural gas supply in Texas, the additional RNG supply in Colorado would displace the same amount of natural gas supply to Colorado. The net outcome would be that the emissions increase in Texas is matched with the decrease in Colorado and there would be no increase in fossil fuel generation and emissions, consistent with the intent of 45V.

The same analysis would hold true for temporal matching.

In essence, the risk of undesirable indirect emissions effects from geographic or temporal mismatches between sources and uses is very low for RNG because the marginal source of gas on the natural gas grid is the same at all times of the day, in all seasons of the year and in all regions of North America. It is natural gas. Furthermore, in the event that new data becomes available that allows the 45VH2-GREET model to differentiate between the emissions of natural gas supply in different regions, it can and should be taken into account in the life-cycle emissions rates determined for clean hydrogen production.

V. Treasury has proposed different incrementality standards for electricity generation and RNG production. These standards should either be reconciled or special provisions should be instituted to ensure that legitimately incremental RNG production is treated as such.

A. The NPRM applies very different incrementality standards for the production of renewable electricity and renewable natural gas.

The NPRM proposes a 36-month buffer between when a renewable electricity generator begins operations and when the clean hydrogen facility it intends to supply starts service. This buffer is likely meant to ease the coordination challenges of synchronizing their development schedules. It gives clean hydrogen producers the assurance that their renewable electricity is operational before they commit to substantial investments in building their own facilities. Additionally, it allows renewable electricity generators to be eligible for energy attribute certificates, even if their own start-up precedes that of the clean hydrogen project they ultimately supply by up to three years.

Conversely, the Treasury has introduced a more rigid rule for RNG producers called the “first productive use” requirement. To qualify for an emission value consistent with biogas-derived RNG instead of natural gas, the initial use of RNG from a particular facility must occur within the same tax year as, or subsequent to, the commencement of the hydrogen plant it aims to supply.

B. Treasury should harmonize incrementality rules for renewable electricity and renewable natural gas or justify the disparity.

Treasury has not explained why the proposed incrementality rules for low-carbon electricity and RNG differ so significantly. The IRA aimed for technology neutrality in its clean hydrogen provisions, but Treasury's approach favors renewable electricity-based clean hydrogen facilities over those using renewable natural gas, despite potential parity in emissions reduction. The rules for both energy sources should either be harmonized or a clear, logical rationale for their divergence should be offered.

C. If Treasury decides not to harmonize treatment of renewable electricity and RNG, it should grant broader leeway (more akin to that for renewable electricity) to RNG projects that unambiguously prove incrementality.

Under Treasury's incrementality proposal, a renewable electricity plant built to supply the general electricity market can ultimately supply a clean hydrogen facility, so long as the clean hydrogen facility is placed in service within three years of when the renewable electricity plant began serving its originally intended market. In contrast, an RNG plant built expressly to supply low-carbon RNG to a clean hydrogen facility—demonstrated, for instance, by a binding off-take agreement made 18 months before its construction is completed—faces stricter and essentially unreasonable constraints. If this RNG plant is ready before the hydrogen facility, it must either halt production or destroy its output to ensure its first productive use coincides with the same year the hydrogen plant begins operations. This requirement could force the RNG plant into unnecessary production delays, even though it clearly meets any reasonable criteria for providing incremental RNG supply. This rule would be particularly burdensome if the target clean hydrogen plant starts up in the early part of the year.

Should Treasury decide to maintain different incrementality standards for renewable electricity and hydrogen, it should offer a safeguard for RNG facilities *that are truly and verifiably incremental*. Specifically, if an RNG facility secures, as proof of its incrementality, a verifiable, binding off-take agreement with a clean hydrogen producer 18 months before it begins RNG production, it should be treated at least 2/3 as well as a renewable electricity generator built originally for the open market. That would mean allowing the RNG facility it to sell its product on the open market for up to two years before the clean hydrogen plant its been contracted to supply commences operation—without jeopardizing its RNG's eligibility for an emission value consistent with biogas-derived RNG.

D. If Treasury decides not to harmonize treatment of renewable electricity and RNG, it should grant broader leeway (more akin to that for renewable electricity) to clean hydrogen producers who unambiguously prove a commitment to source incremental RNG.

Under the Treasury's incrementality guidelines, a clean hydrogen facility is permitted to procure electricity from any renewable source that began operations within the preceding 36 months, regardless of whether it was initially intended for the open market or as an incremental supply for clean hydrogen. This flexibility is crucial for clean hydrogen producers who do contract for truly incremental supply and face the possibility that their contracted renewable electricity supplies might become available only after their own facilities are operational. These clean hydrogen producers are allowed to mitigate such timing mismatches by purchasing power from any renewable facility established in the last 36 months. Yet, for clean hydrogen projects committed to adding incremental RNG capacity— as demonstrated by a binding off-take agreement executed 18 months before its own construction ends—the restrictions are stricter. Should such a hydrogen facility be operational before its RNG counterpart, it may only procure RNG from operations initiated within the same calendar year. This rule could significantly narrow the pool of eligible RNG providers, particularly if the clean hydrogen facility starts up early in the year, leading to potential delays and weighing it down with a disproportionately heavier burden than its renewable electricity-using counterparts.

Should Treasury decide to maintain different incrementality standards for renewable electricity and hydrogen, it should establish a safeguard for clean hydrogen operations that are firmly committed to establishing *truly incremental RNG production*. Specifically, a clean hydrogen facility that locks in a verifiable binding RNG purchase agreement 18 months prior to its own placed in service date should be treated at least as well as a clean hydrogen plant that makes no incrementality commitment towards sourcing renewable electricity. That would mean – if such a clean hydrogen's facility's designated RNG source isn't ready on time, allowing it to buy RNG from any facility started within the past 36 months and still have the RNG qualify for the emission value of biogas-derived RNG.

E. To line up with the IRA's primary objectives, facility 'uprating' should include upgrades that enable reductions in CO2 emissions for clean hydrogen as well as ones that enable more clean hydrogen production.

The primary goal of the IRA's clean hydrogen production credit is to foster the production of hydrogen with lower carbon emissions. This can be achieved by leveraging both low carbon electricity and RNG, which are valued for their potential to reduce carbon emissions—specifically, the amount of CO_2 emissions they can save compared to conventional electricity or natural gas sourced from the grid.

The carbon reduction capacity of a facility can calculated by multiplying its rated nameplate daily energy output (measured in MWh per day or MMBtu per day) by the reduction in carbon intensity achieved compared to the grid's baseline, *i.e*. the difference between the carbon intensity of the grid (for local electricity or natural gas supply) and the rated nameplate carbon intensity of the facility's production (each expressed in kg CO_2 per MWh or kg CO_2 per MMBtu).

Facilities producing low carbon electricity and RNG that invest in technologies to enhance their carbon reduction capacity —for instance, through adding carbon capture and storage (CCS) systems—are effectively increasing their contribution to the IRA's goal of reducing emissions of hydrogen production. Such investments are equally valuable to the purposes of the IRA as investments in increasing energy production capacity and should be acknowledged as such. This could be accomplished by a simple amendment of the definition of "uprated production capacity" to cover incremental increases in carbon reduction capacity. More specifically, producers should be permitted to base their uprated production capacity on:

> *the incremental carbon reduction capacity (in nameplate kg CO_2 per day) divided by the post uprate capacity (in nameplate kg CO_2 per day).*

This revised definition would encompass improvements that boost annual energy output even without directly lowering carbon intensity, thereby recognizing a broader range of enhancements that contribute to emission reduction goals.

Example 1. An RNG Production Facility undergoes an uprate that expands its rated nameplate capacity from a pre-uprate capacity of 3,000 MMBtu/day to a post-uprate capacity of 4,000 MMBtu/day. After the uprate, its generation output increases to a total of 1,400,000 MMBtu for the year.

The RNG Production Facility's incremental generation capacity is 1,000 MMBtu/day, its uprated production rate is 0.250 (1,000 MMBtu/day divided by 4,000 MMBtu/day).

One quarter (0.250) of each MMBtu of the RNG Production Facility's production should be considered uprated RNG production.

Example 2. An RNG Production Facility producing 3,000 MMBtu per day undergoes an uprate that increases its CO_2 reduction capacity by capturing and sequestering CO_2 from the facility capturing 30 kg CO_2 per MMBtu. The GHG pre -uprate emissions rate for the RNG facility is 20 kg CO_2 per MMBtu and the post up-rate emissions rate for the facility is -10 kg CO_2 per MMBtu (20 kg minus 30 kg). Its pre and post uprate RNG annual RNG production is 1,050,000 MMBtu.

The baseline emissions for natural gas is 70 kg per MMBtu (rounded numbers provided for simplicity).

Prior to the uprate, the facility's CO_2 reduction capacity 150,000 kg CO_2 /day (3,000 MMBtu/day multiplied by 50 kg CO_2 per MMBtu (70 kg minus 20 kg)). After the uprate, the facility's CO_2 reduction capacity is 240,000 kg CO_2/day (3000 MMBtu/day multiplied by 80 kg CO_2 per MMBtu (70 kg minus (-10 kg))

The RNG Production Facility's incremental CO_2 reduction capacity is 90,000 kg CO_2 /day, its uprated production rate is 0.375 (90,000 kg CO_2 per day divided by 240,000 kg CO_2 /day).

Three eights (0.375) of each MMBtu of the RNG Production Facility's production should be considered uprated RNG production.

Example 3. An RNG Production Facility producing 3,000 MMBtu per day expands its rated nameplate capacity from a pre-uprate capacity of 3,000 MMBtu/day to a post-uprate capacity of 4,000 MMBtu/day and adds CO_2 capturing and sequestering capacity to capture capturing 30 kg CO_2 per MMBtu of the new production. The GHG pre -uprate emissions rate for the RNG facility is 20 kg CO_2 per MMBtu and the post up-rate emissions rate for the facility is -10 kg CO_2 per MMBtu (20 kg minus 30 kg). Its pre and post uprate annual RNG production is 1,050,000 MMBtu and its post uprate annual RNG production is 1,400,000 MMBtu.

The baseline emissions for natural gas is 70 kg per MMBtu (rounded numbers provided for simplicity).

Prior to the uprate, the facility's CO_2 reduction capacity 150,000 kg CO_2 /day (3,000 MMBtu/day multiplied by 50 kg CO_2 per MMBtu (70 kg minus 20 kg)). After the uprate, the facility's CO_2 reduction capacity is 320,000 kg CO_2/day (4000 MMBtu/day multiplied by 80 kg CO_2 per MMBtu (70 kg minus (-10 kg)).

The RNG Production Facility's incremental CO_2 reduction capacity is 170,000 kg CO_2 /day, its uprated production rate is 0.531(170,000 kg CO_2 per day divided by 320,000 kg CO_2 /day).

53.1% (0.531) of each MMBtu of the RNG Production Facility's production should be considered uprated RNG production, combining both the effects of an increase in RNG production and the addition of carbon capture.

VI: Treasury should clarify that the environmental benefits claimed by clean hydrogen producers and their customers, stemming from either government schemes or private efforts, are legitimate and not subject to accusations of double counting

Treasury has correctly pointed out that the integrity of lifecycle GHG emissions rate calculations, which underpin EACs, would be compromised by double counting. This issue arises when two entities claim environmental benefits from the same unit of energy. This rule against double counting should cover both low carbon electricity and RNG.

In addition, Treasury should clarify that clean hydrogen produced under 45V is indeed *clean hydrogen* and should qualify as such under any government program or private initiative. Specifically, Treasury should confirm that, even if clean hydrogen benefits from the 45V production credit, it would still be eligible to claim benefit for it under the requirements of:

- mandates that apply to the use of low carbon hydrogen, including the Federal Renewable Fuel Standard, California Low Carbon Fuel Standard, European Renewable Energy Directive, or any similar future regulations;
- any future mandates or incentives for products made with clean hydrogen, like clean fertilizer or steel, ensuring clear support for clean hydrogen's broad application.

Likewise, Treasury's 45V regulations should allow clean hydrogen producers and their customers to assert claims about the lifecycle GHG emissions of their clean hydrogen and its derived products, even when these claims lead to economic advantages.