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February 26, 2024

The Honorable Daniel I. Werfel
Commissioner, Internal Revenue Service
U.S. Treasury Department
1500 Pennsylvania Ave, N.W.
Washington, DC 20220

Submitted electronically: Federal eRulemaking Portal at www.regulations.gov.

RE: Response to IRS Proposed Rule for Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property; Docket ID: REG-117631-23

Dear Commissioner Werfel:

Project Canary, PBC (Project Canary), appreciates the opportunity to provide comments on the Proposed Rule, Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property (hereafter referred to as the "Proposed Rule"), established in the Inflation Reduction Act (IRA). We support the Treasury Department and Internal Revenue Service (hereafter referred to as "the Department") effort to accelerate development of the U.S. clean hydrogen industry.

However, Project Canary has significant concerns about the Proposed Rule. The IRA statutory definition of clean hydrogen is technology neutral and intended to be by the law's authors[1]. A taxpayer may satisfy the requirements for the 45V tax credit from diverse energy sources provided the hydrogen is produced through a process that results in a lifecycle greenhouse gas (GHG) emissions rate that does not exceed the statutory emissions rate. The production of clean hydrogen and the corresponding tier amount of the credit is not

[1] "When developing the Inflation Reduction Act, we intended for the clean hydrogen incentives to be flexible and technology-neutral.", U.S. Senator Tom Carper (D-Del.), Chairman of the Senate Environment and Public Works Committee, member of the Senate Finance Committee, and the lead author of the Inflation Reduction Act's clean hydrogen production tax credit (45V). Statement December 22, 2023. Carper Statement on Treasury's Proposed Guidance for Clean Hydrogen Tax Credit - Majority News - U.S. Senate Committee on Environment and Public Works

dependent on the use of any particular feedstock or energy source or the deployment of any particular process for the production of the qualified clean hydrogen. Given that the Tax Code ties the tax credit to carbon intensity and not a specific process or feedstock, tax law should encourage ways to create more accurate measures of the carbon intensity of the specific feedstock and not discriminate or treat production differently based on the process or feedstock. Project Canary is concerned that the Proposed Rule regarding integrating project-specific data in carbon intensity calculations does not meet this test. In Section V of the Proposed Rule, Procedures for Determining Lifecycle Greenhouse Gas Emissions Rates for Qualified Clean Hydrogen, subsection A. The GREET Model, the Department asserts that "(u)sers of 45VH2–GREET may not change background data" and that "background data are parameters for which bespoke inputs from hydrogen producers are unlikely to be independently verifiable with high fidelity, given the current status of verification mechanisms."

Accurate and verifiable project-specific data on the methane intensity of natural gas feedstock is available in the marketplace today and can be collected through a number of measurement and emissions data collection systems, such as those provided by Project Canary, and independently verified by established 3rd party assurance groups. The availability and accuracy of project-specific data will also continue to be more readily available and reliable as the Biden Administration's several methane-related regulations become final in 2024, such as the Environmental Protection Agency's (EPA) Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review[2] (hereinafter "NSPS OOOOb/EG OOOOc") and the IRA Methane Fee[3] (hereafter referred to as the "WEC") and associated Greenhouse Gas Reporting Program (GHGRP) Subpart W rules[4] (hereafter referred to as "Subpart W").

Through the "3 Pillars" framework, i.e., incrementality, temporal matching, and deliverability, the Department has established a new precedent that ensures decarbonization through green hydrogen. The Department can similarly catalyze more decarbonization of blue hydrogen by enabling the use of project-specific supply chain emissions data in lieu of published 45VH2-GREET (Gases, Regulated Emissions and Energy use in Technologies) default estimations for the calculation of the lifecycle greenhouse gas emissions rate in the Final Rule. Such an approach can incentivize a more accurate understanding of natural gas methane emissions, with the added benefit of resulting in continued decarbonization of natural gas. The National Greenhouse Gas Inventory (GHGI) Guidelines published by the Intergovernmental Panel on Climate Change (IPCC), emphasizes this point, "it is preferable to use data that are directly related to the item being quantified rather than to use surrogate data (i.e., alternative data that have a correlation with the data that they are replacing)."[5]

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[2] ENVIRONMENTAL PROTECTION AGENCY 40 CFR Part 60 [EPA-HQ-OAR-2021-0317; FRL-8510-01-OAR] RIN 2060-AV16: Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, December 6, 2023

[3] Proposed Waste Emissions Charge for Petroleum and Natural Gas Systems, Docket Id. No. EPA-HQ-OAR-2023-0434 (January 2024) Federal Register :: Waste Emissions Charge for Petroleum and Natural Gas Systems,

[4] Greenhouse Gas Reporting Rule: Revisions and Confidentiality Determinations for Petroleum and Natural Gas Systems, 88 Fed. Reg. 50,282 (Aug 1, 2023)

[5] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 2: Approaches to Data Collection. Justin Goodwin (UK), Mike Woodfield (UK) Mirghani Ibnoaf (Sudan), Matthias Koch (Germany), and Hong Yan (China). https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_2_Ch2_DataCollection.pdf

We urge the Department to allow the use of verifiable measurement data to determine project-specific methane emissions as foreground data in the 45VH2-GREET model on the effective date of the Final Rule. The use of direct measurement in lieu of GREET default values ensures that reported emissions are representative of actual emissions. Project-specific supply chain emissions data, namely methane leakage, and the overall supply chain carbon intensity, collected through advanced technologies, can be independently verified and the necessary verification mechanisms are readily available. While the independent verification or audit process and providers are in the early stages of development, the foundation provided by other emissions assessment auditing, such as the Low Carbon Fuel Standard (LCFS), are well developed. The Department should incentivize and enable the growth of more accurately measured supply chain carbon intensities that can be independently verified for purposes of a successful 45V program and because of the clear environmental benefits of supporting the reduction of methane from the natural gas supply chain.

Below please find Project Canary's comments on the Proposed Rule generally and in response to the Department's specific requests for comment in the Proposed Rule.

I. About Project Canary

Project Canary, based in Denver, Colorado, is a mission-driven B-Corporation accountable to a triple bottom line of people, planet, and profit. Our goal is to mitigate climate change by enabling the oil and natural gas industry to operate on a cleaner, more efficient, more sustainable basis. Project Canary is a climate technology company focused on providing needed emissions intelligence to help companies identify, measure, understand, and act to reduce emissions across the energy value chain. The Company started with methane and has expanded to other greenhouse gases. Project Canary leverages sophisticated data solutions to help companies improve and report on their emissions footprint. Project Canary offers a vertically integrated technology service that incorporates various monitoring technologies, sophisticated software and data architecture and physics-based models to identify and quantify actual emissions. We are technology agnostic and can ingest 3rd party sensor data as well as our own monitoring system which includes multiple fixed methane sensors placed around the fence line of a facility. We characterize the accuracy of emissions data and deploy advanced physics-based AI-powered models to both identify leaks and quantify total site level emissions. The combination of top-down measurements from monitoring technologies and bottom-up inventory using emissions factors with advanced analytics can provide an accurate measurement-informed inventory. Our quantification model is underpinned by machine learning to measure total site emissions versus single emission events. We provide an accurate inventory of emissions generated by all sources, from consistent, relatively small operational emissions from pneumatic controllers to larger, intermittent abnormal emission events. Our technology can also identify emissions from offsite sources. We track the cumulative effect of extremely short duration emissions sources, such as pneumatic releases. Dual methodology (bottom-up and top-down) provides high fidelity data for regulatory, compliance, and sustainability/ESG reporting. Our solutions undergo significant 3rd party testing and the Canary SENSE™ data can be audited by 3rd parties[6]. We continually work to advance and improve our monitoring technologies, which have been in use since 2019 at oil and natural gas facilities across the U.S.

[6] Note that Project Canary is not a 3rd party verifier nor intending to become one.

II. Advanced Methane Detection and Quantification Innovation

Before we address our specific comments on the Proposed Rule, we offer the following information about advanced methane detection and quantification technologies, and verification available today. This fast-growing sector can supply high quality, accurate and verifiable data which is much more precise than the emission factors in the 45VH2-GREET model and can provide feedstock production and transport path-specific measured carbon intensity data. A Payne Institute for Public Policy at Colorado School of Mines study provides an estimation that ~30% of U.S. natural gas production is currently assessed as lower methane intensity.

1. GREET Model Default Emission Factors Are Based On Industry-Average Data And Are Often Inaccurate.

Historically, emissions have generally not been measured directly, but instead have been calculated using either engineering calculations or by multiplying activity or equipment counts by average emissions for the activity or the equipment's operation, referred to as emission factors. The GREET bottom-up/top-down hybrid approach attempts to account for emission factor underestimations, however, it still allocates average performance across all operators, when studies show that a small subset of emitters contribute to over half of total emissions[7]. Over the past decade, numerous peer-reviewed studies featuring field measurements of emissions from oil and natural gas facilities have cast doubt on the accuracy of emissions inventories calculated using emission factors, such as the following:

a. "Recent studies have emphasized a ~1.5-2x divergence between the EPA GHGI estimates of CH4 emissions from O&NG and those estimated from field measurements […]; our estimate is ~1.8 times that of the [EPA] GHGI."[8]
b. "Our facility-based estimate of 2015 supply chain emissions is 13 +/- 2 Tg a^{-1}, equivalent to 2.3% of gross US gas production […]; ~60% higher than the US EPA inventory estimate."[9]
c. "We estimate a mean US oil/gas methane emission of 14.8 (12.4 to 16.5) Tg a^{-1} for 2010 to 2019, 70% higher than reported by the United States Environmental Protection Agency."[10]

To put these shortcomings into perspective, consider the *Benchmarking Methane and Other GHG Emissions of Oil & Natural Gas Production in the United States Report* by MJBradley, which provides operator-specific methane intensities reported to the EPA under Subpart W of the Greenhouse Gas Reporting Program (GHGRP)[11]. Assuming a 0.2% methane intensity threshold[12] for differentiated or low methane intensity

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[7] Evan Sherwin, Jeffrey Rutherford, Zhan Zhang et al. Quantifying oil and natural gas system emissions using one million aerial site measurements, 16 January 2023, https://doi.org/10.21203/rs.3.rs-2406848/v1

[8] Rutherford, J. S.; Sherwin, E. et al. Closing the methane gap in US oil and natural gas production emissions inventories. *Nature Comm.* 2021 12:4715. DOI: 10.1038 s41467-021-25017-4

[9] Alvarez, R; Zavala-Araiza, D et al. Assessment of methane emissions from the U.S. oil and gas supply chain. *Science.* 2018 361 186-188. DOI: 10.1126/science.aar7204

[10] Lu, X; Jacob D et al. Observation-derived 2010-2019 trends in methane emissions and intensities from US oil and gas fields tied to activity metrics. *PNAS.* 2023 (120)17 10.1073/pnas.2217900120

[11] Benchmarking Methane and Other GHG Emissions of Oil & Natural Gas Production in the United States, Robert LaCount, Tom Curry, Luke Hellgren, Pye Russell. https://www.catf.us/wp-content/uploads/2021/06/OilandGas_BenchmarkingReport_FINAL.pdf

[12] S&P Global, Market will develop for gas with very low methane intensity. Tom DiChristopher, 22 August 2023, "The methane intensity standard that has emerged for gas production is 0.2%, which means that no more than that percentage will be lost through methane emissions. Members of the industry's Oil and Gas Climate Initiative set a 0.2%

natural gas, the MJBradley report suggests that over 70% of natural gas production would qualify as low methane intensity natural gas with no additional action taken. An abundance of scientific evidence suggests that actual emissions exceed GHGRP inventories, yet the status quo reporting methodologies would recognize nearly three quarters of U.S. oil/natural gas production as below 0.2% methane intensity.

The underestimation signature of GHGRP emissions calculations is primarily driven by abnormal operations or events, such as a stuck valve, an open hatch on a tank, or an unlit flare, which can result in large and intermittent release events. Emission factors used in Subpart W engineering calculations do not account for abnormal operations, resulting in underestimation when aggregated across many assets over broad time scales. This lack of accounting for consequential abnormal operations or events can be rectified through direct measurement technologies, which can quantify emissions on a wellsite and provide time series data to identify large emissions due to abnormal operations or events. Similarly, measurement-based reporting frameworks, discussed further in Sections II.3 and II.4, are intended to identify gaps in engineering calculations and reconcile them using measurement data to improve the accuracy of reported emissions inventories.

Emissions include large numbers of sources that emit at relatively low rates and small numbers of sources that emit at large rates. In addition, emissions may be continuous or episodic and may be intended or unintended, making their characterization challenging. Simply refreshing emissions factors is unlikely to resolve the discrepancy.[13] In addition, emission factors are backward-looking. They do not take into account, for example, mitigation that will occur in the years ahead through implementation of the Biden Administration's suite of methane rulemaking such as the NSPS OOOOb/EG OOOOc regulations and the WEC. As a result, emission factors will only become increasingly inaccurate over time.

2. Capabilities and Growth of the Advanced Technology Sector

Traditional approaches for Leak Detection and Repair (LDAR) have typically involved optical gas imaging (OGI) cameras that provide a visual of methane leaks at various resolutions and distances at survey frequencies that vary generally from once a year to four times a year. New advanced technology measurement approaches use more sophisticated sensors that detect emissions at much greater frequencies than the traditional OGI approach and can also quantify emissions. This increased frequency and the higher fidelity of the data provides a much more comprehensive inventory of methane emissions.

In parallel with increased scrutiny of methane emissions from the energy sector, technologies to detect and quantify methane emissions from energy supply chains have [...] been rapidly developed and deployed. Advances in emission detection and quantification technologies over the past decade--increasingly applied at

methane intensity target, and the US Inflation Reduction Act used this threshold as a baseline for its methane emission fee for oil and gas producers." https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/market-will-develop-for-gas-with-very-low-methane-intensity-8211-project-canary-ceo-77161602

[13] Scientific Challenges of Monitoring, Measuring, Reporting, and Verifying Greenhouse Gas Emissions from Natural Gas Systems David Allen,* Arvind Ravikumar, and Erin Tullos. ACS Sustainable Resource Management. https://doi.org/10.1021/acssusresmgt.3c00132

the equipment, asset, sub-regional, and regional scale--have provided new insights into methane emission sources from the energy sector, particularly in North America.[14]

Advanced technologies are of two general types. Ground-based continuous monitoring systems (CMS) provide real-time, on-site monitoring, which makes them highly effective for pinpointing emission sources quickly. Remote sensing technologies such as satellite-based sensors or aerial surveys can cover large areas with snapshot measurements. They lack precision in identifying specific sources and small sources of emissions due to higher detection thresholds and can miss intermittent sources of emissions due to their periodic nature, however, they can provide detection and quantification of large persistent sources of emissions. When combined with a CMS, periodic satellite and aerial surveys can provide valuable information about a facility's emissions profile. Both remote sensing and continuous monitoring technologies play a critical role in determining a more accurate estimate of emissions at a given site.

A Washington, D.C., based consultancy produced a report in 2022[15] that describes the variety of advanced methane detection technologies available today. Technology solutions typically include a hardware component (sensor and other devices or vehicles) and a software component (data analytics and cloud-based platforms). In many cases, emissions data is gathered by hardware and then analyzed by software to quantify methane. The report details six technology categories and 30+ detailed profiles of leading methane emissions technologies. This assessment also highlights technology initiatives where multiple stakeholders have collaborated to integrate multiple measurement and monitoring technologies in the field and validate the resulting data for use in reporting. The sector has evolved significantly since publication of this report, however, it provides the Department with an overview of the breadth and capability of the sector to produce high fidelity data suitable for use in the tax credit Life-cycle Analysis (LCA).

Advanced methane technologies and methodologies have seen widespread adoption and increasing use for regulatory compliance. In the proposed NSPS OOOOb/EG OOOOc rule, EPA has finalized an alternative pathway for the adoption of advanced methane technologies and methodologies in their Alternative Test Method (ATM) program. The Biden Administration, as a part of The U.S. Methane Emissions Reduction Plan, also has several other rulemakings underway that are intended to drive the uptake of innovative and advanced technologies such as Subpart W, and the associated WEC, the Bureau of Land Management (BLM) Waste Minimization rule[16], the Pipeline and Hazardous Material Safety Administration (PHMSA) Leak Detection rule[17], and climate disclosure rules at the Securities and Exchange Commission[18] and the

[14] Ibid.
[15] METHANE QUANTIFICATION: TOWARD DIFFERENTIATED GAS An Assessment of Methane Measurement and Monitoring Technologies, March 2022. https://static1.squarespace.com/static/639b3b72e83c684b858a4f5a/t/63a1f523d4ba823b06e02507/1671558437284/220300+-+REPORT+-+Methane+Quantification+-+CO2EFFICIENT.pdf
[16] Waste Prevention, Production Subject to Royalties, and Resource Conservation, BLM-2022-0003-0001. https://www.regulations.gov/document/BLM-2022-0003-0001.
[17] Pipeline Safety: Gas Pipeline Leak Detection and Repair Proposed Rule, PHMSA, Docket No. PHMSA-2021-0039, RIN 2137-AF51, (June 2023). https://www.regulations.gov/document/PHMSA-2021-0039-2101.
[18] Enhancement and Standardization of Climate-Related Disclosures for Investors, SEC (May 12, 2022), https://www.regulations.gov/document/SEC-2022-0655-0001

Department of Defense[19]. The State of Colorado will now allow for the use of advanced technologies to develop measurement-informed inventories for annual greenhouse gas reporting (see Section II.3). Also, the European Union (EU) is poised to regulate methane emissions associated with imported natural gas. Although these rules have not yet been finalized, Liquified Natural Gas (LNG) exporters into the Union will be required to report independently verified methane reduction efforts and meet a specific methane intensity. The U.S. Department of Energy (DOE) has an initiative underway now, in partnership with the EU, to agree on a monitoring, measurement, reporting and verification (MMRV) framework. This is designed to ensure clear best practices for MMRV and a shared approach between the U.S. and EU, and the several other countries that have joined this initiative.[20]

Continuous Monitoring

Project Canary's proprietary hardware solution is CMS. This monitoring system relies on multiple fixed methane sensors placed around the fence line of a facility. CMS works by detecting methane that moves from a given source at the facility to one of the fence line sensors, which then measures the methane concentration in the air. Methane concentrations, along with meteorological data, are then uploaded to the cloud where the data can be processed further, providing emissions localization and quantification of total site emissions. This includes both small intermittent emissions from sources such as pneumatic devices and fugitive emissions that can persist over long periods of time. Our CMS and Canary SENSE models transform raw sensor measurements (e.g., ambient gas concentration readings, wind speed, and wind direction) into composite data identifying if, when, where, and at what rate emissions occurred at the facility. Our system translates concentrations into quantified mass values at the site level, calculating increasingly accurate emissions, taking into account atmospheric effects such as wind.

Mass quantification models have evolved significantly in the last several years and will continue to improve rapidly, driven both by regulatory programs described above and by voluntary corporate GHG reduction commitments. The progress of monitoring technologies and emissions quantification capabilities has been fueled by research investments spanning academic institutions, energy stakeholders, non-governmental organizations (NGOs), and monitoring technology companies.

Numerous academic studies supported by leading research consortiums such as the Energy Emissions Modeling Data Lab (EEMDL), Colorado State University's (CSU) Energy Institute, and Stanford's Natural Gas Initiative (NGI) have shown the importance of measurement[21,22] and characterized the performance of a variety of measurement technologies through controlled release testing in partnership with advanced

[19] Federal Acquisition Regulation: Sustainable Procurement Rule, (August 2023) https://www.federalregister.gov/documents/2023/08/03/2023-16012/federal-acquisition-regulation-sustainable-procurement. FAR Case 2022-006, 88 Federal Register 51672 (August 3, 2023). https://www.regulations.gov/document/FAR-2022-0006-0001

[20] Greenhouse Gas Supply Chain Emissions Measurement, Monitoring, Reporting, Verification Framework, U.S. DOE https://www.energy.gov/fecm/greenhouse-gas-supply-chain-emissions-measurement-monitoring-reporting-verification-framework

[21] Colette Schissel and David T. Allen Environmental Science & Technology Letters 2022 9 (12), 1063-1067 DOI: 10.1021/acs.estlett.2c00731

[22] William S. Daniels, Jiayang Lyra Wang, Arvind P. Ravikumar, Matthew Harrison, Selina A. Roman-White, Fiji C. George, and Dorit M. Hammerling Environmental Science & Technology 2023 57 (32), 11823-11833 DOI: 10.1021/acs.est.3c01121

monitoring technology providers. For example, NGI has supported controlled release experiments, simulating large emissions events exceeding 1,000 kg/hr, similar to an unlit flare. This experiment was conducted to test the efficacy of aerial, satellite, and CMS.[23] The study finds that remote sensing technologies such as satellites can detect emissions as low as 200-400 kg/hr, a range typical of an open thief hatch on a tank. Broad measurement campaigns have found that 50% of emissions come from less than 5% of sources, underscoring the important role remote measurement technologies can play in reducing emissions.[24] Similarly, CSU's Methane Emission Technology Evaluation Center (METEC) blinded Advancing Development of Emissions Detection (ADED) protocol simulates smaller operational releases, typically less than 5 kg/hr, and has created CMS performance evaluation standards and transparency.[25] Multiple ADED participants have demonstrated the capability to detect emissions of 3 kg/hr with 90% probability, evidencing the readiness of such technologies to reliably detect and quantify abnormal emissions events and enable more rapid mitigation. Project Canary publishes our ADED test results, providing full transparency. Partnerships across academic researchers, operators, and technology providers have rapidly advanced both the development of monitoring technologies and their performance. Experiments such as ADED are critical in defining performance standards for technologies, including minimum detection limit (MDL). MDLs are a key input to the EPA's NSPS OOOOb/EG OOOOc ATM approval process and can be directly applied to the 45V tax credit emissions claims as is further outlined in Section II.5.

3. Measurement-informed Inventories

Natural gas producers are increasingly adopting measurement-informed GHG inventories as a result of state regulations and voluntary reporting initiatives. These measurement-informed inventories are an effort to correct the shortcomings of the GHGRP.

A measurement-informed inventory integrates direct measurements, combining bottom-up calculations using traditional engineering estimates and emission factor-based methods with advanced technology quantification and operational insights often derived from parametric monitoring data. This approach ensures a higher level of accuracy compared to the inventories currently utilized for the GHGRP reporting, of which many of the GREET emission factors for natural gas pathways are derived. These enhanced measurement-informed inventories not only improve the accuracy of emissions accounting but also act as a crucial link between data and leak repair action, facilitating tangible and meaningful reductions in emissions in the oil and gas industry.

The State of Colorado finalized a rule in July 2023 that will require owners and operators of certain types of oil and gas facilities to directly measure their methane emissions on a facility-specific basis.[26] The state will use these calculations to derive state-wide emission inventories to assure compliance with the state's GHG

[23] Sherwin, E.D., Rutherford, J.S., Chen, Y. et al. Single-blind validation of space-based point-source detection and quantification of onshore methane emissions. Sci Rep 13, 3836 (2023). https://doi.org/10.1038/s41598-023-30761-2
[24] Evan Sherwin, Jeffrey Rutherford, Zhan Zhang et al. Quantifying oil and natural gas system emissions using one million aerial site measurements, 16 January 2023, PREPRINT https://doi.org/10.21203/rs.3.rs-2406848/v1]
[25] Clay Bell, Chiemezie Ilonze, Aidan Duggan, and Daniel Zimmerle Environ Sci & Tech 2023 57 (14), 5794-5805 https://doi.org/10.1021/acs.est.2c09235
[26] Colorado Dep't of Public Health, "Colorado Adopts First-of-its-Kind to Verify Greenhouse Gas Emissions From Certain Oil and Gas Sites" (July 2023), https://cdphe.colorado.gov/press-release/colorado-adopts-first-of-its-kind-measures-to-verify-greenhouse-gas-emissions-from.

intensity (emissions per unit output) thresholds. It is expected that facility owners will use advanced measurement technologies to comply with their direct measurement obligations. In addition to requiring a measurement informed inventory, the rule requires that operators undergo a 3rd party audit. This audit will review all records used to support the development of the measurement informed inventory. Details on this audit program can be found below in Section II.6. The Colorado rule came about as the result of a comprehensive stakeholder dialogue involving industry, technology providers, and environmental groups. The Environmental Defense Fund issued a statement praising the rule as a "commonsense proposal to directly measure methane emissions in the field."[27] Through this rule, Colorado is fostering technology advancement and adoption and ensuring the operators in the state are utilizing empirical data to reduce their emissions and report the most accurate emissions data available.

Multi-scale measurements, including the use of a CMS, are important for creating accurate measurement-informed emissions inventories. A recent 11-month, peer reviewed, methane measurement study[28] used CMS to validate snapshot measurements from aerial fly-over technologies to determine how they relate to the temporal emission profile of given sites and to create a measurement-informed site-level inventory that can be validated with aerial measurements to update calculated conventional inventories. This study demonstrates that multi-scale advanced measurement technologies can be used to accurately reconcile emissions in a way that results in an accurate annual emissions inventory without double counting emissions. Reconciliation protocols, such as OGMP 2.0 and GTI Veritas, are designed to help operators build accurate and verifiable measurement informed inventories.

4. Reconciliation Initiatives

The Oil & Gas Methane Partnership[29] (OGMP 2.0), a part of the United Nations Environmental Programme, is a comprehensive, measurement-based reporting framework for the oil and gas industry. Member companies are public, private and national oil companies covering the upstream, midstream and downstream segments of the industry. OGMP 2.0 consists of a robust reporting framework that requires direct measurement of emissions across all segments of the natural gas value chain. OGMP 2.0 member companies commit to a "gold standard" of reporting that integrates bottom-up source-level reporting with independent site-level measurements. OGMP 2.0 provides technical guidance on how its members must calculate emissions to meet the reporting requirements for the most common material sources. Several of these calculation methodologies differ from Subpart W, which is currently based on calculation methodologies and emission factors, by requiring more accurate inputs, empirical data, and direct measurement. OGMP 2.0 members are also required to establish a methane emissions reduction target and track progress against this target.

[27] Environmental Defense Fund, "Colorado Adopts Ground-breaking Methane Measurement Rule" (July 2023), https://www.edf.org/media/colorado-adopts-groundbreaking-methane-measurement-rule
[28] William S. Daniels, Jiayang Lyra Wang, Arvind P. Ravikumar, Matthew Harrison, Selina A. Roman-White, Fiji C. George, and Dorit M. Hammerling Environmental Science & Technology 2023 57 (32), 11823-11833 DOI: 10.1021/acs.est.3c01121
[29] https://www.unep.org/

GTI Veritas[30] is a standardized, science-based, technology-neutral open-source methodology created to guide the oil and gas industry on how to calculate an accurate measurement-informed methane emissions inventory. GTI Veritas provides protocols for each segment of the natural gas industry for measurement, emissions reconciliation, methane intensity calculation, value chain summation, and assurance. These protocols provide companies with a consistent approach to measuring and verifying methane emissions by creating a consistent and verifiable methodology to be used across the natural gas value chain. Sponsors of GTI Veritas include companies along the natural gas value chain, investors, technology companies and environmental NGOs.

GTI Veritas and OGMP 2.0 are working together to develop a new methodology for meeting the requirements of OGMP 2.0 by utilizing the Veritas protocols. The goal of both programs is to use measurement to create a more accurate accounting and understanding of emissions. Programs like these enable credible and verifiable methodologies throughout the natural gas supply chain.

5. Verification Methods and Services

The readiness of verification mechanisms for transitioning supply chain methane leakage rates to foreground data in the 45VH2-GREET model has accelerated with the finalization of the NSPS OOOOb/EG OOOOc ATM regulations. Relying on the NSPS OOOOb/EG OOOOc ATM for EPA approval of monitoring technology, accredited independent 3rd party verification services can be used to audit or validate the methane intensity and carbon intensity of the natural gas that was produced, for example, at a well site that utilized a technology approved by, and to the standards of, the EPA ATM program during the time in question. The EPA has further enabled adoption of the ATM program by allowing operators to implement approved advanced technologies on NSPS OOOOa sites[31] until EG OOOOc implementation. Therefore, the EPA has created an approval pathway for advanced monitoring technologies that is valid for more wells and facilities than just those subject to NSPS OOOOb. Since these technologies will have gone through the rigorous approval process by EPA, data collected using these technologies will be accurate and can be independently verified regardless of whether a producer is utilizing the technology for EPA compliance or not. Data from approved advanced monitoring technologies can be used to ensure that the measured methane intensity is reflective of the emissions reported and will ensure that the required methane intensity was met. For example, if the methane intensity measured by an NSPS OOOOb/EG OOOOc technology is statistically similar to the methane intensity calculated using the GHGRP methodology, then one can be confident that the calculated emissions using this methodology is accurate. EPA GHGRP methodology and data can be accurate when accurate inputs and assumptions are made in the calculations and when there are no unreported large emissions events, often referred to as super-emitter events. In these instances, an approved technology can be used to corroborate these emissions, and the monitoring technology data can be verified by an accredited 3rd party verifier to assure operations consistent with standards set by the NSPS OOOOb/EG OOOOc ATM. The emissions calculations themselves can be easily verified—environmental consultancies specialize in these types of calculations—and these calculated emissions can be used as bespoke foreground data for 45V tax credit tier determination. Relying on the EPA ATM approval pathway eliminates the need for verifiers to verify the efficacy of a technology itself and allows verifiers to conduct assessments similar to current

[30] https://veritas.gti.energy/about

[31] NSPS OOOOb applies only to wells and facilities constructed or modified after December 6th 2022; EG OOOOc, to be implemented by the states, will replace existing NSPS OOOOa standards for facilities constructed on or before December 6, 2022.

practices for emissions reporting assurances such as Low Carbon Fuel Standards (LCFS) which has an established verification process that would be substantially similar to assessing the accuracy of methane intensity.

In the LCFS methodology, independent verifiers audit emissions calculations to ensure that they are accurate, parallel to this proposed verification process for treating methane leakage as foreground data. California's LCFS program provides an alternative pathway for operators to utilize if they find a different calculation methodology or emission factor that could better represent their pathways versus what is outlined in the default California GREET model. The LCFS verification process includes auditing data accuracy and instrument calibration, both of which are reflective of a verification requirement for measurement data. The California Air Resources Board (CARB), which manages this program[32], has a team of experts on staff who specialize in the specific industry segments to approve these alternative pathways. Through this alternative pathway, CARB has established a mechanism to encourage better than average performance. Oregon has a similar program in place.[33] These verification programs are well established and could be used to provide both processes and resources for verification programs for methane intensity data in service to 45V tax credit verification requirements.

Questions assessed by accredited independent verifiers could include:

- Site – what well site and what wells currently produce into the site
- Time Period – what time period, i.e., daily, weekly, monthly, quarterly, annual, etc.
- Technology deployed – was an EPA-approved technology deployed at this site during the time period
- Operational – was the EPA-approved technology operating the vast majority of the time period and is the data gathered approximately every 12 hours
- EPA approved – was the technology approved by the EPA for the application in question
- Kilograms (kg) of methane emitted – how much methane was reported over the time period from the technology provider
- Independence – the technology provider could provide data that can be verified or audited by an accredited independent verifier
- Production values – how much methane did this site produce in the given time period and is this confirmed by the last gas composition sample taken
- Calculation of methane leakage rate – the verifier can use the data from 3rd parties (emissions from the technology company and production volume from the operator), as described above, and can then calculate a reliable methane leakage rate to compare to reported GHGRP emissions for a given wellsite or asset.

This verification approach will likely rely on environmental consultancies such as Spirit Environmental, ERM, SLR, Geosyntec, Ramboll, and others, by leveraging their existing practices and expertise.

6. Verifiable Measurement-informed Inventories

The progress of voluntary measurement-based reporting frameworks, such as OGMP 2.0 and GTI Veritas, create standardized measurement methodologies that are verifiable for measurement-informed inventories.

[32] California Air Resources Board Verification Program, https://ww2.arb.ca.gov/lcfs-verification
[33] Oregon Third Party Verification Program, Department of Environmental Quality, https://www.oregon.gov/deq/ghgp/3pv/Pages/default.aspx

These frameworks have seen rapid adoption—more than 120 companies spanning over 70 countries have joined OGMP 2.0[34]—and this progress towards transparent and accepted protocols for measurement-informed inventories provides the basis of independent verification. As discussed above in Section II.3, Colorado has approved an intensity verification rule that would require a 3rd party audit or verification of the reported measurement informed inventories. The audit will require the review of all records used to support the development of the measurement informed inventory. These audit provisions are still in development, but it is expected to address calculation methodologies, measurement sampling frequency, monitoring technology, and the uncertainty of any emission factors and measurement used, as applicable. Colorado will accredit 3rd party auditors that operators will be allowed to use to audit their inventories. These auditors will be expected to have experience performing audits and evaluating GHG emissions and calculations. As noted above in Section II.5, California and Oregon have well-established 3rd party audit programs for the LCFS. Leveraging measurement-informed inventories to replace standard engineering estimates will also be a key aspect of new EU import regulations which will use OGMP 2.0 Level 5 processes and reporting to augment regional and import requirements.[35]

All associated data described above that is independently verified can easily be provided to many digital registries, which tracks and assures emissions data.

7. Distributed Ledger Technology And Blockchain Platform Registries

Registries are private servers which track environmental attributes, such as carbon intensity, attributable to natural gas production. These registries play a critical role in building the infrastructure necessary for project-specific environmental claims in hydrogen production. Registries ensure the veracity and accountability of foreground supply chain emissions data by tracking the ownership of these attributes through to their retirement. Differentiated natural gas registries, such as EarnDLT and Xpansiv, have built mechanisms to transact and track project-specific emissions, enabling accounting for data-backed carbon intensities spanning the physical path of a given molecule from where it is extracted, through processing and transportation, to consumption. This is consistent with deliverability in the "3 Pillars" framework. These registries ensure that no attributes are double-counted and facilitate the aggregation of carbon intensities across processes (such as production, gathering and boosting, and transportation and storage) and assets with disparate ownership. Further, registries track metadata, such as the facility, data provider, date range, verifier, and assumptions, which allow for such claims to be verified and audited.

8. Conclusion

The Department has asserted in the Proposed Rule that adoption of natural gas project-specific supply chain emission data for 45V carbon intensity claims requires the readiness of advanced monitoring technologies and verification frameworks. Measurement technology capabilities have advanced with extensive research

[34] https://ogmpartnership.com/our-member-companies/#:~:text=Over%20120%20companies%20with%20operations,countries%20have%20joined%20OGMP%202.0.

[35] https://www.europarl.europa.eu/doceo/document/TA-9-2023-0127_EN.html "This Regulation builds on the OGMP 2.0 framework insofar as it meets the criteria referred to in Recitals 24 and 25, to contribute towards the collection of reliable and robust data that would form a sufficient basis for monitoring methane emissions and if necessary to build additional action to further curb methane emissions." Recital 26, Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on methane emissions reduction in the energy sector and amending Regulation (EU) 2019/942, COM/2021/805 final, December 2023. EUR-Lex - 52021PC0805 - EN - EUR-Lex (europa.eu)

by industry and academia, the development of standardized, independent controlled-release testing, and broad field measurement campaigns. With the EPA implementation of the NSPS OOOOb/EG OOOOc rule, these technologies have an established pathway to regulatory approval, assessment by independent verifiers and tracking on private registries. Independent verifiers can apply their existing practices to verify that advanced monitoring technologies were operational, used in appropriate conditions, and corroborate GHGRP calculated emissions. Independent verifiers can ensure natural gas emissions claims have not been double counted by leveraging registries. Measurement-informed inventories are preferred over less granular and often inaccurate GHGRP data. This migration toward measurement-informed inventories establishes standards and protocols that can be independently verified.

Measurement data can also prove the accuracy of GHGRP reported emissions which can be used as foreground data in the 45VH2-GREET model. As described in II.1, measurement data is critical to ensuring that large emissions events due to abnormal operations did not occur at a wellsite over a time period of production. As these protocols advance and develop verification standards for measurement-informed inventories, these measurement-informed inventories can replace GHGRP emission inventories as foreground data. As measurement-informed inventories are adopted, independent verifiers will develop capabilities to audit sampling strategies necessary to verify methane intensity and carbon intensities across the energy supply chain using measured emissions from advanced technologies.

While the independent verification or audit process and providers are in the early stages of development, the foundation provided by other emissions assessment auditing, such as the LCFS, are well developed. The Department should incentivize and enable the growth of independent verification services for the purposes of a successful 45V program and because of the clear environmental benefits of supporting the reduction of methane from natural gas production.

Academic research continues to show a high degree of variability in emissions across basins, operators, and assets. Implementing a default 45VH2-GREET emissions rate as background data is regressive. In the Department's Proposed Rule, 0.2% methane leakage yields the same tax credit tier as 2%. This does not serve the Department's goal of incentivizing low carbon intensity hydrogen. Through the "3 Pillars" framework, the Department has established a new precedent that ensures decarbonization through green hydrogen. The Department can similarly catalyze the decarbonization of blue hydrogen by enabling the use of supply chain emissions data as foreground data. Allowing a hydrogen producer to use accurate, verifiable project-specific emission data provides a more accurate measure of the GHG emissions for hydrogen production and, therefore, an economic incentive through the tax credit for measurement, capture and mitigation of fugitive methane with the added benefit of resulting in the decarbonization of natural gas.

The Department should allow for the use of verifiable measurement data to determine project-specific methane emissions, or methane leakage as it appears in 45VH2-GREET, as foreground data in the 45VH2-GREET model when the Final Rule is effective. The Department should not defer the use of project-specific data for a later version of the 45VH2-GREET model.

III. Specific Comments on the Proposed Rule

1. **In Section V. *Procedures for Determining Lifecycle Greenhouse Gas Emissions Rates for Qualified Clean Hydrogen*, subsection A. The GREET Model, the Department asserts that "(u)sers of 45VH2–GREET may not change background data" and that "background data are parameters for which bespoke inputs from hydrogen producers are unlikely to be independently verifiable with high fidelity, given the current status of verification mechanisms." The Department requests comment on "the readiness of verification mechanisms that could be utilized for certain background data in 45VH2– GREET if it were reverted to foreground data in future releases. For example, the upstream methane loss rate is background data in 45VH2–GREET, and the Treasury Department and the IRS seek comment on conditions, if any, under which the methane loss rate may in future releases become foreground data (such as certificates that verifiably demonstrate different methane loss rates for natural gas feedstocks, sometimes described as responsibly sourced natural gas)."**

    a. **Regarding the Department assertion that "(u)sers of 45VH2–GREET may not change background data."**

    Given the pattern of inaccuracy described above in Section II.1, the burden of proof should be high for the Department to not allow project-specific measurements methods in favor of emission factors.

    For calculations that require use of emission factors, an owner or operator of an applicable facility would have no means of demonstrating that its actual facility emissions are lower than the applicable factor. As a result, the use of the 45V-GREET model does not reflect its actual emissions. Under the Proposed Rule, the owner or operator may not submit data from any kind of advanced methane detection system to rebut such a calculation—even from a continuous monitoring system approved by EPA as a "best system of emission reduction" under the NSPS OOOOb/EG OOOOc regulations. The use of the 45VH2-GREET model does not reflect actual emissions thus unfairly denying a taxpayer of showing a carbon intensity that could well qualify for the 45V tax credit. This approach also frustrates the Congressional intent to provide a technology neutral tax credit.

    b. **Regarding the Department's assertion that "(b)ackground data are parameters for which bespoke inputs from hydrogen producers are unlikely to be independently verifiable with high fidelity, given the current status of verification mechanisms".**

    As described in detail in Section II, bespoke inputs for the methane intensity of the natural gas feedstock are independently verifiable with high fidelity. Project-specific supply chain methane emissions data collected through advanced monitoring technologies can be independently verified and the necessary verification mechanisms are available. Measurement data from advanced monitoring technologies, approved through the EPA NSPS OOOOb/EG OOOOc ATM process, should be used to corroborate the emissions inventories reported for a given wellsite. Independent 3rd party verifiers can assess both the measured data and the emissions calculations for their accuracy and reliability and allow for GHGRP emissions to be used as bespoke inputs, provided that measurement data complies with the NSPS OOOOb/EG OOOOc ATM rule and corroborates emissions inventories calculated using Subpart W. As voluntary measurement-based reporting frameworks, such as OGMP 2.0 and GTI Veritas, advance and

establish standards that can be assured, these measurement informed inventories can replace the use of GHGRP data for project-specific foreground data in the 45V tax credit tier determination.

c. Regarding the Department's request for comment on "conditions, if any, under which the methane loss rate may in future releases become foreground data".

The conditions for the Department to allow methane loss rates to be foreground data are in place now. Measurement technology capabilities have advanced with the development of standardized, independent controlled-release testing and broad measurement campaigns. With the EPA implementation of the NSPS OOOOb/EG OOOOc ATM rule, these technologies have an established pathway to regulatory approval, assessment by independent 3rd party verifiers and tracking on private registries. Independent verifiers can apply their existing practices to verify that advanced monitoring technologies were operational, used in appropriate conditions, and corroborate GHGRP calculated emissions. Independent verifiers can ensure natural gas emissions claims have not been double counted by leveraging registries. Measurement-informed inventories are increasingly preferred over less granular and often inaccurate GHGRP calculated data. This migration toward measurement-informed inventories establishes standards and protocols that can be independently verified. The Department should allow for the use of verifiable measurement data to determine project-specific methane emissions as foreground data in the 45VH2-GREET model.

While the independent verification or audit process and providers are in the early stages of development, the foundation provided by other emissions assessment auditing, such as the Low Carbon Fuel Standard (LCFS), are well developed. The Department should incentivize and enable the growth of independent verification services for the purposes of a successful 45V program and because of the clear environmental benefits of supporting the reduction of methane from natural gas production.

Academic research continues to show a high degree of variability in emissions across basins, operators, and assets as well as day to day operations. Implementing a default 45VH2-GREET emissions rate as background data is regressive. In the Department's Proposed Rule, 0.2% methane leakage yields the same tax credit tier as 2%. This does not serve the Department's goal of incentivizing low carbon intensity hydrogen. Through the "3 Pillars" framework, the Department has established a new precedent that ensures decarbonization through green hydrogen. The Department can similarly catalyze the decarbonization of blue hydrogen by enabling the use of project-specific supply chain emissions data as foreground data. Such measures incentivize a more accurate understanding of natural gas emissions, with the added benefit of resulting in the decarbonization of natural gas.

d. The Department should allow the use of independently verified bespoke inputs immediately upon finalization of the Proposed Rule versus waiting for a future release of the 45V-GREET model.

The guidance issued in December requires green hydrogen producers to provide granular data, demonstrating incrementality, deliverability, and temporal matching to ensure low-carbon production. It is assumed that this requirement is due to the variability of grid emissions: in the evening, when demand increases and solar supply decreases, electrolyzers consume electrons produced from more carbon-intensive facilities. This same variability exists in the natural gas supply chain as it relates to methane

intensity and carbon intensity of the production, processing and transportation path. Numerous measurement campaigns have demonstrated that emissions distributions are highly skewed. The Permian Basin-wide index shows that the top decile operators have methane loss of less than 0.5% while the bottom decile have methane loss rates exceeding 5%.[36] In terms of 45V tax credits, a 0.5% methane loss rate contributes only 0.5 kg CO2e/kg hydrogen to the total hydrogen carbon intensity; a 5% methane loss rate contributes more than 5 kg CO2e/kg hydrogen, precluding it from qualifying for the 45v tax credit even before considering other supply chain and process emissions.

The intent of the 45V tax credit is to incentivize low carbon hydrogen production. Relying on a default methane loss rate as background data falls short to this end. The immediate adoption of a methane loss rate as foreground data can meet the verification requirements of the Department and will support the technology neutral construct of the 45v tax credit with the added environmental benefits of incentivizing operators to accurately measure and reduce their emissions.

Figure 1 – Methane leakage can contribute nearly 75% of total hydrogen production Carbon Intensity, ranging from 0.5 kg CO2e/kg H2 to 5 kg CO2e/kg H2 for 0.5% methane leakage and 4% methane leakage, respectively[37]

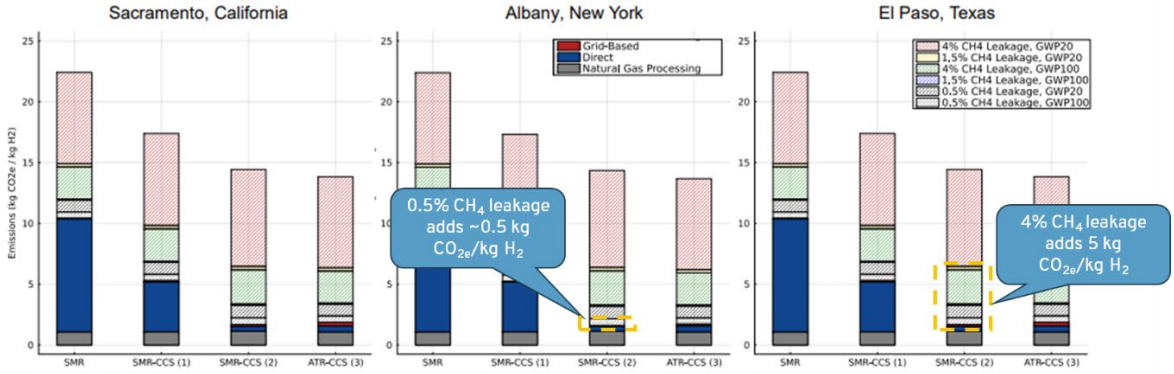


Figure S.4: Next-decade GHG emissions of various fossil-based hydrogen production pathways.

2. **In Section V., subsection B. Provisional Emissions Rate, the Department states that, "A taxpayer may not use the PER process if its feedstock and hydrogen production technology are represented in 45VH2–GREET, even if the taxpayer disagrees with the underlying assumptions (that is, background data) or calculation approach used by the most recent 45VH2–GREET."**

   If there is project-specific independently verifiable data provided by technologies compliant with the NSPS OOOOb/EG OOOOc ATM rule and if the Department determines in the Final Rule that the data is not allowed to be applied as foreground data in calculations using the GREET model, then the

[36]Basinwide, Independent methane emission insights, https://www.basinwide.org/#:~:text=The%20Basinwide%20Methane%20Emissions%20Index,a%20coalition%20of%20industry%20experts.

[37] Bracci, J.M., Sherwin, E.D., Boness, N.L. *et al.* A cost comparison of various hourly-reliable and net-zero hydrogen production pathways in the United States. *Nat Commun* **14**, 7391 (2023). https://doi.org/10.1038/s41467-023-43137-x

Department should allow for such data to be used in a Provisional Emissions Rate (PER). This exception should be provided if the independently verifiable measurement data, such as the methane leakage rate at a wellsite, proves that the project-specific data is statistically different from the 45VH2-GREET default methane leakage rate. Such data proves that the available pathways within 45VH2-GREET do not accurately represent the project, warranting the use of a PER in place of available background data. To the extent there is any question about the technology being used to derive the project specific data, such technology can be reviewed as part of the PER process. It is preferable, however, that such project-specific data be independently verified and directly applied as foreground data as outlined previously.

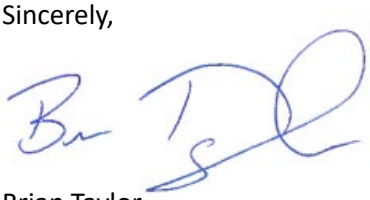
* * * *

Supporting and enabling innovation in next-generation technologies to detect, measure and reduce methane emissions via continued adoption of advanced technologies that provide reliable data on real-time methane emissions is a cornerstone of the Biden Administration's U.S. Methane Emissions Reduction Action Plan. These technologies offer a quicker and more accurate way to identify methane leaks throughout the oil and gas industry, ensure these leaks are remediated much sooner and accelerate the nation's progress toward its ambitious climate goals. These technologies provide a global competitive advantage for the U.S. natural gas sector that will promote economic growth and spur job creation in the high-tech and energy sectors and can assist regulators in creating more targeted and effective policies.

If finalized with improvements we respectfully offer here, the Final Rule offers an outstanding opportunity for the nation to invest in a long-lasting clean hydrogen market and methane monitoring infrastructure to enable oil and gas production, processing, and transmission with minimum associated methane emissions. We appreciate your consideration of our comments on the Proposed Rule.

Should you have any questions, please feel free to reach out to me at brian.taylor@projectcanary.com. We look forward to continuing to work with you and your staff on this important rulemaking.

Sincerely,



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