



December 21, 2022

Dr. Cheryl Laskowski
Chief, Transportation Fuels Branch
California Air Resource Board
1001 I Street Sacramento, CA 95814

Submitted Electronically

Re: Comments regarding potential changes to the Low Carbon Fuel Standard

Dear Dr. Laskowski,

Thank you for the opportunity to provide informal comments on potential changes to California's Low Carbon Fuel Standard. Environmental Defense Fund (EDF) appreciates the work CARB staff have already put into considering changes to the LCFS through the informal workshop process. EDF looks forward to engaging in the formal rule-making next year.

As we have stated in previous comments regarding the final Climate Change Scoping Plan, updates to programs, and potentially new programs, are key to delivering the outcomes and emission reductions envisioned in the Scoping Plan. As such, timely changes to the LCFS are an essential part of realizing the important vision of the Plan and ensuring that California is on track to exceed our 2030 statutory emission reduction goal as the Plan models, but also achieve our 2045 climate goals as well.

To that end, we offer the comments below regarding three aspects of the LCFS: 1) crediting for manure biogas, 2) crediting for medium- and heavy-duty vehicle charging and 3) sustainable decarbonization of the aviation sector. These comments are not exhaustive but are intended to reflect initial thoughts on the future direction of these aspects of the LCFS.

1. Crediting for manure biogas

Only manure biogas projects that also meaningfully improve local environmental conditions should be eligible for inclusion in the LCFS moving forward.

Agriculture, particularly the dairy industry, is a major source of California's methane emissions. Almost 25% of California's total methane emissions are estimated to come from dairy manure.

Addressing dairy manure methane emissions is a key action needed to meet California's climate goals. We applaud the state in establishing a specific methane reduction for the dairy and livestock sectors in SB 1383 (Lara, 2016). California dairy farmers, as price takers, have little market power to pass costs associated with methane reduction solutions on to the consumer, we therefore also recognize the important role that programs such as the LCFS play in incentivizing and supporting reductions in livestock methane sources. While we continue to support inclusion of specific manure biogas systems in the LCFS, we also believe that lessons learned through the first phase of the LCFS will allow CARB to couple meaningful local environmental and community improvements as a condition of future manure biogas system participation in the LCFS.

Manure biogas systems, when operated and installed in a responsibly maintained farm system, are a proven technology that can address existing sources of agriculture methane (from dairy manure storage systems) while replacing fossil fuel-derived methane. Given the large number of liquid manure systems that exist on California (and US) dairies, continuing to include manure biogas systems—as part of an environmentally comprehensive farm nutrient management system—in the LCFS is a powerful tool to drive agriculture methane reductions from existing sources. Continued eligibility is important to meet California's climate goals and drive further agriculture methane reductions across the US.

Today the LCFS is the most impactful market-based tool to incentivize livestock farmers to adopt methane capture technologies. However, as with any program, it is not perfect. An important lesson from the first phase of the LCFS is that we cannot focus on solving methane, a global climate pollutant, without also ensuring meaningful improvement in the local environment and community. Following the intent of longstanding environmental policies such as NEPA and CEQA, it is incumbent upon CARB to ensure that manure biogas systems are only eligible for LCFS participation if they contribute to the reduction of environmental impact and risk from farm systems on the local community. This includes engagement with local communities to address their specific concerns and establishing and meeting aggressive local water quality and air quality standards as requirements for LCFS participation.

Manure biogas systems outside of California must also provide meaningful improvement in local environmental conditions to be eligible for LCFS participation.

Beyond accelerating the capture of manure methane emissions on California livestock farms, the LCFS, in its current form, has also helped address methane emissions from manure across the US. Under the current regulation, the LCFS allows for indirect accounting of biomethane injected into the North American natural gas pipeline without a deliverability requirement. This enables farm systems across the country to participate in supplying biomethane for the LCFS. This provides positive benefit for California residents in two ways. The first is that it creates additional supply of credits into the marketplace, helping lower overall cost to administer the LCFS system. It is also serving to lift the conversation on manure methane emissions across the country and push other states to engage in how to address agriculture methane emissions. Since methane emissions are a global pollutant, the current LCFS regulation helps reduce methane emissions in broader context than just California. We recommend continuing the existing biogas

methane regulation regarding indirect accounting with regard to deliverability, provided out-of-state biogas systems are also contributing to the overall improvement of the local environment and community.

As the market regulator, CARB has the ability and responsibility to ensure that out-of-state manure biogas systems are being implemented in a manner that protects local water quality and air quality, and that meaningfully reduces the impact of livestock on local communities. Biogas systems are complex operations and if farm systems are not currently meeting equivalent environmental regulations and expectations to those followed by California biogas systems, out-of-state biogas systems should not be eligible for participation in the LCFS.

CARB should review the long-term viability of manure biogas systems and seek to reduce market distortions and unintended impacts on the farm economy of the existing LCFS program.

The significant market value of LCFS credits to date have created significant financial incentives for farms to implement manure biogas systems. However, since only larger farms can generally install manure biogas systems, this has targeted the incentives at one specific type of farm management system (namely larger dairies or hog operations using liquid manure systems). While the decision to change management systems on farms is often complex with numerous variables taken under consideration, there is concern that the current focus of the LCFS creates additional incentive to shift towards larger farms using liquid systems. To counter unintended consequences to the structure of US agriculture, CARB should review the LCFS program and find ways to support smaller dairies in participating in manure methane reductions. This could include a host of options such as: creating a smaller-farm biogas tier with different crediting incentives or different avoided methane time-frames and building a manure methane avoidance pathway within the LCFS to support manure management systems such as composting and dry-lot that avoid methane generation in the first place.

The current reduction in the price of credits will likely reduce the impacts of unintended economic distortions on the livestock sector (provided the price remains at its current levels). However, the lower credit price also creates a challenge for the long-term viability of manure biogas systems. There are numerous examples across the US of manure biogas systems that, upon reaching the current technology end-of-life, are no longer being used and manure methane emissions are again being released into the atmosphere. Without ongoing appropriate economic incentives, farms will not continue to operate manure biogas systems and will not reinvest in the technology. CARB needs to consider how best to address manure biogas systems when they reach the end of the ten-year avoided methane crediting period.

2. Crediting for medium- and heavy-duty vehicle charging

LCFS crediting for medium- and heavy-duty vehicle charging can support the deployment of necessary infrastructure to help California realize the full benefits of the Advanced Clean Trucks and Advanced Clean Fleets rules.

Medium- and heavy-duty vehicles are responsible for a disproportionate amount of greenhouse gas (GHG) and local pollution relative to the size of their population. In California, despite the fact that trucks are just seven percent of all vehicles in the state, they emit nearly 33% percent of particulate matter, 25% percent of nitrogen oxides (NOx), and nearly 9% percent of greenhouse gas emissions;¹ electrifying these vehicles will therefore produce outsized climate and local air pollution benefits. This is particularly important in the state's disadvantaged communities, because while the health impacts, which can negatively affect "every organ in the body," are experienced to some extent all across the state, "low-income and communities of color...are often disproportionately affected by emissions from freight movement due to their proximity to transportation infrastructure," such as ports, railyards, and freight corridors. Because of this disproportionate impact there is an urgent need to electrify medium- and heavy-duty vehicles in these neighborhoods, and to support that transition, a critical need for adequate financing for MHDV charging in these same communities.

As such, the goals embedded in the Advanced Clean Trucks and Advanced Clean Fleet regulations, setting sales and purchase targets for zero-emission vehicles, are crucial components for a sustainable, equitable transportation future. But in order for those targets to be realized, charging that is sufficient in number and well-designed to support these medium- and heavy-duty vehicles in the state needs to be deployed. The ability to sell LCFS credits to address money needed for those deployments can be a critical mechanism to accomplish this, but important principles should be kept in mind.

Trucks and buses have physical and operational differences compared to passenger vehicles that give rise to distinct needs. For example:

- Medium- and heavy-duty vehicles, due to their significantly larger battery size, have fundamentally different power requirements than their light-duty counterparts.
- Medium- and heavy-duty vehicles have highly varied operational profiles. As a result of this variation, they will have a wide diversity of charging needs – with some needing access to rapid charging infrastructure dedicated to medium- and heavy-duty vehicle needs, while others, such as some school buses, may be able to rely on lower-power charging equipment. Moreover, some of these vehicles will be operated by large companies with extensive experience managing high levels of electric consumption, while others will be operated by entities that are entirely new to the large charging and infrastructure space. Given all this diversity in operating realities and capabilities, a variety of state-supported funding solutions will be needed for the full range of fleets to be able to charge in a manner that is affordable to them while optimally managing their grid impact.

¹ <https://ww2.arb.ca.gov/ghg-inventory-graphs>

3. Sustainable decarbonization of the aviation sector

EDF welcomes Governor Newsom's letter to CARB on July 22, 2022 requesting bolder action for the aviation sector and CARB's related efforts over the last twelve months.² The adoption of a 20% clean fuels target for the aviation sector represents a unique opportunity to set a future-proof program that delivers climate and public health benefits without unintended consequences on ecosystems, livelihoods, and communities. Delivering on that target for the aviation sector to contribute to the 2030 climate goal is also a precondition for delivering on the actions for the Scoping Plan Scenario for AB 32 GHG inventory sectors (20% of aviation fuel demand is met by electricity (batteries) or hydrogen (fuel cells) in 2045, and SAF meets most or the rest of the aviation fuel demand that has not already transitioned to hydrogen or batteries.

To meet that additional demand for clean fuels for the aviation sector, Governor Newsom requested that CARB evaluate and consider and increase in the stringency of the LCFS and to work with relevant agencies to accelerate refinery transitions away from petroleum to production of clean fuels. The Governor issues this call to action with full awareness that the aviation sector is directly regulated by the federal government.

CARB should consider adopting a sub-target for aviation within the LCFS.

Considering the above, the only way to ensure that alternative fuels are deployed for aviation and represent an incremental climate and public health benefit in California, the LCFS reform would need to consider adopting a sub-target for aviation within the LCFS (hereinafter referred to as aviation LCFS). Voluntary and incentive-based measures alone cannot deliver on that goal and are not sustainable policy options to decarbonize aviation. Still, the existence of a battery of incentives at the federal level, provides a unique opportunity for CARB to embark on the decarbonization of the aviation sector.

The successful adoption of a sub-target for aviation within the LCFS implies CARB adopts measures to prevent the negative environmental and social consequences of certain feedstocks that result in indirect land use change emissions. This would also ensure a level playing field across sustainable aviation fuel (SAF) pathways, including e-fuels for aviation, a sine-qua-non condition for ensuring resources are invested wisely and effectively.

Governor Newsom's request represents a milestone for aviation with nationwide implications. The structured deployment of SAF opens an opportunity to chart a path forward for civil aviation to deliver on the imperative of a global net-zero climate impact by 2050. Expanding the scope of the LCFS program to include aviation fuels beyond the existing opt-ins is a necessary step towards that goal and for achieving carbon neutrality in California by 2045.

² <https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf?emrc=1054d6>

CARB should extend the LCFS to cover all fossil jet fuel uplifted in California to ensure maximum climate and public health benefits.

While CARB might have initially envisioned the scope of LCFS to cover only intrastate flights considering the AB 32 GHG inventory sectors, nothing should prevent CARB from extending it to cover all fossil jet fuel uplifted in California to ensure tangible climate and public health benefits and to fulfill the Governor's request. According to California inventory data,³ constraining action to intrastate flights would represent a mere 10% of emissions from jet fuel uplifted in California or around 6% of the total aviation emissions from flights to and from California. Meaning that Governor Newsom's requested aggressive 20% clean fuels target for the aviation sector would only deliver emissions reductions on the order of 1%.

Important to note, legal questions around federal preemption would apply to intrastate, interstate, and international flights alike. Thus, California needs to properly address any potential federal preemption concerns before it embarks on the decarbonization of the aviation sector.

The rest of our comments and recommendations on aviation are organized as follows. First, we provide insights on how to potentially address federal preemption concerns. Second, we focus on a way forward to ensure CARB can deliver an enhanced SAF sustainability framework within the short timeframes available for rulemaking. We also provide a set of guiding principles to inform eligibility. Finally, we unfold the detailed guidance necessary to prevent the negative environmental and social consequences of certain feedstocks that result in indirect land use change emissions.

a. Questions around legal authority to address aviation emissions

California policymakers have historically faced significant questions around their legal authority to address aviation emissions. This is because, under Sec. 231 of the Clean Air Act (CAA), only the Environmental Protection Agency (EPA) has authority to promulgate emissions standards that foster new technologies and cleaner fuels; and Sec. 233 of the CAA clearly establishes that states cannot adopt or attempt to enforce diverging standards for aircraft engine emissions. However, this need not prevent CARB from including fossil jet fuel under the LCFS.

While Sec. 233 is undoubtedly applicable to aircraft engine design standards (e.g., those addressing CO₂ emissions or fine particulate matter), the GHG emissions reductions from SAF use do not occur at the aircraft level, but rather upstream in the value chain of the fuel. Whether an air carrier burns fossil jet fuel or a SAF blend, the carbon dioxide emissions from the aircraft engine itself will be the same. Instead, the relevant emissions reductions from the use of SAFs take place in sectors covered under the scope of AB 32 GHG inventory. Furthermore, the point of regulation under the LCFS is not the aircraft operator, but the fuel supplier, who falls already within the boundaries of AB 32 and LCFS's existing regulation.

³ Based on 2020 data available at: https://ww2.arb.ca.gov/sites/default/files/classic/cc/inventory/ghg_inventory_scopingplan_sum_2000-20.pdf (October 26, 2022 update)

As a result, including aviation under the LCFS does not necessarily represent an attempt to enforce any standard covered under Sec. 233 of the CAA. As such, CARB has the authority to expand the LCFS to include all jet fuel uplifted in California (i.e., for all flights taking off from California, independent of destination) as long as: 1) the eligible SAF has been certified by ASTM International as safe for use in aircraft, in accordance with the Federal Aviation Administration's existing standards; and 2) the LCFS targets respect the maximum blending limit of SAF use (currently of 50%).

b. Implementation of an aviation LCFS

Implementation would not represent an overwhelming nor untimely burden to CARB rulemaking if cross-references to the Inflation Reduction Act's (IRA) eligibility requirements for SAF are included in the regulation. Including these cross-references will automatically:

- (1) Bring in the full-fledged and globally operational sustainability framework for SAF that was developed in the context of ICAO's methodology for SAF under the Carbon Offsetting and Reductions Scheme for International Aviation (CORSA).
- (2) Constrain eligibility to only SAF that delivers at least a 50% minimum emission reduction compared to fossil jet fuel lifecycle emissions, and thereby avoid unintended consequences on ecosystems and communities from certain food and feed crops.
- (3) Expressly exclude petroleum projects from credit generation eligibility.

When designing the aviation LCFS, CARB should also consider the need to:

- (1) Constrain SAF eligibility to those pathways that deliver overall societal benefits, such as reductions in other air pollutants, and other benefits to the environment and public health in line with AB 32.
- (2) Incentivize the uptake of key enabling technologies such as e-fuels, fostering the synergies between e-fuel production and the power sector's decarbonization strategy (see EDF's letter to CARB regarding the August 18 workshop⁴).
- (3) Implement a transparent reporting and accounting system to prevent double counting that integrates both the inventory report and the necessary information to properly reflect the use of SAF and to track progress towards the achievement of California's climate goals and, an integral component of the SAF framework and a key design element that has not yet been fully developed in California. For more information see Part C of EDF's high-integrity SAF Handbook,⁵ which provides guidance to governments for avoiding double claiming of SAF and recommendations that are also applicable at the state level.
- (4) Ensure that credit generation applies only to SAF that effectively contributes to reduce emissions in a manner consistent with United Nations Framework Convention on Climate Change (UNFCCC)'s Paris Agreement reporting and accounting obligations. To ensure integrity, CARB should exclude emissions credits such as landfill emissions credits (LEC) from municipal solid waste (MSW) based SAF pathways from being embedded in the lifecycle emissions value. The ICAO CORSIA LEC methodology,

⁴ <https://www.arb.ca.gov/lists/com-attach/73-lcfs-wkshp-aug18-ws-Wz5VN1A3UFwDYQV3.pdf>

⁵ <https://www.edf.org/sites/default/files/2022-08/EDF%20HIGH-INTEGRITY%20SAF%20HANDBOOK.pdf>

similarly to the LCFS, assumes emissions as a function of a 100-year life-cycle business as usual scenario that is not re-evaluated to match real world evolving conditions, granting emissions reductions that would only have happened –if at all– over the 100 years after MSW-based SAF use. This is not a minor issue; a substantial share of the environmental benefits claimed with MSW-based SAF will likely come from changes in waste management rather than attributional life-cycle emissions reductions. This advises caution and calls for rightfully aligning the CORSIA-LCFS LEC methodology with the standard LEC methodologies that would be entitled to generate units for CORSIA consistent with UNFCCC accounting (see Appendix D.2 of EDF’s high-integrity SAF Handbook for a detail description). We note that MSW can still contribute meaningfully despite the absence of a valid way forward for LEC in CORSIA-LCFS does not mean MSW cannot contribute effectively; ICAO CORSIA allows for fuel producers to claim the environmental benefits of the biogenic MSW fraction independently of the fossil-based fraction from plastics.

c. Adoption of additional guidance to prevent the negative environmental and social consequences of certain feedstocks that result in indirect land use change emissions

It is crucial for a successful decarbonization of aviation that a robust methodology is applied to avoid unintended consequences on ecosystems and communities and undermining emissions reduction targets (see EDF’s letter to CARB regarding July 7, 2022 public workshop⁶). Relying on first-generation, food-based biofuels to rapidly develop the California SAF markets would be misguided, counterproductive, and would create an expensive and risky distraction from long-term aviation decarbonization.

Without proper safeguards, those fuels could trigger substantial land-use impacts and food price inflation, and disadvantage U.S. industry in new markets for low-carbon aircraft and hydrogen-based fuels such as e-fuels. The technologies used to produce first-generation food-based biofuels simply do not provide a technological steppingstone to the advanced biofuels and e-fuels necessary to drive deeper decarbonization.

Safeguards exist to minimize the risk of ILUC under the ICAO CORSIA regulation and subsequently also under that of the IRA. In this context, land-based fuel producers –including food and feed fuel producers– have the option to implement measures covered under the low LUC risk practice module (see Section 5 in ICAO document “CORSIA Methodology for Calculating Actual Life Cycle Emissions Values”⁷) to prevent ILUC and, consequently, claim zero ILUC values. This approach is a key component to the risk-based approach to LUC in the SAF lifecycle emissions methodology. CARB should ensure that any such claims are based on a robust implementation of the low LUC risk methodology (to ensure, e.g., that the counterfactual

⁶ <https://www.arb.ca.gov/lists/com-attach/137-lcfs-wkshp-jul22-ws-AmdRM106WSdSNwdo.pdf>

⁷ <https://www.icao.int/environmental-protection/CORSIA/Documents/ICAO%20document%2007%20-%20Methodology%20for%20Actual%20Life%20Cycle%20Emissions.pdf>

scenarios are representative) and that only new practices are granted zero ILUC values. This can be achieved by recognizing RSB's Low ILUC Risk Biomass Criteria and Compliance Indicators.⁸

While the combination of the language in the IRA and ICAO's CORSIA SAF framework noted above include the critical guardrails to prevent the deployment of unsustainable aviation fuels, significant guidance is necessary to ensure proper implementation and interpretation. Such additional CARB guidance should aim to:

- i. *Ensure that land-based feedstocks that cause or contribute indirectly to the loss of natural habitats, including forests, grassland, or wetlands, are not eligible for generating credits.*

Feedstocks with a significant induced land-use change (ILUC) risk should not be entitled to generate LCFS credits unless measures are adopted to reduce that risk. As noted above, the ICAO CORSIA SAF framework already has operational methodologies to recognize land management practices that reduce the risk of ILUC. Only land-based feedstocks that comply with them should be entitled to generate credits under the LCFS.

The 50% reduction threshold in lifecycle GHG emissions in the IRA was intended to prevent eligibility of those pathways that pose a high risk for ecosystems and vulnerable communities. Therefore, any attempt to reduce lifecycle emissions by means of, e.g., avoided emissions, carbon capture and storage or removal credits to compensate for ILUC GHG emissions and meet the 50% reduction threshold is at odds with the need to prevent negative impacts on ecosystems and vulnerable communities and should not be allowed.

Perennial energy crops with default negative ILUC values (net carbon sequestration) rely on the assumption that such feedstocks have been grown on marginal land to reduce the risk of ILUC. Fuel producers would need to demonstrate compliance with that assumption using ICAO CORSIA methodology for demonstrating low land use change risk. Then, for estimating the carbon sequestration, fuel producers would need to follow the direct land use change methodology in ICAO document "CORSIA Methodology for Calculating Actual Life Cycle Emissions Values."⁹ No soil organic carbon sequestration (SOC) and biomass sequestration should be recognized until a robust methodology has been developed and approved.

Similarly, perennial energy crops such as sugarcane with default positive ILUC values (net carbon release) should not use SOC and biomass sequestration to compensate ILUC emissions from, e.g., indirect forest and pastureland conversion, and thereby meet the 50% lifecycle emissions goal. As a general rule, the estimated SOC and biomass sequestration credit needs to be subtracted from the default ILUC values applicable to such perennial energy crops in accordance to the breakdown of the ILUC value estimates available in ICAO supporting document "CORSIA Eligible Fuels – Life Cycle Assessment Methodology."¹⁰ But

⁸ <https://rsb.org/wp-content/uploads/2018/05/RSB-STD-04-001-ver-0.3-RSB-Low-iLUC-Criteria-Indicators.pdf>

⁹ <https://www.icao.int/environmental-protection/CORSIA/Documents/ICAO%20document%2007%20-%20Methodology%20for%20Actual%20Life%20Cycle%20Emissions.pdf>

¹⁰ https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_Eligible_Fuels/CORSIA_Supporting_Document_CORSIA%20Eligible%20Fuels_LCA_Methodology_V5.pdf

as noted above, feedstocks with a significant induced land-use change (ILUC) risk should not be entitled to generate LCFS credits unless measures are adopted to reduce that risk. If that is the case, fuel producers need to follow the direct land use change methodology for estimating any carbon sequestration credit. However, no soil organic carbon (SOC) sequestration nor biomass sequestration should be recognized until a robust methodology has been developed and approved.

- ii. Ensure that feedstocks that are entitled to claim zero ILUC values such as used cooking oil and tallow do not contribute indirectly to the loss of ecosystems, food insecurity, malnutrition and hunger.

The ICAO CORSIA SAF framework assumes that these feedstocks have zero ILUC emissions. Therefore, to claim zero ILUC values, SAF producers would need demonstrate that their feedstocks are entitled to claim zero ILUC values through certification. For example, in a mixture of edible tallow and inedible tallow traditionally used for energy purposes, only the inedible fraction should be entitled to claim zero ILUC values. The ICAO CORSIA methodology is subject to interpretation on this matter and CARB should provide clear guidance to prevent unintended consequences on ecosystems and people. Where a fuel producer claims zero ILUC values, the producer should prove that claim by demonstrating compliance with RSB's low ILUC Risk Biomass Criteria (RSB-STD-04-001). When a fuel producer cannot demonstrate low displacement emissions other than from ILUC, the fuel producer should estimate and add the displacement emissions¹¹ to the life-cycle value. For estimating these displacement emissions, fuel producers should use RSB's Methodology for Displacement Emissions (RSB-STD-04-002).¹² Where a feedstock is shown to have ILUC risk, it should be automatically ineligible.

- iii. Ensure that SAF pathways involving large quantities of natural gas properly capture upstream methane emissions in the lifecycle emissions rates.

There are several SAF production pathways that involve large quantities of natural gas being used as process energy (see for instance the corn-based ethanol to jet pathway for which the energy from natural gas amounts to around 60% of total energy in the jet fuel) and/or as a feedstock for hydrogen production. While large quantities of natural gas use result in large lifecycle emissions, some SAF producers are envisioning using Carbon Capture and Storage (CCS) to address them and stay competitive. However, SAF with significant natural gas input are also subject to upstream emissions: methane leaks from venting, flaring and fugitive emissions from natural gas production. Upstream emission estimates derived from data reported in inventories and used for lifecycle analyses have traditionally led to significant underestimation of total emissions from the oil and gas sector, with the greatest divergence in the production segment.¹³ A large body of peer-reviewed literature has documented this

¹¹ Not all displacements result in displacement emissions, e.g., when the displacement occurs in a sector that is covered under a cap-and-trade system.

¹² "[RSB Methodology for Displacement Emissions](#)" 2018.

¹³ See, e.g., [Ramon A. Alvarez et al., Assessment of methane emissions from the U.S. oil and gas supply chain, 361 Sci. 186, 187 \(July 13, 2018\)](#); Rutherford et al., Closing the Methane Gap in US Oil and Natural Gas Production Emissions Inventories, 12 Nature Comms. 4715 (2021), <https://www.nature.com/articles/s41467-021-25017-4#citeas>.

failure to fully capture methane emissions, primarily attributing the divergence to the failure to account for intermittent, large emission events. Over the last decade, research by EDF and others has quantified the significance of methane emissions caused by oil and gas production and the persistent underestimation of fugitive and abnormal process emissions.¹⁴ Accounting for these emission events can increase methane emissions estimates by 60-70%.¹⁵ CARB needs to make sure that the lifecycle values applying to SAF pathways involving large quantities of natural gas fully capture methane emissions accordingly.

We are looking forward to supporting your administration as it charts a path for aviation to contribute to the state's goal of achieving net-zero greenhouse gas emissions by 2045. These efforts also stand to significantly improve local air quality and public health.

Thank you for your consideration of these comments. EDF looks forward to working with you in the development of updates to the LCFS. If you have questions or would like to discuss any of these recommendations, please contact Katelyn Roedner Sutter at kroedner@edf.org.

Sincerely,

Dr. Pedro Piris-Cabezas
Senior Director, Global Transportation
Lead Senior Economist

Larissa Koehler
Director, Vehicle Electrification
Senior Attorney

John Tauzel
Senior Director, Global Agriculture Methane

Dr. Jamie Fine
Senior Economist

Lauren Navarro
Senior Manager, Regulatory and Legislative Affairs

Katelyn Roedner Sutter
California State Director

Amy Hughes
Senior Manager, Climate Smart Agriculture

¹⁴ EDF, Methane Research Series: 16 Studies, <https://www.edf.org/climate/methane-research-series-16-studies>.

¹⁵ Alvarez et al., *supra* note 3.