Stanford | Climate & Energy Policy Program
Woods Institute for the Environment

California's Low Carbon Fuel Standard: Simulating an EJ Scenario using CARB's CATS Model

Authors: M. Wara, M. Ahumada-Paras, M. Mastrandrea, H. Zhu, C. Morton, R. Chor

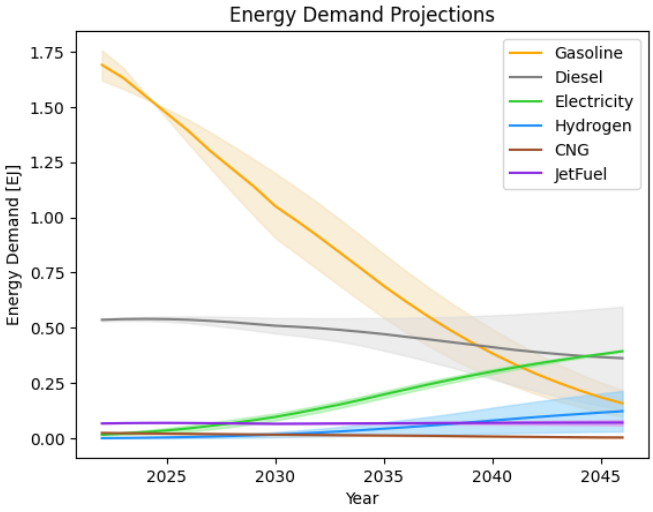
The California Air Resource Board (CARB) runs the Low Carbon Fuel Standard (LCFS) program to incentivize the technological innovation and adoption of alternative transportation fuels with lower carbon intensities (CI) in support of California's climate goals. Compliance targets are modeled through the California Transportation Supply (CATS) Model, an optimization tool that simulates the future transportation fuel mix incentivized under LCFS by finding the least cost solution to meet fuel demand given a greenhouse gas (GHG) emission constraint. The compliance target represents the allowed average CI of transportation fuels each year, a parameter within the CATS model that dictates the stringency of the program. The solution space in which the LCFS program operates is sensitive to different compliance curves, making this one parameter the key driver of the program's success. The analysis in this study assumes CARB's proposed compliance target of 30% reduction in CI by 2030; thus, the findings are shown through 2030 to avoid speculation thereafter.

EJ Scenario Proposal

We modeled an alternative scenario, referred to as the environmental justice or "EJ scenario", designed to mitigate unwanted outcomes of the LCFS program while still maintaining an operational program consistent with CARB's priorities. This alternative model was compared to a baseline scenario obtained from CARB's public model [v0.2].

Design modifications

- Energy demands per fuel aligned with 2022 CARB Scoping Plan.
- Adjusted CI values for avoided methane pathways starting in 2024 instead of 2040 as currently proposed.
- Imposed a cap on biofuel crop feedstocks instead of not enforcing a cap.
- Allow spending of banked credits to adjust credit pricing.

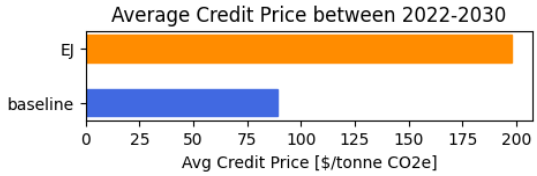


The shaded area is upper bounded by CARBs current projections and lower bounded by the Scoping Plan. The solid lines represent the proposed energy demand profiles.

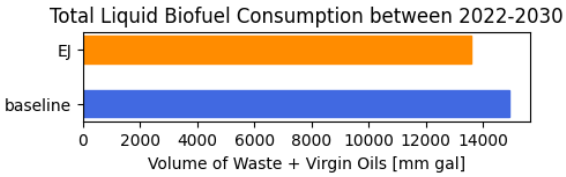
Main takeaways

- It is critical for LCFS planning to update energy demand assumptions that reflect rapidly changing regulation and ZEV adoption.
- The EJ scenario, including methane crediting adjustment and crop-based biofuel cap is achievable at reasonable credit prices.
- Our modeling suggests the EJ scenario could achieve CARB's goals while lessening impacts to EJ communities and potentially improving climate and air quality outcomes.

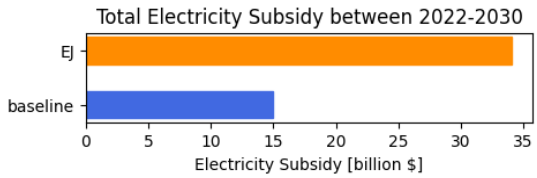
Energy Demands Fuel demand in the CATS model is projected based on the vehicle fleet composition in California. Complementary state policies to the LCFS, including Advanced Clean Cars II (ACCII), Advanced Clean Trucks (ACT),and the Advanced Clean Fleets (ACF), impact turnover rate from Internal Combustion Engines (ICEs) to Zero Emission Vehicles (ZEVs). The implementation of these policies will allow a faster decline in demand for petroleum-based fuels and faster adoption of alternatives. The fleet composition of ICE vehicles to ZEVs is forcasted to reach 50/50 in 2036 according to the 2022 Scoping Plan. We proposed a conservative energy demand projection in the CATS model adjusted to a midway point between the Scoping Plan projections- an optimistic outlook- and projections published by CARB in 2022 that do not reflect all the aforementioned ZEV policies. This assumption was applied to both, the EJ and baseline, scenarios.



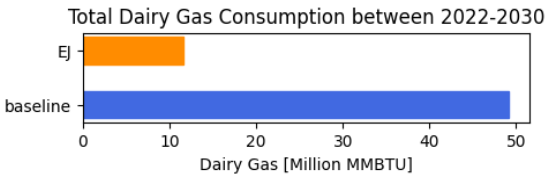
Biofuel Feedstock Cap CARB's baseline scenario allows for unlimited use of crop oils as alternative fuel feedstock. In accordance with the briefing by the International Council On Clean Transportation, we added a cap on oils of 1.2 million DGE. Without a cap, California's demand of crop for fuels could scale at an unsustainable pace that can lead to imbalance in other markets, increases in food prices and forest depletion. **The EJ scenario avoided using an additional 500,000 acres of land for crops and 1.35 billion gallons of biofuels.** These avoided biofuels would otherwise emit local air pollutants in EJ communities. Marginal land for soy production, the most common feedstock, is often provided by destroying Amazonian rainforests. Furthermore, updating Indirect Land Use Change (ILUC) assumptions as part of this rulemaking will enable the assessment of GHG emissions caused by land conversions from forests to farms for crop-based biofuels.



Credits and Prices All pathways in the LCFS program either generate credits when their CI is lower than the benchmark or generate deficits when their CI is higher than the benchmark. The benchmark is the displaced fuel's CI (gasoline, diesel or jet fuel). A current feature of the LCFS program is the **credit bank**, which allows producers that have a credit surplus to store credits to sell or use at a future date without expiration. As of 2022, the program recorded more than 15 million MT of banked credits. The growth of the credit bank reveals a miscalculation in compliance targets. Although the CATS model does not include a market mechanism, we implemented drawing down the current bank at a constant rate through 2030 in order to stabilize prices. The banking function is not eliminated, and will still have the flexibility of banking credits year-to-year. **The average baseline credit price through 2030 is $89 per MT, while the EJ scenario's is $198 per MT.**



Methane Crediting Alternative fuels are certified after completing a Life Cycle Assessment (LCA) to determine their CI; each calculation is complex and includes various assumptions that, if inaccurate, can lead to diminished attainment of GHG reductions or can negatively impact EJ communities. Methane crediting is a pathway that allows capture of methane from animal manure, predominately at CAFOs, to be credited to fossil gas use at energy facilities like refineries. The EJ scenario updates the CI value of methane crediting pathways to ≈40 gCO2e/MJ starting in 2024, compared to values as low as ≈-350 gCO2e/MJ. The EJ scenario generates a total amount of energy from **dairy gas of 21 million MMBTU compared to 86 million MMBTU** for the baseline. The EJ proposal is consistent with reduced economic consolidation in the dairy industry, and reduces use of grey hydrogen produced at existing steam methane reformers that emit local air pollutants to frontline communities.



Other Impacts LCFS subsidies or profits from the crediting system should focus predominately on areas likely to produce long-run transformation of the transportation sector, including electrification and electrolytic hydrogen. **The EJ scenario increases the incentive for electric vehicles from $15 billion to $34 billion**, better supporting the adoption of EVs and a faster path to decarbonization of the vehicle fleet.

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