To: California Air Resources Board

From: Jeremy Martin, Daniel Barad, Samuel Wilson, David Reichmuth and Don Anair

Date: February 20, 2024

Subject: LCFS Amendments

The Union of Concerned Scientists (UCS) is a long-standing supporter of the Low Carbon Fuel Standard (LCFS) and has been actively involved in its implementation for more than 15 years. We urge the California Air Resources Board (CARB) to modernize the LCFS to ensure it equitably meets the needs of Californians and supports the attainment of air quality standards. Beyond California's borders, the LCFS is an important policy model for other states and the federal government, which could help address the many deficiencies of the Renewable Fuel Standard. But to meet these needs the LCFS must be modernized, to rebalance credit markets, provide reliable support for non-combustion pathways, strengthen safeguards against deforestation and the diversion of food to fuel use and phase out counterproductive methane digester subsidies that are contributing to dairy and meat industry consolidation.

Rebalance supply and demand for credits by reducing credits that are misaligned with California's goals rather than focusing entirely on increasing stringency.

The low credit prices and growing bank of credits do not simply reflect success and signal a need ramp stringency faster but are instead sign of disfunction, as a huge share of credits are awarded to vegetable oil-based renewable diesel and manure biomethane pathways that do little or nothing to benefit California and create major problems elsewhere. A durable solution must address the root cause of the problem by limiting the supply of these counterproductive credits. Limiting supply will stabilize credit prices without such dramatic increases in overall stringency, which will reduce regressive passthrough costs to California drivers of gasoline powered vehicles. While passthrough costs have been very modest to date, CARB should carefully consider the impact of the LCFS on costs to drivers from increasing stringency. Support for transportation electrification has clear returns to California drivers (and people breathing the air) but the same is not true for bidding up the global price of vegetable oil or subsidizing manure digesters in other states.

Update transportation electrification provisions to support a fast and equitable transition.

The LCFS provides vital support for transportation electrification, and as such it underpins other critical regulations that help cars and heavy-duty trucks transition to zero emission vehicles. The Total Cost of Ownership analysis used for the Advanced Clean Fleets Rule was based on an LCFS credit prices of $200 through 2030, while recent prices have been below $80 which creates problems for these policies. CARB should ensure the LCFS continues to support the transition to electrification by retaining a 2.5% credit cap for light duty vehicle fast charging infrastructure credits, increase the flexibility and overall credit cap for the proposed medium and heavy-duty infrastructure credits, facilitate electrification of other modes and applications by establishing default energy economy ratios, and support a combination of electrification and vehicle mile traveled reduction by updating LCFS eligibility for fixed guideway systems and establishing credit multipliers for mass transit vehicles. Specific recommendations for improvements to transportation electrification provisions are below.

Cap compliance from vegetable oil-based biofuels to ensure the LCFS doesn't exacerbate global hunger and deforestation.
We published extensive analyses earlier this year on the implications of the boom in renewable diesel consumption in California for global food markets and deforestation (Attachment 1) and why a cap on the use of vegetable oil-based fuels for LCFS compliance is essential to avoid this harm and stabilize the LCFS (Attachment 2). The reasons given in the Initial Statement of Reasons (ISOR) to reject a cap on virgin oil-based fuels in Alternative 1 are based on inaccurate claims of climate and air quality benefits and associated health outcomes, which double count climate benefits already required by federal law and ignore CARB's own research on air quality benefits from new technology diesel engines running on renewable diesel. A corrected analysis would show that there are few if any real climate or air quality benefits associated with unlimited use of vegetable oil-based fuels and there are enormous harms. The proposed sustainability guardrails are inadequate because they do not address vegetable oil diverted from food to fuel use. Alternative 1 discussed in the ISOR is a useful step forward, but a better solution would be to limit the use of all lipid-based fuels at a reasonable share, certainly less than half, of the feedstock available for fuel production in the United States, or about 1.5 billion gallons. While chain of custody tracking is an inadequate safeguard against deforestation, it should be implemented for used cooking oil to reduce the risk of fraud.

Phase out credits for "avoided methane emissions" and limit LCFS carbon intensity scores to no less than zero to wind down what has become in effect a poorly run offset program.
We recently published an analysis of the problems caused by crediting manure digesters with avoided methane emissions, substituting an energy subsidy for a much-needed pollution regulation, and creating what is in effect a poorly run offset program (Attachment 3). Negative carbon intensity scores have no place in the LCFS. The LCFS should support the transition away from fossil fuels and hold all fuel producers accountable for pollution in their own supply chains. The California Legislature gave CARB the authority to start regulating dairy pollution in 2024, and CARB should start developing these regulations. However, instead of winding down the subsidies, the ISOR is doubling down, suggesting credit for avoided methane pollution could remain in place for decades after the legislature granted CARB the authority to regulate and extending the problems into the power and hydrogen sectors. Using negative carbon intensity (CI) biomethane to generate negative CI electricity or hydrogen is greenwashing, which will subsidize digesters in other states in place of supporting investment to reduce emissions in California.

Carbon sequestration associated with enhanced oil recovery or any fossil fuel extraction should not be credited under the LCFS.
SB 1314 and SB 905 make it clear the legislature does not support carbon dioxide captured for use in enhanced oil recovery and therefore CARB should exclude this use of sequestered carbon from credit generation within the LCFS whether it occurs within California's borders or outside. Expanded federal support already provides generous support for the use of captured carbon dioxide, and adding LCFS compliance value to federal tax credit effectively subsidizes oil-extraction at the expense of California drivers.

Transportation electrification

To address climate change and reach California's goals of net zero emissions by 2045, the rapid electrification of mobile emissions sources is needed. The LCFS provides a vital source of investment in transportation electrification which complements other state, federal, local, utility, and private investment. Hence the proposed changes to the transportation electrification elements of the LCFS program are particularly important for keeping California's transition on track. UCS urges the following modifications to the proposed electrification components to increase the effectiveness in LCFS support for transportation electrification.

Light-Duty

The fast-charging infrastructure credits for light-duty vehicles have supported the further development and expansion of charging infrastructure in CA and can be a continued catalyst for investment through 2035 as the transition towards 100 percent zero emission vehicle sales continues. UCS urges CARB to maintain a program cap of 2.5% credits through 2035, rather than reducing the cap to 0.5% as proposed and to maintain the current power and charging port limits of the current program.

CARB should update the Energy Economy Ratio (EER) for light duty plug-in electric vehicles to reflect the current efficiency of vehicles sold. Based on sales over the prior 5 years, the sales-weighted and utility factor-weighted average efficiency of plug-in light duty EVs was 0.305 kWh/mi.[1] When compared to the most recent average fuel economy for the light duty fleet (26.0 mpg), an EER of 4.2 is justified.[2] At a minimum, CARB should increase the EER to 4.0 from the current value of 3.4 approved for light duty electric vehicles.

Heavy-duty

Medium- and heavy-duty vehicles (MHDVs) are responsible for the most significant contributions of lung-damaging and ozone-forming pollutants from vehicles on California's roads and highways. As such, CARB has adopted several transformative regulations, including the Advanced Clean Trucks and Advanced Clean Fleets rules, to accelerate the economy-wide transition to zero-emission trucks and buses. While these rules are necessary to increase vehicle availability and adoption, the LCFS also plays a vital role in this transition, particularly given the large amount of fuel consumed by commercial vehicles and the potential for the program to generate support for early adopters of clean trucks and buses and companies providing charging infrastructure.

We appreciate the recognition of the unique electrification needs of MHDVs compared to LDVs in the draft. However, the current draft could be significantly improved upon by better accounting for the diverse duty cycles and charging needs of currently deployed and forthcoming battery-electric MHDVs, particularly in the language regarding charging infrastructure credits. Where the current draft does not maximize potential near-term investments and deployment of zero-emission MHDVs, several tweaks could accelerate and embolden the much-needed transition to electric delivery, short-haul, vocational, and drayage trucks. At the highest level, the LCFS should better balance vastly different electrification barriers and opportunities within MHDV classes and duty cycles.

Increase flexibility of funding for critical electrification catalysts

Staff's current proposal includes a cap on credits for Fast-Charging Infrastructure (FCI) of 2.5 percent of deficits. While we understand the need for LCFS revenue to support a wide range of projects, funding priorities within the program should reflect both the dire need to reduce emissions from the MHDV sector

---

[1] New electric vehicle sales data for 2019-2023 as reported by the California Energy Commission "ZEV and Infrastructure Stats Data", online at https://www.energy.ca.gov/files/zev-and-infrastructure-stats-data. Model vehicle fuel economy values and plug-in hybrid range data was sourced from US EPA and Department of Energy's fueleconomy.gov website.

[2] "The 2023 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975", EPA-420-R-23-033, December 2023.

and the financial barriers facing early adopters and developers of charging infrastructure. FCI is most likely to serve Class 7 and 8 tractor trucks, which consume the largest amount of fuel and contribute the highest amount of pollution among the state's MHDV fleet, despite being a small fraction of total trucks and buses. Additionally, where most commercial electric vehicles are likely to charge at depots, long-haul tractor trucks are far more likely to rely on publicly available FCI as a primary fueling source.

Given this, it becomes apparent that the development of high-power FCI is a primary barrier to an accelerated shift to zero-emission long-haul freight. Increasing the cap on FCI credits, or developing a dynamic cap based on real-world data including vehicle registrations and ZEV deployment goals, is necessary to address the often-cited barrier of FCI deployment and the very real problem of climate-warming and toxic air pollution from long-haul trucks.

A successful LCFS can and should facilitate accelerating the electrification of both "low-hanging fruit" and "harder-to-electrify" MHDVs. While FCI development is a primary barrier for long-haul electrification, the vast majority of commercial vehicles in operation – straight trucks, delivery vans, and the like – are unlikely to use public charging regularly or require FCI access due to lower daily mileage and tendency to return to depots each night. According to the US Census Bureau's 2021 Vehicle Inventory and Use Survey data, *78 percent of non-tractor MHDVs travel less than 50 miles on a typical day*.[3] Because of this duty cycle, model availability, and total-cost of ownership upsides, these vehicle types are ripe for early electrification. However, the current draft's prohibition of credit generation at lower power charging depots removes economic incentives for these fleets to electrify sooner. Additionally, high power charging requirements for credit generation may lead to fleets pursuing charging capabilities greater than their needs, which may lead to interconnection delays. It is important that the LCFS include flexibilities that promote the "right-sizing" of charging infrastructure for different types of vehicles and duty cycles.

Geographic and station size restrictions may hinder near-term MHDV electrification

Current draft language in Section 95486.3 limits the eligibility of MHDV FCI to areas including Federal Highway Administration Alternative Fuel Corridors and areas currently used for MHDVs parking. We assume that staff's inclusion of geographic and charging station power restrictions were meant in some way to focus LCFS support to charging infrastructure development in the most appropriate areas. However, the proposed restrictions are excessive and premature given the current state of the zero-emission MHDV market and infrastructure deployment.

While we appreciate that the current proposed language may be intended to prioritize some of the hardest to electrify MHDVs, the program should include flexibilities to respond to both current and future market trends and align with the ACT and ACF's influences on the market. The proposed geographic restrictions may reduce opportunities for developing zero-emission fueling stations geared towards regional haul and last-mile delivery vehicles in the near term. As mentioned above, these vehicles are far more likely to return to a home base depot each night and are currently well-suited for electrification given their duty cycles and model availability. These vehicles are also on an accelerated electrification timeline in both the ACT and ACF. The LCFS would be in better alignment with these market trends and regulations by allowing for increased geographic flexibility.

Increasing geographic flexibility may help to address common barriers to charging station development including grid capacity, land availability, and zoning. By restricting eligibility to sites currently used as

[3] United States Census Bureau. "Vehicle Inventory and Use Survey Public Use File." Accessed January 2024. https://www.census.gov/data/datasets/2021/econ/vius/2021-vius-puf.html

vehicle parking or depots, the program fails to consider that these sites may not have existing grid capacity to support fleet electrification. As such, opportunities to accelerate near-term freight electrification may be stifled. A more strategic approach may be to consider phased-in restrictions that consider factors such as market trends, vehicle availability, and grid readiness and aligns with existing regulatory requirements for fleets and vehicles manufacturers.

While we support increasing geographic flexibilities for zero-emission fueling stations, the program should include restrictions to avoid increasing traffic and noise burdens in communities adjacent to freight and industrial operations. We encourage CARB to work directly with these communities and consult pollution and traffic data when designing credits and incentives for ZEV fueling stations.

The program should also allow for additional station size and power flexibilities over the near term to influence accelerated zero-emission MHDV deployment. The proposed restriction of 10 FSEs or 10 MW for MHD-FCI sites within one-quarter mile may reduce appetite for early investments in station development. We understand the need for balanced credit generation to maintain sustainable credit prices, however, such restrictions should not be placed on electrified commercial transportation given its emerging natural and clear environmental upsides over combustion fuels.

Finally, we recommend that rule language regarding restrictions be placed with corresponding eligibility language (such as that in Section 95486.2 (b)(1)), rather than with application requirements, to improve readability.

Facilitate support for electrification of other applications

There are many electrification opportunities beyond cars and trucks that can contribute to lowering carbon and other tailpipe emissions from the use of combustion fuels. However, they lack a readily accessible pathway to participate in the LCFS. CARB should establish default EERs for equipment, vehicles, and vessels in emerging electrification applications such as agriculture and forest management, mining, marine, aviation, and other off-road to facilitate market participation and encourage greater electrification. Establishing default, conservative EERs would provide support for these emerging opportunities and minimizing complexity and barriers to participation.

Prioritize support for zero emissions transit to support communities and reduce car dependence

To ensure the LCFS is aligned with the vehicle mile reduction targets of the scoping plan, CARB should remove the penalty on credit generation for fixed guideway systems installed prior to 2011. This penalty is inconsistent with the treatment of other fuels and should be corrected to ensure the LCFS appropriately supports one of the most vital strategies to support CARB’s Policy Framework to Advance Sustainable and Equitable Communities. If older fixed guideway transit system were treated the same as newer systems, they would generate 3.1 to 4.6 times as many LCFS credits, depending on the type of vehicles that use the system. This would help cash-strapped systems maintain and improve service, reduce car dependence and ease the associated burdens that are inequitably borne by California’s low-income communities and communities of color.

CARB should also implement a credit multiplier for zero-emissions mass transportation vehicles to account for the outsized impact of vehicles that reduce vehicle miles travelled on the carbon-intensity of California’s transportation fuels. For example, a 2x multiplier would be appropriate in support of the Scoping Plan objective to double transit capacity and service frequency by 2030.

Attachment 1. Everything You Wanted to Know About Biodiesel and Renewable Diesel. Charts and Graphs Included

January 10, 2024. Available online at https://blog.ucsusa.org/jeremy-martin/all-about-biodiesel-and-renewable-diesel/

Back in 2016 I wrote a long post about biodiesel, explaining what it is made from (mostly vegetable oil) and arguing that EPA should show restraint in setting targets for biodiesel because of the limited availability oils and fats and the harmful consequences of drawing too heavily from these limited sources. The world has changed in many ways since 2016, but the large-scale diversion of vegetable oil from food to fuel remains a bad idea. Now it is California policymakers' turn to establish sensible guardrails on fuel policies to avoid creating problems in California, and around the world.

Since 2016, EPA has generally shown restraint in setting targets for biodiesel and related fuels, insofar as the law allows, and biodiesel consumption has actually fallen. But in its place renewable diesel is booming, produced in large oil refineries retrofitted for the purpose and consumed primarily in California. Biodiesel and renewable diesel are closely related fuels made from the same oils and fats, which remain scarce, expensive, and linked to deforestation and food price spikes.

For this reason, it is important that policy makers, not only at EPA but also in California, are realistic about the sustainably available supply of oils, and implement fuel policies to avoid excessive diversion of vegetable oil into transportation fuel production. The idea that a large number of oil refineries can keep humming along by replacing petroleum diesel with vegetable oil or used cooking oil is a dangerous illusion. Biofuels can play a productive role when used at a sustainable level. But we need to be realistic about where they come from, and limit feedstocks to sustainable resources used at a reasonable scale to avoid turning a helpful tool into a harmful dead end.

This article draws heavily from a series of articles on the Renewable Diesel Boom by Maria Gerveni, Scott Irwin and Todd Hubbs at farmdoc daily that I heartily recommend for more quantitative economic analysis. The conclusions and policy recommendations are purely my own.

Biodiesel and renewable diesel are mostly made from vegetable oil

Biodiesel and renewable diesel are made from the same starting materials, are both blended into diesel fuel, and are supported by the same regulations. Collectively biodiesel and renewable are referred to as bio-based diesel, which is especially relevant when considering the availability of oils and fats.

More than 80 percent of bio-based diesel is made from vegetable oil (the rest is mostly animal fats). The soybean and canola oil that make up the majority of biodiesel is basically the same as the cooking oil you buy at the grocery store, while the corn oil is mostly an inedible byproduct of ethanol production that is generally used for animal feed and other purposes. Yellow grease is a catch all term that includes used cooking oil as well as lower quality tallow from rendering facilities.

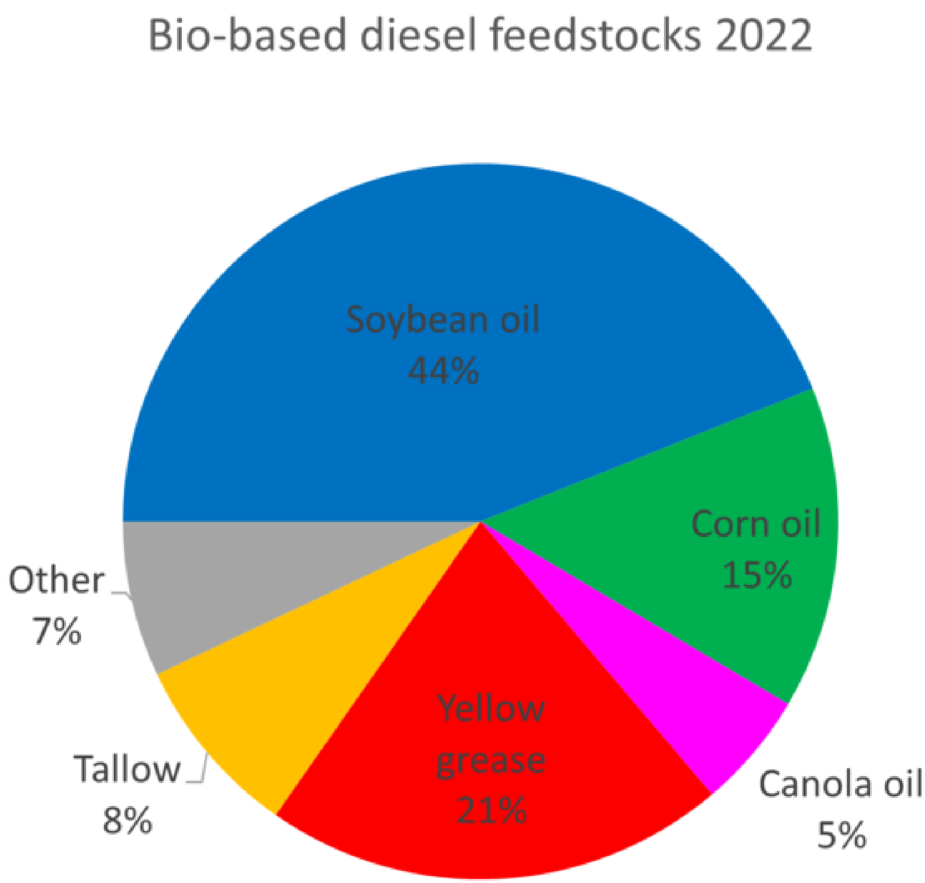


Figure 1. Most bio-based diesel fuels are made from vegetable oil. The chart above shows the oils and fats used to make biodiesel and renewable diesel in 2022. (Source EIA Monthly Biofuels Capacity and Feedstocks Update)

Using more oils and fats for fuel instead of food and animal feed has consequences for competing users of these products and for the global agricultural system. Of particular importance from a climate perspective is the relationship between rising use of oils and fats for fuel in the United States and soybean expansion in South America and palm oil expansion in Southeast Asia, both of which are major drivers of deforestation and global warming pollution. Figure 1 above shows that palm oil itself is not a significant direct source of US biofuel production. However, there are important indirect links between how much soybean oil bio-based diesel we use in the US and how quickly palm oil plantations expand in Indonesia or Malaysia. I'll get to these connections shortly, but first, let's consider the relationship between biodiesel and renewable diesel.

Renewable diesel is the fastest growing part of the US biofuel market

Biofuels overall account for a small but growing share of US transportation energy. Figure 2 shows that petroleum supplies 94 percent of US transportation energy while biofuels are 6 percent. Of the biofuels, ethanol, biodiesel and renewable diesel make up 70, 13 and 14 percent respectively. Ethanol consumption grew rapidly between 2000 and 2010 but after 2010 biodiesel took over as the major source of biofuel growth before being eclipsed by renewable diesel after 2016.

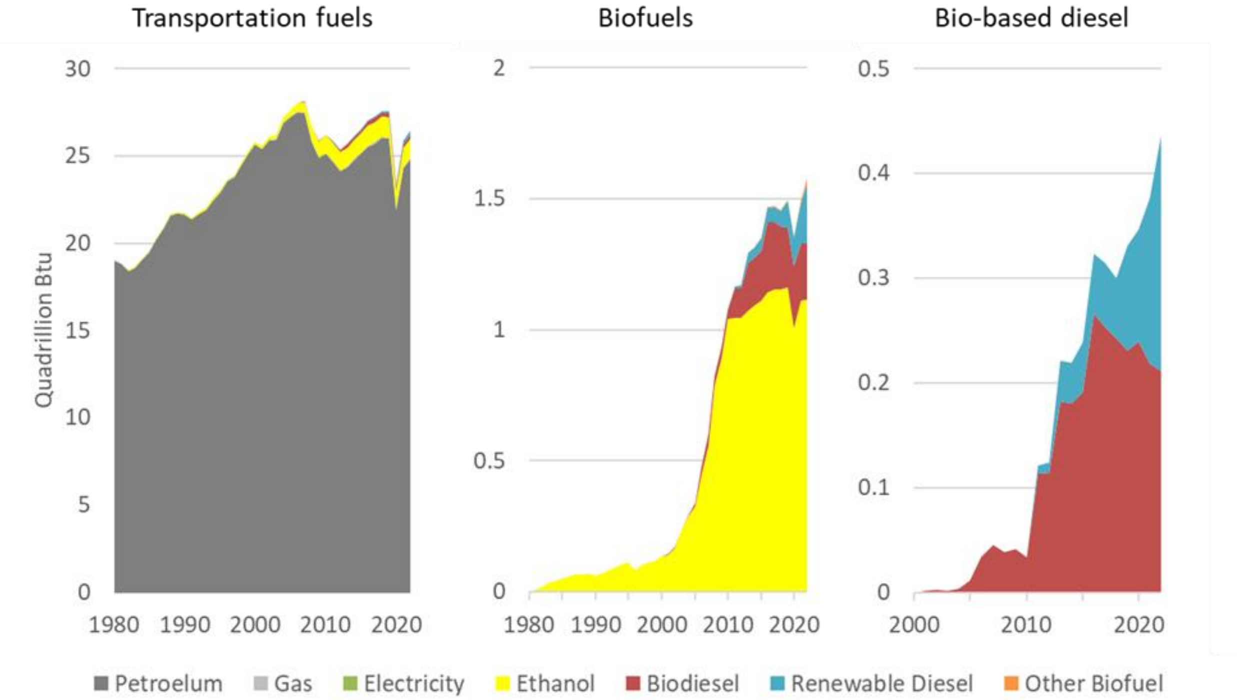


Figure 2. While ethanol remains the largest US source of biofuel, biodiesel and more recently renewable diesel have accounted for most of the growth since 2010. Source US Energy Information Administration.

Biodiesel versus renewable diesel

Biodiesel and renewable diesel have several similarities and a few key differences. Both fuels are made from vegetable oils and fats and are blended into diesel fuel. Both fuels satisfy the requirements of the Federal Renewable Fuel Standard (RFS), which requires oil companies to blend biofuels into the gasoline and diesel they sell. So, in that sense biodiesel and renewable diesel compete for both feedstock and customers.

Biodiesel = an additive blended into diesel
Renewable diesel = a replacement for diesel fuel
Bio-based diesel = biodiesel + renewable diesel

Although biodiesel and renewable diesel are derived from the same feedstocks, the processes used to make them are different. Renewable diesel production uses a hydrogen treatment to remove oxygen from the fats and oils, while biodiesel is produced by a less complex process and retains some oxygen.

Renewable diesel, like fossil diesel, is a pure hydrocarbon and is so similar to fossil diesel that they can be used interchangeably. That is why renewable diesel is often described as a “drop in” fuel. By contrast, biodiesel is limited to specific maximum blends (usually 5 or 20 percent) and higher blends must be specially labeled and their use is limited to compatible vehicles.

The hydrogen treatment used to remove oxygen from the fats and oils increases the costs of renewable diesel production, but adds flexibility, so the latter may be produced from animal fats that are less readily made into biodiesel.

These differences also connect to historical and geographical differences. The growth of the biodiesel industry was promoted by soybean producers as a way to expand the market for soybean oil. As such it is not surprising that the Midwest has 70% of U.S biodiesel capacity, which is primarily in Iowa, Missouri, Illinois, and Indiana.

The renewable diesel industry is less centralized, but the largest share of production capacity, 60 percent, is in the Gulf Coast states, primarily Louisiana and Texas. US renewable diesel production was initially linked to animal fat. Tyson Foods helped launch a Renewable Diesel facility in Geismar, Louisiana that started up in 2010 as the first large US producer of renewable diesel made from animal fat.

More recently, much of the growth in renewable diesel has been from converted oil refineries, which already have the facilities for hydrogen treatment as well the logistics to receive trains or tanker ships of incoming oil (fossil or vegetable) and ship out finished diesel fuel. The oil industry increasingly controls bio-based diesel fuel production. Among other links, in 2022 Chevron purchased the largest biodiesel producer in the US, the Renewable Energy Group, and Marathon Petroleum and Phillips 66 are converting oil refineries to produce renewable diesel.

Perhaps the most notable difference between biodiesel and renewable diesel is that since 2016 renewable diesel consumption has been booming while biodiesel consumption has been declining. Biodiesel consumption in the US peaked in 2016, and by 2022 had declined 24 percent, while renewable diesel use has risen rapidly, growing almost 4-fold between 2016 and 2022. In 2022 renewable diesel surpassed biodiesel for the first time and combined the two sources of bio-based diesel now account for 7.3 percent of US diesel fuel consumption by volume.

Renewable diesel is (mostly) a California story

Most of the renewable diesel consumed in the United States is consumed in California (Figure 3). The concentration of renewable diesel in California is partly the result of California's Low Carbon Fuel Standard policy, discussed later in this post. In 2022 California consumed half of US bio-based diesel. Rising California consumption has come partly at the expense of biodiesel consumption elsewhere in the US, which fell 28% percent in 2022 compared to its peak in 2016.

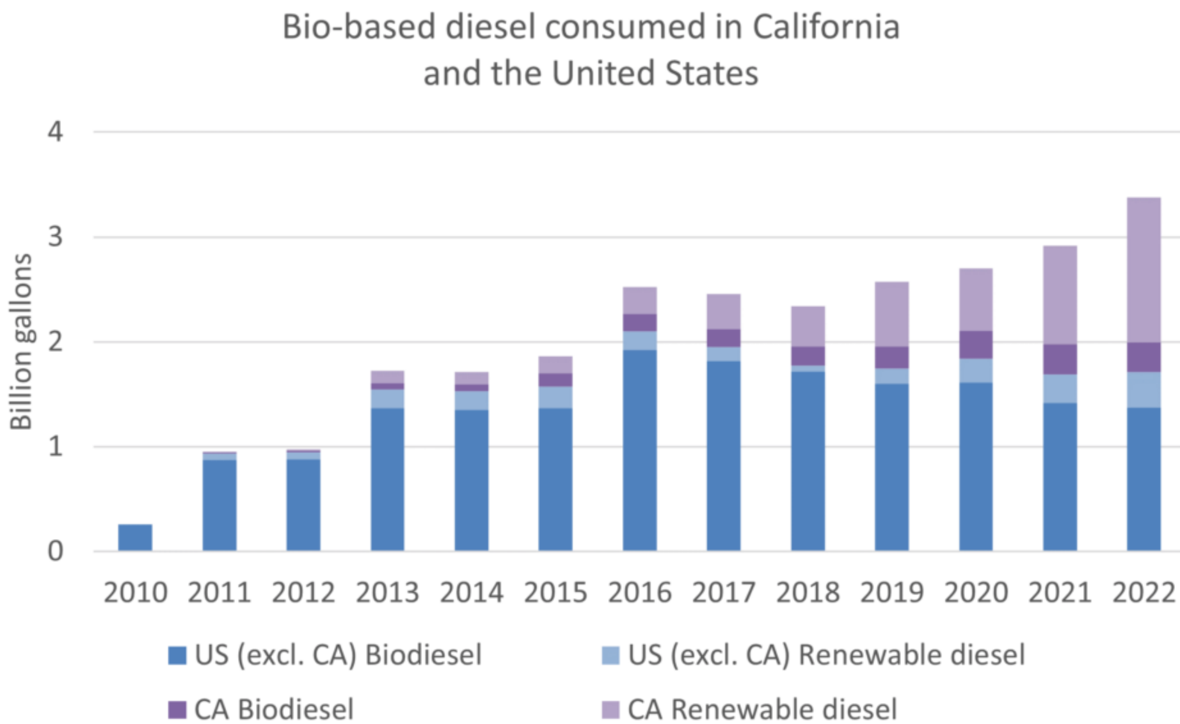


Figure 3. Since 2016 California has dramatically increased consumption of renewable diesel, partly at the expense of biodiesel used elsewhere in the US. California Air Resources Board, US Energy Information Administration.

The blend rate of bio-based diesel in California is rising rapidly. In the first half of 2023, the combined share of renewable diesel and biodiesel rose to 59 percent of total diesel fuel use in California. Outside of California the share of bio-based diesel has fallen from 5 percent in 2016 to only 3.8 percent in 2022. A recent analysis from researchers at the University of California Davis found a 50 percent chance that petroleum diesel would disappear from California by 2028.

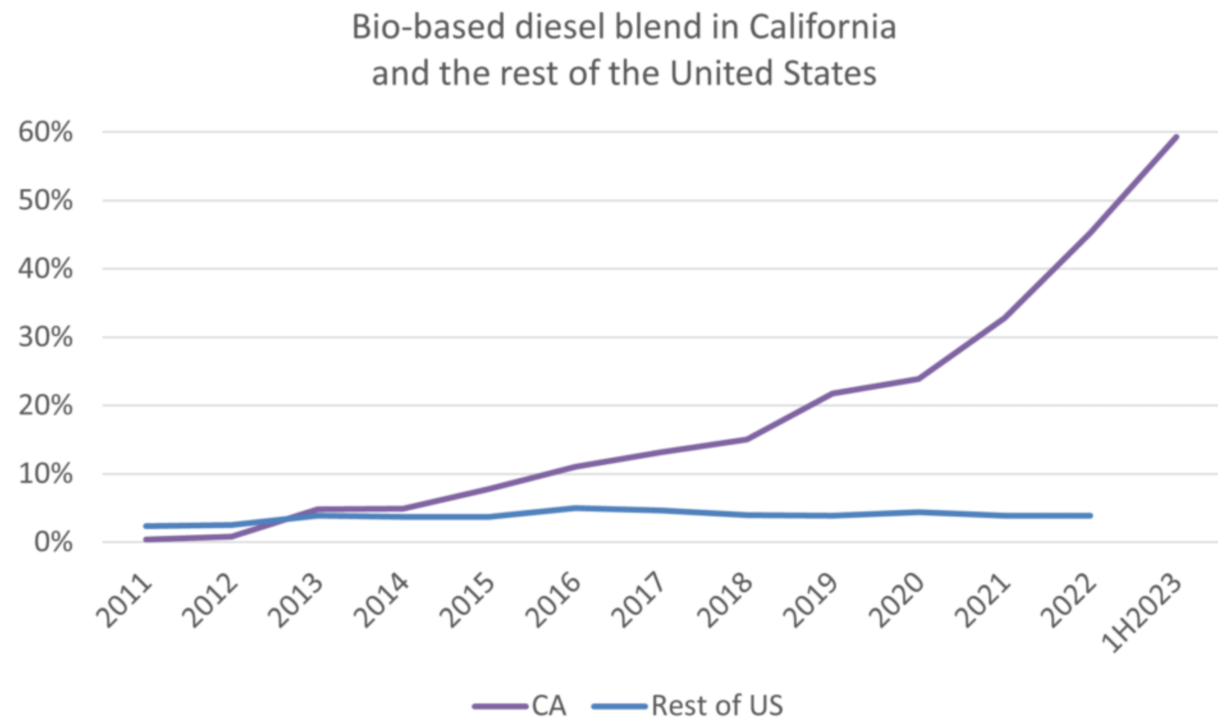


Figure 4. The share of renewable diesel and biodiesel blending into diesel fuel sold in California has grown rapidly and in the first half of 2023 it reached 59 percent. Outside of California the blend rate fell, from a peak of 5 percent in 2016 to 3.8 percent in 2022. Source California Air Resources Board, US Energy Information Administration.

Renewable diesel production capacity is poised to grow rapidly

Renewable diesel production capacity in the United States is in the middle of a massive expansion. Production capacity grew by 400 percent between 2019 and 2022 and based on announced and planned projects, it could double again by the end of 2024. The figure below from a recent analysis of *farmdoc daily*, March 29, 2023 illustrates the massive, planned capacity buildout for renewable diesel. Whether all these facilities get built and operate at their full capacity depends a lot on policy decisions in California, DC and elsewhere.

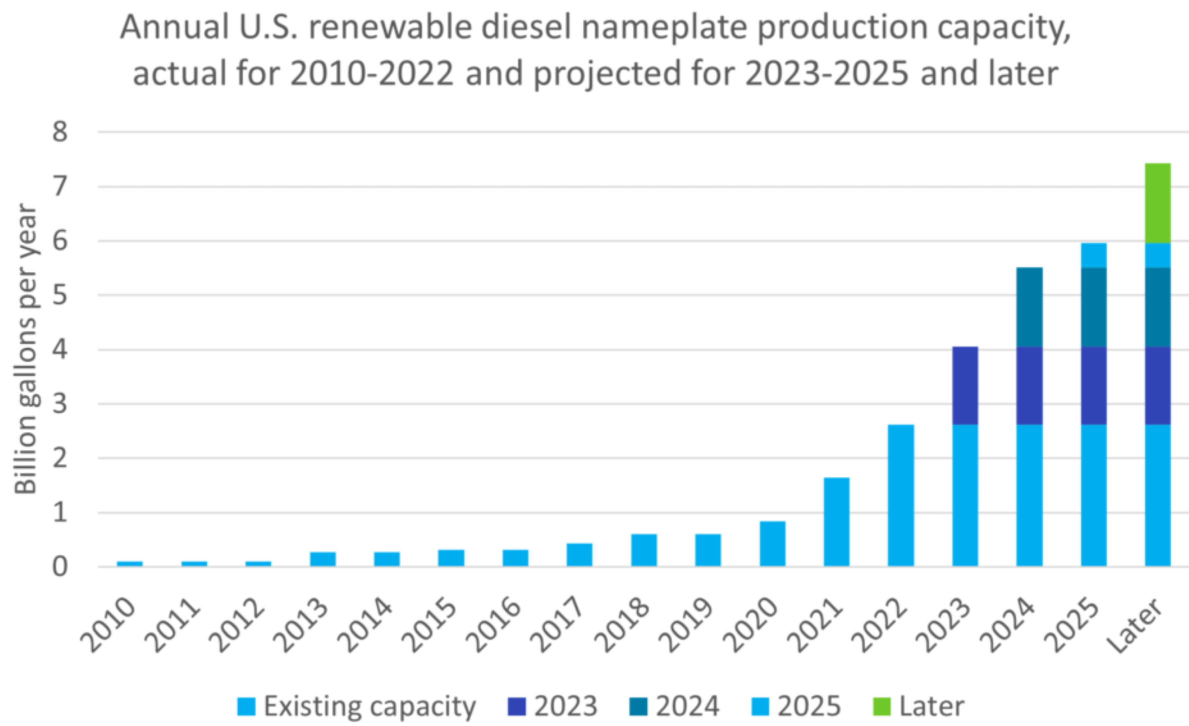


Figure 5: Renewable diesel production capacity has expanded dramatically and is poised to grow much further. farmdoc daily, [March 29, 2023](#).

California is at the eye of the storm, both as the main driver of demand and soon as a major producer as well. Two thirds of the capacity planned for 2023 and 2024 is in California, especially two projects in the San Francisco Bay area, the Marathon Martinez and Phillips 66 Rodeo refineries. These two facilities plan to bring on-line capacity of more than 1.4 billion gallons by the end of 2024.

Converted oil refineries

An important caveat to keep in mind when looking at renewable diesel capacity growth announcements, both recent and planned, is that the renewable diesel production facilities are generally not new facilities being built from the ground up for renewable diesel production. Many are oil refineries being converted from fossil fuel production to renewable fuel production. Petroleum refineries are massive compared to biofuel facilities. The difference in scale reflects both the larger scale of the demand for petroleum fuel and the economies of scale associated with the required facilities and infrastructure, including pipelines and ports to offload crude from tankers. Biofuel production facilities have generally been built on a smaller scale, reflecting the economic advantage of producing the fuel closer to where the vegetable oil or animal fat is produced.

Because oil companies are converting facilities they already have, the decision on capacity is based in part on the scale of the facilities they are converting. If these were new construction projects, the massive capacity expansions might be interpreted as reflecting a strong belief by investors that demand is likely to expand a commensurate amount, otherwise it would be foolish to invest their money. But for an oil company with an excess refining capacity, the decision to convert to renewable diesel may have a much lower threshold, and the capacity may be a function of the capacity of the existing infrastructure as much as a bet of new money on the scale of a new opportunity.

Another motivation for renewable diesel conversions is to help oil companies more cost effectively meet their obligations under the federal RFS and state fuel policies. The RFS requires companies selling gasoline and diesel to purchase biofuels to blend into the fuels they sell or else purchase credits from others who sell biofuels. The decision to convert an unneeded oil refinery to renewable diesel production facility reflects a decision that it is more cost effective to buy the feedstock and directly produce the fuel required for compliance compared to buying the fuel or associated credits from someone else. Selling renewable diesel in California also helps refiners satisfy the requirements of the California LCFS.

Finally, the conversion of a petroleum refinery to renewable diesel is attractive in part because it forestalls the need to begin a costly and complicated process of decommissioning an old refinery. UCS commissioned a recent report about lessons learned from the closure of a Philadelphia Oil refinery, which highlights how reluctant refiners are to close their refineries. A conversion to renewable diesel postpones the day of reckoning and gives the refinery owner more time to develop the most advantageous exit strategy.

The bottom line is that oil companies have a clear motivation to overstate the potential to convert oil refineries to biofuel production. The realistic potential for biofuel conversions is quite small because of the limited availability of suitable feedstocks. Exaggerated hype about potential for refinery conversions to biofuel production amounts to greenwashing that distracts from more scalable solutions.

Fuel markets are much bigger than feedstock markets

Securing adequate feedstock is a very different challenge than finding excess petroleum refining capacity. It is clearly not feasible for many states or the whole country match the rapid scaleup of bio-based diesel underway in California because the feedstocks are just not available. To produce 100 percent of 2022 US diesel fuel consumption in the transportation sector would require more than 160 million metric tons (MMT) of feedstock, which is 10 times US production of vegetable oils in 2022 or 80 percent of global vegetable oil production in 2022 (Source US Energy Information Administration, USDA Foreign Agricultural Service)[4]. To get a handle on the realistic potential for bio-based diesel, and the consequences of rapidly ramping up production, we need to explore the current and potential future supply of feedstock.

Where does the feedstock come from?

Figure 6, produced using data from *farmdoc daily* December 11, 2023, December 20, 2023, illustrates the feedstock used to produce the bio-based diesel fuels produced in the United States. Total feedstock consumption more than doubled in the last decade, exceeding 11 MMT in 2022. Imported bio-based diesel fuel consumed another 1.0 MMT of feedstock for fuel production abroad, so total US bio-based diesel consumption in 2022 required 12 MMT of feedstock, half of it to supply fuel to California.

[4] In the discussion of feedstock requirements I make a few simplifying assumptions about conversion rates and report everything in millions of metric tons (MMT). My estimates are based fuel consumption data from EIA reported in gallons and assuming 7.55 pounds of feedstock per gallon for biodiesel and 8.125 pounds per gallon for renewable diesel, consistent with *farmdoc daily*, May 1, 2023. Actual values will vary by feedstock, conversion process and facility, but this should be a reasonable and consistent approximation.

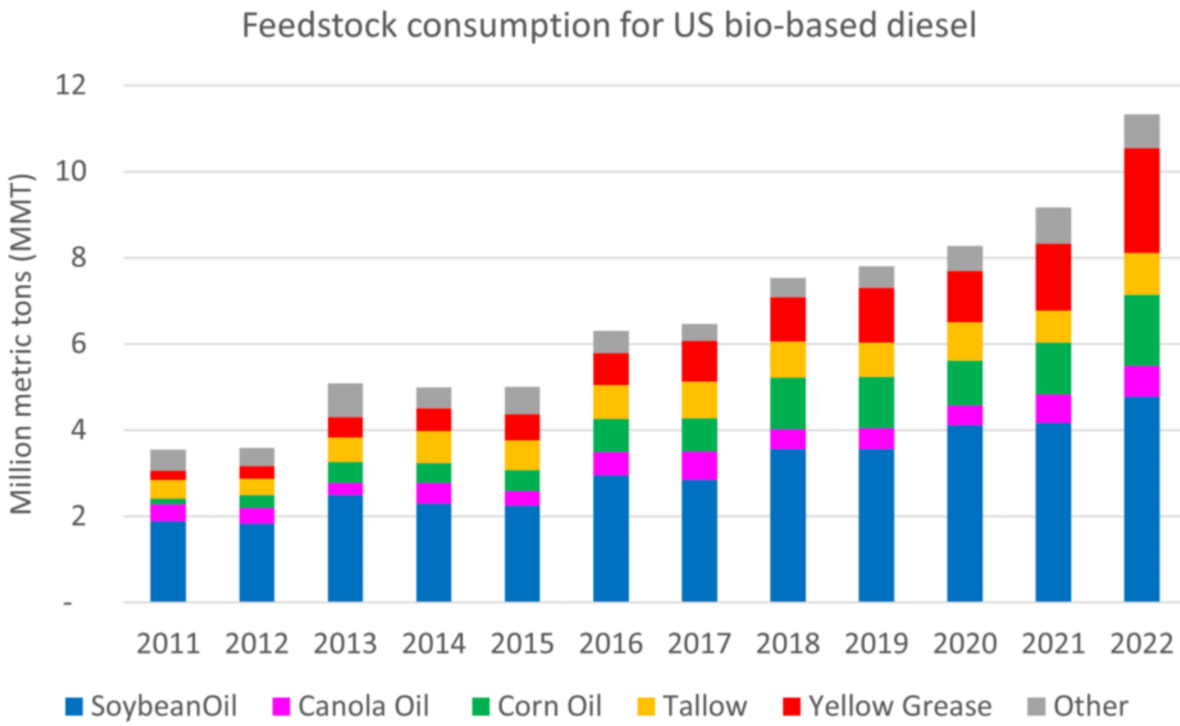


Figure 6. Feedstock consumption for bio-based diesel fuel produced in the US has more than doubled since 2012 and exceeded 11 MMT in 2022. Source *farmdoc daily* December 11, 2023, December 20, 2023.

Soybean oil is by far the most important source of bio-based diesel feedstock, accounting for almost half of the total. Combined with corn and canola oil, vegetable oils make up more than two thirds of feedstock. Yellow grease and tallow make up most of the remaining oil. Yellow grease includes used cooking oil and some other animal fats.

The US Department of Agriculture tracks the share of US vegetable oil production devoted to bio-based diesel, which has risen steadily and exceeded 40 percent in 2022.

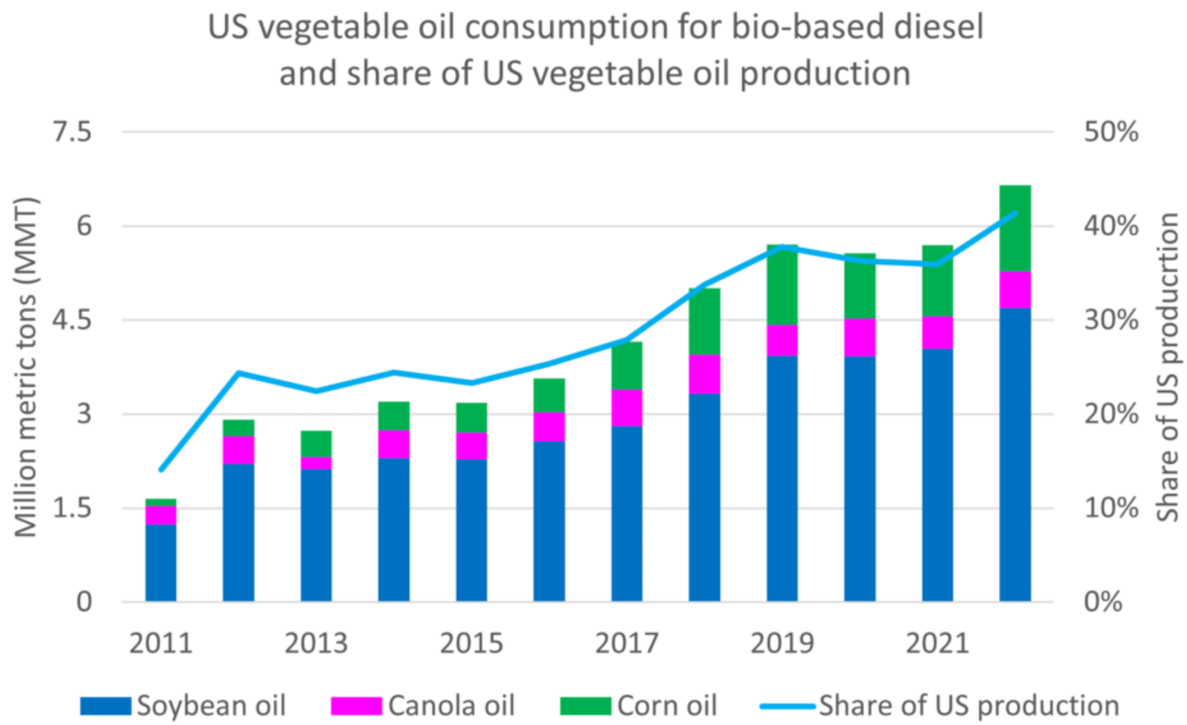


Figure 7: Use of vegetable oil to produce bio-based diesel increased more than 4 fold between 2011 and 2022 and the share of US vegetable oil production used for biofuels exceeded 40 percent in 2022. Source USDA Oil crops yearbook.

Statistics for yellow grease, tallow and other feedstocks are less well documented, so it is hard to assign a precise share, but experts agree that a large share of the available resources are now being used to produce the bio-based diesel.

The growing share of US vegetable oil used for bio-based diesel production is reflected in the balance of US trade in vegetable oil. Net vegetable oil imports grew by about 4 MMT between 2006 and 2022, especially canola oil and palm oil, which have replaced soybean oil in food uses. This has been a gradual process that reflects both changing consumer preferences and diversion of soybean oil to fuel production. More recently the US has effectively exited the export market for vegetable oil entirely and is now the 4th largest importer of vegetable oil after India, China and the European Union (USDA Foreign Agricultural Service).

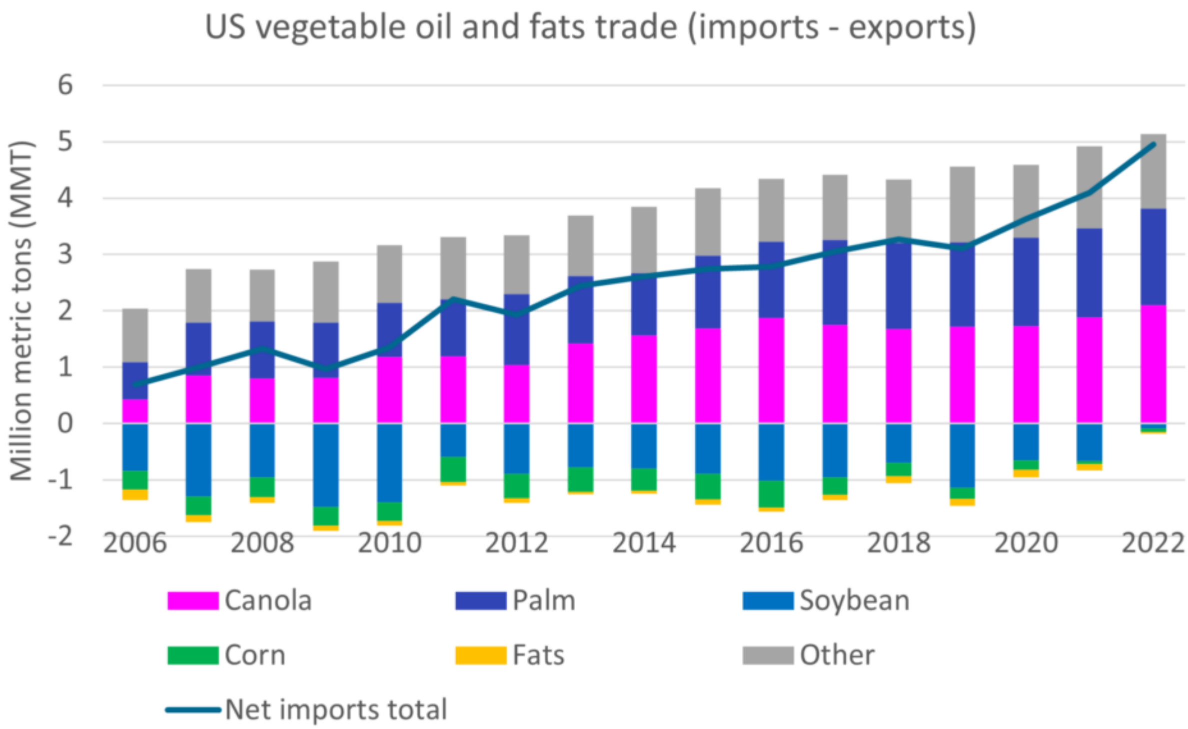


Figure 8. US vegetable oil imports have steadily risen, and exports have fallen as bio-based diesel production has climbed. Source USDA Oil Crops Yearbook.

How much feedstock is needed for future bio-based diesel production?

Scaling up bio-based diesel production requires more than production capacity; it also requires feedstock and demand. Figure 9 summarizes the quantity of feedstock that would be consumed if the planned renewable diesel facilities are built and operate at full capacity and the biodiesel industry continues to operate at its capacity as of the end of 2022. Capacity for feedstock consumption could rise by 10 to 20 MMT a year, or even more, a massive increase compared to the 11 MMT of actual US consumption in 2022. Declining production of biodiesel could potentially free up some feedstock for renewable diesel production, but since only 6 MMT of feedstock was used for biodiesel in 2022, even completely shutting down biodiesel production would free up just half of the feedstock required by renewable diesel capacity expansion announced for 2023 and 2024.

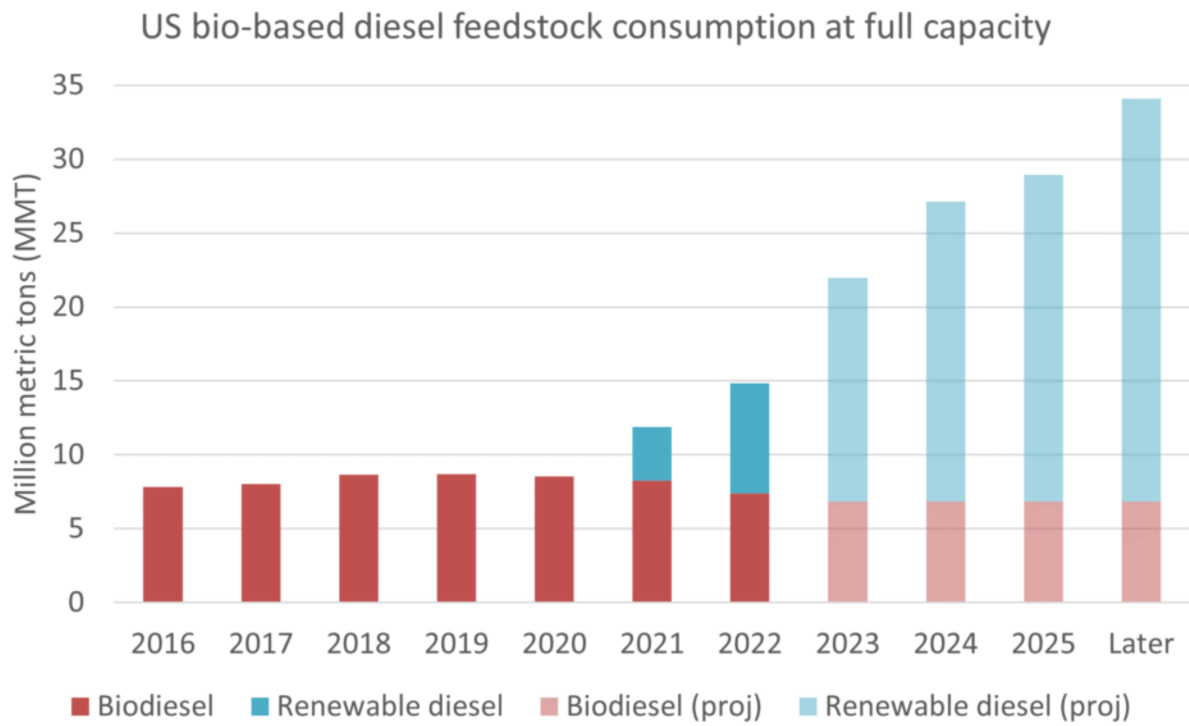


Figure 9: Combining current and announced renewable diesel production capacity and existing biodiesel production capacity, total feedstock consumption at full capacity could reach 34 MMT in the next few years. Source Energy Information Administration and farmdoc daily, March 29, 2023.

Where could an additional 10-20 MMT of feedstock come from?

The scale of demand for vegetable oil required to operate planned renewable diesel capacity is so large that meeting it would require dramatic changes to global markets for oils and fats with major implications for food consumers around the world and tropical deforestation. The bottom line is that palm oil is the only source of vegetable oil that could plausibly scale up to provide 10-20 MMT of additional vegetable oil in the next few years. Since palm oil is not an eligible feedstock for US biofuel production, other sources of oil, especially soybean oil, would most likely be diverted from food to fuel, while palm oil backfilled the soybean oil. It may seem absurd to even discuss increases this large, but analysis commissioned by a trade association for the renewal diesel industry argued recently that US feedstock for bio-based diesel could rise to 32 MMT in 2030, primarily from soybean oil.

A detailed explanation is provided in the appendix, but the main points are summarized below. Figure 10 shows global vegetable oil production in 2022.

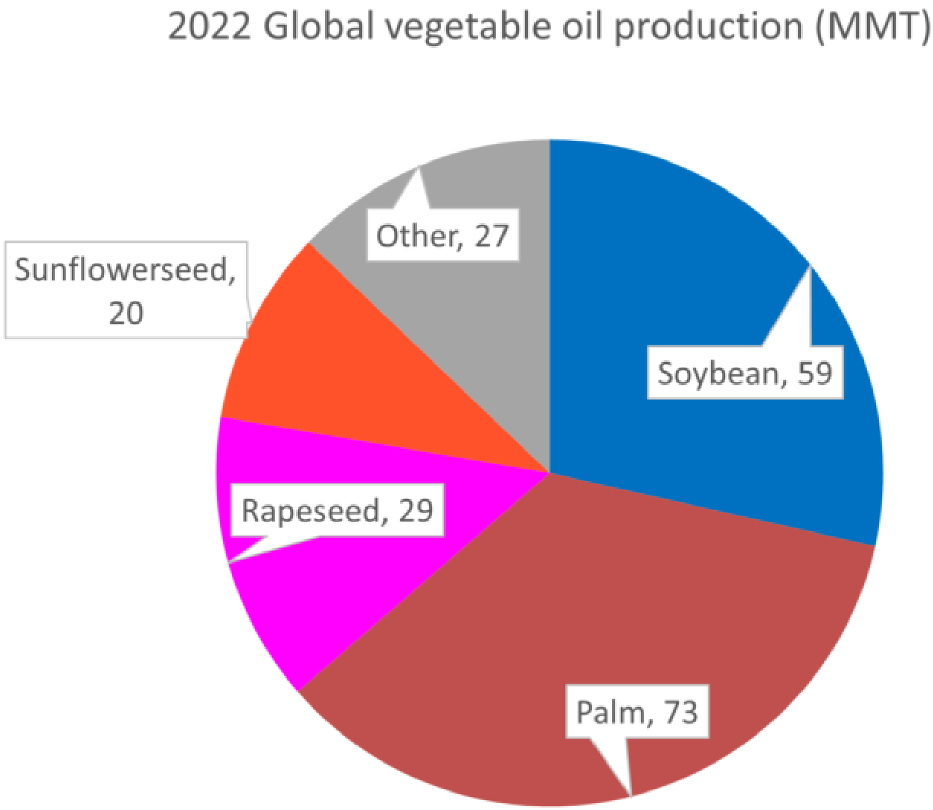


Figure 10: Global vegetable oil production in 2022 totaled 208 MMT of which palm oil accounted for 35 percent and soybean oil 29 percent. Source USDA Foreign Agricultural Service Oilseeds: World Markets and Trade.

Soybean oil accounts for three quarters of US vegetable oil production, and 29% of global production. and is the most plausible sources of supply for large increases in domestic production. To secure millions of metric tons of additional soybean oil, the US would need to reduce exports of whole soybeans and start importing soybean oil from Argentina and Brazil. If US oil companies are willing to outbid all other consumers, they could theoretically secure 10-20 MMT of additional RFS eligible feedstock. The bidding war would pit US oil companies against people's food consumption. Over the longer term, oil crop cultivation would catch up with demand and stabilize prices. But because soybean oil is a joint product with soybean meal, it is not economic to expand soybean production faster than demand for soy meal as animal feed. Thus, the additional vegetable oil required to replace the soybean oil used for fuel will mostly come from palm oil, which together with soybean oil made up 64 percent of global vegetable oil production in 2022. Domestic production and imports of other oil crops like canola/rapeseed and increased imports of used cooking oil from around the globe can contribute a small amount. But at the scale of the biodiesel boom there is no plausible source of feedstock other than soybean oil backfilled in cost sensitive food markets by palm oil.

Advice to policymakers

The idea that oil refineries can keep humming along by replacing petroleum diesel with vegetable oil or used cooking oil is a dangerous illusion. Having US oil companies backed up by billions of dollars in direct and indirect subsidies compete on the global market for vegetable oil to make into fuel is an expensive dead-end that does not support investment in scalable low carbon technology but drives up food prices and ultimately serves mostly to expand the cultivation of palm oil to replace the soybean and other oils made into fuel.

When policymakers subsidize new technologies, the justification is often the potential that scaling up a new technology will lead to cost reductions over time. But producing soybean oil and refining it at existing oil refineries is not catalyzing any fundamentally novel technology, so there is no reason to expect breakthroughs in cost to result. Policymakers need to pay attention to where the vegetable oil and feedstocks for bio-based diesel fuels come from. And when policies are placing an unsustainable draw on scarce resources, they need to act decisively to limit feedstock utilization at a sustainable level.

Today the renewable diesel boom in California is at risk of becoming a crisis, and policymakers at the Air Resource Board must act now to stop the massive expansion of soybean oil-based renewable diesel. California officials should ensure that California does not use more than half the US supply of feedstocks for bio-based diesel and related fuels.

A comparison with electric vehicles in instructive. In 2016, California accounted for 50 percent of the registrations of passenger car EVs in the US. Since that time, EV registrations in California have grown 540 percent, but registrations in the rest of the US have grown even faster, so the share of EV registrations in California has fallen to 37 percent (Source: Alternative Fuels Data Center). Over the same timeframe, consumption of renewable diesel in California has grown almost as fast as EV registrations, up 440 percent between 2016 and 2022. But where early action by California policymakers led to reduced cost and increased availability of EVs elsewhere, California's appetite for bio-based diesel feedstocks led to a decline of bio-based diesel consumption in the rest of the United States, with US consumption of bio-based diesel outside of California falling 19 percent between 2016 and 2022. The biodiesel boom is increasing costs and decreasing availability of renewable diesel and biodiesel in the rest of the United States and if the boom in California is not contained, it will lead to disruptions of global vegetable oil markets and accelerate tropical deforestation. More details on UCS's proposals to reform the Low Carbon Fuel Standard can be found here.

Ultimately, excessive utilization of any source of biofuel can become a problem if exploited at an unsustainable level. Biofuels can play a productive role if the crops used to produce them are grown without displacing food production or expanding the footprint of agriculture onto sensitive ecosystems. Policymakers need to be realistic about where biofuels come from, and limit feedstocks to a sustainable scale to avoid sending our fuel policies down a damaging dead-end road.

Appendix: Where could an additional 10-20 million metric tons of vegetable oil to produce bio-based diesel come from?

Soybean oil

Soybean oil is the natural place to start a search for additional US bio-based feedstock, since it accounts for 70 percent of US vegetable oil production and is the only domestic feedstock that could plausibly scale up by several MMT in a few years' time. As shown in Figure 1 below, the US produced almost 12 MMT of soybean oil in 2022, or which 4.7 MMT was used for bio-based diesel production.

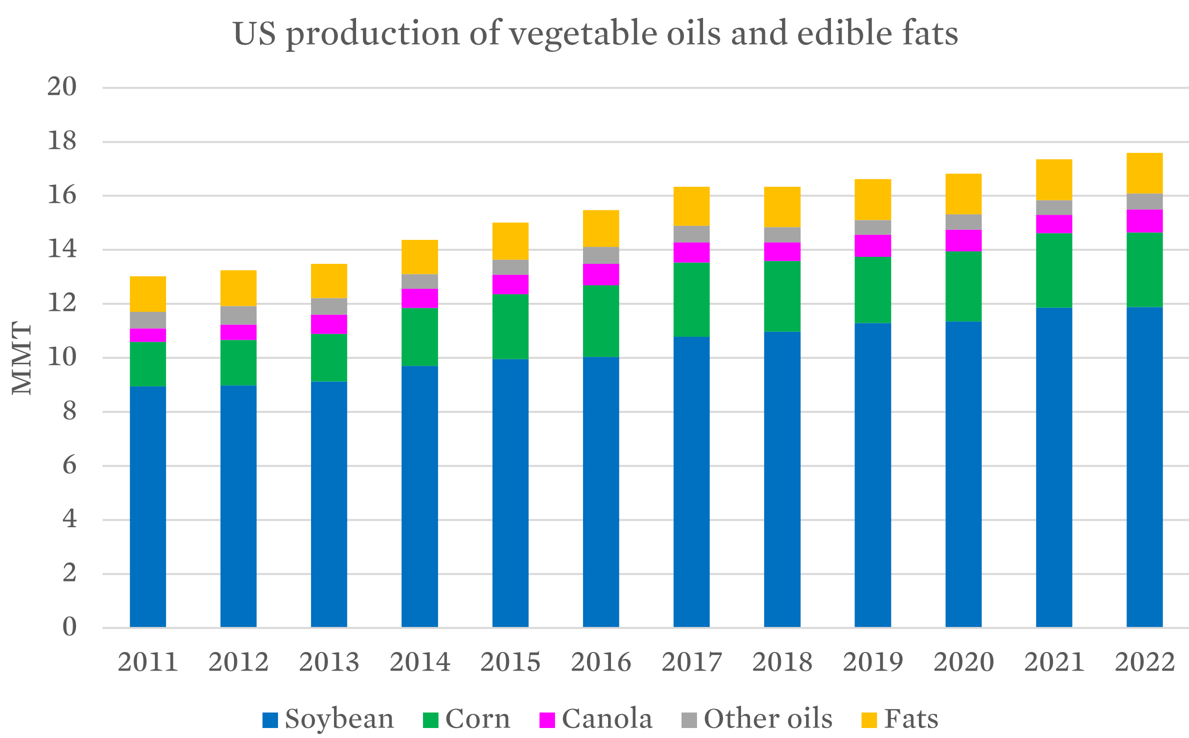


Figure A1. Soybean oil is the largest source of vegetable oil. Source USDA Economic Research Service Oil Crops Yearbook.

As shown in Figure 8, between 2006 and 2010 the US exported between 0.8 and 1.5 MMT of soybean oil, but has recently stopped exporting soybean oil and is projected by USDA to become a net importer of soybean oil in marketing year 2023/2024 (USDA ERS).

But US soybean oil production tells only part of the story since the US is a major exporter of whole soybeans. The soybeans exported by the US are processed, or crushed, in the importing countries into soybean oil and protein meal, used for animal feed. In recent decades the US has exported between a third and a half of the soybeans it produces, about 2 billion bushels in recent years. Crushing an additional 2 billion bushels of soybeans in the US would yield about 10.7 MMT of oil, or enough to produce 2.9 billion gallons of renewable diesel. Combining this with the soybean oil the US produced in 2022 leads to a total of over 22 MMT. Since only 5 MMT of soybean oil was used for fuel in 2022, the

US could more than double bio-based diesel production by redirecting US soybeans away from existing markets for vegetable oil and whole soybeans.

The idea that the US should scale up domestic production of bio-based diesel by crushing all of US soybeans for fuel production is effectively the argument made by the Advanced Biofuels Association backed up by an analysis suggesting that US feedstock for bio-based diesel could rise to 32 MMT in 2030, primarily from soybean oil. However, idea that the US could crush all of its soybeans ignores the practical barriers to crushing more soybeans and the more profound consequences of changes in global markets for food and agricultural commodities as the US redirects food into fuel markets.

Crushing more US soybeans

In the last few years, as renewable diesel producers made plans to increase production, so did the soybean crushing industry. Some of these were partnerships, such as the Marathon Petroleum partnership with ADM in North Dakota. By the end of the 2022, 23 new facilities or expansions had been announced totaling 750 million bushels a year of new crushing capacity, equivalent to 4 MMT of soybean oil, which would increase US crushing capacity by 34 percent if they were all completed as planned.

Dramatically increasing US soybean crushing for domestic biofuel production has complex and uncertain implications for three commodities: (fuel, vegetable oil and meat) especially in three regions of the world (North America, South American and Asia).

Soybean economics

Soybeans are an interesting crop, connected to their sister crop corn in complex ways in the agriculture, food and fuel system. While you may occasionally encounter soybeans in their immature form as edamame, the majority of soybeans are crushed to make soybean oil and a high protein meal that is mixed with corn in animal feed.

Historically, soybean meal has been the more valuable product of soybean crushing, often worth twice as much as the oil. The economics of soybean production depend jointly on the oil and the meal. As you would expect, increased demand for soybean biodiesel will raise demand and prices for soybean oil, but meal goes the other direction. As more soybeans are crushed to supply oil, the price of soybean meal will fall as increased production meets unchanged demand.

Since soybean prices depend on the sum of oil and meal prices, the net result is that soybean prices are only weakly linked to soybean oil prices. In a specific example worked out and explained in this analysis prepared by a Professor at Purdue University for the United Soybean Board, a 20 percent increase (0.84 MMT) in the use of US soybean oil for fuel led to an 8.2 percent increase in soybean oil prices, a 1.9 percent decrease in soybean meal prices and a 0.7 percent increase in soybean prices. The study also estimated changes in food prices, predicting a 4.4 percent in retail vegetable oil prices and much smaller decreases in the retail prices of eggs (0.16 percent), poultry (0.13 percent) and other animal products that benefit from reduced feed prices.

The consequence of all of this is that using more US soybean oil for fuel is expected to have a very small (0.2 percent) impact on US soybean production because meal prices that move the other direction will reduce the economic incentive to increase soybean production. The larger impacts occur overseas as the US trade patterns shift, with the US exporting fewer soybeans and increase net imports of vegetable oil, including not just soybean oil but also other oils that replace soybean oil.

Global consequences of increasing US soybean oil-based fuel production

There are three plausible consequences of increasing US production of soybean oil-based fuel: people eat less vegetable oil, soybean cultivation in increased or increased cultivation of other oils backfills the soybean oil used for fuel.

Decreased consumption of soybean oil for food

In the short term, higher prices for soybean oil prices lead to decreased consumption. Over the last few years, high prices for vegetable oil have been a major contributor to the food crisis**.** According to the food price index of the Food and Agriculture Organization of the United Nations, the vegetable oil price index reached 188 (versus 100 for 2014-2016), and was the leading contributor to a food price index that peaked at 144 overall in 2022. Biofuel policies were certainly not the primary contributor to these price spikes. But in an article from the International Food Policy Research Institute titled Food versus Fuel v2.0: Biofuel policies and the current food crisis, Joseph Glauber (former Chief Economist of USDA) and Charlotte Hebebrand showed that on a global basis, 15 percent of vegetable oils are now used for fuel production and while some countries temporarily reduced biofuel production in light of vegetable oil shortages, US consumption of vegetable oil for fuel rose steadily throughout the crisis. Prices, although still elevated, came down in 2023, and over time increased production will presumably stabilize prices.

It is important to remember that feedstocks for fuel are also food, and in a bidding war for vegetable oil, the lowest income food consumers are most likely to lose out. The previously cited study on the impact of increased use of soybean oil for fuel found that "a 20% increase in quantity of soybean oil demanded for use in biofuels increases the food-at-home component of the [Consumer Price Index] by only 0.05%." This very small impact on US consumers reflects that increased vegetable oil prices are partly offset by decreased prices for animal products, but mostly that agricultural commodity prices are a small share of US retail food prices. These mitigating factors are less relevant for the lowest income global consumers, who eat less animal protein and spend a much higher share of their food budget on basic commodities like vegetable oil.

Increased cultivation of soybeans outside the US

For reasons discussed above, increased US consumption of soybean oil for fuel will have a very modest impact on US production of soybeans but a larger impact in soybean exports. In the previously cited study, a 20% in US soybean oil consumption for fuel led to a 0.2 percent increase in US soybean production, but a much larger 1.1 percent decrease in US soybean exports.

The US and Brazil are the two largest global soybean producers, accounting for more than 70 percent of the global soybean production in 2022 between them, so reduced exports from the US are likely to be replaced by Brazil. China is by far the largest importer of soybeans, accounting for 68 percent of imports in 2022.

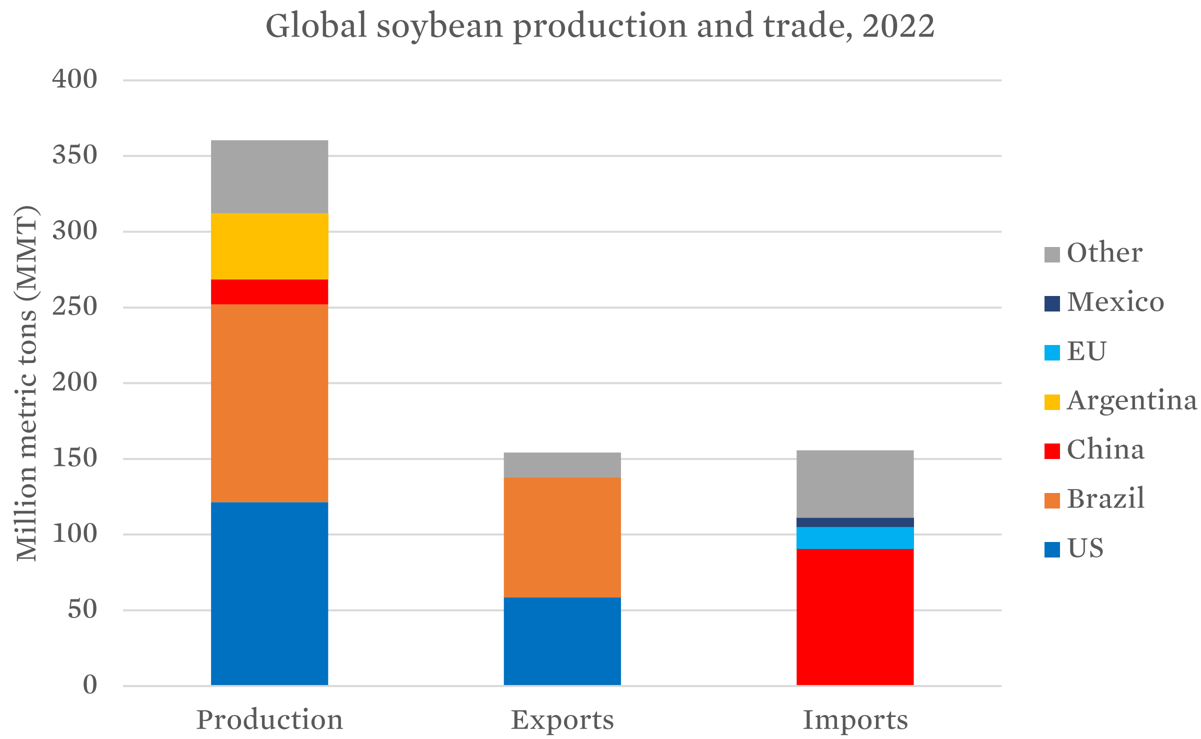


Figure A2: Source USDA Foreign Agricultural Service [Oilseeds: World Markets and Trade](#).

Soybean production has grown rapidly in Brazil, and Brazil recently surpassed the US to become the world's leading producer and exporter of soybeans. Both increased acreage and increased yields have contributed to Brazil's increased soybean production, with acreage increasing 50 percent in the last decade, versus a 20 percent increase in yield (USDA FAS). Thus, increased cultivation of soybeans in Brazil contributes to the rapidly growing footprint of land used for soybean production, which is linked to deforestation and other damaging land use changes.

Soybean production around the world will likely continue to grow both through increases in yield and expanded acreage. But, as discussed previously, the growth of soybean cultivation will ultimately be limited by demand for soybean meal. If demand for soybean oil for both food and fuel uses outstrips demand for soybean meal, it will depress meal prices and mitigate demand for soybeans. For this reason, other oils will play a large role filling the gap left by diversion of soybean oil into fuel markets.

Increased US imports of vegetable oil

Because bio-based diesel is consuming an increasing share of US vegetable oil production, the US has also increased imports and decreased exports of vegetable oil. As shown in Figure 8, the US has increased imports of palm and canola oil, and decreased exports of soybean and corn oil. The net change since 2006 has been about 4 MMT. In the case of reduced exports of soybean and corn oil, trade was directly affected by use of these oils for fuel production, imported canola oil is used for both food and biofuel production, while imported palm oil replaced soybean oil diverted from food markets into fuel production.

Because of rising oil imports, the US is now the 4th largest vegetable oil importer in the world, after India, China and the European Union, and ahead of Pakistan. Notably, while the US and EU use 40 percent or more of their vegetable oil for fuel production, India and China consume more than 90 percent of vegetable oil as food (USDA FAS).

Notwithstanding common rhetoric describing biofuels as about home-grown fuels, it is increasingly clear that a growing share of the feedstock for new renewable diesel production will come from outside the US. A recent analysis from the USDA Economic Research Service on U.S. Biofuel Policies Impact on Vegetable Oil Trade concluded:

> *This structural shift in the U.S. vegetable oils market is likely to continue to affect trade flows moving forward as biofuel use continues to grow. With lower exportable supplies, the United States' key trading partners are likely to continue to shift to other markets, decrease usage, or seek other oils to fill the gaps. The strong domestic demand for vegetable oils is also forecast to continue increasing imports of vegetable oils. This is projected to push the United States to be a net importer of soybean oil in MY 2023/24.*

This analysis of national trends is reinforced by a recent LCFS pathway application Phillips 66 files with the California Air Resources Board for renewable diesel made from soybean oil from Argentina. In light of the trends discussed above, it is not be surprising that fuel producers are looking overseas, especially given the scale of oil required for a facility of this size. Running at full capacity, the Phillips 66 Rodeo facility would consume 2.5 MMT of feedstock a year. The Phillips 66 Rodeo facility presumably has the necessary logistics to unload oil directly from tanker ships coming from the Pacific Ocean. And Argentina is the world's largest exporter of soybean oil, exporting 4-6 MMT of soybean oil in recent years out of a total production of 6-8 MMT. This one huge facility could potentially consume about half Argentina's exports.

Total global soybean oil exports from all countries have been around 12 MMT in recent years, so increasing US soybean oil imports by several MMT could have a major impact on global vegetable oil trade, pushing current importers to reduce consumption and switch to palm and other vegetable oils. Argentina and Brazil are the largest exporter of soybean oi, and India is the largest importer. However, most soybeans are crushed in the country that consumes the oil, so a more complete comparison is between the countries where soybeans are grown to the countries where soybean oil is consumed. Soybean production is dominated by Brazil, the United States and Argentina, which account for 36, 34 and 12 percent respectively in 2022. China, the United States, Brazil and India were the largest soybean oil consumers, accounting for 28, 19, 13 and 10 percent respectively.

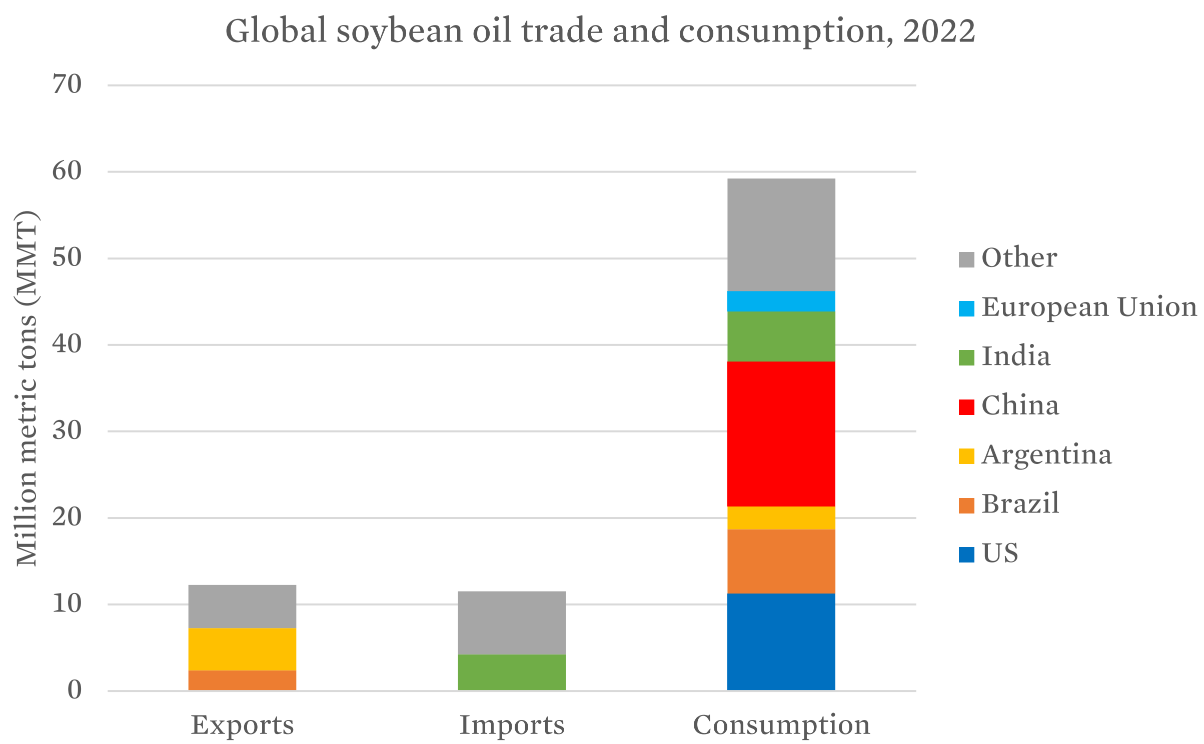


Figure A3: Source USDA Foreign Agricultural Service [Oilseeds: World Markets and Trade](#).

Other vegetable oils.

If US oil consumption of soybean oil for fuel increases faster than global demand for protein meal, it will create an imbalance in global markets for soybean oil and soybean meal. The way to rebalance these markets is to shift a larger share of vegetable oil production toward crops that produce more oil relative to meal. Of the major global oil crops, palm, canola and sunflowers produce a higher share of oil than soybeans. Corn oil is mostly a byproduct of ethanol production that is already almost fully utilized for bio-based diesel production, so it is not a plausible replacement for soybean oil.

Canola oil

Canola oil is the third largest source of vegetable oil produced in the US after soybean oil and corn oil. However, canola oil has a significantly higher yield of oil relative to protein meal compared to soybeans, so increasing cultivation of canola relative to soybeans can shift the balance of oilseed production in favor of oil. In 2022 Canola accounted for less than 1 MMT or about 5 percent of US vegetable oil production. So increased domestic production is likely to have a modest effect on US vegetable oil production in the near term. Globally canola/rapeseed oil accounts for 15 percent of vegetable oil production, and the US imported more than 2 MMT of canola oil in 2022. So canola oil imports are likely to play a larger role in the near term.

Longer term there are other promising oils crops in development, including camelina, winter hardy oilseeds and energy crops bred for high oil content. These crops have potential ecological advantages including improving water quality in addition to potentially significant vegetable oil production. But it will take time to develop and scale up these new crops, so they are not likely to supply millions of metric tons of oil in the next few years. Longer term these novel crops could be a potentially more significant source of increased US vegetable oil production.

Palm oil

Palm oil looms large over the vegetable oil debate because rapidly expanding palm oil cultivation in Indonesia and Malaysia has often come at the expense of draining peat forests, leading to major carbon emissions and other environmental and human rights harms. For this reason, palm oil is not an eligible feedstock for bio-based diesel fuel production under the federal RFS, and the California LCFS assigns land use change emissions to palm oil biodiesel that are 1.5 times higher than soybean oil biodiesel and 3.6 times higher than corn ethanol. Thus, it is very unlikely that palm oil is used to produce bio-based diesel in the US.

However, while palm oil won't be used directly to produce US biofuel, it is likely to play a primary role in replacing the soybean oil that is diverted from food markets to fuel production. As shown in Figure 8, palm oil and canola oil imports to the US have grown as soybean oil has increasingly been redirected to fuel production. But a potentially more significant shift is possible in global markets, particularly in Asia.

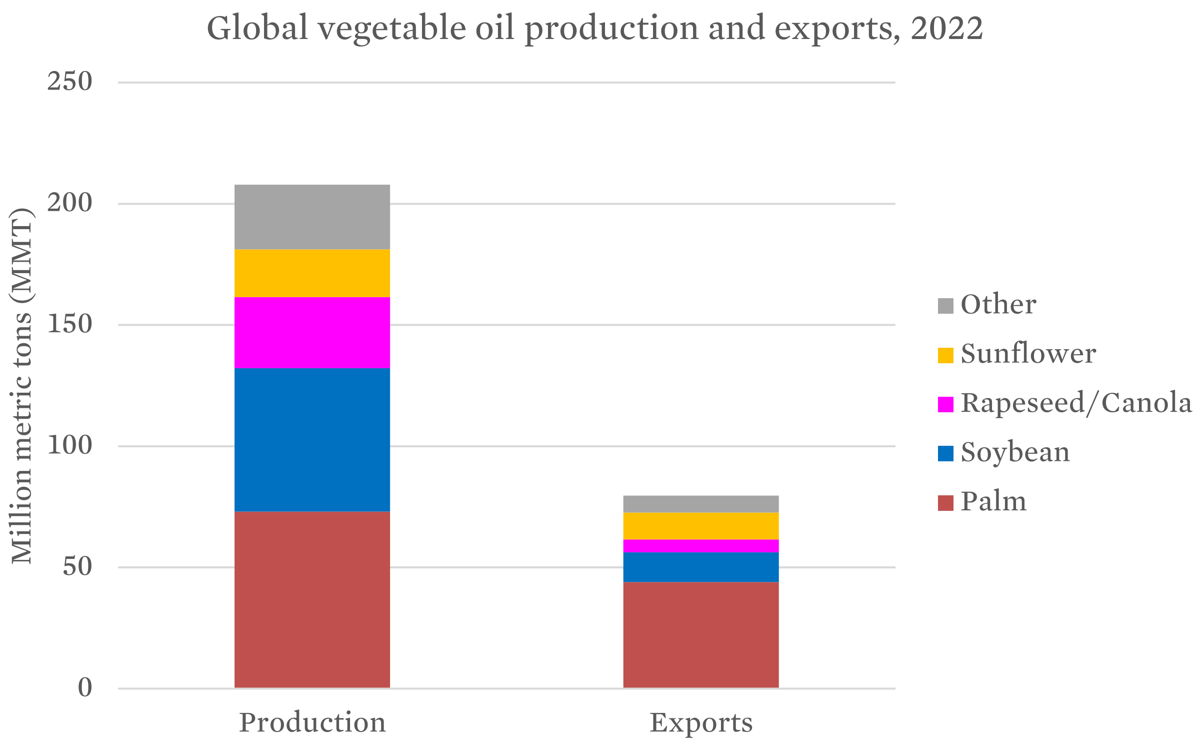


Figure A4: Source USDA Foreign Agricultural Service Oilseeds: World Markets and Trade.

Palm oil is the largest and fastest growing source of vegetable oil in the world, accounting for 35 percent of global vegetable oil production and 55 percent of global trade in vegetable oil in 2022, and is less expensive than many other vegetable oils. And while soybean oil production responds weakly to demand because it is produced jointly with soy meal, palm oil is the primary product of oil palm production, and thus much more responsive to increased demand for vegetable oil. For all these reasons, palm oil is likely to be the primary replacement for soybean oil that is diverted from global markets.

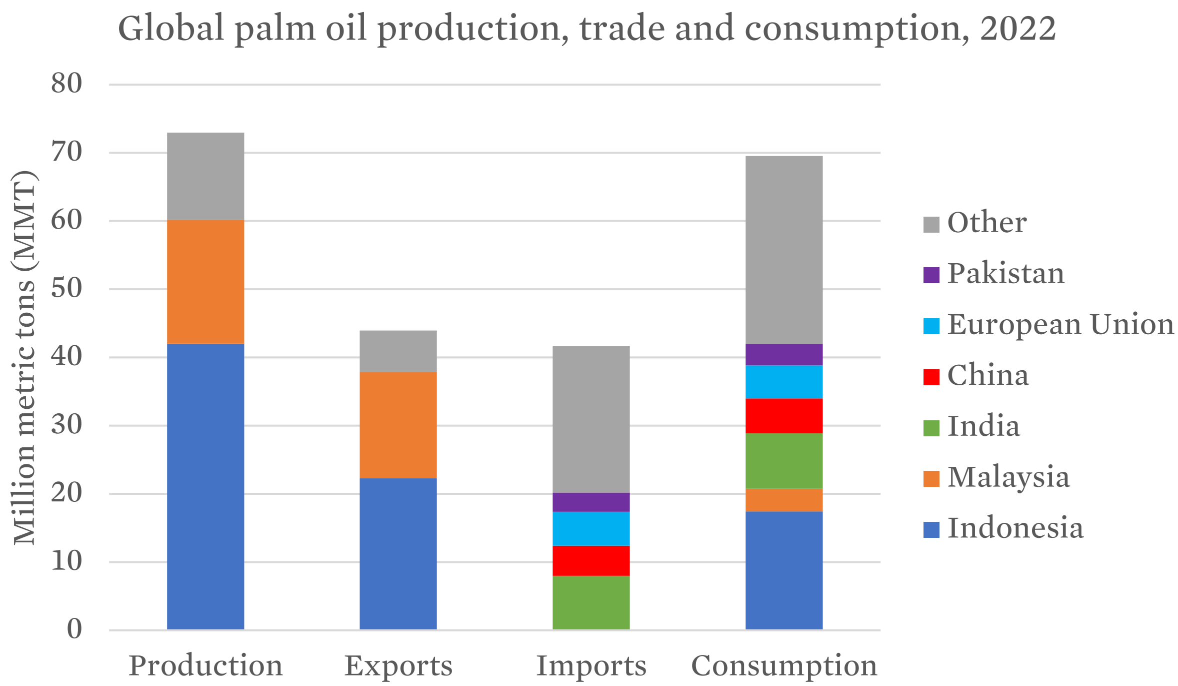


Figure A5: Source USDA Foreign Agricultural Service [Oilseeds: World Markets and Trade](#).

More than 80 percent of palm oil is produced in Indonesia and Malaysia, and India, China and the European Union are the largest palm oil importers. If the US starts importing a more soybean oil from global markets for fuel production, cost sensitive consumers in these and other countries will accelerate their shift toward less expensive palm oil. Additionally, if the US reduces its exports of whole soybeans and expands exports of soybean meal while using the oil for fuel production, China and other countries currently importing whole soybeans will need to find a replacement for the soybean oil they would have crushed domestically, further increasing consumption of palm oil.

Yellow grease and other secondary fats and oils

California's LCFS policy (and related policies in Oregon and Washington) include a substantial preference for fuels produced from secondary fats and oils, including used cooking oil, inedible distillers corn oil, and animal fats. At an LCFS credit price of $100 per ton of avoided CO2 This incentive is worth $0.25 – 0.75/gallon for renewable diesel made from yellow grease instead of soybean oil depending on the LCFS credit price[5]. The justification for this incentive is that consumption of these feedstocks will not expand the cultivation of crops, and thus not contribute to land use change. Because of these policy preferences, fuel producers making bio-based diesel fuel for these markets have a substantial incentive to use these feedstocks. Marathon Petroleum recently entered into a joint venture with Neste, an oil company from Finland, to supply used cooking oil and other feedstocks to the converted oil refinery in

[5] Calculated at credit prices of $66 and $200 per LCFS credit. Each credit represents one metric ton of carbon dioxide equivalent pollution below the standard.

Martinez California. Across the country in Louisiana, Diamond Green filed an LCFS pathway application that shows it plans to produce renewable diesel for California sourced from used cooking oil and animal fats from South America, Asia and Oceana.

While expanding fuel production without expanding crop production seems like free lunch of sorts, reality is not that simple. First, there is a very limited supply of secondary fats and oils, and the available supply in the US is almost fully utilized. That's why imports from around the world feature so prominently in the plans of the big renewable diesel producers. The generous incentives for recycled oils also create an increased risk of fraud. If palm oil is successfully passed off as used cooking oil, it would not only avoid the prohibitions and penalties associated with palm oil-based biofuel, it would receive the favorable treatment reserved for secondary fats and oils.

Moreover, the assumption that secondary fats and oils have no impact on crop production is an oversimplified view of these resources. Very little of the secondary fats and oils were truly a waste product but are instead used for animal feed or to produce soaps and detergents. Just as consumers of soybean oil can substitute other oils, current users of secondary fats and oils will switch to other resources if secondary fats and oils are expansive or unavailable. Used cooking oil and distillers corn oil are also used for animal feed. As these sources of oil are diverted to fuel production, the oil calories in feed are replaced by other sources of calories as animal feeds are reformulated to reflect the cost and availability of inputs.

The point is that even secondary fats and oils are no free lunch. There is a limited supply of used cooking or animal fat, and increasing demand for these in fuel markets will displace existing users of these products. So it is important to be realistic about available supply of secondary fats and oils and the impact of diverting them from existing uses to fuel production.

Attachment 2. A Cap on Vegetable Oil-Based Fuels Will Stabilize and Strengthen California's Low Carbon Fuel Standard

January 30, 2024. Available online at https://blog.ucsusa.org/jeremy-martin/a-cap-on-vegetable-oil-based-fuels-will-stabilize-and-strengthen-californias-low-carbon-fuel-standard/

I have long been a supporter of California's Low Carbon Fuel Standard (LCFS). The LCFS is the leading example of a Clean Fuel Standard, an approach to transportation fuel policy that holds oil refiners accountable to reduce the carbon intensity (CI) of transportation fuels. The CI is determined through a lifecycle analysis of the global warming pollution associated with the production and use of gasoline, diesel, biofuels, electricity, or other alternative fuels. Oil refiners comply with the LCFS by blending cleaner alternative fuels into the gasoline and diesel they sell, and also by buying credits generated by vehicles that don't use any gasoline or diesel at all, such as electric vehicles (EVs). The LCFS has delivered important benefits to California, including billions of dollars of support for transportation electrification, and has been a model for other states. Oregon and Washington have enacted similar policies, and Minnesota, Illinois, Michigan, New York, and New Mexico have taken up legislation to adopt similar policies. Federal transportation fuel policy would also benefit from a more comprehensive approach that supports electricity, among other alternatives to petroleum and focuses on emissions reductions rather than simply requiring the use of increased volumes of biofuels.

But California's LCFS has been struggling and is approaching a treacherous precipice. A flood of credits from renewable diesel and manure biomethane have depressed credit prices, undermining the support the LCFS provides for electrification and more scalable low carbon fuels. A rulemaking process is underway to amend the rules of the LCFS including updating the scheduled increases in stringency. The current rules require a 20 percent reduction in the CI of transportation fuels by 2030, which the proposed amendments would change to 30 percent in 2030 and 90 percent in 2045. The California Air Resources Board (CARB) is set to consider the proposed changes on March 21.

Getting this right is important, both for California and to ensure the LCFS remains a workable model for other states and the federal government. When the Board meets in March to update the LCFS, they should place a cap on vegetable-oil based fuels for four major reasons:

1. **Broken policies:** Counter-productive interactions of the LCFS with federal policy are leading oil companies to redirect most of the bio-based diesel (biodiesel and renewable diesel) they are required to sell in the United States to California, which now consumes more than half of the national supply, even though California consumes only 7 percent of the nation's overall diesel fuel (bio-based and fossil diesel combined). This is drawing bio-based diesel fuel out of other states and putting California and federal fuel policies into a vicious cycle that is contributing to ever more unsustainable and expensive fuel policies.
2. **Global hunger and deforestation:** Excessive consumption of bio-based diesel fuels has already contributed to the 2022 global food crisis, and is accelerating deforestation caused by increased soybean and palm oil cultivation around the world.
3. **Gas prices:** Without a cap, the flood of bio-based diesel into California will continue, requiring a rapid increase in stringency to stabilize LCFS credit markets, sending 2030 stringency from the 30 percent proposed in the regulation to 34.5 percent or even 39 percent with a commensurate increase in costs for California drivers.

4. **Credit price stabilization and support for EVs:** Limiting the use of vegetable oil-based biofuels, as CARB staff considered in a proposal to cap the use of fuels made from virgin oils, will stabilize LCFS credit markets with less dramatic increases in stringency, supporting a balanced set of clean transportation solutions, including EVs, while reducing costs for California drivers.

This post focuses on the need for a cap on vegetable oil-based fuels, which is one of several necessary reforms to the LCFS. For more information on our position on manure biomethane and other topics, see my post, "Something Stinks: California Must End Manure Biomethane Accounting Gimmicks in its Low Carbon Fuel Standard."

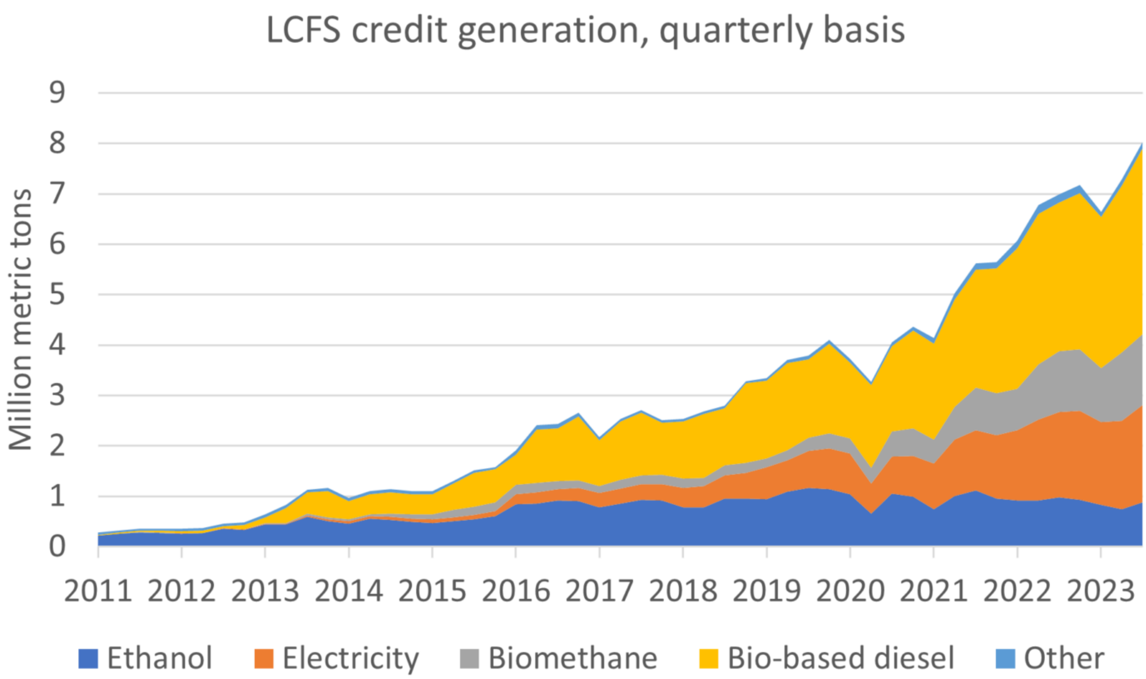


Figure 1. LCFS credit generation. Source California Air Resources Board.

What broke the LCFS?

To solve a problem, it is important to understand the root causes. California's transportation fuels policy creates a market for low carbon fuels, which are tracked using a system of credits and deficits shown in Figure 1 below. The supply of credits from low carbon fuels has been exceeding the requirements of the LCFS, leading to falling credit prices. You might think that low credit prices mean the program is meeting its goals at lower cost than expected, which would be great. Unfortunately, this is far from the truth. More than 60 percent of the credits flooding the program are coming from bio-based diesel and biomethane, crowding out the support the LCFS would otherwise provide to electric cars and trucks to support California's transition away from combustion fuels.

Stabilizing credit prices at a level that supports steady progress (roughly $150 per metric ton) is a key goal of the rulemaking process. Since credit prices are set by the balance of supply and demand, prices could be raised by either restricting the supply of credits or by increasing LCFS stringency to raise demand. During the two years of workshops that preceded the formal proposal, concepts discussed by

CARB staff included changes to the rules that would reduce the supply of credits from bio-based diesel and biomethane and increased stringency to increase demand for credits. But the official proposal abandoned any meaningful effort to address supply and focuses almost entirely on increasing stringency.

CARB has proposed increasing the 2030 stringency of the LCFS by 50 percent, from the current requirement of a 20 percent reduction in the carbon intensity in 2030 to a 30 percent reduction in 2030. CARB has also proposed an auto-acceleration mechanism, which could see the 2030 stringency rise to 34.5 percent or 39 percent if the supply of credits continue to substantially exceed demand.

In my feedback over the last 2 years, I argued CARB should cap support for bio-based diesel made from vegetable oil and phase out credits for avoided methane pollution to wind down what has become, in effect, a poorly run offset program. Bio-based diesel and manure biomethane generate a lot more credits than an accurate assessment of their climate benefits would support, and are causing additional problems to boot. Unfortunately, the official proposal ignores the oversupply of low value credits and focuses almost exclusively on increasing demand by accelerating the pace of the program. This won't work—and will make the LCFS needlessly costly for California drivers, while postponing the needed reforms that would restore the stability of the LCFS. Moreover, absent reform, the LCFS is not a replicable model for other states or the federal government.

Capping the renewable diesel boom

Bio-based diesel refers to two closely related fuels, biodiesel and renewable diesel that are made from vegetable oils and animal fats and blended into diesel fuel. I just posted a detailed article describing the surge in renewable diesel—used mostly in California and made increasingly from soybean oil—that threatens to create major problems in global vegetable oil markets and accelerate tropical deforestation caused by expanding cultivation of soybeans and palm oil.

California may seem like an unlikely driver of deforestation from soybean and palm oil biofuels. The California LCFS has, since its inception, included significant disincentives for the use of crop-based biofuels, including soybean and palm oil-based diesel. Instead, the LCFS encourages the use of fuels made from used cooking oil, animal fats or other secondary fats and oils. For almost a decade, these disincentives effectively kept crop-based diesel fuels out of the California market. However, for reasons explained below, this incentive-based safeguard has become ineffective, and since 2020 California's bio-based diesel has increasingly been made from soybean oil, some of it sourced directly from South America.

The proposed amendments to the LCFS acknowledge the risks posed by the rising use of soybean oil-based renewable diesel. This reflects concerns raised by many stakeholders, myself included, at LCFS workshops since December 2021 (I submitted technical feedback on this topic six times over the last two years, and coauthored a paper on the subject). The first page of the rulemaking document suggests CARB intends to "[strengthen] guardrails on crop-based fuels to prevent deforestation or other potential adverse impacts." The proposal considers a cap on the use of fuels made from virgin vegetable oils in Alternative 1, but then rejects it based on flawed arguments addressed below. Instead of a cap, the proposal suggests tracking the chain of custody for crop-based feedstocks, an ineffective approach that will not address the root causes of the problem.

I'll explain why the cap described in Alternative 1 is the right decision, why the arguments against it are wrong, and why the feedstock tracking proposal is not an adequate safeguard. But first it's important to understand how the implementation of the LCFS is being distorted by complicated interactions with federal biofuels policy, since this explains the root cause of the renewable diesel problem and points the way to a solution.

The LCFS operates on a playing field shaped by federal policy

If the California LCFS acted without the influence of federal policy, there would be no renewable diesel boom, and there would certainly not be a flood of soybean oil-based diesel. The limited support offered by the LCFS for soybean oil-based fuels would not come close to covering the cost of expensive soybean oil needed to make the fuel. It's the interaction of the California LCFS with federal policy, particularly the Renewable Fuel Standard (RFS), that has led to California's renewable diesel boom.

The RFS requires oil companies to blend increasing amounts of a few types of biofuels into the gasoline and diesel they sell. In its early years, between 2005 and 2010, the RFS helped launch the massive scaleup of corn ethanol that established 10 percent ethanol as the de facto standard for US gasoline. After 2010, bio-based diesel fuels (biodiesel and renewable diesel) have been the main beneficiary of the RFS.

Bio-based diesel fuels are expensive. Without substantial policy support, there would be little if any bio-based diesel fuel produced or consumed in the United States. Analysis by the Environmental Protection Agency (EPA) in the most recent RFS rulemaking finds that more than 90 percent of the costs of complying with the RFS, $7 to $8 billion a year, are associated with bio-based diesel fuels[6]. These costs are spread across all the diesel fuel consumed in the United States, adding 13 to 15 cents per gallon to the cost of diesel fuel in the United States, according to EPA.

The RFS sets national targets, but also includes a system of tradable credits that allow overcompliance in one region (or by one company) to offset undercompliance in another region (or by another company). This flexibility allows for higher levels of biofuel consumption in states with supportive policies to offset lower consumption elsewhere. Economic factors and practical limits on blending keep ethanol and biodiesel widely distributed. In 2020, every state except Alaska blended at least 9.5 percent ethanol into their gasoline versus a US average of 10.3 percent, while 35 states blended at least 2 percent biodiesel into their diesel, versus a US average of 3.8 percent.

Renewable diesel is a different story. Since renewable diesel is a replacement for diesel rather than an additive, there are no practical blending constraints. This has allowed oil companies to meet a rising share of their RFS obligations in California, where the same fuel also provides compliance for the LCFS. **In 2022 half of the bio-based diesel consumed in the United States was consumed in California, which accounts for just 12 percent of US population and just 7 percent of the nation's overall diesel (bio-based and fossil diesel combined).** The factors that concentrated half of US bio-based diesel in California are only getting stronger, as more renewable diesel production capacity comes on-line in California, and California raises the targets for the LCFS.

[6] US EPA. Renewable Fuel Standard (RFS) Program: Standards for 2023–2025 and Other Changes. Regulatory Impact Analysis. Section 10.4.2, specifically table 10..4.2.2-4. Online at nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1017OW2.pdf

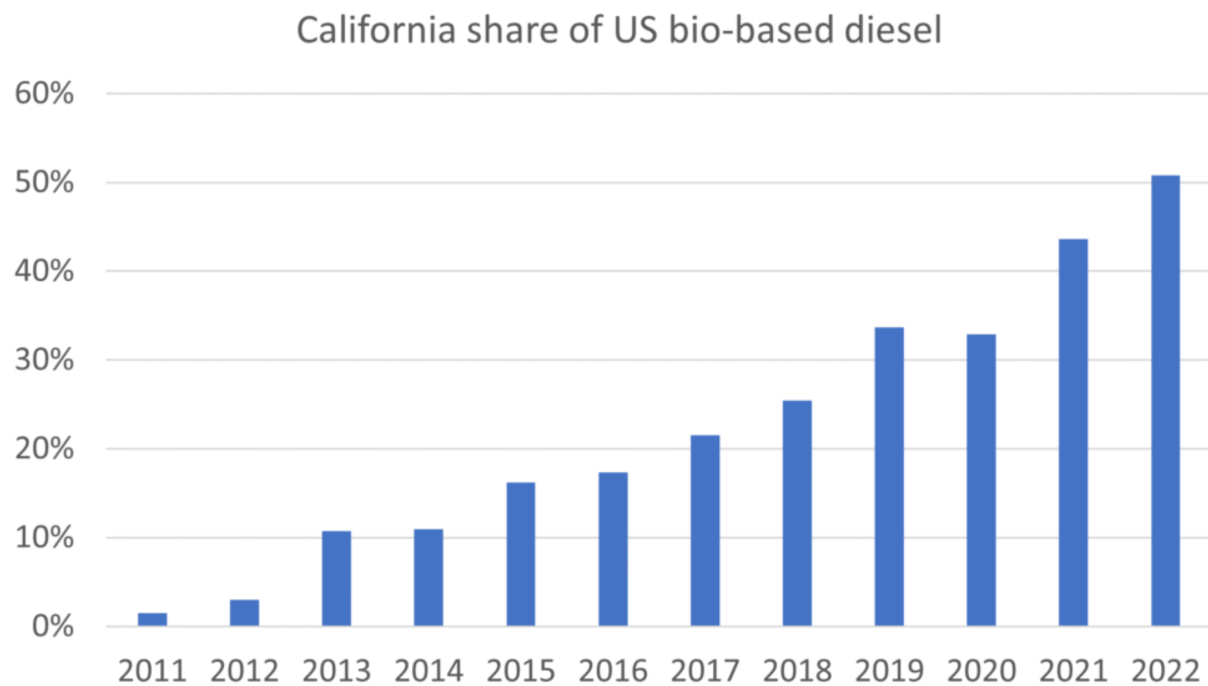


Figure 2: Share of California consumption of US bio-based diesel fuel (biodiesel and renewable diesel) weighted by their RFS compliance value. Source California Air Resources Board, US Energy Information Administration.

Unless CARB changes course, California is likely to consume well over half of US bio-based diesel, including increasing amounts of soybean oil-based fuel, putting pressure on the EPA to raise RFS targets to unsustainable levels that harm access to food and accelerate deforestation. Concentrating RFS compliance in California reduces oil companies' compliance costs, but it destabilizes both the RFS and LCFS. It makes no sense for California to consume most of the US supply of bio-based diesel.

Capping vegetable oil-based fuels is the right decision

The CARB rulemaking document called the Initial Statement of Reasons (ISOR) includes consideration of Alternative 1 on pages 88 to 102 that "includes a limit on total credits from diesel fuels or sustainable aviation fuel produced from virgin oil feedstocks." Because Alternative 1 reduces credit generation, the 2030 stringency is adjusted from 30 percent to 28 percent, but the 2045 stringency remains the same (90 percent). The lower stringency results in lower costs and reduced economic impact of the regulation. The ISOR says, "The macroeconomic impact analysis results shown in Table 23 indicate that Alternative 1 would result in more positive impacts on gross state product (GSP), personal income, employment (Figure 14), output (Figure 15) and private investment when compared to the proposed amendments." The main reasons CARB gives for rejecting Alternative 1 are the climate and air quality benefits CARB attributes to the higher use of renewable diesel. However, these apparent benefits result from faulty analysis.

According to official analysis from CARB and EPA, soybean oil-based diesel has lower lifecycle carbon emissions than fossil diesel, but this finding is quite uncertain. EPA recently conducted a model comparison exercise that found that the climate benefits attributed to soybean oil biodiesel depend entirely on which model is used to conduct the assessment. While the particular model used by CARB for the LCFS finds that soybean oil biodiesel has lower emissions than fossil diesel, other well-regarded models find that soybean oil biodiesel is more polluting than fossil diesel. But even putting aside this uncertainty, the ISOR overstates the climate benefits of using soybean oil-based fuels because it ignores the fact that use of this fuel in the United States is already mandated by the RFS, so if California uses less, another state will use more. In past rulemakings, CARB accounted for this policy overlap by only including climate benefits that exceed those required by federal law. But in the current rulemaking, CARB ignores the federal requirements, inflating the claimed climate benefits.

The inflated climate benefits attributed to renewable diesel are especially significant because California's renewable diesel boom has exhausted the supply of low-carbon sources of renewable diesel. Alternative 1 caps fuels made from virgin oils such as soybean oil, which produce few if any climate benefits not already required by the 50 percent emissions reduction requirements of the federal RFS. So Alternative 1 will have little if any real impact on global warming pollution, even putting aside the contested and uncertain benefits of soybean oil-based fuels in general.

The ISOR also attributes health benefits to increased use of renewable diesel in California, especially associated with reduced fine particulate matter, or PM2.5. This is based on a 2011 analysis and ignores a more recent 2021 study prepared for CARB that looks at the NOx and PM from biodiesel and renewable diesel used in legacy and new technology diesel engines. The key finding is that air quality benefits from older engines are not observed in new technology diesel engines, which are now required in California. This undercuts one of the main justifications offered to reject limits on renewable diesel. Ironically, because renewable diesel does offer PM and NOx emissions in older trucks that are still in use elsewhere in the US, concentrating most of US renewable diesel in California does not help Californians, but it does harm others across the United States.

Finally, the ISOR also claims that Alternative 1 has lower cost effectiveness than the proposed amendments, but this is a direct result of the inflated CO2 and health benefits. A corrected analysis would reduce or eliminate the difference in cost effectiveness.

Without a cap, things could get a lot worse

This ISOR has several deficiencies compared to previous rulemakings, starting with transparency. It is hard to understand precisely how CARB modeled Alternative 1. Based on my current understanding of the information in the proposal, it appears that the total amount of fuels made from oils and fats is projected to peak in 2025 and then to hover at roughly 2 billion gallons a year thereafter[7]. The share of bio-based diesel blend in overall diesel fuel consumption, or blend rate, is assumed to range between 44 and 56 percent through 2035, and then to increase as total diesel fuels consumption falls, as heavy-duty electrification starts to gain traction.

Reality is running well ahead of CARB projections. Bio-based diesel consumption in the first half of 2023 was at 59 percent, a level CARB modeling does not anticipate prior to 2037. I can't see any reason

[7] While there are a lot of long documents on the CARB rulemaking website, there is not a clear and quantitative description of the various alternatives, which are described inconsistently in different documents. There is no downloadable table of the quantities of fuels and credits associated with the different alternatives, or enough information to reproduce this information using the CATS tool CARB used for modelling fuel projections. In order to clarify what is at stake, I'll summarize my understanding based on the available documents. In the ISOR CARB projects that bio-based diesel will peak at 2 billion gallons in 2025, fall below 1.8 billion gallons by 2028 and then hover between 1.5 and 1.8 billion gallons thereafter. They also project several hundred million gallons of alternative jet fuel, of which half is made from virgin oils.

why bio-based diesel consumption in California would fall while renewable diesel production capacity in California is ramping up and CARB is proposing to substantially raise LCFS stringency. CARB projects total diesel consumption at 3 billion gallons or more until 2035, so actual consumption could be more than 50 percent higher than CARB's projection if bio-based diesel fully replaces fossil diesel, as a recent study from UC Davis found was 50 percent likely by 2028. If this happens, the extra credit generation beyond what is modelled in the ISOR could trigger the auto acceleration mechanism, pushing 2030 stringency to 34.5 or even 39 percent, with a commensurate increase in costs. Moreover, if all the diesel used in California is bio-based, all of the compliance costs associated with the LCFS will be borne by drivers of gasoline cars.

Alternative 1 described in the ISOR has roughly 25 percent less biobased diesel at the peak in 2025, so roughly 1.5 billion gallons. That is consistent with 2022 consumption of bio-based diesel in California, and since RFS standards are rising gradually, this would result in California consuming a little less than half of the bio-based diesel and related fuels required for RFS compliance in the United States.

The 2 billion gallons of bio-based diesel projected for the ISOR would satisfy about two-thirds of the 2025 RFS requirements, but if actual consumption exceeds the projection, California consumption could push the RFS mandate for bio-based diesel and related fuels into overcompliance. All sorts of weird things would happen if the RFS became non-binding, starting with RFS credit prices falling and the effective cost of renewable diesel available in California rising, with implications for the cost and feasibility of the LCFS[8]. A non-binding RFS is not a stable long-term situation, for both economic and political reasons. It could also create a lot of turbulence, not just in fuel markets but in food markets for vegetable oil as well.

A vicious cycle of bad fuel policy decisions

My biggest concern is that a feedback loop between California LCFS and the Federal RFS push US consumption of vegetable oil for fuel to ever more unsustainable levels. This feedback loop is influencing fuel policies today and could become a vicious cycle.

Interactions between the LCFS and the RFS have been a major contributor to the renewable diesel boom, which has flooded California with renewable diesel and depressed LCFS credit prices. Increased renewable diesel production capacity to serve the California market was one of the factors cited in EPA's decision to raise RFS standards for 2022-2025. And even with the higher RFS targets, increased renewable diesel production in and for California has at least temporarily pushed the RFS into overcompliance, sending credit prices down sharply.

If California regulators respond to low credits prices by dramatically increasing the stringency of the LCFS without a workable mechanism to avoid concentrating RFS compliance in the state, it will keep pulling a growing share of US bio-based diesel fuel into California. This puts the Midwestern biodiesel industry under pressure, and puts Midwestern soybean oil producers at a disadvantage compared to used cooking oil imported from as far away as Australia. This will create enormous political pressure on EPA to raise the RFS standards to ensure that they continue to support soybean biodiesel, renewable diesel, and growing consumption of sustainable aviation fuel in states outside of California. The resulting higher RFS standards will increase the use of vegetable oil-based fuels, driving up the cost of the RFS with uncertain climate benefits and very real risks to food markets and deforestation. Meanwhile, higher RFS standards

[8] For more on the implications of a non-binding RFS, see *Gerveni, M., T. Hubbs and S. Irwin. "Is the U.S. Renewable Fuel Standard in Danger of Going Over a RIN Cliff?" farmdoc daily (13):99, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, May 31, 2023.*

will support ever more vegetable oil-based fuel in California, further diluting the LCFS, and the vicious cycle continues.

This vicious cycle explains why raising LCFS stringency alone will not rebalance supply and demand for LCFS credits. **CARB can break this vicious cycle by limiting California's share of US bio-based diesel consumption to a reasonable level.** The proposal described in Alternative 1 to cap virgin oil-based fuels would do the job, while still leaving California as the largest consumer of bio-based diesel in the US. A cap would also leave space in the bio-based diesel market for other states that have or are considering policies like the LCFS.

As I explained in my earlier article on the renewable diesel boom, successful fuels policy in California and the United States requires being realistic about the available resources used to make biofuel. Vegetable oil is an expensive way to make biofuel with limited potential to sustainably increase scale, especially in the short term. A bidding war between the oil companies and people consuming vegetable oil for food already contributed to the recent food crisis, and may do so again. In the longer term, increased use of vegetable oil-based fuels leads to increased palm oil production to replace the soybeans diverted from food markets to make fuel, contributing to deforestation. Capping vegetable oil used for fuel at a reasonable level will encourage fuel producers to look beyond vegetable oil to more scalable feedstocks. A cap will also save California drivers money, by rebalancing supply and demand for LCFS credits without such a steep acceleration in stringency.

The guardrail proposed in the ISOR is inadequate

CARB's ISOR mentions the risks posed by crop-based fuels, but unfortunately, the proposed guardrail is inadequate. From page 32:

> CARB staff are proposing to require pathway holders to track crop-based and forestry-based feedstocks to their point of origin and require independent feedstock certification to ensure feedstocks are not contributing to impacts on other carbon stocks like forests. CARB staff are also proposing to remove palm-derived fuels from eligibility for credit generation, given that palm oil has been demonstrated to have the highest risk of being sourced from deforested areas.

Tracking the chain of custody won't work because there is more than enough soybean oil produced on existing cropland in the US, Argentina, and Brazil to produce 100 percent of California's diesel fuel. The problem with chain of custody tracking is that California won't be tracking the chain of custody of vegetable oils used to replace those diverted from global food markets for consumption in India or China.

As I mentioned in the appendix to my recent post on the renewable diesel boom, the Phillips 66 Rodeo facility is scaling up production of renewable diesel at a converted oil refinery near San Francisco. Phillips 66 filed paperwork recently indicating it plans to produce renewable diesel and other fuels using soybean oil from Argentina. At full capacity, the massive facility would consume 2.5 million metric tons (MMT) of vegetable oil a year. Argentina is the world's largest exporter of soybean oil, exporting 4-6 MMT of soybean oil in recent years out of total global soybean oil exports of about 12 MMT. This one huge facility could potentially consume about half Argentina's exports and 20 percent of global exports. To replace soybean oil from Argentina, major vegetable oil importers like India would import more soybean and palm oil that would not be subject to chain of custody tracking.

CARB has long been a leader in biofuel land use change (I served on an expert workgroup on the topic in 2010), so the staff should appreciate the complex and indirect ways demand for biofuel feedstocks can lead to deforestation. It is disappointing to see this obviously inadequate proposal in place of meaningful action to address a real problem. The proposal to remove eligibility for palm oil-based fuels is even more meaningless, given that the land use change values used in the current regulation already effectively do the same thing.

Ironically, the one place chain of custody tracking is needed is for used cooking oil, which the proposal ignores. The LCFS creates a large incentive to pass off virgin palm oil as used cooking oil. And with renewable diesel producers importing used cooking oil from around the globe, extra vigilance is merited.

Capping vegetable oil fuels and investing in alternatives to combustion

The oil industry is in transition. After a brazen display of fossil fuel industry interference at the global climate talks at COP28, it is clear that the only path to a stable climate is phasing out petroleum and other fossil fuels. Biofuels are not made from petroleum, but a realistic assessment of the available resources makes it clear that biofuels can only play a supporting role and must be limited to a sustainable scale to avoid creating more problems than they solve. Vegetable oil is expensive, its availability is limited, and expansion is linked to deforestation, so the large-scale diversion of vegetable oil to fuel production is an especially bad idea. Yet the oil industry has embraced the idea that their existing oil refineries can help solve climate change by tweaking them to process vegetable oil instead of petroleum.

Renewable diesel has recently overtaken biodiesel as the main bio-based diesel fuel used in the United States. Redirecting vegetable oil from biodiesel to renewable diesel does not reduce petroleum use or overall global warming pollution, but it does allow the oil industry to maximize the overlap in state and federal fuel regulations. The predictable next step is to move vegetable oils from renewable diesel production to jet fuel production, claiming generous tax credits while still generating RFS and LCFS credits and trumpeting an innovative new “climate solution.” Shifting the same limited supply of vegetable oil from one fuel to another will not do anything to address climate change, but it does enable misleading hype and greenwashing from the oil industry and airlines suggesting we can address climate change without phasing out combustion. Likewise, shifting more of the US supply of bio-based diesel into California won’t do anything to help the climate, but it is breaking the LCFS.

The oil industry was once the primary opponent of the LCFS, but they have found a way to work the system to their advantage. Oil companies are taking control of the bio-based diesel industry and trumpeting their plans to scale up biodiesel, renewable diesel, and sustainable aviation fuel, despite knowing there is not enough vegetable oil to make the rhetoric reality. The renewable diesel boom is partly a battle for market share as oil companies flush with fossil fuel profits fight to control the largest share of the small but symbolically important market for renewable fuels. But the collateral damage of this clash between the oil giants is not just the stability and viability of fuel policies, but food availability, deforestation, and the prices of food and transportation fuel.

California should modernize the LCFS to align with its goal of transitioning away from combustion to a zero emissions future. A sensible cap on vegetable oil-based fuels will break the vicious cycle between the RFS and the LCFS, make the LCFS less expensive and more effective, and make it easier for other states to adopt and implement LCFS-style policies. It will also help ensure the LCFS doesn’t exacerbate global hunger and deforestation. The board should send the ISOR back to staff and tell them to get this important policy back on track.

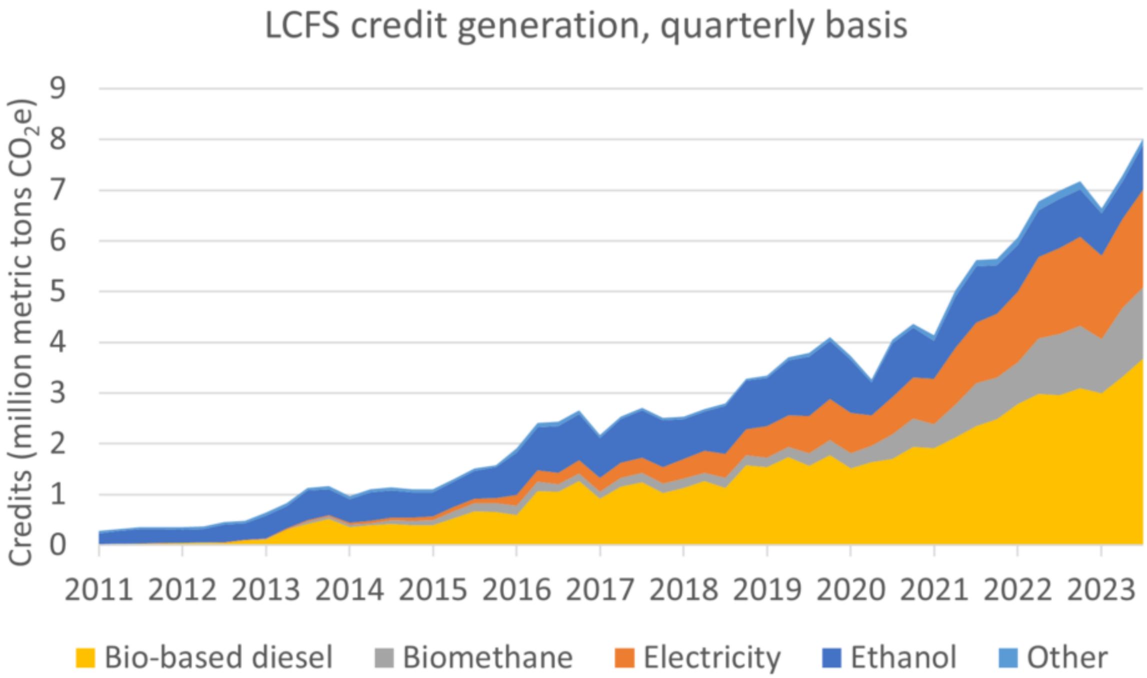
Attachment 3. Something Stinks: California Must End Manure Biomethane Accounting Gimmicks in its Low Carbon Fuel Standard

February 15, 2024. Available online at https://blog.ucsusa.org/jeremy-martin/something-stinks-california-must-end-manure-biomethane-accounting-gimmicks-in-its-low-carbon-fuel-standard/

California's transportation fuel policy is knee deep in cow poop, and it's not a good look. The California Air Resources Board (CARB) is considering amendments to its Low Carbon Fuel Standard (LCFS) regulation, but indicated they have no plans to address the problems caused by counter-productive subsidies for manure biomethane. CARB's use of the LCFS as a cash cow to fund manure digesters is bad transportation fuel policy and bad agricultural policy. Accounting gimmicks disguise a poorly run offset scheme as a magic carbon negative climate solution. CARB needs to phase out credits for "avoided methane pollution," refocus the LCFS on transportation and get to work developing a more suitable regulation for pollution from dairies.

The immediate goal of the current LCFS rulemaking is to stabilize LCFS credit markets so that the policy can continue to provide much needed support for transportation electrification. LCFS credit markets are out of whack because the supply of credits is outstripping the demand. CARB has proposed to rapidly increase the stringency of the standard to increase demand for credits, but it should also address the supply of credits, to make sure the fuels supported by the LCFS help move California towards a clean transportation future.

A quick glance at the latest data from CARB shows there are three large and growing sources of credits: bio-based diesel, biomethane and electricity.



Bio-based diesel, biomethane and electricity are the largest and fastest growing sources of LCFS credits in recent years. Each credit one metric ton of carbon dioxide equivalent pollution below the standard. Source California Air Resources Board.

I've written recently about why a Cap on Vegetable Oil-Based Fuels Will Stabilize and Strengthen California's Low Carbon Fuel Standard, which addresses the bio-based diesel credits. The growing credits for electricity reflect the growing number of EVs on the road in California, and support California's goal of phasing out combustion technologies in favor of zero emissions vehicles. But what about the rapidly increasing credits generated by biomethane? Vehicles powered by biomethane consume about one percent of California's transportation fuel, but in the first three quarters of 2023, biomethane used to fuel these vehicles accounted for 17 percent of LCFS credit generation. The reason a small amount of biomethane generates such a large amount of credit is that biomethane gets credit not only for reducing transportation emissions, but also for reducing methane pollution from manure lagoons at dairies and hog farms across the United States. CARB does not break down the share of credits awarded for avoided methane pollution, but according to my calculations 85 percent of credits awarded by the LCFS in 2023 have nothing to do with transportation but are a poorly disguised offset program creating a gold rush of unverified claims of avoided methane pollution from manure lagoons.

A recent post by UC Davis economist Aaron Smith puts the question quite directly, Cow Poop is Now a Big Part of California Fuel Policy: Are the state's new low-carbon fuel regulations full of BS? The short answer is yes, California's approach to subsidizing manure digesters through its transportation fuel policy is a disaster, and California officials need to wind down a poorly run offset program that is going to cost California drivers at the pump without creating a viable long term strategy to address the problem of manure methane pollution from huge dairies.

For the last few years, I have been getting deeper into manure policy than I ever expected. My primary expertise is in lifecycle-based transportation fuel policy, which has recently been providing increasing financial support for biomethane generated from anaerobic digesters at dairy manure lagoons. For a legal perspective on the topic, read the report (and summary blog) by Ruthie Lazenby at UCLA's Emmett

Institute, for an economic perspective see Aaron Smith at UC Davis, and to understand the impact of pollution from massive dairies on the people that live in adjacent communities, read this article on How a California Dairy Methane Project Threatens Residents' Air and Water.

In this blog, I will cover the following:

- Transportation fuel policies are based on lifecycle analysis.
- Negative carbon intensity scores are inconsistent with the LCFS and amount to an offset program.
- The LCFS manure methane offset program costs drivers more and delivers worse results than a similar policy designed to target dairy methane pollution.
- LCFS biomethane subsidies contribute to consolidation in the meat and dairy industry.
- California's LCFS is causing problems for other states and the federal government.

The LCFS is designed to hold fuel producers accountable for their supply chain emissions

The LCFS and related Clean Fuel Standard policies are performance standards for transportation fuel based on lifecycle analysis. This is a little different than other similar sounding policies like Renewable Energy Standards, which can create some confusion. A Renewable Energy Standard requires utilities to source an increasing amount of the energy they generate or sell from renewable sources like wind and solar, heading towards a 100 percent standard that would reflect a 100 percent renewable grid with no further combustion.

But while a Renewable Energy Standard treats all sources of qualifying renewable energy equally, the LCFS has a more complicated approach, based on lifecycle analysis. Under the LCFS each fuel pathway gets a unique carbon intensity (CI) based on a lifecycle analysis of the greenhouse gas emissions associated with the production and use of the fuel. This approach originated from the recognition that many alternative fuels, especially ethanol, involve a lot of fossil fuels and other pollution in their production. When I started working on biofuel policy back in 2008, there was a lot of criticism of corn ethanol because in some cases it had lifecycle emissions higher than gasoline. This conclusion came from adding up the emissions from coal used to power the production process, natural gas-based fertilizer and diesel fuel used to farm and transport the corn and ethanol. To address this concern some folks at UC Davis and Berkeley had the idea of giving transportation fuels partial credit based on how much they reduced emissions on a lifecycle basis compared to gasoline or diesel. This, in a nutshell, is the logic of the LCFS. For more information on this type of policy see our page on Clean Fuel Standards.

Gasoline has a CI of about 100 grams carbon dioxide equivalent pollution per megajoule of fuel energy (g/MJ) once the emissions from extracting oil, refining it into gasoline and burning it in cars and trucks are added up. The CI of an electric vehicle charged with solar power is zero, and most of the biofuels fall somewhere in the middle[9]. This approach holds fuel producers accountable for reducing fossil fuel use and other global warming pollution in their supply chains. When the LCFS eventually gets to a carbon intensity of zero, you would think all the fuels used to power transportation should be zero carbon fuels.

---

[9] For more on the carbon intensity of transportation fuels, see my 2016 report, Fueling a Clean Transportation Future. For more technical discussion on lifecycle methodology issues, see the report of a 2022 National Academies committee on which I served, Current Methods for Life-Cycle Analyses of Low-Carbon Transportation Fuels in the United States.

But unfortunately, this is where the implementation of the LCFS has drifted away from this idea of partial credit to hold fuel producers accountable for their own supply chains.

Negative CI scores are nothing more than a poorly regulated offset program

As Professor Smith explains in his latest cow poop post, California has been giving manure digesters large negative CI scores. "The carbon intensity of dairy [biomethane] ranges between -102.79 and -790.41 depending on characteristics of the digester. The current average carbon intensity for dairy [biomethane] is -269." A negative CI score would suggest an almost magical climate solution that pulls several carbon dioxide molecules from the atmosphere for each one that comes from the tailpipe of a truck running on dairy biomethane. Unfortunately, this is far from the truth. The justification for negative CI scores is an assumption built into the lifecycle analysis that if the methane was not used as transportation fuel it would be emitted into the atmosphere. And because methane is such a potent heat trapping gas, credit for avoided methane emissions can be quite large.

Without the credit for avoided methane pollution the CI of dairy methane would be about 36 g/MJ[10] instead of -269 g/MJ, which means that 85 percent of the credit claimed by dairy biomethane is associated with avoided methane pollution at the manure lagoon. Only 15 percent of the climate benefit assigned to dairy biomethane is associated with replacing fossil fuels with bio-derived fuel used for transportation[11].

Blurring together the impact on transportation and agriculture creates confusion and leads to exaggerated claims of the benefits of manure digesters. Considered as a source of energy, anaerobic digesters are an expensive way to produce a small amount of energy. As Professor Smith explained in an earlier post, "the cost of an anaerobic digester is 10 times the market value of the gas it produces." Dairy manure digesters are also an expensive strategy to mitigate methane emissions. More optimistic assessments of cost effectiveness ignore the multiple subsidies digesters receive, double (or triple) counting the climate benefits while understating the costs.

Professor Smith's most recent blog explains that the main motivation to keep the avoided methane offset scheme in the LCFS is to continue to supply incentives to California dairy farmers to cover the high costs of installing and operating digesters as a means of reducing methane pollution from dairies.

Negative CI scores undermine California's goal of phasing out fossil fuels and combustion fuels in general. Imagine a fleet of 7 diesel trucks in California, owned by a progressive company that wants to achieve carbon neutrality. Under existing LCFS accounting, this hypothetical company can convert 2 of its 7 trucks to run on compressed natural gas and contract with a manure digester to purchase the rights to match the fossil gas consumption of the trucks to the digester operator's pipeline gas injection somewhere else in the continental United States (this is called book and claim accounting). According to the logic of the LCFS, the two biomethane fueled trucks now have negative emissions that more than offset the emissions of the 5 diesel trucks, so the fleet is notionally carbon neutral.

---

[10] O'Malley, J., N. Pavlenko, Y.H. Kim. 2023. 2030 California Renewable Natural Gas Outlook: Resource Assessment, Market Opportunities, And Environmental Performance

[11] This calculation is based on average carbon intensity of a dairy digester of -269, as reported in Aaron Smith's January 2024 post, the 2024 LCFS standard for diesel of 87.89 g /MJ and a carbon intensity of 36.4 g/MJ for dairy biomethane without avoided methane credits, per O'Malley, J., N. Pavlenko, Y.H. Kim

The key word here is ***offset***. Obviously the 5 diesel trucks are still using fossil fuels and all 7 trucks are using internal combustion engines, creating tailpipe pollution that harms people in the communities in which the trucks operate. The claim embedded in the LCFS carbon intensity score is that avoided methane emissions from a manure lagoon offset the fossil CO2 emissions from the production and use of fossil diesel. Officially CARB claims that the LCFS includes no offset program. If it did, it would be subject to rules governing offsets that CARB would be required to enforce. I am not a lawyer, so I won't venture a legal opinion, but from where I sit this is a distinction without a difference. A negative CI score is an offset because it allows continued use of fossil fuels in a regime that claims to achieve zero emissions.

Negative CI scores are inconsistent with the logic of holding fuel producers accountable for the fossil fuel use and global warming pollution in their supply chains. It flips this logic on its head by allowing fossil fuel producers to continue to sell fossil fuels by claiming credit for offsetting methane emissions reductions that are part of a milk or meat producer's supply chain. And unfortunately, CARB's insistence that it is not running an offset scheme keeps them from running it properly. Thus, the LCFS does not require evidence that claimed methane emissions reductions are real and additional, as would be required from any credible offset program.

Transportation fuel regulations are not the right tool to reduce dairy methane pollution

As a general rule, public policies are more effective when they directly address the problem they are trying to solve. The LCFS regulates oil refiners, who are primarily responsible for the production of high carbon intensity transportation fuel. The use of carbon intensity as a metric for the LCFS adds complexity, but it allows for a comprehensive approach to an increasingly diverse set of transportation fuels, including gasoline and diesel, various biofuels and different sources of electricity. The LCFS does not stand alone, but complements regulations that require car and truck manufacturers, fleets, and electric utilities to reduce pollution from their products and services.

The primary business of dairies is to produce milk rather than transportation fuel, so using the LCFS to reduce pollution from dairies is quite indirect. To illustrate the problems caused by this indirect approach, consider how things would be different if the LCFS were adapted to directly target dairy pollution by creating a **Low Carbon Milk Standard** that operated alongside the LCFS. This hypothetical Low Carbon Milk Standard would resemble the LCFS but focus on milk rather than gasoline and diesel. It would assign a carbon intensity score to milk sold in California and set a steadily decreasing standard for the industry. I shared this idea with CARB staff and leadership last August, to help explain why focusing regulations on methane mitigation would be a better strategy to meet California's methane goals than subsidizing manure biomethane production through a poorly run offset program.

Benefits of a Low Carbon Milk Standard (or other agricultural methane regulations)

Just as the LCFS is based on the supply chain emissions of transportation fuel per unit of energy, a low carbon milk standard (LCMS) would be based on the supply chain emissions per unit of milk. While structurally similar, the milk supply chain emissions would include all the emissions associated with milk production, not just the manure, and would apply to all milk producers, whether they use a digester to capture and sell biomethane or use a different manure management strategy that minimizes the production of methane in the first place.

Under the LCFS, credits are only awarded for biomethane that is captured and used for fuel, and it is presumed that this methane is an inevitable consequence of milk production. Under a LCMS, there is no need for any such presumption, and all strategies that reduce methane pollution are treated equally. This avoids distorting the market for methane mitigation in favor of more polluting manure management strategies. California has an alternative manure management program (AMMP), that provides financial assistance for the implementation of non-digester manure management practices including composting and conversion to or expansion of pasture-based systems. These practices reduce climate pollution and provide other air and water quality benefits. Under the LCFS, dairies that use AMMP practices are at a competitive disadvantage compared to dairies that use digesters and can generate a substantial revenue stream from selling manure to operators of the digesters.

Opponents of dairy regulations claim that if California enacts stricter regulations on dairies than other states, dairies may just leave California, continuing to pollute but outside the reach of California regulations. This is called emissions leakage, and is discussed by both Ruthie Lazenby and Aaron Smith. The LCMS addresses leakage in the dairy sector the same way the LCFS does in the fuel sector. Out-of-state milk producers would be held to the same standards for pollution as California producers. The LCFS has survived legal challenges, and the same arguments should apply to an LCMS.

An LCMS would also address arguments that phasing out LCFS credits for avoided methane pollution would cause digesters to shut down, making it harder for California to meet its methane pollution targets. Digesters would continue to operate to meet the LCMS standard unless the dairies found a more cost-effective way to mitigate methane. Digesters make the most sense economically at large dairies, and at these facilities digesters would likely remain a cost-effective way to meet LCMS obligations. They can even keep selling biomethane to displace fossil gas, but the biomethane would not be credited with avoided methane emissions within transportation fuel or other energy policies.

Regulating manure methane directly would save California drivers money

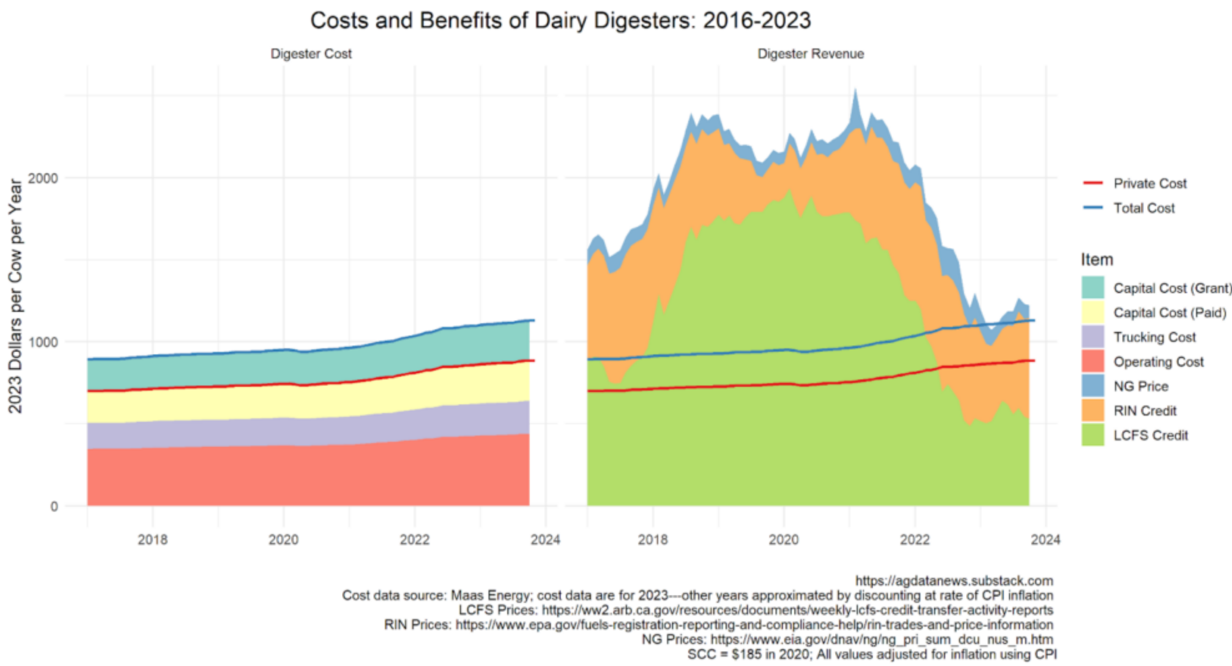
The California LCFS is designed to support the production of low carbon transportation fuel, and it applies the same lifecycle analysis methodology to all fuels, regardless of where they are produced, so long as they are used in California. As previously described, biomethane is allowed to use book and claim accounting. As a result, manure digesters at both dairies and swine concentrated animal feeding operations (CAFOs) all over the country have been granted LCFS pathways to produce biomethane with large negative CI scores. This means that California drivers are being asked to bear the cost of large subsidies for milk and meat producers nationwide, even though any reductions in methane pollution will not reduce California's emissions.

Regulating pollution from dairies through an LCMS or other regulation would shift the costs of reducing methane pollution to milk producers, and these costs will presumably be passed along to milk consumers. But these costs are likely to be quite a lot lower than current LCFS costs for three reasons. The LCFS is subsidizing manure digesters at dairy and swine CAFOs across the United States while the costs of a regulation would be limited to milk produced and/or sold in California, depending on the structure of the regulation. Second, a regulation developed for dairies should support a wider set of practices and technologies to mitigate pollution suitable for different types of dairies, which should bring down costs compared to limiting support to expensive digesters with gas cleanup and injection required to sell biomethane. And finally, a well-designed regulation should reduce the windfall profits that have accrued to biomethane developers selling credits into LCFS markets.

LCFS biomethane subsidies create a gold rush available only to very large farms, which encourages dairy (and meat) industry consolidation and distorts food markets

LCFS credits for avoided methane are one of several sources of support for digesters, with additional support coming from the Federal Renewable Fuels Standard Program (RFS) and grants from California's Department of Food and Agriculture and programs from the US Department of Agriculture. Professor Smith has analyzed how profitable these subsidies are in detail in his recent post.

> *Between mid 2018 and the end of 2021, revenues from selling biogas and the associated* [RFS credits, called RINs] *and LCFS credits were approximately double the cost of installing and running a typical digester, as shown in the figure below. LCFS credit prices have declined in the last two years, making the typical digester closer to a break even proposition. If and when credit prices go back up, then the profits will return.*



There has been an extensive coverage of the gold rush these generous subsidies started, in trade press and even the Wall Street Journal, which headlined its piece "California's Green-Energy Subsidies Spur a Gold Rush in Cow Manure: A lucrative state incentive to make natural gas from dairy waste is attracting companies from Amazon to Chevron."

These extremely profitable subsidies also contribute to consolidation. Building and operating a digester and the equipment required for gas cleanup and pipeline injection is very expensive, and even with large subsidies is generally only economic at very large dairy and swine CAFOs. At the largest CAFOs, the payments a farmer receives from a digester operator can be a significant portion of their income. But digesters generally don't make sense on smaller farms, because without thousands of cows or pigs, there is just not enough poop to make a digester and gas collection cost effective.

Smaller facilities can use other manure management strategies that reduce methane production in the first place or capture and flare methane, but since these strategies don't result in methane to sell to energy markets, they are excluded from LCFS biomethane subsidies. If digesters really were efficient producers of transportation fuel, LCFS support would make sense. But in reality, 85 percent of the LCFS subsidy is based on claims of avoided methane pollution, so excluding other strategies that can also avoid methane pollution distorts the lucrative market for avoided methane pollution by disguising it is a market for transportation fuel. This means that the largest dairies have preferential access to a lucrative revenue stream that is decoupled from the low margin high risk business of selling milk.

A 2020 report from the US Department of Agriculture on Consolidation in U.S. Dairy Farming highlights that "[t]he number of licensed U.S. dairy herds fell by more than half between 2002 and 2019, with an accelerating rate of decline in 2018 and 2019, even as milk production continued to grow." Several factors contribute to consolidation, and there is a heated argument over the evidence that LCFS subsidies have played a significant role. The basic economic arguments are clear enough. While key details are contested and not all the relevant data is publicly available, there is no real dispute that the LCFS biomethane subsidies have been a boon to large CAFO dairies and exclude smaller farms. This insight is not limited to opponents of the digesters and can also be found in the dairy trade press. A 2021 article explains the unintended consequences as follows:

> *The net effect will be that dairy farms with methane digesters and other green energy technologies will make decisions based more on returns from energy than returns from milk. It fundamentally changes dairy farm economics as well as milk and dairy product prices. If this comes to fruition, dairy market signals to raise or reduce milk production will be less effective. This could lead to a structural oversupply of milk in the domestic market[…]. Michael McCully. Hoard's Dairyman. 2021*

Structural oversupply in the milk market would certainly be hard for dairies without digesters whose business is limited to selling milk and are excluded from the LCFS biomethane gold rush.

The dispute is over the evidence that LCFS biomethane subsidies have already caused consolidation and how the role of the LCFS can be disentangled from other factors. The data question is complicated by the fact that key statistics are published only every 5 years. Until this week, the most recent data was from 2017, and comparing 2012 to 2017 does not say much about LCFS supported digester boom, which mostly happened after 2017. The data from the 2022 USDA Agriculture Census was released on February 13th and it confirms that dairy consolidation in California is continuing. The share of dairy cows in California on farms of 2500 cows or more grew from 46 percent in 2017 to 61 percent in 2022. Disentangling the role of the LCFS from other factors is beyond my expertise, so I am looking forward to reading what the experts have to say about it.

California's bad biomethane policy is causing problems across the United States

I work on transportation fuel policies across the United States. For several years I have been part of a Midwestern Clean Fuels Policy Initiative, and I have been working with Minnesota-based non-profits to develop a clean fuel policy for Minnesota. I was recently part of a Clean Transportation Standard Work Group run by the Minnesota Department of Transportation. The members of the work group have diverse perspectives on many things but agree that Minnesota should not copy California's LCFS but learn from it and create a policy that makes sense for Minnesota. Several Minnesota groups I have spoken with have major concerns that California LCFS subsidies for digesters are driving small dairies out of business. This is a very real concern in Minnesota, which ended in 2023 with 146 fewer dairy farms than it had at the beginning of the year. But a major challenge to crafting a Minnesota specific policy is that the largest dairies in Minnesota, run by a company called Riverview Farms, are already enrolled in the California LCFS. The result is that California drivers are spending increasing amounts of money to subsidize digesters in Minnesota in a manner that distorts dairy markets in Minnesota and is largely outside the control of Minnesota voters or policymakers.

The problem arises from treating manure digesters as a source of magic negative carbon energy instead of recognizing that their primary climate benefit is pollution mitigation from manure lagoons. Digesters do not pull methane out of the atmosphere; they capture methane that was created by the deliberate choice to collect and store manure in anaerobic conditions in huge lagoons. The idea that manure methane is uniquely valuable is leading to proposals from the biogas developers to truck manure from smaller farms to a central digester so that they too can participate in the digester gold rush, or to figure out how to install digesters at beef cattle feedlots that currently use dry manure management.

Crediting methane collected from these projects as if it is an inevitable consequence of manure management and assuming it would otherwise be vented into the atmosphere is clearly wrong from a technical perspective. It also sends a signal to farmers that they should get into the energy business and "get big or get out," in the infamous words of Nixon's Secretary of Agriculture Earl Butz. Most policymakers now recognize the harmful consequences of this attitude, so they should make sure their policies support their stated goals.

Decisions about the most suitable strategy for manure management are complex and depend on many local factors that affect not only the farm's profitability but also the local environment and community. These decisions should not be dominated by the results of a lifecycle analysis spreadsheet developed for a California transportation fuel regulation that only values "avoided methane pollution" when it is associated with transportation fuel production. If policymakers want to provide support to help farmers reduce methane pollution, they should provide at least equivalent support for methane pollution that is actually avoided because it was never created. When energy policy and agricultural policy intersect, we should make sure the results are supporting good outcomes in both spheres, and the California LCFS credits for avoided methane pollution are clearly failing that test.

What started as a clever way for California regulators to indirectly support expensive dairy digester projects in California is putting smaller farms across the United States at a disadvantage, especially those that use more sustainable manure management strategies, and potentially pushing them out of the business entirely. The problem is not limited to transportation fuel policy, it is also setting a damaging precedent that threatens to undermine the integrity of numerous new lifecycle-based tax credits, including the federal clean hydrogen production tax credit .

Agricultural methane policy should help food producers reduce pollution rather than paying for poop

Real harm results from disguising manure digesters as a magic negative carbon energy technology. Reducing pollution from food production is important, and so is scaling up renewable energy production to replace fossil fuels. Connecting these goals with a de facto offset regime is creating a lot of problems, and we need a better approach.

Policy makers must ensure that regulations and incentives shaping our food system not only address methane pollution from sources like manure lagoons but build a better food system—one that provides healthy, sustainably produced food for all and treats everyone at every stage of the system fairly. This is a big task, which can seem daunting and unrealistic. The magnitude of the challenge leads some to argue digester subsidies, by whatever means they can be financed, are a justifiable short-term expedient to address an urgent problem. But California's de facto offset regime is doing more harm than good, undermining California's transportation fuel policy, distorting milk and meat markets across the country in favor of the largest producers of manure and setting a damaging precedent that could undermine federal support for hydrogen or any other policy based on lifecycle analysis.

Negative carbon intensity scores have no place in transportation fuel policies. These policies should support the transition away from fossil fuels and hold all fuel producers accountable for pollution in their supply chains. The California Legislature gave regulators authority to start regulating dairy pollution in 2024, and they should start developing these regulations. My hypothetical Low Carbon Milk Standard illustrates the major structural problem with the LCFS biomethane offset program that is fixed by refocusing dairy methane policy on the primary polluter. But real policies that affect agriculture should be designed to meet the needs of farmers, farm communities and the environment, and not copied directly from the energy or transportation fuel sector.

Policymakers outside of California should understand that supporting methane pollution reduction using lifecycle analysis accounting gimmicks can seriously backfire and hurt small farms. Any policy that aims to reduce pollution from milk (or meat) production, whether as part of a regulation or an incentive, must be designed to reduce methane pollution, rather than to increase biomethane use. Fixing our broken food system requires a more thoughtful approach that grapples with the realities of the system, rather than just throwing money at the largest polluters.