

To: Cheryl Laskowski  
From: Jeremy Martin  
Date: March 15, 2023  
Subject: February 22, 2023 workshop: 2 of 2 Why an LCFS cap on lipid-based fuels is required.

### **What are the consequences of rising California lipid-based fuels consumption?**

At the last workshop, CARB staff indicated that they had not decided about whether to move forward with a proposal to cap lipid-based or crop-based fuels. While we have commented extensively on this point earlier, I think it is important for CARB to think through the implications of proceeding without a cap.

CARB indicated a readiness to set higher stringency and potentially even a ratcheting mechanism in an effort to stabilize Low Carbon Fuel Standard (LCFS) credit prices at a higher level. However, efforts to raise credit prices will be challenging if CARB does not address the main factor that is driving the prices down. Shuffling bio-based diesel (BBD) already required for compliance with the federal Renewable Fuel Standard (RFS) advanced mandate into California is flooding the LCFS compliance market with cheap credits. Without a policy constraint, this counterproductive shuffling will continue as the LCFS gets more stringent until eventually RFS advanced mandates are rendered non-binding and RFS credit prices fall. This will transfer the cost of federal RFS compliance onto California drivers without producing any environmental benefits, destabilize California fuel markets and make it more difficult and expensive for other states to adopt LCFS policies. If California's policy and other state CFS policies push US lipid fuel consumption beyond the already very high levels mandated by the RFS it would also exacerbate land use change and food price impacts in global vegetable oil markets. All of these bad outcomes can be easily avoided by capping the share of LCFS compliance at a level that ensures other states can also access lipid-based fuels without collectively surpassing the levels required for RFS compliance.

### **Navigating the maze of fuel policies affecting lipid-based fuels**

The implications of rising California consumption of lipid based fuels are confusing because of the interaction of several state and federal policies, including the federal Renewable Fuel Standard (RFS) federal tax credits for and bio-based diesel (BBD) and sustainable aviation fuel (SAF), state level Clean Fuel Standards including the California LCFS, the Oregon Clean Fuel Program (OR-CFP), the Washington Clean Fuel Standard (WA-CFS), state biodiesel (BD) blending requirements and state tax credits for BBD and SAF. Additional complexity comes from the variety of feedstocks including vegetable oil and used fats and oils, and final fuels, including BD, renewable diesel (RD) and SAF.

Despite these many moving pieces, the most important implications can be understood by focusing on the most important variables, which I describe below in a simplified model based on the following simplifying assumptions. After considering the simplified model I come back to the implications of some of the additional variables.

- Start by considering the two most important drivers of BBD from the two most significant jurisdictions, the Federal RFS and the CA LCFS.
- Assume that CARB is committed to maintaining a stable market signal through the LCFS and will increase LCFS stringency to bring credit prices back to a target price level to compensate for shuffling of RFS compliance into CA. Assume that RFS mandates will not change based on the LCFS.
- Consider just two primary feedstock categories, vegetable oil (VO) and used cooking oil and other recycled feedstocks (UCO), each of which can be converted into either BD or RD.
- Assume BD faces a blending constraint limiting it to 10% of diesel fuel (by volume) while RD can be blended at any level.
- The RFS requires that 3 BG of BBD be consumed in the US each year<sup>1</sup>.
- 1 BG worth of UCO is available<sup>2</sup>, and the supply of all US vegetable oils and fats is adequate to produce 5 BG, and if all US soybean production was crushed this could be expanded to 8 BG<sup>3</sup>
- CA diesel consumption is about 4 billion gallon a year (BG)<sup>4</sup>, US diesel consumption is about 40 BG
- Assume that adequate RD refining capacity will soon be available to meet 100% of California's diesel fuel consumption<sup>5</sup>.
- In the CA-LCFS UCO generates double the LCFS compliance of VO<sup>6</sup>.

Production of BD is less costly than RD, particularly because of the much higher capital costs of RD production. However, when oil refineries that would otherwise be decommissioned are retrofitted for RD production, the capital costs are much lower, and the continued operation of the facility postpones the need to begin the costly decommissioning and environmental remediation and preserves optionality for refiners in the face of an uncertain future fuel market and policy context.

---

<sup>1</sup> The non-cellulosic advanced biofuel mandate has been proposed for 2023, 2024 and 2025 at 5.1, 5.2 and 5.3 billion ethanol equivalent gallons respectively and EPA projects that BBD may be used to meet the conventional standard at a level of 660, 360 and 310 million ethanol equivalent gallons in 2023, 2024 and 2025 respectively for a total of 5.5, 5.4, and 5.5 billion ethanol equivalent gallons in 2023, 2024 and 2025 respectively<sup>1</sup>. Since a gallon of RD generates 1.7 ethanol equivalent gallons worth of credits, total US BBD consumption required to meet the RFS mandate is 3.2 billion gallons of renewable diesel.

<sup>2</sup> How much BBD feedstock should be classified as available and appropriately no land use impact is certainly debatable. This approximating is useful for illustrative purposes, but see further discussion of this topic below.

<sup>3</sup> These production figures do not account for the fact that there is no surplus vegetable oil, so increased fuel use of oil displaces food and other uses leading to increased food prices in the short term and increased production of oilseeds in the US and abroad in the long term. Since global demand for crops is outpacing yield growth even without increasing demand for biofuels, the additional demand will inevitably increase the footprint of row crop agriculture globally and contribute to pressure for deforestation, although the exact extent of deforestation depends on many factors and is hotly contested.

<sup>4</sup> according to EIA this California diesel consumption has been between 4.1 and 4.8 billion gallons a year over the last decade: [https://www.eia.gov/dnav/pet/pet\\_cons\\_refoth\\_d\\_SCA\\_VWR\\_mgalpd\\_a.htm](https://www.eia.gov/dnav/pet/pet_cons_refoth_d_SCA_VWR_mgalpd_a.htm) A203750061 California No 2 Distillate Wholesale/Resale Volume by Refiners

<sup>5</sup> According to recent EIA report, existing and planned US RD capacity could reach 5.9 billion gallons a year by the end of 2025. [Domestic renewable diesel capacity could more than double through 2025](https://www.eia.gov/todayinenergy/detail.php?id=55399). <https://www.eia.gov/todayinenergy/detail.php?id=55399>

<sup>6</sup> VO BBD fuels have a CI of 55 g/MJ while UCO BBD has a CI of 20 g/MJ and the standard is 90 g/MJ, so while VO and UCO BBD are both credit generators, VO generates 35 g/MJ while UCO generates about 70 g/MJ.

In the first decade of the RFS and LCFS, most of the RFS BBD compliance was provided by BD owing to its lower cost. Because of blending constraints, BD usage is widely disbursed, with 80 percent of states blending biodiesel at a rate between 1.5 and 8.1 percent in 2021. In the last few years, however, RD consumption has grown rapidly, concentrated heavily in California. As described in our previous report with ICCT, California's share of national BBD consumption has increased rapidly, growing from 2% in 2011 to 44% in 2021<sup>7</sup>.

The concentration of RD in California is understandable because RD sold in California generates both RFS and LCFS compliance value. Initially RD sold in California was primarily produced from UCO, because these feedstocks produce twice the LCFS compliance value of VO-RD. However, the conversion of massive oil refineries to RD production has exceeded the availability of UCO, and even with the lower compliance value of VO-RD, it still provides more compliance value than VO-BBD sold elsewhere in the US and thus eligible for only RFS compliance value. The growth in RD has occurred during a timeframe in which RFS advanced biofuel mandates were rising rapidly, but even so it has not been entirely additional to BD but has increasingly displaced BD by outcompeting it for feedstock<sup>8</sup>.

With this framework in place, Let's consider the economic and environmental implications of rising CA RD consumption in 2025.

### **Implications for LCFS compliance costs**

RD production is marginally more expensive than BD, so there are some costs associated with outcompeting current BD producers for feedstock and converting oil refineries for RD production. However, so long as the RFS remains binding, the costs of RD will be largely covered by the RFS compliance value it generates. This is what has motivated the large-scale shuffling of RFS compliance into CA and led LCFS credit prices to fall dramatically. If CARB does not adjust the stringency of the LCFS in response to over compliance and low credit prices, the impact of shuffling RFS BBD compliance into CA will be to lower LCFS compliance costs for refiners. This will also reduce the support the LCFS provides for other low carbon fuels including EVs.

However, CARB has signaled that it intends to address low LCFS credit prices by raising the stringency of the standard. The first expected market response to increased LCFS stringency would be to shuffle more RFS BBD-mandate compliance into California. This would be achieved by shuffling BBD feedstock out of BD production for dispersed national supply and into RD production for concentrated California supply. Only once this low-cost compliance through shuffling has been exhausted will credit prices return to the equilibrium that existed before large scale shuffling of RFS compliance into California began. The net

---

<sup>7</sup> Jane O'Malley, Nikita Pavlenko, Stephanie Searle (ICCT), and Jeremy Martin (Union of Concerned Scientists). Setting a lipids fuel cap under the California Low Carbon Fuel Standard. <https://theicct.org/publication/lipids-cap-ca-lcfs-aug22/> The growth in RD has not been entirely additional to BD but has increasingly displaced BD by outcompeting it for feedstock. As described in our previous report with ICCT, California's share of national BBD consumption (illustrated below with the green line) has increased rapidly, growing from 2% in 2011 to 44% in 2021<sup>7</sup>.

<sup>8</sup> U.S. biodiesel consumption in 2021 is down 375 million gallons or 18 percent from its peak in 2016 while renewable diesel consumption rose 772 million gallons or 277 percent over the same period. EIA Monthly Energy Review Table 10.4a and 10.4b. <https://www.eia.gov/totalenergy/data/browser/>

result will be a gradual increase in LCFS compliance costs as the LCFS credits must cover the costs of moving RFS compliance into CA and everything else that is cost effective at the target credit price.

As CA BBD consumption approaches the 3 BG level required for RFS compliance, the RFS will become less binding and RFS credit prices for conventional and advanced biofuels will begin to fall. As RFS credit prices fall, the cost of BBD compliance in CA will rise as LCFS credit prices will need to cover more of the cost of BBD production. If LCFS prices were high enough, the RFS could become non-binding and credit prices could fall towards zero. However, because of the low compliance value assigned by the LCFS to VO RD I do not expect that the LCFS compliance value of VO-RD would be enough even at the cost containment price ceiling to push the RFS credit value all the way to zero<sup>9</sup>. If nothing else were changing, the market should find an equilibrium at a level where RFS prices have fallen enough that the combined value of the LCFS and RFS is sufficient to cover the costs of complying with the relevant RFS mandates. At this point CARB would no longer be motivated to raise stringency to maintain credit prices.

However, the discussion of market equilibrium does not account for the dynamic nature of many of the factors that would determine the equilibrium. Credit prices and compliance costs depend on fuel and feedstock prices, policy decisions in DC and Sacramento and investor expectations about these things. As a result, I expect that if LCFS prices start to pull down RFS credit prices, the result will be very unstable credit prices in both RFS and LCFS markets until it becomes clear that the RFS will be permanently non-binding or RFS advanced mandates rise well beyond the level that that can be met with shuffling and become binding again.

While it is hard to predict the exact amount that RFS prices would decline, any drop in RFS compliance costs will likely be offset by increased LCFS compliance costs. Thus, if the RFS/LCFS equilibrium causes RFS credit prices to fall by 50 cents per D5 RIN, it would reduce RFS compliance costs by more than \$2.5 billion dollars a year<sup>10</sup> and increase LCFS compliance costs by at least the same amount. Note that this will not lead to any increase in net BBD consumption, just shuffling of those fuels into California.

If California caps the share of LCFS compliance from BBD at a level significantly below the RFS BBD mandate, it will ensure that RFS remains binding, which will reduce LCFS compliance costs in California compared to a situation in which it raises stringency to a level that begins to drag down RFS credit prices. It might seem as if limiting the use of BBD would force refiners to use more expensive LCFS compliance options, increasing compliance costs. But that ignores CARB's commitment to raise LCFS stringency enough to compensate for the cheap compliance offered by RFS shuffling. If CARB caps BBD compliance at its current level, it will reduce the extent to which CARB must increase stringency to bring LCFS prices back to a desirable range. While this will limit the use of a cheap compliance through shuffling, it will lower overall compliance costs compared to an alternative in which the stringency is increased enough to exhaust the cheap compliance through shuffling and bring prices back to a target level.

---

<sup>9</sup> At \$200/MT RD with a CI 35 g CO<sub>2</sub>/MJ below the standard would generate \$0.90/gallon of compliance value, which is far below the historical cost differential between diesel and BD, which I expect to be slightly lower than for RD (see Figure 2 of Gerveri, M., T. Hubbs and S. Irwin. "[Biodiesel and Renewable Diesel: It's All About the Policy](#)." *farmdoc daily* (13):27, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 15, 2023.).

<sup>10</sup> Based on RFS advanced mandate of > 5 billion D5 RINs per year.

The main beneficiaries of a failure to cap RFS shuffling into California are refiners and drivers outside of California. As California covers a larger share of the RFS advanced biofuel compliance costs, refiners outside of California will see RFS compliance costs fall and drivers in those states may see a small reduction in fuel costs.

### **Nominal GHG benefits**

Below 1BG consumption, CA-LCFS BBD demand can be met with UCO, which has a lower CI score than VO-BBD. This will provide some nominal GHG benefits beyond those required by the RFS BBD mandate<sup>11</sup>. However, as CA BBD consumption rises from 1 to 3 BG, CA BBD consumption exceeds the available UCO, and all additional BBD will come from VO. Since consumption of this VO-BBD is already mandated by the RFS, there are no net GHG benefits, just shuffling RFS compliance from other states to California. If California BBD consumption rose beyond the 3BG required by the RFS, that would render the RFS mandates non-binding which would lead to some nominal GHG benefits based on CA's existing CI score for VO-BBD. But this would also dramatically increase LCFS compliance costs and the risk of land use change and other market impacts<sup>12</sup>.

### **California petroleum market impacts**

As California blends increasing amounts of RD into diesel fuel, the amount of ethanol blended into gasoline has remained about the same. Since refineries cannot readily change the ratio of gasoline and diesel they produce, the recent increase in RD consumption led to a commensurate increase in fossil diesel exports from the state. The resulting imbalance in refinery output was highlighted by the California Energy Commission as one of the factors destabilizing California gasoline markets<sup>13</sup>. Since total RFS BBD compliance amounts to more than half of California's diesel consumption, shuffling RFS BBD compliance into California in a short timeframe could result in major logistical challenges as California must export large quantities of fossil diesel or import gasoline to balance refinery output with consumer demand. These challenges will increase compliance costs and could also add to fuel market instability.

### **Implications of complexities not included in the simplified model**

#### *Other states with Clean Fuel Standard policies*

Oregon and Washington also have CFS policies similar to the CA-LCFS and are competing with California for access to low CI BBD, and other states may soon enact similar policies. If CA sets a limit on BBD

---

<sup>11</sup> Even without the LCFS, some RFS compliance may have been met with UCO or other secondary fats and oils, but clearly with LCFS incentives BBD producers will have a stronger incentive to prioritize these resources over VO than they would absent the LCFS.

<sup>12</sup> While some stakeholders argue that land use change is effectively discouraged by the indirect land use change emissions calculation included in the CI score for VO-BBD, the level of VO-BBD consumption and pace of expansion used to estimate these emissions were considerably lower than the level that would be required to realize the increase in consumption of lipid fuels required if a large portion of the projected RD capacity buildout were to operate at full capacity, not to mention what could be required to additionally meet state and federal SAF targets. Our view is that it would be very harmful to expand lipid use for fuel beyond the RFS mandates, both in terms of agricultural expansion and food market impacts.

<sup>13</sup> Commissioner Hearing on California Gasoline Price Spikes, Refinery Operations, and Transitioning to a Clean Transportation Fuels Future. November 29, 2022. Presentation 2A - Factors Leading to High California Gasoline Prices in 2022 - Ysbrand van der Werf <https://www.energy.ca.gov/event/workshop/2022-11/commissioner-hearing-california-gasoline-price-spikes-refinery-operations>

assuming CA will consume all available low CI feedstock in the United States, it will interfere with the ability of other CFS states to replicate the LCFS, since the pool of lowest CI fuels from which they can draw will have been exhausted, and to the extent they bid feedstock away from California, it will push California to rely on high CI feedstocks. Ideally the CFS states would work together to set a limit on BBD based on available low CI feedstocks so that all CFS states combined would not exceed this level. Absent interstate coordination, a simple expedient would be for California to set its targets based on a fair share of demand for low CI feedstock, for example 70 percent of the low CI feedstock, equal to its share of combined diesel fuel consumption within existing CFS states.

#### *Other states with biodiesel mandates or market participants with preferences*

In addition to CFS states, there are other states with BD or BBD blending mandates and some government or private fleets have BBD purchase requirements. As refiners selling RD in California outbid BD produced for feedstock, these mandates become increasingly costly to implement. If they remain in force the point at which the RFS becomes non-binding is lower than would be suggested if only CFS states are considered.

#### *Tax credits*

In addition to the CFS, RFS and state blending requirements, there are also tax credits in place for BBD blending. These tax credits transfer part of the burden of RFS compliance from oil refiners to taxpayers. While the interaction between these policies is complex<sup>14</sup>, my expectation is that so long as the RFS is binding, the primary impact of tax credits would be lower RFS credit prices, and the impact on LCFS credit prices and compliance costs would be small. However, the presence of tax credits also increases the potential for the LCFS to push the RFS into a non-binding situation below the LCFS cost containment ceiling.

#### *Other lipid-based fuels*

In addition to BD and RD, lipids can also be used to produce other fuels, including SAF and renewable gasoline (RG). There are substantial new incentives in place for SAF at both the federal and state level. SAF draws on the same feedstocks as BBD fuels and lipid-based SAF generates similar RFS and LCFS compliance as BBD. To date, a combination of technical factors and incentive structure have favored RD over SAF and RG, but recently passed tax credits could potentially tip the balance in favor of SAF production. The problems associated with excessive CA consumption of lipid-based BBD would also apply to SAF and RG, with the exception that if the balance of production of RG, RD and SAF more closely mirrored demand for gasoline, diesel and jet fuel, it would reduce the challenges associated with balancing refinery output with demand.

#### *Leaving room for other state CFS policies*

CARB has emphasized the importance of implementing the LCFS in such a way that it can be an exportable model for other states. As discussed above, CFS compliance costs rise rapidly when the combined impact of CFS states make the RFS non-binding. Given the size and number of states

---

<sup>14</sup> Gerverni, M., T. Hubbs and S. Irwin. "[Biodiesel and Renewable Diesel: It's All About the Policy](#)." *farmdoc daily* (13):27, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 15, 2023. [Permalink](#)

considering adopting an CFS, including New York, New Mexico, Illinois, Michigan, and Minnesota, it would be wise to leave some headroom so that the addition of a few more states does not push the policy into a circumstance that dramatically increases compliance costs for all CFS states. If this happened, it would make CFS policies much less attractive for other states to adopt and limit the exportability of the CFS policy.

#### *Feedback to RFS targets*

In the preceding discussion, I considered that LCFS stringency would rise in response to low credit prices but assumed that RFS mandates would remain fixed. However, it is possible that if state clean fuel policies (both CFS style and BD blending mandates) increased demand for lipid based fuels to a level where the RFS mandates starts to become less binding and RFS credit prices fall, the EPA would respond by setting higher RFS targets. Without a check on shuffling from CFS states, this would presumably mostly lead to further expansion of BBD in states with CFS policies. However, given the underlying scarcity of lipid feedstocks and their link to deforestation, expanding already excessive RFS advanced biofuel targets would be a damaging outcome.

#### *Fungibility of secondary fats and oils*

If CARB caps only VO-RD without any constraint on overall lipid-based fuels, it will increase the already large incentive for RD producers to source uncapped feedstocks so they can continue to take advantage of RFS shuffling. Many of the feedstocks which CARB assigns a zero land use penalty, including tallow and technical corn oil, are not wastes but are used for animal feed or as feedstocks for soaps and detergents among other purposes. Historically these secondary fats and oils trade at a modest discount to first use vegetable oils. However, a cap on VO-RD will decrease the compliance value of vegetable oil and increase the already substantial premium available for these feedstocks under the LCFS is likely to displacing historical consumers of these secondary fats and oils, who will then need to use either first use vegetable oil or other substitutes. This undermines the nominal benefits assigned by the LCFS to these low CI feedstocks. For this reason a cap on all lipid-based fuels at a reasonable share of overall RFS compliance levels is preferable to only capping vegetable oil based RD.

#### **Summary recommendation**

Factoring the complexities above, I recommend that CARB cap the use of lipid-based fuels of all categories at between 700 million and 1 billion gallons a year. It should do this by setting a cap on the share of compliance that can be demonstrated from these feedstocks. If CARB is not willing to constrain the use of secondary fats and oils or set limits below recent consumption, it should cap crop-based lipid fuels (including RD and SAF) at no more than 300 million gallons per year. An alternative approach would be to cap CA's share of RFS advanced biofuel compliance. In that case I would recommend a limit equivalent to no more than 30 percent of the non-cellulosic advanced biofuel mandate, or approximately 1 billion gallons of renewable diesel.