

# **Low Carbon Fuel Standard 2018 Amendments**

**Pre-Rulemaking Concept Paper**

**July 24, 2017**

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## I. Introduction

Transportation plays a key role in California's economy and lifestyle. The production and use of traditional petroleum-derived transportation fuels—such as gasoline and diesel—is responsible for nearly 40 percent of the state's greenhouse gas (GHG) emissions. The Low Carbon Fuel Standard (LCFS) is a key part of a comprehensive set of California programs to cut GHG emissions by improving vehicle technology, reducing fuel consumption, and increasing transportation mobility options.<sup>1</sup> The LCFS is designed to decrease the carbon intensity (CI) of California's transportation pool and provide an increasing range of low-carbon and renewable alternatives to conventional petroleum-derived fuels.<sup>2</sup>

The California Air Resources Board (ARB/Board) initially approved the LCFS regulation in 2009. Throughout the nearly eight years since the Board's original adoption, the basic framework of the current LCFS—including the use of life cycle analysis, the LCFS credit market, and the electronic registry for fuel reporting—has worked well and will continue to support growth in an increasingly diverse and low-carbon transportation fuel pool.<sup>3</sup> The program will also remain performance-based and fuel-neutral, allowing the market to determine how the CI of California's transportation fuels should decline.

This concept paper provides an overview of new elements ARB is considering as part of LCFS amendments that staff expects to propose later this year for adoption in 2018.<sup>4</sup> The concepts staff is considering reflect a range of potential changes: from simple updates to improve the program's overall effectiveness, to more significant proposals for improving California's long-term ability to support the consumption of increasingly lower-CI fuels.

The most significant change under consideration is how to strengthen the CI reduction targets beyond 2020 in-line with the California's 2030 GHG reduction requirement enacted through Senate Bill (SB) 32 (Pavley, 2016). Other potential changes include allowing new fuel types to generate credits and adding a system for third-party verification of the data reported to the LCFS. Staff began conceptually discussing many of these items during an informal public process initiated in March of 2016, hosting 14 workshops and fuel-specific working meetings through June of this year. This informal stakeholder outreach process will continue over the next several months and then transition into a formal rulemaking process.

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<sup>1</sup> The Climate Change Scoping Plan explains the overarching framework of California's GHG policies. The current Draft Plan is available from: <https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm>

<sup>2</sup> Carbon intensity (CI) is a measure of the GHG emissions associated with the various production, distribution, and consumption steps in the "life cycle" of a transportation fuel.

<sup>3</sup> Staff presented a progress report on the LCFS program to the Air Resources Board on June 22, 2017. This presentation is available at: <https://www.arb.ca.gov/board/books/2017/062217/17-6-4pres.pdf>

<sup>4</sup> Staff will use the record created in the planned rulemaking to conduct a program review, pursuant to § 95496 of the current regulation, by January 1, 2019.

Staff expects to continue working with stakeholders to refine the concepts discussed in this paper and to identify any alternatives that may be more effective at realizing the objectives of the LCFS.

## II. Status of the LCFS

The LCFS has been working as designed since the regulation went into effect. California has achieved a reduction of more than 2.5 percent in the average carbon intensity of the overall transportation fuel pool.<sup>5</sup> Regulated parties as a whole continue to over-comply with the regulation, providing a significant bank of almost ten million “excess” credits that are available for future compliance. The financial benefits are widely distributed among providers of various alternative fuels,<sup>6</sup> geographically across California,<sup>7</sup> and across the participating credit generators.<sup>8</sup>

The LCFS is driving rapidly increasing use of low carbon fuels in California. Before the LCFS, the only alternative fuels with market share were natural gas and ethanol. Since 2011, renewable diesel use has increased from less than 2 million to 250 million gallons per year. Biodiesel use has grown from 12 million to 163 million gallons. Renewable natural gas use in vehicles has increased from 2 million to 87 million diesel gallons equivalent. Credits in 2016 were generated primarily from ethanol (39 percent), renewable diesel (24 percent), biodiesel (19 percent), and to a lesser—but growing—extent, from biomethane (seven percent) and electricity (nine percent). Credit prices and trading activity reached all-time highs in 2016. Over five million LCFS credits were sold or traded in approximately 929 transactions in 2016 with an average credit price of \$101/metric ton carbon dioxide equivalent (CO<sub>2</sub>e),<sup>9</sup> demonstrating a robust credit market.

Fuel producers are innovating and achieving significant reductions in the carbon intensities of their fuel pathways. New projects with the potential to generate significant credits are being explored at biofuel production facilities, crude production fields (e.g., solar-generated electricity and steam) and petroleum refineries (e.g., production of renewable hydrogen and co-processing of renewable feedstocks). Providers of

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<sup>5</sup> LCFS Data Dashboard. Figure 1 2011-2016 Performance of the Low Carbon Fuel Standard (updated 4/19/2017). Available at: <https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>.

<sup>6</sup> LCFS Data Dashboard. Figure 2 Alternative Fuel Volumes and Credit Generation (updated 04/19/2017).

<sup>7</sup> LCFS Data Dashboard. Figure 11 Map of LCFS Beneficiaries Are Dispersed Throughout California (accessed 04/21/2017). Beneficiaries include California municipal transit agencies, fueling facilities, equipment service providers, utilities, as well as fuel producers and project developers across the U.S. and abroad.

<sup>8</sup> LCFS Data Dashboard. Figure 9 LCFS Credit Market Net Position Histogram (updated 04/19/2017).

<sup>9</sup> Monthly LCFS Credit Transfer Activity Report for March 2017  
[https://www.arb.ca.gov/fuels/lcfs/credit/20170411\\_marcreditreport.pdf](https://www.arb.ca.gov/fuels/lcfs/credit/20170411_marcreditreport.pdf)

electricity and hydrogen for battery electric and fuel cell vehicles are also increasing participation in the program.

### **III. Timeline and Process**

Staff will conduct a public workshop on August 7, 2017 to discuss the concepts outlined in this paper and receive feedback from stakeholders. As always, staff is also available to meet with interested stakeholders to discuss via conference calls and one-on-one meetings. Staff's goal is to propose a comprehensive LCFS amendment package in late 2017 for Board action in early 2018. Staff will schedule additional public workshops as needed to keep stakeholders informed of progress as proposals are further developed.

### **IV. LCFS 2018 Rulemaking Amendments**

The major amendments staff is currently considering as part of the rulemaking effort include:

1. Establishing appropriate average carbon intensity requirements through 2030
2. Changes to the fuels that are subject to the regulation
3. Addition of third-party verification of fuel pathways and credit/deficit generation data

Other changes, updates and improvements to existing provisions, models and procedures include:

4. Pathway application and CI determination streamlining (including updates to carbon intensity quantification)
5. Fuel amount reporting improvements
6. Enhancement to credit transaction reporting
7. Carbon capture and sequestration quantification and permanence protocol
8. Crude petroleum credit provisions
9. Refinery credit provisions

The rest of this paper provides a summary and discussion of current staff thinking on these items. This thinking is subject to change based on additional stakeholder feedback and staff deliberation.

#### **1. Establishing Appropriate Average Carbon Intensity Requirements Through 2030**

The current LCFS targets a 10 percent reduction in average fuel carbon intensity by 2020 and maintains that target for all subsequent years. Strengthening the compliance targets of the LCFS regulation through 2030 is one of the primary objectives of this

rulemaking.

In 2016, the California legislature adopted Senate Bill (SB) 32, which builds on the progress of Assembly Bill (AB) 32 (2006) by codifying a statewide target to reduce GHG emissions 40 percent below 1990 levels by 2030. California's 2017 Climate Change Scoping Plan Update, currently underway, will set out the State's path to achieve this target through continuation of existing measures implemented under AB 32 and through the development of new strategies. Staff's preferred scenario from the 2017 Climate Change Scoping Plan Update proposes an LCFS target of an 18 percent reduction in average transportation fuel carbon intensity compared to a 2010 baseline by 2030 as one of the primary measures for achieving the state's GHG 2030 target.

The LCFS regulation defines a CI reduction target (or standard) for each year, which the rule refers to as the "compliance schedule." Achieving the SB 32 GHG reduction goals will require the use of a portfolio of low carbon transportation fuels beyond the amount expected to result from the current compliance schedule. Staff is conducting in-depth scenario analysis that will inform possible compliance schedules through 2030. This analysis will seek to account for the potential effects of additional proposed changes to the LCFS, such as the addition of alternative jet fuels, crediting for carbon capture and sequestration (CCS), and revisions to refinery credit provisions, which may affect the volumes and types of fuels used to comply with the standard.

Staff has developed several modeling tools that take into account feedstock supply, fuel prices, fuel incentives, and capacity constraints to assess the technical and economic feasibility of bringing low carbon fuels to California. Staff is using these modeling tools to assess fuel supply variability and sensitivity to LCFS credit price and other uncertain market effects on a year-by-year basis. Staff will use these modeling results, together with stakeholder feedback and information obtained from market reports on alternative fuel technology development, to inform any proposed compliance schedule through 2030.

Appendix A provides additional details on the methodology staff envisions for proposing an updated compliance schedule.

## **2. Changes to Fuels Subject to the Regulation**

Staff is considering amendments that would broaden the list of fuels subject to the LCFS regulation and alter the opt-in and/or exempt status of particular fuels. These potential changes include:

- The addition of alternative jet fuels (AJF) as opt-in credit-generating fuels;
- Removing the opt-in status for fossil compressed natural gas (CNG) derived from North American sources;
- Removing the opt-in status for hydrogen;

- Removing the exemption for propane; and
- Allowing alternative fuels used in military tactical vehicles and aircraft to opt-in.

a. Alternative Jet Fuel

AJFs are “drop-in” fuels made from fossil or renewable sources, which can replace conventional jet fuels without the need to modify aircraft engines and existing fuel distribution infrastructure. When used at approved blending levels, staff expects AJFs to have the same performance characteristics as conventional jet fuel.

Staff is considering amendments to allow low-CI pathways for AJF to generate credits as opt-in fuels under the LCFS. Staff’s current thinking is that conventional jet fuel, in contrast to gasoline and diesel, would not be subject to the LCFS regulation and would therefore not generate deficits. Similar to other liquid alternative fuels under the LCFS, the rule would likely designate the AJF producer or importer as the initial regulated party eligible to generate credits. Opt-in AJF pathways would be eligible to generate credits for the total volume loaded to planes in California, whether the destinations are in California or out of the state.

The rule would establish an annual compliance schedule determined specifically for calculating credit from alternative jet fuels. Staff’s current thinking is that the AJF annual compliance schedule would be anchored to a to-be-determined 2010 baseline CI for conventional jet fuel and would incorporate the same annual percent reductions as the compliance schedule for gasoline and diesel. The CI of AJF pathways, as well as the 2010 baseline CI for conventional jet fuel, would be determined using the CA-GREET model. AJF would generate credits based on the difference between the AJF pathway’s CI and that of the jet fuel compliance standard for the given year.

Including AJF in the LCFS may result in several benefits. First, incorporating AJF would clearly signal California’s interest in addressing a significant and growing source of GHG emissions. Currently, GHG emissions from aviation contribute to approximately two percent of the total global emissions and are expected to grow.<sup>10</sup>

Second, because AJF and renewable diesel (RD) are often produced in the same facility using the same feedstock, inclusion of AJF may lead to increased investment in facilities, thereby increasing the production of both alternative fuels. The airline industry is developing a strong record for partnering with alternative fuel producers through direct investment and off-take agreements,<sup>11</sup> which provide the certainty necessary to get these advanced biofuel facilities built.

Third, providing incentive for use of AJF may potentially reduce criteria pollutant

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<sup>10</sup> <https://www.c2es.org/federal/executive/epa/reducing-aircraft-carbon-emissions>

<sup>11</sup> See slide 27 and 28 at the following link for a list of examples:  
[https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/031717presentation.pdf](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/031717presentation.pdf)



emissions during taxi, takeoffs, and landings, which may result in positive health impacts especially near airports. Recent studies have shown that there are significant reductions in particulate matter and sulfur oxide emissions and a slight reduction or no change in nitrogen oxides (NOx) emissions when AJFs replace conventional jet fuel.

#### b. Fossil CNG

In the current regulation, North American fossil CNG is an opt-in fuel because this fuel is presumed to have a CI that meets the standard in every year through 2020. As the CI standard continues to decline beyond 2020, however, staff anticipates some pathways for fossil CNG will have a CI that exceeds the standard and become deficit-generating fuels. The possibility of deficit generation may increase if additional revisions to CI numbers for fossil CNG occur due to new information about methane leakage along the natural gas supply chain.<sup>12</sup> Therefore, staff is considering a proposal to remove the opt-in status of fossil CNG, thereby requiring that regulated parties report all quantities of fossil CNG under the LCFS. Liquefied natural gas (LNG), and L-CNG (LNG that is regasified and compressed for dispensing to CNG vehicles) are already required to report under the LCFS; the result is a requirement that all fuel derived from fossil natural gas would be covered by the program.

Renewable natural gas to bio-CNG pathways, which ARB anticipates will continue to have CIs below the declining standards, would maintain their opt-in status. Given the rapid rate at which renewable natural gas has replaced fossil natural gas in CNG vehicles, staff does not expect this change to be burdensome to CNG providers.

#### c. Hydrogen

Similar to North American CNG, hydrogen is an opt-in fuel under the current regulation because this fuel is presumed to have a CI that meets the compliance standard in every year through 2020. Staff is considering changing the opt-in status of hydrogen to allow ARB to use the LCFS reporting framework to monitor statewide compliance with the greenhouse gas emission and renewable energy resource requirements of California SB 1505.<sup>13</sup> The low volume threshold exemption (an aggregated 420 million megajoules (MJ) of fuel per year by all providers of a particular fuel, equivalent to 3,500 MT of hydrogen) would remain in place, thereby requiring the reporting of all hydrogen dispensed for transportation purposes only after statewide use grows to reach this threshold.

Staff will also clarify who is eligible to generate credits in cases where an upstream party, such as an industrial gas producer, supplies hydrogen to a refueling station where it is compressed and cooled prior to being dispensed. Staff is considering a proposal to designate that the fueling facility owner as the reporting party with the first right of

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<sup>12</sup> See the discussion of this issue in the CI Determination section below.

<sup>13</sup> Lowenthal, 2006. Available at: <https://www.arb.ca.gov/msprog/hydprod/hydprod.htm>

refusal to generate the credits (or the obligation to generate any deficits). This entity would also have the ability to contractually pass the opportunity to generate credits/deficits to the upstream producer (from the station to the supplier), who would then become the reporting party.

#### d. Propane

Liquefied petroleum gas (LPG or “propane”), including renewable propane, is exempt from the current regulation, meaning its use as a transportation fuel generates neither credits nor deficits. Staff is considering removing this exemption for propane and considering it as both a gasoline and diesel substitute for credit and deficit accounting purposes. The station owner for fossil propane and the producer or importer for renewable propane would be the initial regulated party.

Similar to fossil CNG, some propane pathways may exceed the CI standard and would generate deficits under the more stringent compliance standards potentially proposed in this rulemaking. Therefore, reporting of dispensed volumes for these propane pathways would be required. Renewable propane, however, will likely have a CI value that meets the compliance standard for each year, and the new regulation would likely classify it as an opt-in fuel.

#### e. Military Vehicle Applications

The LCFS currently exempts all fuels supplied for use in military tactical vehicles and support equipment from both credit and deficit generation. Producers of renewable fuels used in these applications have expressed concern that this provision reduces their incentives to sell low carbon fuels to the military. These producers have requested opt-in status for the alternative fuels sold for use in these military applications. Staff is supportive of this approach because it simplifies the decision-making framework created by the LCFS for low carbon fuel producers, but we seek stakeholder feedback on this issue.

### **3. Addition of Third-party Verification**

A successful GHG reduction program requires a system to monitor, report, and verify GHG emissions to support implementation and tracking of the effectiveness of emission reduction strategies. To date, the LCFS has relied upon a robust reporting program that includes ARB staff evaluation of fuel CI during the fuel pathway application process and random sampling for the reporting of quarterly fuel quantities per fuel pathway.

ARB is now considering supplementing the work of ARB staff with a verification system that would include independent third parties engaged by entities reporting to ARB under the LCFS. Conceptually, LCFS verifiers would perform GHG accounting checks in a role similar to the independent, objective evaluations of organizations’ financial reports by financial auditors. ARB has extensive experience with an analogous system under the regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR)

pursuant to AB 32, and through the verification of GHG compliance offset projects under ARB's Cap-and-Trade Program.<sup>14,15</sup>

In October of 2016, ARB released a white paper presenting initial thoughts on a framework for Low Carbon Fuel Standard Verification.<sup>16</sup> The discussion below builds off many of the concepts explained in that document.

#### a. Data Types Subject to Verification

Under staff's preliminary LCFS verification program proposal, much of the fuel pathway CI and fuel quantity data submitted in the LCFS Data Management System (DMS)<sup>17</sup> would be subject to third-party review, including:

- Initial Validation of Fuel Pathway Applications (CIs): An initial third-party review of input values submitted for new fuel pathways, referred to as *validation*, would be conducted to reduce the amount of time ARB staff needs to take for the fuel CI certification process. Other ARB programs require verification prior to credit issuance, while LCFS credit generation is based on past CI performance, and credits are issued before annual verification. The validation step would assure that the calculated CI is based on valid, independently-reviewed, site-specific data, eliminating the need for ARB staff to review energy and feedstock invoices, and providing additional confidence to ARB in issuing subsequent credits based on the certified CI. Credits would continue to be issued quarterly, prior to annual verification.
- Ongoing Verification of Operational CI Calculation and Fuel Quantities: Once ARB certifies a CI value and the certified CI is used in Quarterly Fuel Transactions Reports, ARB issues credits or deficits. Ongoing third-party review of fuel quantities and fuel pathway CI calculations, referred to as *verification*, would be required to assure the validity of issued credits and deficits. This would require new annual reporting of ongoing CI performance to ARB. Annual Fuel Pathway Reports (certified CI calculator updated to include the most recent two calendar years of operational data) would be submitted by March 31, the same deadline for Q4 Fuel Transactions Reports. Fuel pathway holders—including those who do not opt-in to fuel transaction reporting in the

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<sup>14</sup> AB 32 explicitly supported verification calling for ARB to “adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance...” Health and Safety Code (H&SC) section 38530(a). Program information on MRR verification is available at: <https://www.arb.ca.gov/cc/reporting/ghg-ver/ghg-ver.htm>.

<sup>15</sup> Offset Verification Program. Available at: <https://www.arb.ca.gov/cc/capandtrade/offsets/verification/verification.htm>.

<sup>16</sup> Available from: [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/verification\\_whitepaper\\_102116.pdf](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/verification_whitepaper_102116.pdf)

<sup>17</sup> The LCFS Data Management System (DMS) is an interactive, secured web-based system which comprises the following three modules: LCFS Reporting Tool (LRT), Credit Bank and Transfer System (CBTS) and the Alternative Fuels Portal (AFP). More information is available at: <https://www.arb.ca.gov/fuels/lcfs/reportingtool/datamanagementsystem.htm#lrt-cbts>.

LRT-CBTS—would demonstrate to their verifiers that their procedures for assigning and communicating fuel pathway codes conform to ARB’s material balance (FPC allocation methodology) or energy balance requirements, and to ARB’s product transfer document requirements.

- Ongoing Verification of Petroleum Data: Data reported by project applicants to calculate innovative crude and refinery credits, quantity reports used for gasoline and diesel deficit claims, and crude oil volume reports would also be subject to verification.

#### b. Entities Responsible for Verification

For fuels with complex supply chains, it is important to clarify which entities would have responsibility for contracting with the verification bodies for verification services. Staff proposes the following entities should be responsible for verification:

- Fuel pathway applicants (who become fuel pathway holders once their pathway is certified) for all material related to the fuel pathway carbon intensity.
- Parties reporting quarterly amounts of fuel in the LRT using the following transactions:
  - Produced, imported, and exported for all liquid fuels;
  - Natural gas and propane vehicle fueling; hydrogen vehicle fueling for hydrogen produced from pipeline-injected biomethane.
- Project operators for innovative crude projects and refinery credit projects.
- The party supplying data related to imported crude carbon intensity.
- Feedstock suppliers who apply for separate ARB recognition and elect to be responsible for separate validation and verification.

#### c. Verification Process and Verification Statement

The process for validation and verification is very similar. Both include the following key steps:

- Development of a validation/verification plan: the general approach to validation/verification for the specific client and data type;
- Development of a risk assessment and sampling plan: Verifiers design and update sampling plans to assess the validity of calculated CI values, fuel pathway quantities, and other data reported in the DMS to calculate credits and deficits. To inform the sampling strategy, a verifier assesses the risks of failure to detect errors according to their professional judgement of the *uncertainty* of reported data and its *relative contribution* to the calculated CI, fuel pathway

quantity, or project data. The verifier's preliminary risk assessment informs the initial sampling strategy, with each informing the other until the verifier concludes that sampling was sufficient to reach reasonable assurance that if significant errors existed, they were detected.

- Requirement for a site visit and data checks: Most validations/verifications would focus on evidence available directly from the responsible entities' data management, record keeping, and accounting systems, and on-site personnel;
- Assessment of material misstatement (potential for significant errors) using a quantitative process; Material misstatement is the sum of errors that may cause a verifier to believe that the key reported value(s) contain errors greater than 5 percent. Material misstatement would be defined for each type of reported data.
- Development of a validation/verification report with log of issues uncovered during the validation/verification process and their resolution; and
- Submission of a validation/verification statement to ARB: Verifiers would be required to attest whether they have a high degree of confidence that final submitted data are valid. When submitting a validation/verification statement, the verifier must have reasonable assurance there is no [*remaining*] material misstatement in the data reported to ARB.

#### d. Requirements for Verification of Certain Feedstocks

Staff is drafting risk assessment and sampling requirements for verification of certain feedstocks that staff considers higher risk for mischaracterization or quantification errors.

Under this proposal, staff would designate "specified source feedstocks" for which verification requires chain-of-custody evidence from the point of origin to the fuel producer to demonstrate accurate feedstock characterization and to confirm that environmental attributes have not been double counted.

Staff would specify the recordkeeping requirements for upstream feedstock chain of custody documentation and—for less transparent supply chains—additional verification risk assessment and sampling requirements.

Some feedstock suppliers may elect to obtain separate verification services to reduce the potential for multiple verifications when they supply multiple fuel production facilities or if they want to substantiate CI claims that are lower than the standard values used in CA-GREET.

#### e. Material Misstatement Definition by Data Type

If the verification body attests that they cannot say with reasonable assurance that the submitted data are free of material misstatement or the verification body attests that the application or report contains correctable errors, they would submit an adverse verification statement to ARB and the client.

- *CI and Fuel Quantities by FPC by Quarter*: “Material Misstatement” means any discrepancy, omission, or misreporting, or aggregation of the three, identified in the course of validation/verification services of CI or Fuel Quantity reporting that leads a verification team to believe that the reported CI calculation (g CO<sub>2e</sub>/MJ) or reported fuel quantity per FPC per quarter contains errors greater than 5 percent, as applicable. Material misstatement is calculated separately for each CI and each quarterly fuel quantity per FPC.
- *Refinery, Innovative Crude, and CCS projects*: “Project Material Misstatement” means a discrepancy, omission, misreporting, or aggregation of the three, identified in the course of project verification services that leads a verification team to believe that a Project Report contains errors resulting in an overstatement of the reported total GHG emission reductions or GHG removal enhancements greater than 5 percent. Discrepancies, omissions, or misreporting, or an aggregation of the three, that result in an understatement of total reported GHG emission reductions or GHG removal enhancements in the Project Report is not a project material misstatement.

#### f. Verification Outcomes

Staff is considering the following outcomes for initial validation of pathway applications:

- **Positive**: A positive validation statement means that the verification body can say with reasonable assurance that the application is free of material misstatement and that the application conforms to the regulatory requirements. A positive validation statement would result in continued evaluation of the fuel pathway application for ARB certification.
- **Qualified Positive**: A qualified positive fuel pathway validation statement means a statement rendered by a verification body attesting that the verification body can say with reasonable assurance that the calculated CI in the submitted Fuel Pathway Report is free of material misstatement and contains no correctable errors, but the site-specific CI data may include one or more other nonconformances with the requirements of the regulation which do not result in a material misstatement. A verification body would issue a qualified positive validation statement in cases when there is a nonconformance that cannot be corrected, but the reported data are acceptable. An example of a nonconformance that could result in a qualified positive validation statement is when the entity reporting the data has correctly used an acceptable missing data substitution method. In this case, the verifier would issue a finding of nonconformance with data monitoring

requirements and a finding that the substituted data are acceptable. A qualified positive validation statement would result in continued evaluation of the fuel pathway application for ARB certification.

- Adverse: An adverse validation statement means a statement rendered by a verification body attesting that the verification body cannot say with reasonable assurance that the submitted CI calculation is free of material misstatement, or attesting that the CI data submitted in the application contains correctable errors, or both. An adverse validation statement would result in denial of the fuel pathway application with the opportunity to reapply.

For ongoing verification of Annual Fuel Pathway Reports (the certified CI calculator updated to include the most recent two calendar years of operational data), the verifier would evaluate validity of the site-specific operational data submittal *and not evaluate conformance with the certified CI*. ARB would separately determine whether the calculated CI is in compliance with the certified CI.

For ongoing verification of Quarterly Fuel Transactions Reports, the verifier would evaluate the validity of fuel transactions data.

Staff is considering the following outcomes for verification of the Annual Fuel Pathway Report and Quarterly Fuel Transactions Reports:

- Positive: A positive verification statement means that the verification body can say with reasonable assurance that the reported data is free of material misstatement and that the report conforms to the regulatory requirements.
  - For verification of Fuel Pathway Reports (CI), a positive verification statement means the updated site-specific operational data are valid. If ARB determines that the calculated CI is greater than the certified CI, ARB could revise or revoke the fuel pathway for future transactions reporting, regardless of the verification outcome.
  - For verification of Fuel Transactions Reports, a positive verification statement means that the originally submitted Quarterly Fuel Transactions Reports or, the Annual Report if corrections have been made to quarterly data, are valid.
- Qualified Positive: A verification body would issue a qualified positive verification statement in cases when there is a nonconformance that cannot be corrected, but the reported data are acceptable. An example of a nonconformance that could result in a qualified positive verification statement is when the entity reporting the data has correctly used an acceptable missing data substitution method. In this case, the verifier would issue a finding of nonconformance with data monitoring requirements and a finding that the substituted data are acceptable.

- For verification of Fuel Pathway Reports (CI), a qualified positive verification statement means the updated site-specific data submitted in the Fuel Pathway Report are acceptable. A qualified positive fuel pathway verification statement means a statement rendered by a verification body attesting that the verification body can say with reasonable assurance that the calculated CI in the submitted Fuel Pathway Report is free of material misstatement and contains no correctable errors, but the site-specific CI data may include one or more other nonconformances with the requirements of the regulation, which do not result in a material misstatement.
- For verification of Fuel Transactions Reports, a qualified positive verification statement means that the originally submitted Quarterly Fuel Transactions Reports or, the Annual Report if corrections have been made to quarterly data, are acceptable. A qualified positive verification statement means a statement rendered by a verification body attesting that the verification body can say with reasonable assurance that the quarterly fuel transactions are free of material misstatement and contain no correctable errors, but the data may include one or more other nonconformances with the requirements of the regulation which do not result in a material misstatement.
- Adverse: An adverse verification statement is a statement rendered by a verification body attesting that the verification body cannot say with reasonable assurance that the reported data are free of material misstatement, or attesting that the data contain correctable errors, or both.
  - For verification of Fuel Pathway Reports (CI), an adverse verification statement means the updated site-specific data submitted contains a material misstatement, or that the data submitted contains correctable errors, or both. An adverse verification statement would result in ARB investigation and may require correction and reverification to continue using the certified fuel pathway.
  - For verification of Fuel Transactions Reports, an adverse verification statement means that one or more of the quarterly fuel transactions reported per FPC is not valid. The verification statement would be based on either the originally submitted Quarterly Fuel Transactions Reports or, on the Annual Report if corrections have been made to quarterly data. An adverse verification statement for a Quarterly Fuel Transactions Report (fuel quantities per FPC) may result in ARB adjustment of credits or deficits and may require reverification.

Only a positive or qualified positive verification outcome for Innovative Crude or Refinery Credit Reports would result in issuance of credits.

In general, the entity reporting the data would have an opportunity to correct errors



discovered during validation/verification prior to the verifier determining the outcome of the verification, and staff expects entities will receive a positive or qualified positive validation/verification outcome in most instances. To ensure consistent verification services, staff will audit a subset of verifications, including those that result in positive or qualified positive verification statements.<sup>18</sup>

If errors are discovered after a positive or qualified positive validation/verification statement is submitted or a high level of conflict of interest existed between the verification body and the client, the Executive Officer may set aside the validation/verification statement and require reverification within 90 days by a different verification body. In instances where a report error is determined by ARB to not affect the calculated credits or deficits, the change may be made without a set aside of the positive or qualified positive verification statement.

#### g. Verification Frequency and Credit Generation

Staff is proposing that verification of CI data and fuel quantities for most fuels reported using fuel pathway codes occur annually, with an annual site visit. ARB will continue to issue credits through the existing quarterly reporting process and the verification timeline will not delay credit generation for these sources of credits.<sup>19</sup> This means that ARB would issue credits prior to verification of the data for the period in question, but after an initial CI validation.

Staff proposes that the verification frequency for alternative-fuel-based crediting could be reduced for alternative fuel production facilities that generate less than or equal to 6,000 credits in a calendar year.<sup>20</sup> For those that fall below this threshold, staff is considering triennial verification.

In contrast to alternative-fuel-based credits generated using fuel pathway codes, staff is proposing that ARB would issue refinery credits and innovative crude credits only after receiving a positive or qualified positive verification statement for the data period in question. Since these projects lack an initial third-party validation step, this will ensure that a verifier has checked the data underlying credits issued for these projects prior to issuance. This would also allow the project applicant the flexibility to pay for verification that is more frequent, if they desire to do so, to expedite credit issuance.

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<sup>18</sup> A positive or qualified positive verification statement does not preclude credit adjustments or possible enforcement action by ARB staff. Verifier findings simply supplement staff's own compliance audits of LCFS participants; they do not protect the entity contracting for verification from any potential negative consequences ARB deems necessary based on the existing methods ARB has at its disposal to monitor and correct LCFS data.

<sup>19</sup> Beyond the potential new requirement to annually report actual CI performance, no changes in the timing of reporting alternative fuel quantities by pathway and ARB credit issuance are proposed.

<sup>20</sup> Entities that fall below the threshold of 6,000 credits are responsible for less than one percent of total credits generated in 2016.

#### h. Verification Deadlines

Staff suggests that the annual verification deadline should be August 31<sup>21</sup> for Annual Fuel Pathway Reports and Quarterly Fuel Transactions Reports. Staff suggests an earlier verification deadline of April 30 may be necessary for imported crude oil reporting, to accommodate staff's crude CI calculations (based on Marketable Crude Oil Name volumes). This would allow for potential incremental deficit adjustments prior to the annual compliance report deadline for gasoline and diesel.<sup>22</sup>

As described above, credits generated by refinery or innovative crude projects would be able to set their own timing for verification (providing that the verification commences after the data quarter subject to verification has closed).

#### i. Accreditation and Oversight

Staff's proposal for the accreditation and oversight program for LCFS verification bodies will likely be consistent with MRR, Cap-and-Trade Program, and ISO 14065 and 14064-3. Staff is also considering establishing selection criteria for International Certification Systems (i.e., ISCC and Bonsucro) and minimum requirements for cooperating certification bodies to offer LCFS validation and verification services as an add-on to their certification services.

ARB staff anticipates that Quality Assurance Plan (QAP) providers and accounting firms that provide attestation engagement services under U.S. EPA's Renewable Fuel Standard (RFS) program would apply for accreditation to perform LCFS validation and verification services. MRR and offset verifiers also would be eligible to apply for LCFS accreditation. California refineries that report CARBOB and diesel may choose to bundle additional LCFS verification requirements during MRR verification services.

As part of verification program oversight, staff would audit a subset of responsible entities, including those with acceptable verification outcomes (positive or qualified positive verification statements) or unacceptable verification outcomes (adverse verification statements). If any entity discovers errors after a verifier has submitted a positive or qualified positive verification statement for a given set of reported data, ARB may set aside the previous verification statement and require reverification, as discussed above. Staff's current thinking is that the same verification body would not be allowed to reverify the corrected report, but the prior verification body would be allowed to continue to provide verification services for subsequent reports to minimize potential audit disruption in other low carbon fuels programs.

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<sup>21</sup> The deadline would be the next working day when the due date falls on a weekend or State holiday.

<sup>22</sup> Note that production, imports, and exports would not require reconciliation. See reporting deadlines in section 95491 Table 12. Annual Compliance Calendar. February 14 is the deadline for uploading transactions prior to reconciliation with counterparties. March 31 is the deadline for submitting the final quarter (Q4) Quarterly Fuel Transactions Report. April 30 is the deadline for submitting the final Annual Report for the preceding year.

#### j. Conflict of Interest Assessment, Disclosure, and Monitoring

As explained in staff's initial white paper on LCFS verification, the need to mitigate and prevent conflict of interest and establish the expected level of assurance and material misstatement for auditing is an important part of verification program design.<sup>23</sup>

For verification bodies, staff is considering similar conflict of interest requirements as those under MRR. To mitigate potential bias due to longstanding familiarity with the client's operations, a maximum continuous relationship of six consecutive years of LCFS validation/verification services would be specified, beginning with the effective date of the amendments, January 1, 2019, such that verification body rotation would be required in 2025. The six-year rotation could be restarted after a three-year break.

To ensure verifiers and verification bodies do not provide services considered high risk of potential conflict of interest, a look-back period for conflict of interest would be phased in, beginning with a three-year look-back period during 2019 and 2020 and a five year look-back beginning in 2021. Verification bodies would be required to monitor emerging conflicts for 12 consecutive months after submitting validation or verification statements.

Staff would like stakeholder feedback on this approach to facilitate a smooth transition allowing RFS QAP providers and accounting firms who provide RFS attest engagement services to implement policies and procedures consistent with LCFS. Staff is considering a list of prohibited LCFS validation/verification client services, consistent with MRR section 95133(b) and Cap-and-Trade section 95979(b). Prohibited client services would include engaging in LCFS market activities, providing internal fuel audit services such as reviewing LCFS data before it is submitted to ARB, submitting LCFS data to ARB, recommending CI-reducing actions, or calculating CIs for validation/verification clients.

#### k. Missing Data Provisions

Staff is evaluating if the current missing data provisions in MRR may be appropriate for use in the LCFS. Verifiers would be required to ensure any missing data in a client's report conforms to the missing data requirements in the regulation.

#### l. Petition Process

A petition process would be available to responsible entities whose verifiers are intending to submit an adverse validation/verification statement and who cannot reach agreement with their verification body on necessary corrections to address findings of nonconformance. Entities responsible for validation/verification and their verification bodies would be expected to raise questions of regulatory interpretation to ARB in a

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<sup>23</sup> [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/verification\\_whitepaper\\_102116.pdf](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/verification_whitepaper_102116.pdf)

timely manner to prevent the need for using the petition process, as feasible.

Appendix B provides tables summarizing the key elements of the proposed verification program.

#### **4. Pathway Application and CI Determination**

Staff is considering changes to the CI pathway application and certification process to better integrate with the system for third-party verification discussed above. Staff expects these changes to reduce application preparation time by the applicant as well as evaluation and processing time by ARB. Our goal is to enhance transparency and simplicity of CI calculations while ensuring accuracy of raw data inputs and basic pathway information through independent third-party verification.

##### **a. Changes to the General Application Process**

###### Initial Validation

General changes to the application process may include removing the requirement to submit certain pieces of supporting documentation<sup>24</sup>—such as invoices and receipts for feedstocks and energy consumed, metered records of fuel production and co-product sales, and demonstration of fuel transport mode—that staff currently reviews to substantiate the inputs to the CA-GREET model. Under the new proposal, independent verifiers, instead of ARB staff, would review this material as part of a new validation step in the pathway application process. Validation would occur after staff reviews the application for completeness and before the Executive Officer certifies the pathway. Supporting documentation would still be part of the applicant’s recordkeeping requirements and must be made available to staff and verifiers upon request.

###### Addition of a Monitoring Plan

To facilitate ongoing verification conformance reviews and support more efficient and robust verification of fuel pathways, staff is considering potentially proposing a requirement that each entity responsible for validation or verification develop and maintain a “monitoring plan.”

As discussed in the October 2016 verification white paper<sup>25</sup> such a monitoring plan would be a road map intended to demonstrate to the verifier how a responsible entity monitors reported fuel quantities and operations that affect the site-specific CI values. A monitoring plan would prompt entities responsible for verification to explain their supply chains, data management systems, key personnel responsibilities and training,

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<sup>24</sup> Supporting documentation requirements can be found in sections 95488(c)(3) and (4) of the current LCFS regulation.

<sup>25</sup> [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/verification\\_whitepaper\\_102116.pdf](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/verification_whitepaper_102116.pdf)

operational procedures, and recordkeeping. A well-documented monitoring plan aids in audit planning as it helps verifiers understand how the entity intends to maintain conformance with LCFS requirements. As envisioned by staff, the verification body would review the monitoring plan as a component of a fuel pathway application. The applicant would also make the plan available to ARB upon request.

Once a fuel pathway CI value is approved and subsequently used by fuel providers in commerce, it is likely that entities will change their practices and procedures (e.g., feedstock procurement practices, feedstock sourcing, and data management systems). In these cases, responsible entities would be required to update and retain their monitoring plans, again making them available upon request by ARB and third-party verifiers.

Staff plans to draft monitoring plan guidance for stakeholder feedback that would include general and fuel-specific elements. Staff envisions that a monitoring plan would include existing recordkeeping and CI application requirements and harmonize with U.S. EPA RFS requirements when appropriate. Furthermore, ARB may require that additional fuel-specific monitoring requirements be included in a fuel pathway application to substantiate site-specific information for Tier 2 pathways. Errors in the plan itself would not be subject to enforcement and not result in credit adjustment by ARB, nor an adverse verification statement by the verification body. The entity's actual practices (not the monitoring plan) would be evaluated relative to LCFS regulatory requirements and result in the final verification statement, whether positive, qualified positive, or adverse.

### Pathway Classification

Staff plans to simplify the lexicon used to describe various pathway types. Currently, staff breaks applications into two tiers: Tier 1 includes conventionally produced first-generation fuel pathways and Tier 2 includes two application Methods (2A and 2B) for next-generation fuels, first-generation fuels produced using innovative processes, Lookup Table pathways, and pathways with an existing reference pathway.<sup>26</sup> Staff plans to update and simplify these distinctions, allowing for pathways with certain innovative practices to remain in the Tier 1 classification, and removing Lookup Table pathways from Tier 2 to clarify application requirements. Unique pathways that fall under the Tier 2 classification would no longer be subdivided into Methods 2A and 2B.

#### b. Update to the CA-GREET Life-Cycle Analysis (LCA) Model

Staff is implementing an update to the current CA-GREET 2.0 model used for calculating life cycle CI values. Staff plans to base the new model (CA-GREET 3.0) on the GREET1 2016 model developed by Argonne National Laboratory (ANL) and

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<sup>26</sup> For more information on the current application requirements and pathway classifications, see *Guidance Document for LCFS New Pathway Applications*. Nov. 5, 2015. Available from: <https://www.arb.ca.gov/fuels/lcfs/fuelpathways/newpathway-11052015.pdf>

released in October 2017, with modifications to incorporate California-specific technical information and to allow users to determine pathway-specific CI values. The CA-GREET model is updated periodically to incorporate new data and improved calculated methodologies, and as necessary to reflect changes to the LCFS regulation. New technical data may reflect changes in fuel production parameters, feedstock-fuel properties, tailpipe emission factors, and other factors that impact pathway CI values.

Full documentation of the changes staff will make to modify GREET1 2016 will be made available with the regulatory package in 2018. In summary, significant changes to the ANL version include the following:

- Electricity resource mixes from EPA eGRID 2014
- Emission factors for natural gas leakage, transmission, and fugitives
- EMFAC2014 tailpipe emission factors
- Chemical use data for ethanol, biodiesel and renewable diesel to reflect data from applications processed in 2016-17
- Efficiency values for liquefaction, compression, etc. to reflect data from applications processed in 2016-17
- Crude recovery and transport factors from an updated version of OPGEE
- Others as required

As with the previous revision to the CA-GREET model, staff expects that, after Board approval, all existing certified fuel pathways will likely need their CI values recertified in 2019 using the updated model (CA-GREET 3.0). Specifics of the transition will be discussed in workshops and documents published prior to the release of the Initial Statement of Reasons (ISOR).

#### c. New Simplified CI Calculators for Tier 1 Pathways

To streamline the application, evaluation, and verification process for Tier 1 fuel pathways, staff is developing new simplified CI calculators for each Tier 1 fuel type. Staff intends to have these calculators replace the current Tier 1 Calculator and 24-month operational data summary submittal requirement.

A section of each calculator provides a fillable form for monthly operational data inputs, which the calculator automatically converts to the CA-GREET input values needed to determine the CI score. The operational data form clearly indicates the data inputs that are required to be specific to each pathway, feedstock, or facility and are subject to verification. Using life cycle inventory data, emission factors, and certain standard parameters from the CA GREET model, the calculator performs the needed CI computation. This allows staff to automate unit conversions that are currently performed by applicants, in order to simplify the application process and facilitate a direct comparison of the inputs to meter readings, data loggers, invoices, and other

types of records.

Details of draft simplified CI calculators were presented during fuel-specific working meetings. Example spreadsheets were posted in conjunction with the natural gas, ethanol and biomass-based diesel meetings, and are available for download from the LCFS meetings page.<sup>27</sup>

The draft simplified CI calculators offer a simplified, transparent, and standardized method of demonstrating how operational data impact the CI, and may be useful to producers on an ongoing basis to monitor variations in production, and mitigate risk of exceeding their certified CI. Staff expects that fuel pathway holders will use these calculators for both initial CI validation and will resubmit calculators with updated operational data for ongoing annual verification of actual CIs and reported fuel volumes.

### New Definitions in the Tier 1 Pathway Application Process

To improve clarity in application requirements, staff suggests the following definitions to distinguish among values that would be used in determining the CI of Tier 1 pathway applications:

- **Site-specific:** An input value, or the raw operational data used to calculate an input value, which is required to be unique to the facility, pathway, and feedstock. All site-specific inputs that appear in the simplified CI calculator must be measured, metered or otherwise documented, and be verifiable, (e.g., consumption of utility natural gas or grid electricity at a fuel-production facility must be documented by invoices from the utility). Under this potential framework, an application might be rejected as incomplete if a site-specific input value cannot be determined.
- **Conditional default:** A conservative input value established by ARB staff, which may be used under specified conditions, that is not subject to further conformance review. In a situation in which an applicant cannot provide the necessary information to determine and validate site-specific values, a conditional default may be used as a necessary substitute for the site-specific value. The conditions under which this value must be used are specific to each situation and would be defined by ARB staff accordingly. Conditional default values would be subject to validation that the specified conditions are met, but would not be subject to further verification, with the rationale that the value is based on reasonable assumptions and is sufficiently conservative to encourage use of site-specific values when feasible.
- **Standard:** An input value that would not appear in the simplified CI calculator and could not be modified to a site-specific value unless the applicant receives

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<sup>27</sup> [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/lcfs\\_meetings.htm](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm)

permission from the Executive Officer. These values are intended to be the same for all applicants of a given fuel type, and therefore would not be subject to CI conformance evaluation by ARB or third-party verifiers, e.g., the pipeline transmission distance for fossil natural gas and much of the background data used in CA-GREET, including emission factors, truck capacities, and farming inputs.

d. Annual Submittal of CA-GREET Model (Fuel Pathway Report)

As mentioned in the verification section above, staff anticipates fuel pathway holders evaluating ongoing conformance with certified CIs. Fuel pathway holders of Tier 1 and Tier 2 fuel pathways will submit an annual Fuel Pathway Report, which will include their certified CI calculator updated to include the most recent two calendar years of operational data. Annual Fuel Pathway Reports would be submitted by March 31, the same deadline for Q4 Fuel Transactions Reports. For Tier 2 pathways, this annual report may also include any supplemental data or documentation that the applicant and ARB agreed upon during the pathway evaluation process and listed in the pathway operating conditions issued at the time of certification.

The site-specific data inputs (yellow cells) of the CI calculator should reflect actual data for the operational period, including the summarized monthly energy and material inputs and production quantities as well as any values the pathway holder has averaged or summed to reflect performance over the full two-year period. For example, a volume-weighted average feedstock transport distance should be updated if feedstock suppliers have changed or the share of feedstock from each supplier has changed.

In the Tier 2 pathway evaluation process, ARB staff will work with applicants to determine the site-specific data that the fuel pathway holder must update to reflect actual conditions in each operational period and to distinguish the calculations and background information that the pathway holder must hold standard and not update without additional ARB staff review. This process will ensure that the necessary information is communicated between the applicant, ARB staff and a verifier, to ensure that verification for these unique pathways is equally robust and transparent as the Tier 1 process using Simplified CI Calculators. Staff proposes that the version of the CA-GREET model that the applicant submitted and that ARB staff approved during certification be called the “certified CI calculator.”

Staff’s current thinking is that Lookup Table pathways for renewable electricity and renewable hydrogen would also require submittal of an annual Fuel Pathway Report. This submittal would consist of invoices or metering records to substantiate the type, source, and quantity of the renewable energy input, and any supplemental documentation identified during certification.

Staff’s goal is for the annual fuel pathway report to demonstrate that the fuel pathway holder provided fuel in a way that was consistent with the pathway during the year in question. The pathway holder should not use this report to convey to ARB that material



changes in the pathway or production process have taken place. Instead, the holder should notify ARB staff of such changes, for example, new unit operations, combustion equipment, or energy types that the fuel pathway holder did not include in the original CI application. Staff will then determine whether a new pathway application submittal is required to accurately reflect the operational CI.

The fuel pathway holder must not modify the basic functionality of the approved CI calculator for their pathway in preparing the Fuel Pathway Report. Staff's current thinking is that, in most cases, changes to CA-GREET background calculations, emission factors or other cells that are not designated as site-specific (user-modifiable) from the originally-certified CI calculator without approval of the Executive Officer will be considered fraudulent pursuant to section 95495 of the regulation and subject to enforcement action.

#### e. Lookup Table Pathways

Staff plans to make several changes to the Lookup Table (Table 6 of the existing LCFS regulation). The potential changes staff is considering proposing include adding new Lookup Table pathways for North American Fossil CNG, renewable electricity, and renewable hydrogen; and removing the existing biomethane pathways. If the Board adopts the amended regulation incorporating the CA-GREET 3.0 model, staff will determine CI values for new pathways and update existing Lookup Table pathway CI values using CA-GREET 3.0 as part of the anticipated recertification process in 2019.

Staff is proposing to update the Lookup Table pathway for California grid electricity used to calculate credits for electric vehicle charging. Staff envisions setting a process to update this pathway annually using the most recently available electricity data from the California Energy Commission (CEC) Quarterly Fuel and Energy Report (QFER)<sup>28</sup> or other appropriate data sources suggested by stakeholders. The goal of this annual update is to reflect the rapidly evolving portfolio of electricity generating resources in California driven by the Renewable Portfolio Standard and other factors.

Staff is considering adding a pathway for renewable electricity supplied to electric vehicles from wind or solar-generated electricity. New hydrogen pathways will be added for hydrogen produced by electrolysis using average grid electricity, renewable hydrogen produced via steam methane reformation of renewable natural gas, and renewable hydrogen produced via electrolysis using wind or solar-generated electricity. The regulatory amendments will include conditions for pathways utilizing renewable electricity or RNG, which will apply to these Lookup Table pathways.

Staff is considering removing the Lookup Table pathways for biomethane from food and green waste via high-solids anaerobic digestion and from anaerobic digestion of wastewater treatment plant sludge. These pathways have not been widely utilized and

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<sup>28</sup> QFER CEC-1304 Power Plant Owner Reporting Form, total electricity system power data. Available at: [http://www.energy.ca.gov/almanac/electricity\\_data/total\\_system\\_power.html](http://www.energy.ca.gov/almanac/electricity_data/total_system_power.html).

staff has been unable to identify parameters that would be applicable to more than one such project to justify standardization in a Lookup Table pathway.

See Appendix C for a table of suggested changes to the Lookup Table.

#### f. Renewable Electricity

Staff is considering proposing amendments to clarify the current regulation's requirements for directly supplied renewable power used as process energy in the production of a transportation fuel. Additionally, staff intends to offer new options to add flexibility for accounting for renewable power supplied to distributed/small-scale uses of electricity (such as EV charging stations and for hydrogen produced by electrolysis on-site at fueling stations) where direct supply of renewable power through co-location may be more challenging. This flexibility is considered necessary due to the small footprint of these distributed users of electricity, which are often located in dense urban areas, as well as the fact that electricity is the primary, if not the sole, factor in determining the CI of these fuel pathways.

As discussed at previous workshops and working meetings in 2016, pathways for EV and hydrogen via electrolysis may be eligible for a reduced CI if renewable power is obtained through a program with eligibility requirements that match or are more stringent than the Green Tariff Shared Renewables (GTSR) Program<sup>29</sup> under California Public Utilities Code Section 2831-2833.<sup>30</sup>

#### g. Renewable Natural Gas

Staff is considering proposing amendments to clarify the details of the existing “book and claim” systems of tracking renewable natural gas (RNG) applicants have been using under existing pathways in the LCFS. Staff also plans to provide clarifying distinctions between RNG used as a feedstock in fuel production and contrast feedstock applications with RNG burned as a source of process energy.

In the current regulation, it is not permissible to use indirect accounting mechanisms—such as book and claim—for CI claims related to process energy.<sup>31</sup> Staff considers RNG a feedstock for production of bio-CNG, bio-LNG, bio-L-CNG, and hydrogen (by steam reformation) but a process fuel in most other applications.

### 5. Fuel Amount Reporting Improvements

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<sup>29</sup> Green Tariff/Shared Renewables Program (GTSR): <http://www.cpuc.ca.gov/General.aspx?id=12181>

<sup>30</sup> Public Utilities Code (PUC) Regulation of Public Utilities, Chapter 7.6, Section 2831, available at: [https://leginfo.legislature.ca.gov/faces/codes\\_displaySection.xhtml?lawCode=PUC&sectionNum=2831](https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PUC&sectionNum=2831).

<sup>31</sup> “Book and claim” chain of custody allows reporters to track the physical product (in this case natural gas) separately from the trade in CI attributes of the gas. Tracking physical molecules in the pipeline is not necessary under such a system. Section 95488(b)(2)(f) of the LCFS prohibits using such an approach for RNG used as process energy.

Staff intends to propose several amendments to regulatory provisions related to the LCFS Data Management System account management and to various fuel volume reporting requirements to provide clarity and improve data accuracy. Staff discussed most of these provisions with stakeholders in various public workshops and working meetings carried out in 2016 and 2017.

a. Third-party Designees for Natural Gas, Electricity, and Hydrogen

To enhance participation and provide flexibility, staff is considering providing greater clarity about how CNG, hydrogen, and electricity charging station owners might contractually designate a third party to manage LCFS credit generation for them.<sup>32</sup>

b. Natural Gas Provisions

Staff is also considering proposing a time limit for the book and claim accounting system for RNG use as a feedstock whereby RNG injected to the pipeline in one quarter would have to be attached to natural gas sold as a vehicle fuel in California as RNG by the end of the following quarter. After that period is over, any unmatched RNG would expire for the purposes of LCFS reporting.

In addition to the amount of CNG fuel dispensed at the fueling facility per FPC reported quarterly, staff is suggesting that the total amount of CNG dispensed (both fossil and renewable natural gas) at the fueling facility per quarter also be reported, as measured by the utility meter and reported on the utility bills. This requirement will facilitate energy balance accounting and improve data accuracy.

Staff has found that public CNG and LNG stations do not track the actual vehicle types in most cases. Instead, these stations typically report using the most conservative energy efficiency ratio (EER) of 0.9 for all sales.<sup>33</sup> Staff is considering potentially proposing an amendment to clarify what documentation reporting parties should provide to substantiate use of the more advantageous EER of 1. For example, the rule could assume that any refueling event less than a given quantity (e.g., 15 GGE) is a light/medium-duty spark-ignition engine vehicle (for which the reporter could use an EER of 1). For fueling facilities that serve a dedicated fleet, the fleet operator may be able to provide supporting evidence that they only fuel one vehicle type, allowing them to report the actual EER.

Finally, in order to simplify the reporting process for natural gas, staff is considering proposing to require that reporters provide the amount of natural gas dispensed at all fueling facilities in therms, on the higher heating value basis as shown on utility bills.

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<sup>32</sup> See fuel-specific Staff Discussion Papers for Natural Gas (April 17, 2017), Electricity December 2, 2016) and Hydrogen (December 5, 2016): [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/lcfs\\_meetings.htm](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm)

<sup>33</sup> See Table 4 of the current LCFS regulation text.

The LRT-CBTS system would then convert the amount of fuel reported in therms to MJ on a lower heating value basis.

#### c. Electricity Provisions

LCFS staff has initiated the process of developing more specific EER values for medium- and heavy-duty EV applications working in conjunction with ARB's Advanced Clean Transit team.<sup>34</sup> In addition, staff is considering developing EER values for airport electric ground support equipment (GSE) and truck stop electrification (TSE) so that these applications could generate credits under LCFS.

Staff is considering adopting the EV charging meter accuracy requirements set forth in the California Department of Food and Agriculture Division of Measurement Standards (DMS) EV charging station regulation into the LCFS.

Staff is also considering a new approach to calculating electricity consumption from non-metered EV charging that would capture electricity use more accurately and would avoid "stranded credits" from currently unreported public, workplace, and fleet EV charging. This new calculation methodology would assess credits for electrical distribution utilities based on a quarterly estimate of the full electric use by vehicle type. The calculation would then subtract EV charging directly reported by other parties in that utility's service territory.

#### d. Hydrogen Provisions

Staff proposes to evaluate the most recent studies and data concerning hydrogen vehicle fuel economy and update EER values if necessary. Staff proposes to develop a specific EER category for hydrogen fuel cell buses, separating it from the current generic category of heavy-duty fuel cell vehicles.

#### e. Liquid Biofuels Provisions

To facilitate an accurate accounting of credits and deficits in the program, staff is considering proposing a fuel obligation transfer period of two quarters. This would mean that if a reporter takes ownership of the fuel with obligation in one calendar quarter, it could be transferred to a recipient with obligation no later than the end of the following calendar quarter. After the fuel obligation transfer period is over, the ownership of the fuel could only be transferred without obligation (i.e., without the associated credits in the case of low carbon fuels). Establishing periodical boundaries for the transfer of fuel obligation to better match industry practices would facilitate an accurate accounting of credits and deficits in the program.

Staff is also considering enhancing the existing quarterly reconciliation functionality in LCFS Reporting Tool and Credit Bank and Transfer System (LRT-CBTS). The

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<sup>34</sup> <https://www.arb.ca.gov/msprog/actruck/mtg/170425eerdraftdocument.pdf>

improved reconciliation ability of LRT-CBTS would eliminate the need for third party verification of fuel transactions reported downstream of the initial regulated party reporting credit- or deficit-generating fuel amounts in the LRT-CBTS.

Staff is also considering providing additional clarification and guidance on reporting exports of fuel and fuel blends out of California.

## **6. Enhancement to Credit Transaction Reporting**

### **a. Credit Transaction Provisions**

Staff intends to propose several amendments to allow more accurate and timely reporting of credit transactions in the LRT-CBTS. This includes shortening the window for reporting each credit transaction in the LRT-CBTS after the execution date and adding additional classifications to identify transactions based on different types of credit agreements, which could include bundled price and unpriced credit transfers, future credit deliveries and multiple transfers.

## **7. Carbon Capture and Sequestration Quantification and Permanence Protocol**

Carbon Capture and Sequestration (CCS) is a potentially significant technology for reducing CO<sub>2</sub> emissions from large stationary sources. In light of California's mid- and long-term climate goals, CCS may grow in importance for California as we approach the middle of the 21st Century. In the 2015 LCFS rulemaking, ARB clarified that CCS projects would be eligible to produce LCFS credits upon the adoption of a Board-approved quantification methodology (QM) and relevant regulatory requirements that ensure sequestration permanence.

Staff has begun work on these items and is producing a "CCS Protocol" to address these issues.<sup>35</sup> Staff plans to incorporate the protocol through the upcoming LCFS amendments. The CCS Protocol will lay out the methodology and assumptions to calculate the amount of GHG emissions (metric tons) sequestered over time (after accounting for GHGs that the project emits over the lifecycle of this activity) and ensure that the project demonstrates the sequestration of those amounts by adherence to the Protocol's permanence requirements.

The quantification portion of the CCS Protocol will focus on the following main areas: eligible activities; CCS project boundary; project emission accounting; and reservoir type as well as and monitoring, reporting, and verification of carbon capture and storage quantities.

The permanence portions of the Protocol would establish the requirements to ensure

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<sup>35</sup> Staff released a concept paper on the CCS Protocol in April 2017.  
[https://www.arb.ca.gov/cc/ccs/documents/CCS\\_Concept\\_Paper\\_April\\_2017.pdf](https://www.arb.ca.gov/cc/ccs/documents/CCS_Concept_Paper_April_2017.pdf).

that a project would result in permanent geologic CO<sub>2</sub> sequestration. The permanence requirements would focus primarily on the following areas: risk-based site analysis; injection or production well material and structural integrity; operating requirements; and monitoring, reporting, and independent expert review of sequestration permanence.

## **8. Crude Petroleum Provisions**

As required by the LCFS regulation, ARB needs to consider the following items need on a 3-year cycle through proposed amendments to the LCFS regulation:

- Revisions to the Oil Production Greenhouse Gas Emissions Estimator (OPGEE) model
- Addition of crudes to the Carbon Intensity Lookup Table for Crude Oil Production and Transport (Table 8), and
- Updates to all carbon intensity (CI) values in Table 8.<sup>36</sup>

The Board adopted OPGEE v1.0 as part of the 2011 LCFS amendments and OPGEE v1.1 as part of the 2015 LCFS re-adoption. At a recent working meeting, ARB staff and Professor Adam Brandt from Stanford University presented draft revisions in OPGEE v2.0 and solicited stakeholder feedback.<sup>37</sup> OPGEE v2.0 adds three major features, namely, oil sands mining and upgrading; drilling and hydraulic fracturing; and CO<sub>2</sub> enhanced oil recovery (EOR). Staff has evaluated stakeholder feedback, incorporated additional revisions to the model, and will present the final draft version of OPGEE v2.0 together with draft CI values crudes in conjunction with the August 2017 workshop. In updating the CI values in Table 8, staff is proposing to compile oil field operational data from the year 2015, which is the latest year for which a complete set of data for many of the crudes is available. In addition, the 2010 California Baseline Crude Average CI value will be updated using OPGEE v2.0 together with the oil field operational data for 2010 baseline crudes.

The existing innovative crude portions of the rule provide credit calculations for solar steam produced at three steam quality ranges: 55 to 65 percent, 65 to 75 percent, and greater than 75 percent. In response to stakeholder feedback, staff is proposing to add two additional ranges: 85 to 95 percent and greater than 95 percent. The inclusion of these additional ranges will more accurately represent enthalpy and emissions per barrel for some thermally enhanced oil recovery operations.

Staff also proposes to expand the reporting requirements for solar/wind electricity and solar steam projects under the innovative crude provision. Staff intends to add the following reporting requirements for solar/wind electricity projects:

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<sup>36</sup> Section 95489(c)(3)(C)

<sup>37</sup> Presentations, draft model and technical documentation materials from the April 4<sup>th</sup>, 2017 public meeting are available at: [https://www.arb.ca.gov/fuels/lcfs/lcfs\\_meetings/lcfs\\_meetings.htm](https://www.arb.ca.gov/fuels/lcfs/lcfs_meetings/lcfs_meetings.htm)

- Metered data on solar/wind electricity consumed for crude oil production at the oil field during the quarter (kWh);
- Total electricity consumed for crude oil production at the oil field during the quarter (kWh); and
- An attestation letter stating that all solar/wind electricity was supplied directly for crude oil production at the oil field and that the solar/wind electricity reported for generating LCFS credit did not produce renewable energy certificates or other renewable attributes recognized or credited by any other jurisdiction or regulatory program.

Similarly, the following reporting requirements for solar steam projects are being proposed:

- Metered data on solar steam consumed for crude oil production at the oil field during the quarter (barrels cold water equivalent);
- Total steam consumed for crude oil production at the oil field during the quarter (barrels cold water equivalent);
- Volume-weighted average steam quality for solar steam consumed for crude oil production at the oil field during the quarter; and
- An attestation letter stating that all solar steam was supplied directly for crude oil production at the oil field and that the solar steam reported for generating LCFS credit did not produce renewable energy certificates or other renewable attributes recognized or credited by any other jurisdiction or regulatory program.

Finally, staff is considering an amendment to allow third-party co-applicants on innovative crude projects (e.g., solar steam providers or solar/wind electricity providers) to opt-in and receive credit for innovative projects upon written agreement with the crude oil producer.<sup>38</sup>

## 9. Refinery Credit Provisions

Refineries are significant sources of GHG, criteria, and toxic emissions in California and elsewhere. The LCFS regulation has three refinery crediting provisions that:

- (1) incentivize refineries to lower the carbon footprints of the production of conventional gasoline and diesel through process improvements and renewable hydrogen use; and
- (2) recognize the lower carbon footprints of low-complexity/low-energy-use refineries.

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<sup>38</sup> This will lead to the use of a more generic term for the entity requesting and receiving credits for such projects, such as the “project applicant” who becomes a “project operator” once the project has been approved by ARB. Staff anticipates adding the same term in the Refinery Investment Credit Pilot Program and the Renewable Hydrogen Refinery Credit Pilot Program.

Staff is considering proposing the following improvements to these provisions to enhance their effectiveness:

- Modifying the calculation methodology for the refinery investment credit program,
- Simplifying the calculation methodology and clarifying the scope for the renewable hydrogen refinery credit pilot program,
- Clarifying that the low-complexity/low-energy-use refinery credit will not be awarded until after MRR verification of reported emission data, and
- Eliminating the option for low-complexity/low-energy-use refineries to use a refinery-specific incremental deficit calculation.

#### a. Refinery Investment Credit Pilot Program

This provision allows refineries to generate credits for projects that reduce refinery emissions by at least 0.1 gCO<sub>2</sub>e/MJ, which is equivalent to about one percent of a refinery's GHG emissions, calculated using pre- and post-project GHG emissions at the refinery level. Under the current regulation, applicants calculate credits by subtracting total refinery emissions for the year post-project from total refinery emissions for the year pre-project. This requires the use of data reported under MRR.

A preliminary analysis of MRR data indicates that year-to-year variation in GHG emissions at a refinery can vary up to about 20 percent during normal operations, which may mask individual project impacts unless the project's reductions are significantly more than 0.1 gCO<sub>2</sub>e/MJ. Because of this effect, the current calculation method could potentially overestimate or underestimate the amount of credits due a project. Staff seeks stakeholder feedback on how to make this provision more workable potentially by changing the calculation methodology to account for projects at a more disaggregated level, based on measurements taken at specific units, as well as adding more specificity on what types of activities/projects should qualify for the program.

Staff's initial thoughts of what types of activities/projects should qualify for the program are listed below:

- Carbon capture and sequestration projects,
- Projects to accommodate processing lighter crudes,
- Flare upgrading, centralization, minimization, or switching,
- On-site renewable electricity or steam production, and
- Energy-efficiency upgrades, such as heat exchangers.

#### b. Renewable Hydrogen Refinery Credit Pilot Program



Under the current rule's refinery renewable hydrogen provision, applicants receive credits based on GHG reductions achieved by substituting renewable hydrogen for fossil hydrogen in refineries.

One input to the method listed in the current rule is the carbon intensity requirement of fossil hydrogen in gCO<sub>2e</sub>/MJ from Table 6 of the rule (with the pathway identifier HYG003). This lookup table value includes downstream emissions from use of hydrogen directly as a vehicle fuel. It was never staff's intent to use the full pathway for this calculation due to differences in covered emissions. For example, refineries use of hydrogen as a process input to making conventional gasoline and diesel should not include the emissions associated with transporting hydrogen to retail fueling stations that are included in HYG003. Staff proposes to correct this oversight for clarity.

Refiners produce most, but not all, hydrogen through steam methane reformation (SMR). Staff also proposes to allow a more direct comparison of the amount and CI of fossil versus renewable natural gas used as inputs in SMR rather than requiring a calculation of the amount and CI of fossil vs renewable hydrogen produced by SMR. Staff expects this change will not impact the amount of credits generated but will make credit calculation, reporting, and enforcement under this program more straightforward.

For other renewable hydrogen production pathways in refineries, including solar electrolysis, staff proposes to estimate carbon intensities of fossil and renewable hydrogen at the refinery by requiring applicants to submit fuel pathway applications for both fossil and renewable hydrogen pathways in accordance with section 95488 of the LCFS regulation.

Lastly, staff proposes to clarify that this program applies to both renewable hydrogen produced on-site at a refinery and hydrogen purchased and supplied to a refinery.

#### c. Low-Complexity/Low-Energy-Use Refinery Credit

In order to align with the current efforts on verification in LCFS provisions, staff proposes to clarify that credits awarded under this provision will be deposited into the refiners account after verification of their emissions under MRR is complete. The Board recently adopted a change in the MRR verification deadline, moving it from September 1 to August 10.

#### d. Incremental Deficit for Low-Complexity/Low-Energy-Use Refinery

Low-complexity/low-energy-use refineries had the option to elect to use a refinery-specific incremental deficit calculation by January 31, 2016. No refineries elected to use this provision and as a result, this provision has become defunct. Staff proposes to eliminate this provision.

## **APPENDICES**

### List of Appendices

Appendix A: Development of Illustrative Compliance Scenarios and Evaluation of Potential Compliance Curves

Appendix B: Third-Party Validation and Verification

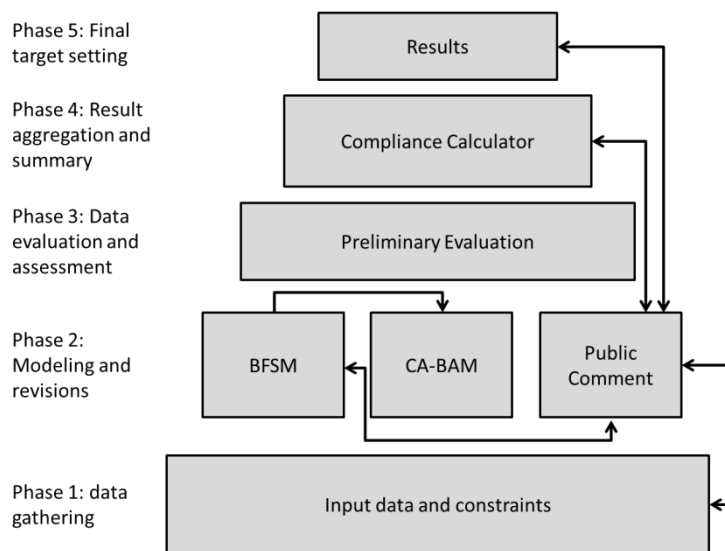
Appendix C: Pathway Application and CI Determination

## Appendix A: Development of Tools for Scenario Analysis and Evaluation of Potential Compliance Curves

ARB has begun to consider a wide variety of fuel production/vehicle technologies and feedstock choices that may be available to firms seeking to comply with the LCFS through 2030. Staff has also begun to develop a multi-step process to evaluate compliance scenarios built from available technology/feedstock combinations. Staff will continue to provide the results of this work to solicit feedback from stakeholders.

Two models have been developed and used to aid in compliance scenario development specifically for the LCFS, the Biofuel Supply Module (BFSM) and the California Biofuel Allocation Model (CA-BAM). In addition, staff continues to review near-term low-carbon biofuel supply projections from Bloomberg New Energy Finance<sup>39</sup> and Lux Research<sup>40</sup> to approximate technology development trajectories and market trends. These subscription services track biofuel market development and capacity expansion.

Setting more ambitious compliance curves for the LCFS will be a 5-phase process that has already begun with comment from the public during the Scoping Plan proceedings and will continue throughout the LCFS rulemaking process. Figure A-1 below shows a graphical representation of the approach taken for establishing LCFS compliance targets through 2030.



**Figure A-1. Anticipated approach for establishing LCFS post-2020 compliance targets**

What follows is a description of the work staff has done to date and how it relates to the process used to help inform compliance curve setting at each phase.

<sup>39</sup> <https://about.bnef.com/>

<sup>40</sup> <http://www.luxresearchinc.com/>

## Phase 1: Input Data and Constraints

### Technology Pathway Consideration and Economics

Given the technological neutrality of the LCFS, It is impossible to exhaustively capture all possible fuel pathways that may exist between now and 2030 and be eligible to receive LCFS credits. Rather than developing an exhaustive list, staff has focused on near-term fuel production pathways for which techno-economic data is available. The following fuel technologies have been considered as part of compliance scenario assessment:

**Table A-1 Fuel Technology Pathways**

Alternative Fuel	Conversion Process	Feedstock
Ethanol	Fermentation	Grains and sugar
Ethanol	Enzymatic hydrolysis	Cellulosic biomass
Biodiesel	Fatty acid methyl ester conversion (FAME)	Fats, oils, and greases
Renewable diesel, jet, and gasoline	Hydrotreating	Fats, oils, and greases
Renewable diesel, jet, and gasoline	Gasification and Fischer-Tropsch synthesis	Cellulosic biomass
Renewable diesel, jet, and gasoline	Pyrolysis, cracking, and hydrotreating	Cellulosic biomass
Renewable diesel, jet, and gasoline	Fischer-Tropsch	Natural gas
Renewable natural gas (CNG and LNG)	Anaerobic digestion	Landfills, dairy manure, wastewater, green waste
Renewable natural gas	Gasification	Cellulosic biomass
Hydrogen	Steam methane reforming	Natural gas
Hydrogen	Electrolysis	Water

The tools staff has developed evaluate the economic feasibility, carbon intensity impacts, and scalability for each technology. Each technology has been considered in conjunction with a variety of possible feedstock choices.

Generally, staff is using conversion costs based on n<sup>th</sup> of a kind (NOAK) projections and engineering studies primarily produced by the National Renewable Energy Laboratory (NREL). The NOAK plant is reached when experience has only a minor effect on reducing costs, which often occurs after five or more plants.<sup>41</sup> For established conversion process such as hydrotreating, anaerobic digestion, and steam methane reforming, NOAK is certainly a valid assumption. For advanced conversion processes such as enzymatic hydrolysis, pyrolysis, and gasification with Fischer-Tropsch synthesis, NOAK may not be reached until later in the analysis period. We have used a variety of NREL's reports and data to inform the cost and conversion efficiency values necessary to

<sup>41</sup>[https://www.netl.doe.gov/File%20Library/research/energy%20analysis/publications/QGESS\\_FOAKtoNOAK\\_Final.pdf](https://www.netl.doe.gov/File%20Library/research/energy%20analysis/publications/QGESS_FOAKtoNOAK_Final.pdf)

evaluate technological feasibility. The LCFS incentive created for each technology is also considered. Additional detail and references for data used are available in the technical documentation for the Biofuel Supply Module.<sup>42</sup>

Staff has also considered how quickly capacity expansion can occur. In our current tools, historical data for corn ethanol and biodiesel expansion in the U.S. has been evaluated to establish guidelines for the maximum feasible expansion or contraction for liquid biofuel volumes. While these rates do not necessarily dictate the rate at which advanced biofuel technologies could scale, they do provide a useful point of reference for the purpose of this work. Staff solicits stakeholder feedback on the conversion costs, conversion efficiencies, and feasible rates for capacity expansion.

### Feedstock Supply Projections

In addition to technology uncertainty, there exists uncertainty in feedstock availability, use, and supply-chain development. For biofuel pathways, staff has primarily relied on data from the Department of Energy (DOE), and the Environmental Protection Agency (EPA) to determine cost and availability of feedstock. The main sources of data for consideration so far have been:

- The Billion-Ton Report<sup>43</sup>
- The EPA Landfill Methane Outreach Program database<sup>44</sup>
- The EPA Livestock Anaerobic Digester Database<sup>45</sup>

Taken together, these datasets facilitate supply estimation for cellulosic materials and biomethane resource potential. Staff considers feedstock alongside technology pathways and costs to understand supply potential and the economics associated with bringing low-carbon fuel supply to California. ARB is also currently researching global waste oil supply potential to better understand how global competition for feedstock supply may affect biodiesel and renewable diesel fuel availability in California. Staff solicits stakeholder feedback on additional data sources for feedstock availability.

### Carbon Intensity Considerations

Feedstock and technology pathway combinations are evaluated using CA-GREET to assess life-cycle carbon intensities for each feedstock and fuel technology considered. For existing pathways, staff will use the average CI reported for that fuel type in 2016; other CI values will be estimated based on CA-GREET default values and specific considerations detailed in the technical documentation.<sup>46</sup>

### **Phase 2: Modeling compliance targets**

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<sup>42</sup> [https://www.arb.ca.gov/cc/scopingplan/bfsm\\_tech\\_doc.pdf](https://www.arb.ca.gov/cc/scopingplan/bfsm_tech_doc.pdf)

<sup>43</sup> <https://energy.gov/eere/bioenergy/2016-billion-ton-report>

<sup>44</sup> <https://www.epa.gov/lmop>

<sup>45</sup> <https://www.epa.gov/agstar/livestock-anaerobic-digester-database>

<sup>46</sup> BFSM Technical Documentation. [https://www.arb.ca.gov/cc/scopingplan/bfsm\\_tech\\_doc.pdf](https://www.arb.ca.gov/cc/scopingplan/bfsm_tech_doc.pdf)

## The Biofuel Supply Module

Staff developed the Biofuel Supply Module (BFSM) to help inform the 2017 Climate Change Scoping Plan Update process. BFSM creates fuel supply curves to satisfy user supplied transportation demand in each year. BFSM is an excel-based model that has been publicly available since September 2016.<sup>47</sup> BFSM incorporates feedstock and technology cost data, alongside life-cycle data to create a set of supply curves for each fuel-technology pair. BFSM then selects the lowest cost fuel-technology pair for meeting transport fuel demand in each year, subject to a set of constraints including feedstock limitations. This tool acts as a check on volume assumptions, and allows estimation of feasible volumes. BFSM also aids in assessing possible fuel trends, and can help identify areas where staff should conduct additional research to better understand fuel technologies and supply. Staff continues to seek feedback to improve this tool.

BFSM will not be the only source of information used for proposing compliance targets. For the LCFS rulemaking, we will attempt to build on the work for the Scoping Plan by expanding our modeling capabilities further. For instance, better treatment of low-carbon fuel policies in other regions would be valuable. Staff is in the process of building out our capacity to assess inter-regional effects, as well as uncertainties associated with fuel supplies and costs through a new tool as described in the following section.

## The California Biofuel Allocation Model

The California Biofuel Allocation Model (CA-BAM) takes the underlying structure and bottom-up formulation for supply determination in BFSM, and ports this model to a Python-SQL interface. Additionally, the model allows fuel and feedstock costs to vary based on probability distributions, and captures fuel demand for all states within the U.S. This facilitates assessment of how regional policies may affect LCFS compliance. CA-BAM results are used to further verify BFSM results and can identify fuel competition issues that are not adequately captured in BFSM.

Given the additional complexity CA-BAM adds, ARB is still going through an internal review process before publicly releasing the model. Pending results of this review, staff intends to release CA-BAM later this summer for stakeholder review and feedback.

### **Phase 3: Model evaluation and feasibility assessment**

Staff will run each model across a variety of scenarios. As part of this process, staff will continue to vet the tools for errors and anomalies. Using modeling results and trends, alongside market reports and public feedback, staff will evaluate model outcomes relative to various possible future LCFS targets. Staff expects that scenario analysis using these tools will determine major variables likely to affect LCFS compliance achievability and illuminate current knowledge limitations.

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<sup>47</sup> BFSM was initially presented at a Scoping Plan workshop on September 14, 2016. An updated version incorporating stakeholder feedback was posted in January, 2017.  
<https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm>

However, these models—especially the python based CA-BAM—may be complex and challenging for stakeholders to run and evaluate themselves. Further, no model—regardless of its complexity—can capture all stakeholder considerations and concerns. Therefore, ARB also plans to create a simpler spreadsheet tool called the Illustrative Compliance Scenario Calculator (Scenario Calculator). This tool will be similar to the sheet used to facilitate stakeholder discussion of scenarios in the 2015 LCFS rulemaking. This Scenario Calculator should improve transparency for fuel volumes and carbon intensity assumptions under various scenarios used to select final targets.

#### **Phase 4: Result aggregation and summary**

Staff will synthesize the trends, results, and public feedback from phases 1-4 for use in the Scenario Calculator. The Scenario Calculator will take user-defined supply volumes for a small-subset of fuels. Average carbon intensities for each aggregate fuel can also be input by the user over time. From these inputs, the calculator will evaluate the number of credits and deficits estimated to be available for a given LCFS compliance target each year. Staff anticipates that the volumes and carbon intensities inputted into final scenarios using the Scenario Calculator will be based on BFSM/CA-BAM model results, alongside other public feedback and market considerations that cannot be adequately represented in the more detailed tools.

#### Projected Fuel Volumes

From model results, feedstock supply projections, and discussions with stakeholders, staff will transparently estimate fuel volume projections under each scenario. Within the Scenario Calculator, the user will be able to specify at least the following values:

- Total demand for diesel and diesel substitutes
- Total demand for gasoline and gasoline substitutes
- Percent of total gasoline pool made up of ethanol
- Cellulosic ethanol volume
- Sugar based ethanol volume
- Renewable gasoline volume
- Hydrogen volumes for LDVs
- Electricity used for LDVs
- Biodiesel volume
- Renewable diesel volume
- Total natural gas demand
- Conventional natural gas volume
- Hydrogen used for HDVs
- Electricity used for HDVs
- Electricity used for rail, forklifts, etc.
- Alternative jet fuel volumes

The user of the Scenario Calculator can also change carbon intensity values for each fuel/technology combination over time or simply specify CI improvement rates.

### Projected Carbon Intensities

Many fuels have shown declines in carbon intensity over time due to process improvements as well as feedstock and fuel switching. For this scenario work, staff will assign projected carbon intensities in each scenario as a starting point for dialogue with stakeholders. Staff solicits stakeholder feedback on the 2017 CI estimates shown in Table A-2 and also on feasible rates at which these CI values may decline over time.

**Table A-2. Possible 2017 Carbon Intensities for Future Scenario Work**

Fuel	Carbon Intensity (gCO <sub>2</sub> e/MJ)
Conventional Ethanol	71
Sugarcane Ethanol	45
Cellulosic Ethanol	30
Renewable Gasoline	30
Hydrogen for LDV (EER Adj.)	35
Electricity for LDVs (EER Adj.)	31
Biodiesel	30
Renewable Diesel	30
Avg of CONV. LNG&CNG	82
Renewable NG (landfill)	40
Renewable NG (dairy)	-273
Hydrogen for HDV (EER Adj.)	46
Electricity for HDV (EER Adj.)	39
Electricity for Rail/Forklift/etc. (EER Adj.)	27
CARBOB	99.78
CARB Diesel	102.01
Alternative Jet Fuel	30

### Additional Types of Credit Generation

Although low-carbon fuels that receive unique fuel pathways are likely to be responsible for the majority of credits used for LCFS compliance, additional credit-generation options are available. Credits can come from innovative crude pathways, refinery investments, and from substitution of renewable natural gas for natural gas in refineries. Taken together, these credit opportunities provide support for achieving LCFS compliance



targets in 2020 and beyond. Staff seeks feedback on the potential magnitude of these sources of credits through 2030.

### **Phase 5: Target Setting**

At the end of Phase 4 staff hopes to have a limited number of scenarios presented in the Scenario Calculator that covers a reasonable range of outcomes. Taken together, these scenarios should allow stakeholders to transparently understand ARB's underlying target setting assumptions, how these assumptions affect compliance outcomes, and perform what-if scenario analysis on the final targets selected.

Based on the results from Phases 1-4, staff will put forth a proposed compliance schedule that will replace Table 1 and Table 2 in the current regulation.

## Appendix B: Third-Party Validation and Verification

Tables B-1 and B-2 summarize staff’s current thinking on the design of the proposed verification system. Table B-1 summarizes who is verified and initial implementation timing. Validation and verification responsibilities are summarized by entity type in Table B-2.

**Table B-1. Summary of Proposed Validation and Verification Requirements**

Topic/Fuel	ARB Staff Proposal
<b>Who is Verified?</b>	<ul style="list-style-type: none"> <li>• The fuel pathway applicants (who become fuel pathway holders once their pathway is certified) for all material related to the fuel pathway carbon intensity.</li> <li>• Parties reporting quarterly amounts of fuel in the LRT using the following transactions:               <ul style="list-style-type: none"> <li>○ Produced, imported, and exported for all liquid fuels;</li> <li>○ Natural gas and propane vehicle fueling; hydrogen vehicle fueling for hydrogen produced with pipeline-injected biomethane.</li> </ul> </li> <li>• The project operator for innovative crude projects and refineries seeking refinery credits.</li> <li>• The party supplying data related to imported crude carbon intensity.</li> <li>• Feedstock suppliers who apply for separate ARB recognition and elect to be responsible for separate validation and verification.</li> </ul>
<b>Timing of Initial Verification Program Implementation</b>	<ul style="list-style-type: none"> <li>• Validation for recertification of existing CIs during 2019; validation of new CI applications beginning in 2019</li> <li>• Annual verification of CI calculator (starting with the 2019 Annual Fuel Pathway Report) and annual verification of quarterly fuel quantities per fuel pathway (2019 Quarterly Fuel Transactions Reports) beginning in 2020 if credits generated during 2019 Q1 or Q2 under recertified or new fuel pathways; annual verification beginning in 2021 if credits generated beginning in 2019 Q3 or Q4 (2019-2020 Annual Fuel Pathway Reports and 2019-2020 Quarterly Fuel Transactions Reports)</li> <li>• For operators of liquid alternative fuel production facilities that generate ≤ 6,000 credits in a calendar year, triennial verification of CI calculators (2019-2021 Annual Fuel Pathway Reports) beginning in 2022 if credits generated during 2019 Q1 or Q2 under recertified or new fuel pathways; verification of CI calculators (2019-2022 Annual Fuel Pathway Reports) beginning in 2023 if credits generated beginning in 2019 Q3 or Q4 under recertified or new fuel pathways</li> <li>• Annual verification of quarterly exported fuel quantities for liquid alternative fuels, gasoline, and diesel; exporters responsible for ≤ 6,000 credits and ≤ 6,000 deficits in a calendar year and that did not produce or import liquid fuels would not be responsible for verification (ARB staff would conduct compliance audits)</li> <li>• Annual verification of quarterly diesel and CARBOB quantities (2019 Quarterly Fuel Transactions Reports) beginning in 2020 for 2019 data</li> </ul>

**Table B-2. Summary of Validation/Verification Responsibility by Entity Type**

Topic/Fuel	ARB Staff Proposal
<b>Reporters of Alternative Liquid Fuels, Renewable Natural Gas, Renewable Propane</b>	<ul style="list-style-type: none"> <li>• Validation and annual verification of calculated CI</li> <li>• Annual verification of quarterly fuel transactions by fuel pathway                             <ul style="list-style-type: none"> <li>○ Produced, imported, and exported liquid alternative fuel quantities</li> <li>○ Dispensed RNG and renewable propane quantities</li> </ul> </li> <li>• Flexibility could be provided for feedstock suppliers to separately engage accredited verifiers</li> </ul>
<b>Reporters of Electricity, Hydrogen, Fossil Natural Gas and Fossil Propane Fueling Using the Lookup Table Pathways</b>	<ul style="list-style-type: none"> <li>• No validation/verification of CI except for pipeline-injected biomethane claims for renewable hydrogen</li> <li>• Annual verification of Quarterly Fuel Transactions Reports for fossil natural gas and fossil propane</li> <li>• ARB staff will conduct periodic compliance audits of electricity and hydrogen, including claims to renewable electricity (solar and wind) and solar- and wind-based renewable hydrogen</li> </ul>
<b>Innovative Crude Producers and Refinery Projects</b>	<ul style="list-style-type: none"> <li>• Verification of Project Reports prior to credit issuance.</li> </ul>
<b>Producers and Importers of Gasoline or Diesel</b>	<ul style="list-style-type: none"> <li>• Annual verification of Production in California, Production for Import, Import, and Export of gasoline and diesel</li> </ul>
<b>Gasoline and Diesel Refineries Reporting Crude Information</b>	<ul style="list-style-type: none"> <li>• Annual verification of marketable crude oil name (MCON) volume reporting (including any purchases from MCONs with innovative crude projects)</li> </ul>
<b>Exporters who are not also Producers or Importers</b>	<ul style="list-style-type: none"> <li>• Exporters responsible for <math>\leq 6,000</math> credits and <math>\leq 6,000</math> deficits in a calendar year and that did not produce or import liquid fuels would not be responsible for verification (ARB staff would conduct compliance audits)</li> </ul>

## Appendix C: Lookup Table Pathways

Suggestions for changes and additions of new pathways to the Lookup Table Pathways table (presently Table 6 of the LCFS Regulation Order) are presented below. The CI values for each fuel pathway will be determined using the CA-GREET 3.0 model when adopted under the amended regulation.

**Table C-1. Suggested Lookup Table Pathways**

Fuel	Pathway Description
CARBOB	CARBOB - based on the average crude oil supplied to California refineries and average California refinery efficiencies
Diesel	ULSD - based on the average crude oil supplied to California refineries and average California refinery efficiencies
CNG	Fossil Natural Gas – Pipeline Average North American Natural Gas to CNG
Propane	Fossil LPG from crude oil refining and natural gas processing used as a transport fuel
Electricity	California average grid electricity supplied to electric vehicles
	Electricity that is generated from 100 percent solar or wind supplied to electric vehicles
Hydrogen	Hydrogen from central reforming of fossil-based NG (with gaseous transport)
	Hydrogen from central reforming of fossil-based NG (with liquefaction, transport, and re-gasification steps).
	Hydrogen from central reforming of biomethane derived from landfill gas (with gaseous transport)
	Hydrogen from central reforming of biomethane derived from landfill gas (with liquefaction, transport, and re-gasification steps)
	Hydrogen from electrolysis using California average grid electricity
	Hydrogen from electrolysis using solar- or wind-generated electricity