Low Carbon Fuel Standard
Public Workshop: Concepts and Tools for Compliance
Target Modeling

NOVEMBER 9, 2022
Purpose

• Discuss need for changes to program
• Introduce modeling tool for scenario development
• Present initial modeling scenarios and inputs for consideration
• Request stakeholder feedback, including alternative approaches to concepts in initial modeled scenarios

Note: The list of potential future changes discussed in this workshop should not be considered exhaustive
Workshop Logistics

• Workshop materials and online docket available on the LCFS Meetings and Workshops page:

• Written feedback may be submitted to the online docket
  o Online docket open November 9 to 11:59 p.m. on December 2

• Q&A during the workshop
  o 1) Use the “Raise Hand” function in the GoToWebinar toolbar, which should be located to the right of your screen as shown
  o 2) When staff call your name, please “Unmute” yourself by clicking the red button, and proceed to introduce yourself
## LCFS as part of State climate policy

### 2022 Scoping Plan: Path to Carbon Neutrality
- Nov 2022 – Revised Scoping Plan to be Released
- Dec 2022 – Second Board Hearing (final proposed plan)


### LCFS Pre-Rulemaking
- Upcoming Workshops
  - Updated scenarios and modeling outputs
  - Life cycle analysis tools
  - ZEV infrastructure crediting
  - Project-based crediting

### LCFS Formal Rulemaking (major steps)
- Issue public Notice of Preparation (NOP)
- Develop language and economic analysis
- Dept of Finance review
- Initial Statement of Reasons (ISOR) and public comment period
- Board Hearing 1
- Respond to comments
- Board Hearing 2 (adoption)
- Office of Administrative Law review
- Implementation begins

Incorporates EO, Legislative direction, Board direction to lay out path to carbon neutrality

Public workshops while/shortly after the Scoping Plan is finalized

Formal process with specific timelines
* One year timeline to complete once ISOR is published
LCFS Status and Trends
LCFS is Over-Performing

2011-2021 Performance of the Low Carbon Fuel Standard

Carbon intensities based on composite of gasoline and diesel fuels
Credit and Deficit Balances

Fig 1. Total Credits and Deficits (MT) for All Fuels Reported Q1 2011 - Q2 2022

Metric Tons (MT)
LCFS Continues to Increase Diversity and Volume of Low-Carbon Fuels

VOLUMES

Fuels supported by the LCFS displaced over 3.1 billion gallons of petroleum fuel in 2021

CREDITS

Growing credit generation from electricity, renewable diesel, and biomethane
LCFS is a Critical Part of California’s Climate Portfolio

• Significant reductions in transportation emissions are needed to achieve state’s air quality and climate goals

• LCFS is a key strategy that supports:
  o Displacing fossil fuels
  o Diversifying transportation fuel mix
  o Accelerating investment in low-carbon fuel production and the associated infrastructure buildout
  o Providing long-term price signals needed to support transition to ZEVs and decarbonizing remaining liquid fuel demand
Aligning with Recent Climate Policy

• 2022 Climate Change Scoping Plan returning to Board in December

• Broad climate package (including carbon neutrality target) signed into California law

• July letter from Governor’s Office to CARB
  o Increase LCFS stringency
  o Clean fuels target for aviation sector
  o Accelerate refinery transitions away from petroleum to clean fuels production

• Adoption of Advanced Clean Cars II
Changes since 2018 Rulemaking

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statewide GHG emission targets</td>
<td>At least 40% by 2030</td>
<td>At least 40% by 2030; 85% anthropogenic emissions reductions by 2045; Carbon Neutrality by 2045</td>
</tr>
<tr>
<td>Light Duty ZEV sales expected</td>
<td>Less aggressive than ACC II</td>
<td>ACC II, 100% ZEV sales by 2035</td>
</tr>
<tr>
<td>Annual sales of ZEVs</td>
<td>7 percent</td>
<td>18 percent</td>
</tr>
</tbody>
</table>
Scenario Modeling: CATS Model Overview
The California Transportation Supply (CATS) Model

- Developed by CARB staff to evaluate potential fuel market and policy assumptions and outcomes
- CATS is a transportation fuel supply optimization model
- CATS minimizes the cost of supplying fuel to meet the specified annual fuel demand
- CATS scenarios do not capture the California fuel markets perfectly; does not necessarily capture all factors that could impact costs and supply in the actual California fuel market
The California Transportation Supply (CATS) Model

• CATS is a transportation fuel supply optimization model
• Minimizes the cost of supplying fuel to meet fuel demand in each year

Fuel Demand
Feedstock Supply Curves
Feedstock Conversion Information (costs, CI, exogenous subsidies, etc.)
Optimization Constraints

CATS Optimization Model

Quantity of feedstock used for each fuel production pathway
Marginal costs of constraints
Credits and deficits
Fuel pool costs
Inputs: Fuel Demand Pools

- Gasoline Fuel Pool
- Diesel Fuel Pool
- CNG Vehicle Fuel Pool
- Light-Duty Vehicle Electricity Fuel Pool
- Light-Duty Vehicle Hydrogen Fuel Pool
- Heavy-Duty Vehicle Electricity Fuel Pool
- Heavy-Duty Vehicle Hydrogen Fuel Pool
- Intrastate Jet Fuel Pool

Total fuel pool demand each year is specified as a model input (not calculated by CATS)
Inputs: Feedstock Supply Curves

- Waste Oil – 3.9 million tons between $600 and $2000 per ton
- Virgin Oil – 6.7 million tons between $600 and $2000 per ton, infinite available at $2200 per ton
- Electricity – infinite available at $80/MWh
- Corn – infinite available at $7/bushel
- Crude Oil – infinite available at $90/barrel
- Natural Gas – infinite available at $6/MMBtu
- Landfills – 51 trillion Btu between $7 and $40 per MMBtu
- CA Dairy Gas to RNG – 6.7 trillion Btu between $30 and $40 per MMBtu
- CA Dairy Gas to Electricity – 10.2 trillion Btu between $50 and $125 per MMBtu
Inputs: Feedstock Conversion Information Included in Model

- Renewable Diesel
- Biodiesel
- CNG from Dairies
- Landfill CNG
- Ethanol
- Alt Jet Fuel
- Conventional Jet Fuel
- Ethanol w. CCS
- CARBOB
- ULSD
- E85
- Renewable Gasoline
- CNG
- HDV Hydrogen
- HDV Hydrogen-CCS
- LDV Hydrogen
- LDV Hydrogen-CCS
- LDV-e (Dairy Gas)
- LDV-e (grid)
- LDV-e (0-CI)
- HDV-e (Dairy Gas)
- HDV-e (grid)
- HDV-e (0-CI)
- HDV Hydrogen (0-CI)
- LDV Hydrogen (0-CI)
- DACCS
- LDV HRI + FCI Credits
- MHDV HRI + FCI Credits
- Incremental Deficits
- Fixed Guideway Credits
- Forklift Credits
- Other offroad Credits
- Advanced Credits
- Bank Drawdown
- Petroleum Projects
The LCFS Policy is added as an optimization constraint to the model

- Fuel demand is met using Feedstock-to-Fuel conversion pathways (e.g., Crude Oil to Gasoline, Biomethane to CNG)
- Each pathway has a defined carbon intensity (CI) and conversion costs. Can be specified annually
- Annual LCFS compliance constraint must be met:
  - Credits ≥ Deficits for every year
  - A user-defined LCFS benchmark trajectory determines the number of credits/deficits generated for each feedstock-to-fuel conversion pathway
- Output: the model estimates the annual LCFS credit price (change in fuel system costs needed to comply with LCFS target at the margin)
Additional Feedstocks Can Be Included

• To consider additional feedstock supplies, CARB needs:
  o Incremental supply estimates by price point
  o Documentation for how supply estimates were determined, including market data used to support estimates
  o Pathway or documentation of feedstock usability in California
  o Peer-reviewed literature to reference technical potential estimates where existing market-data cannot be used
  o Demonstration that inclusion of feedstock is likely to generate at least 1 million credits or deficits over the considered modeling timeframe (significance for inclusion)
Feedback Requested on Model Inputs

Core Model Inputs
- Feedstock Conversion Efficiencies and Costs
- Feedstock Supply Curves

Other Model Inputs
- Annual Energy Demand
- LCFS Annual Benchmarks
- Exogenous Subsidies
- Estimated Pathway CI Values
CATS Inputs and Documentation

• CATS scenarios are simplified representations of California’s total fuel system

• LCFS price outputs and results can be used to gain intuition for how policy scenarios may impact credit prices and fuel supply in the market. Real market values will be different.


• Core model inputs posted: https://ww2.arb.ca.gov/sites/default/files/2022-11/CATS%20Summary%20Inputs.xlsx
LCFS Modeling

3 SCENARIOS FOR INITIAL CONSIDERATION
Goal of Preliminary Scenario Designs

• Provide a wide range of scenario inputs for public discussion to help inform future target-setting and policy design

• Describe the inputs in preliminary scenarios informed by:
  • Regulations, legislation, and plans
  • Potential LCFS policy mechanisms
  • Transportation sector outcomes exogenous to LCFS
  • Public feedback from previous workshops

• Subsequent workshops will follow in more detail
Staff Preliminary Scenario Design Options

- **Baseline**
  - Assumes implementation of Advanced Clean Cars II and Advanced Clean Trucks
  - VMT based on EMFAC 2021 v.1.0.2
  - 20% CI Reduction Target in 2030

- **Alternative A**
  - Higher overall transportation energy demand and higher assumed VMT than Baseline
  - 25% CI Reduction Target in 2030

- **Alternative B**
  - Support State’s Medium- and Heavy-Duty ZEV deployment represented in Baseline assumptions
  - 30% CI Reduction Target in 2030

- **Alternative C**
  - Investment in alternative fuel deployment is front-loaded before 2030 with a more gradual decline in CI targets through 2045
  - 35% CI Reduction Target in 2030

All alternative scenarios achieve a 90% CI reduction target in 2045
Scenario Design: Carbon Intensity Benchmark Schedules

<table>
<thead>
<tr>
<th>Percent CI Reduction</th>
<th>Year</th>
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<tbody>
<tr>
<td></td>
<td>2024</td>
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<tr>
<td></td>
<td>2026</td>
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<td>2028</td>
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<td>2030</td>
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<td>2032</td>
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<td>2040</td>
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<td>2042</td>
</tr>
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<td></td>
<td>2044</td>
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</table>

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Percent CI Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25%</td>
</tr>
<tr>
<td>B</td>
<td>30%</td>
</tr>
<tr>
<td>C</td>
<td>35%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25%</td>
<td>39%</td>
<td>60%</td>
</tr>
<tr>
<td>B</td>
<td>30%</td>
<td>45%</td>
<td>65%</td>
</tr>
<tr>
<td>C</td>
<td>35%</td>
<td>51%</td>
<td>69%</td>
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</table>
Staff Preliminary Scenario Design Options

<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030* Target</td>
<td>25% by 2030</td>
<td>30% by 2030</td>
<td>35% by 2030</td>
</tr>
<tr>
<td>2045 Target</td>
<td>90% by 2045</td>
<td>90% by 2045</td>
<td>90% by 2045</td>
</tr>
<tr>
<td>Gasoline and Diesel Pools Energy Demand</td>
<td>Liquid fuel demand higher than baseline</td>
<td>Liquid fuel demand consistent with baseline</td>
<td>Liquid fuel demand consistent with baseline</td>
</tr>
</tbody>
</table>

*Compliance targets prior to 2030 are assumed to be enhanced in all scenarios*
Assumptions Affecting Modeling

• Limits on Crop-Based Fuel in Diesel Pool
• Biomethane Crediting
• Medium- and Heavy-Duty Zero Emission Vehicle Refueling Infrastructure
• Other topics: Electric Forklift Crediting, Intrastate Jet Fuel, Petroleum Crediting
Crop-Based Biofuels

• Following messaging in the draft 2022 Scoping Plan, comments from the Board and feedback from stakeholders, staff requested feedback on treatment of crop-based biofuels at the July 2022 workshop.

• Staff has received mixed feedback on potential limits to crop-based fuels in the LCFS, with stakeholders for and against such a limit.

• Currently, crop-based biofuels generate credits and are unconstrained

• In light of expected increase in global production capacity, staff continues to evaluate the need for adjustments to prevent potential deforestation, land conversion, and adverse food supply impacts

• Staff requests data and input on this topic
Crop-Based Biofuels Assumptions

<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop-based fuels</td>
<td>Credits for diesel fuels derived from virgin oil feedstock are limited</td>
<td>Credits for diesel fuels derived from virgin oil feedstock are limited</td>
<td>No limit on credits for diesel fuels derived from virgin oil feedstocks</td>
</tr>
</tbody>
</table>

Addresses stakeholder sustainability concerns associated with ramp-up of crop-based feedstocks for fuel

Maximum available biomass-based diesel
Biomethane Crediting Context

Goals:

• Continue to incentivize deployment of methane reduction strategies to support meeting California’s near-term SB 1383 targets and 2030 climate target

• Support Scoping Plan policy direction for long-term deployment/use of biomethane for hydrogen and expanding use of biomethane in non-transportation sectors

• Provide appropriate transition time to ensure alternative options are available - we understand investment, need to avoid stranded assets, and continued project operation depends on continued market and policy support.

Considerations:

• **Phase-down of avoided methane crediting in LCFS at future date?** LCFS currently provides avoided methane crediting for particular pathways, with a guaranteed initial 10-year crediting period, without an end-date.

• **Align deliverability requirements with other fuels?** LCFS regulation allows for indirect accounting of biomethane injected into the North American natural gas pipeline without a deliverability requirement, unlike treatment of low-CI electricity
<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certification of fuel pathways with avoided methane credit</td>
<td><strong>2030</strong>: no new fuel pathways certified with avoided methane</td>
<td><strong>2030</strong>: no new fuel pathways certified with avoided methane</td>
<td>Fuel pathways still certified with avoided methane crediting</td>
</tr>
<tr>
<td></td>
<td>Phaseout of eligibility for existing fuel pathways with avoided methane by 2040</td>
<td>Phaseout of eligibility for existing fuel pathways with avoided methane by 2040</td>
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</table>

Supports development of methane capture projects in near-term while sending long-term signal to transition to other sectors

No change
## Biomethane Crediting – Book & Claim Assumptions

<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomethane book and claim (B&amp;C) eligibility</td>
<td><strong>2025</strong>: B&amp;C for RNG used as transportation fuel is limited to projects in the Western NG network</td>
<td><strong>2025</strong>: B&amp;C for RNG used as transportation fuel is limited to projects in the Western NG network</td>
<td>All North American RNG projects remain eligible for B&amp;C</td>
</tr>
<tr>
<td></td>
<td><strong>2030</strong>: landfill gas B&amp;C only allowed if used to produce H2</td>
<td><strong>2030</strong>: landfill gas B&amp;C only allowed if used to produce H2</td>
<td></td>
</tr>
</tbody>
</table>

- Harmonizes B&C policies between electricity and RNG
- Anticipated RNG projects in western region can replace some of the non-Western volume
- No change
Medium- and Heavy-Duty (MHD) ZEV Refueling Infrastructure

• Draft 2022 Scoping Plan recommends that LCFS develop a provision to support MHD ZEV refueling infrastructure.

• Current ZEV infrastructure provision supports LD ZEV refueling infrastructure and has been a successful tool for supporting buildout while throughput is low.

• Executive Order N-79-20 directs a transition to ZEVs in the MHD vehicle space, and both charging and hydrogen refueling infrastructure will be critical.

• Preliminary modeling concepts: Allow for a combination of LD and MHD ZEV infrastructure credits to be generated up to 10% of deficits.
## Medium- and Heavy-Duty (MHD) ZEV Refueling Infrastructure Assumptions

<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure Crediting</td>
<td>Total infrastructure crediting pool: 5% of deficits</td>
<td>Total infrastructure crediting pool: 10% of deficits</td>
<td>Total infrastructure crediting pool: 10% of deficits</td>
</tr>
</tbody>
</table>

- **Applicable to MHD infrastructure crediting**
- **More credits provided absent of dispensed fuel and GHG emissions reductions**
## Other Modeling Assumptions Under Consideration

<table>
<thead>
<tr>
<th>Component</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Forklifts</td>
<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>Intrastate fossil jet is added as a deficit generator</td>
<td>Intrastate fossil jet is added as a deficit generator</td>
<td>Intrastate fossil jet is added as a deficit generator</td>
</tr>
<tr>
<td>Petroleum crediting</td>
<td>No changes to current structure</td>
<td>Phase out by 2040</td>
<td>Phase out by 2025</td>
</tr>
</tbody>
</table>
## Scenario Comparison: Key Metric Ranking

<table>
<thead>
<tr>
<th>Expected Impact</th>
<th>Alternative A</th>
<th>Alternative B</th>
<th>Alternative C</th>
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</thead>
<tbody>
<tr>
<td>GHG Reductions</td>
<td>🟡</td>
<td>🟡</td>
<td>🟢</td>
</tr>
<tr>
<td>Pace of ZEV Deployment</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Reliance on Crop-Based Fuels</td>
<td>🟡</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Reliance on Biomethane</td>
<td>🟡</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Cost to Consumers</td>
<td>🟡</td>
<td>🟡</td>
<td>🟢</td>
</tr>
<tr>
<td>Pace of Direct Air Capture Deployment</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
<tr>
<td>Continued Reliance on Fossil Fuels</td>
<td>🟢</td>
<td>🟢</td>
<td>🟢</td>
</tr>
</tbody>
</table>

Legend: 🟡 Lowest  🟢 Medium  🟢 Highest
Future Potential Topics

• Target-setting and modeling
  • Modeling outputs
  • Cost estimates
  • Self-adjusting CI target mechanism
• Additional LCFS policy discussions
  • LCA tools
  • ZEV infrastructure crediting
  • Project-based crediting
  • Follow-up on items discussed today
• Broader agency discussions
  • Scoping Plan final board hearing, Dec 2022
  • Landfill methane workshop, mid-December

List is not exhaustive
Standardized Regulatory Impact Assessment (SRIA) Request for Alternatives

- Ensure the submission discusses the alternative’s ability to fulfill the purposes of the initial modeled scenarios as CARB has presented it.
- Submit the associated cost/benefit information and data sources to enable comparison of economic impacts.
- Submit a clear description of the basis for any cost calculations.
Standardized Regulatory Impact Assessment (SRIA) Request for Alternatives

• CARB welcomes public input on alternatives to the initial modeled scenarios discussed in this workshop

• In particular, CARB encourages public input on alternative approaches that:
  o May yield the same or greater benefits than those associated with the proposed regulation, or
  o May achieve the goals at lower cost
Break

WE WILL RESUME IN 15 MINUTES
Workshop Logistics

• Workshop materials and online docket available on the LCFS Meetings and Workshops page: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-meetings-and-workshops

• Written feedback may be submitted to the online docket
  o Online docket open November 9 to December 2

• Q&A during the workshop
  o 1) Use the “Raise Hand” function in the GoToWebinar toolbar, which should be located to the right of your screen as shown
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Next Steps

• Submit written feedback online through December 2, 2022
• Link to submit written feedback found on the LCFS Meetings and Workshop webpage: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-meetings-and-workshops
• Additional workshops in early 2023
# Appendix: List of Relevant Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACC2</td>
<td>Advanced Clean Cars Regulations</td>
</tr>
<tr>
<td>ACF</td>
<td>Advanced Clean Fleets Regulation</td>
</tr>
<tr>
<td>ACT</td>
<td>Advanced Clean Trucks Regulation</td>
</tr>
<tr>
<td>B&amp;C</td>
<td>Book-and-Claim Accounting</td>
</tr>
<tr>
<td>BD</td>
<td>Biodiesel</td>
</tr>
<tr>
<td>EV</td>
<td>Electric Vehicle</td>
</tr>
<tr>
<td>EMFAC</td>
<td>EMission FACtor Model</td>
</tr>
<tr>
<td>FCI</td>
<td>Fast-Charging Infrastructure</td>
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<tr>
<td>HRI</td>
<td>Hydrogen Refueling Infrastructure</td>
</tr>
<tr>
<td>LDV</td>
<td>Light-duty Vehicles</td>
</tr>
<tr>
<td>LFG</td>
<td>Landfill Gas</td>
</tr>
<tr>
<td>MHD</td>
<td>Medium Heavy-Duty</td>
</tr>
<tr>
<td>NG</td>
<td>Natural Gas</td>
</tr>
<tr>
<td>RD</td>
<td>Renewable Diesel</td>
</tr>
<tr>
<td>RNG</td>
<td>Renewable Natural Gas</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle Miles Traveled</td>
</tr>
<tr>
<td>WWTP</td>
<td>Wastewater Treatment Plants</td>
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