

# Low Carbon Fuel Standard

Public Workshop: Concepts and Tools for Compliance  
Target Modeling

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NOVEMBER 9, 2022



# Purpose

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- 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

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- 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
  - Online docket open November 9 to 11:59 p.m. on December 2 
- Q&A during the workshop
  - 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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# 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)

Scoping Plan Webpage:  
<https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan>

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

## LCFS Pre-Rulemaking

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

Public workshops while/shortly after the Scoping Plan is finalized

## 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

Formal process with specific timelines

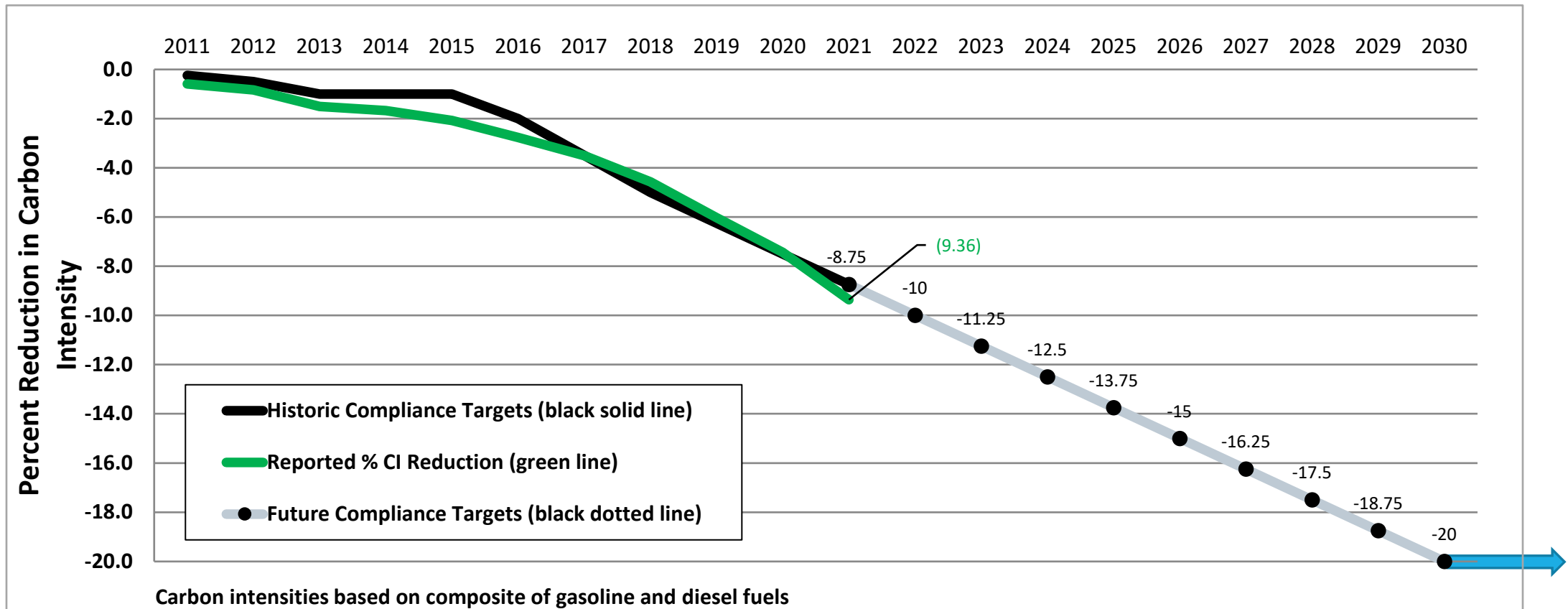
\* One year timeline to complete once ISOR is published

# LCFS Status and Trends

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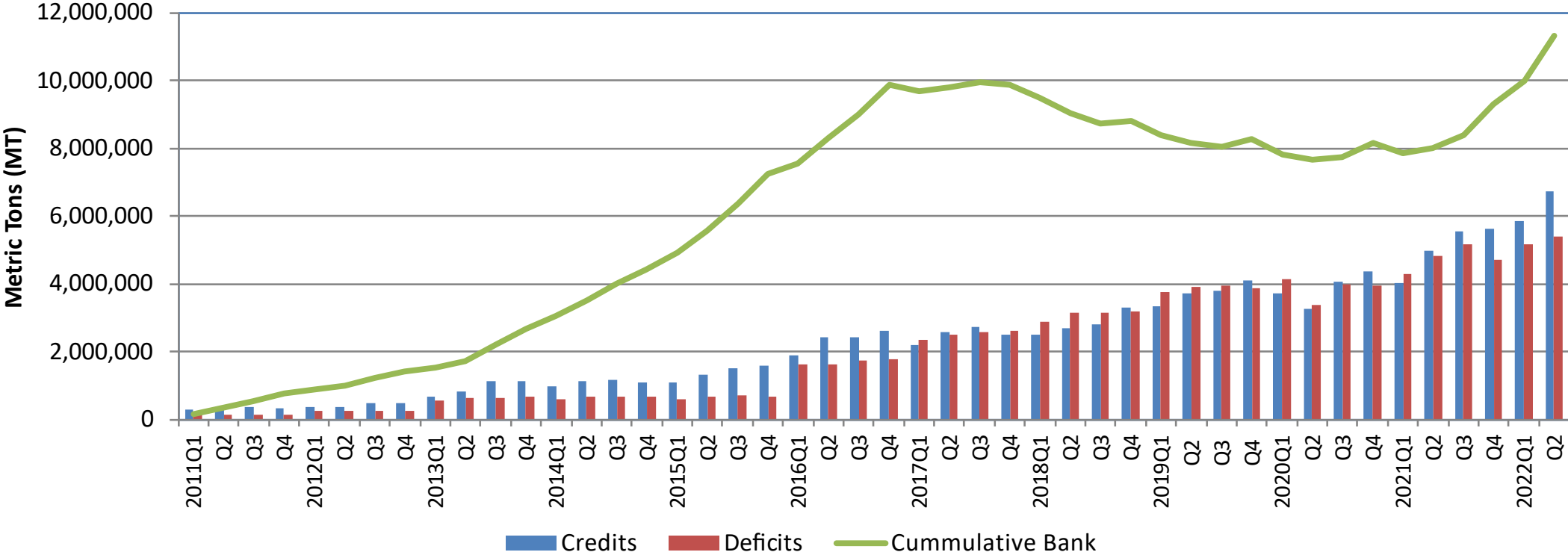
# LCFS is Over-Performing

## 2011-2021 Performance of the Low Carbon Fuel Standard

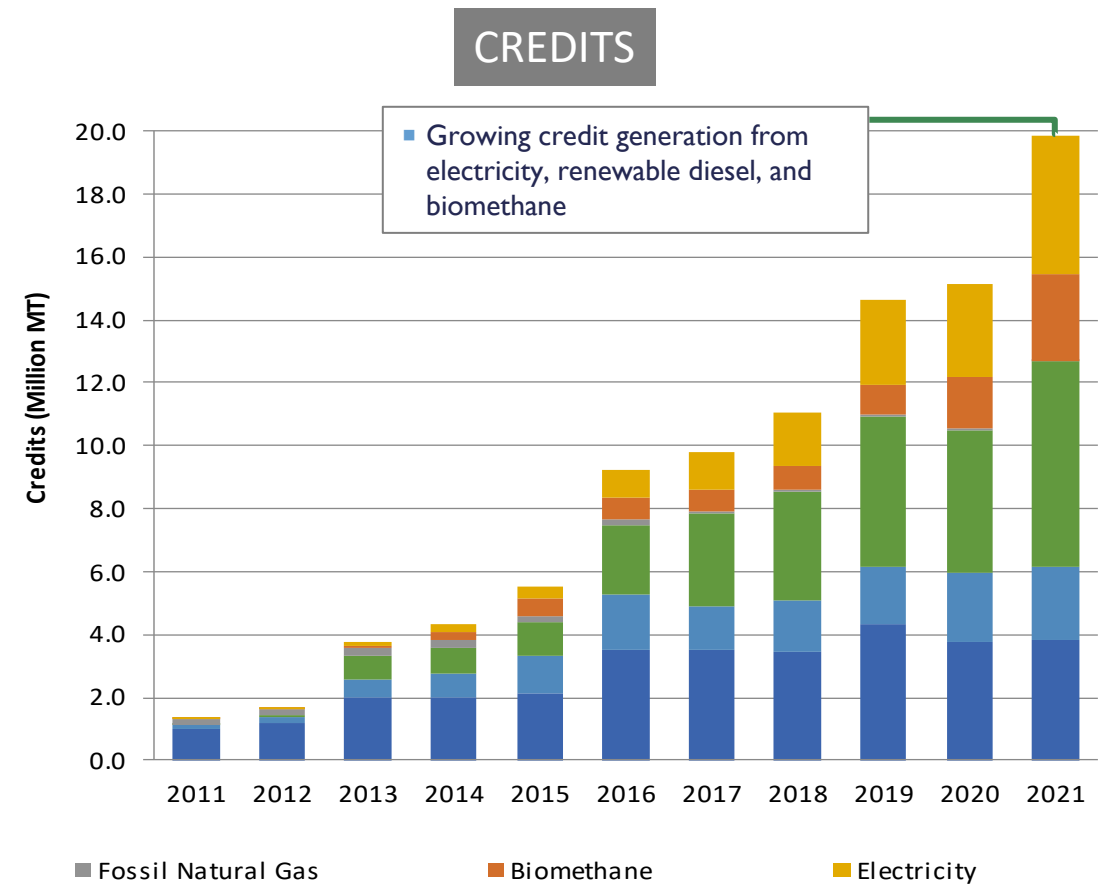
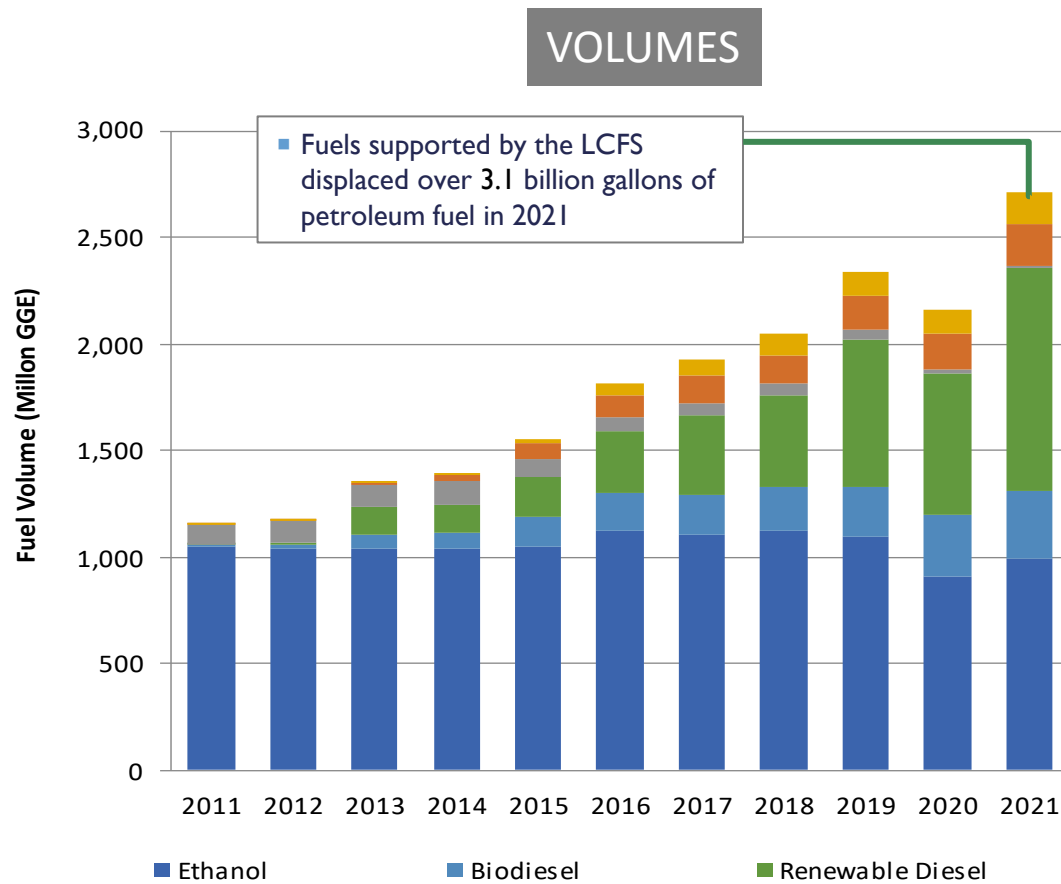


# Credit and Deficit Balances

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



# LCFS Continues to Increase Diversity and Volume of Low-Carbon Fuels





# LCFS is a Critical Part of California's Climate Portfolio

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- Significant reductions in transportation emissions are needed to achieve state's air quality and climate goals
- LCFS is a key strategy that supports:
  - Displacing fossil fuels
  - Diversifying transportation fuel mix
  - Accelerating investment in low-carbon fuel production and the associated infrastructure buildout
  - Providing long-term price signals needed to support transition to ZEVs and decarbonizing remaining liquid fuel demand

# Aligning with Recent Climate Policy

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- 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
  - Increase LCFS stringency
  - Clean fuels target for aviation sector
  - Accelerate refinery transitions away from petroleum to clean fuels production
- Adoption of Advanced Clean Cars II

# Changes since 2018 Rulemaking

	2018	2022
Statewide GHG emission targets	At least 40% by 2030	At least 40% by 2030; 85% anthropogenic emissions reductions by 2045; Carbon Neutrality by 2045
Light Duty ZEV sales expected	Less aggressive than ACC II	ACC II, 100% ZEV sales by 2035
Annual sales of ZEVs	7 percent	18 percent

# Scenario Modeling: CATS Model Overview

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# The California Transportation Supply (CATS) Model

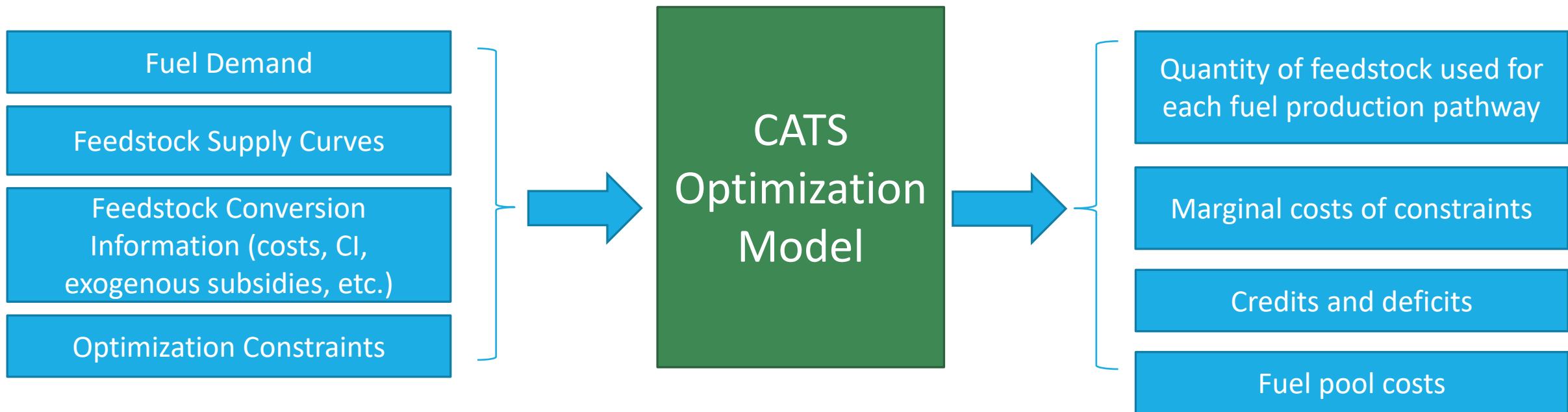
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- Developed by CARB staff to evaluate potential fuel market and policy assumptions and outcomes
- CATS is a transportation fuel supply optimization model
- CATS minimizes the cost of supplying fuel to meet the specified annual fuel demand
- CATS scenarios 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

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



# Inputs: Fuel Demand Pools

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- 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

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- 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

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- 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

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- 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  $\geq$  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

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- To consider additional feedstock supplies, CARB needs:
  - Incremental supply estimates by price point
  - Documentation for how supply estimates were determined, including market data used to support estimates
  - Pathway or documentation of feedstock usability in California
  - Peer-reviewed literature to reference technical potential estimates where existing market-data cannot be used
  - 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

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## 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

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- 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.
- Model documentation posted:  
<https://ww2.arb.ca.gov/sites/default/files/2022-11/CATS%20Technical.pdf>
- Core model inputs posted:  
<https://ww2.arb.ca.gov/sites/default/files/2022-11/CATS%20Summary%20Inputs.xlsx>

# LCFS Modeling

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3 SCENARIOS FOR INITIAL CONSIDERATION

# Goal of Preliminary Scenario Designs

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- 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

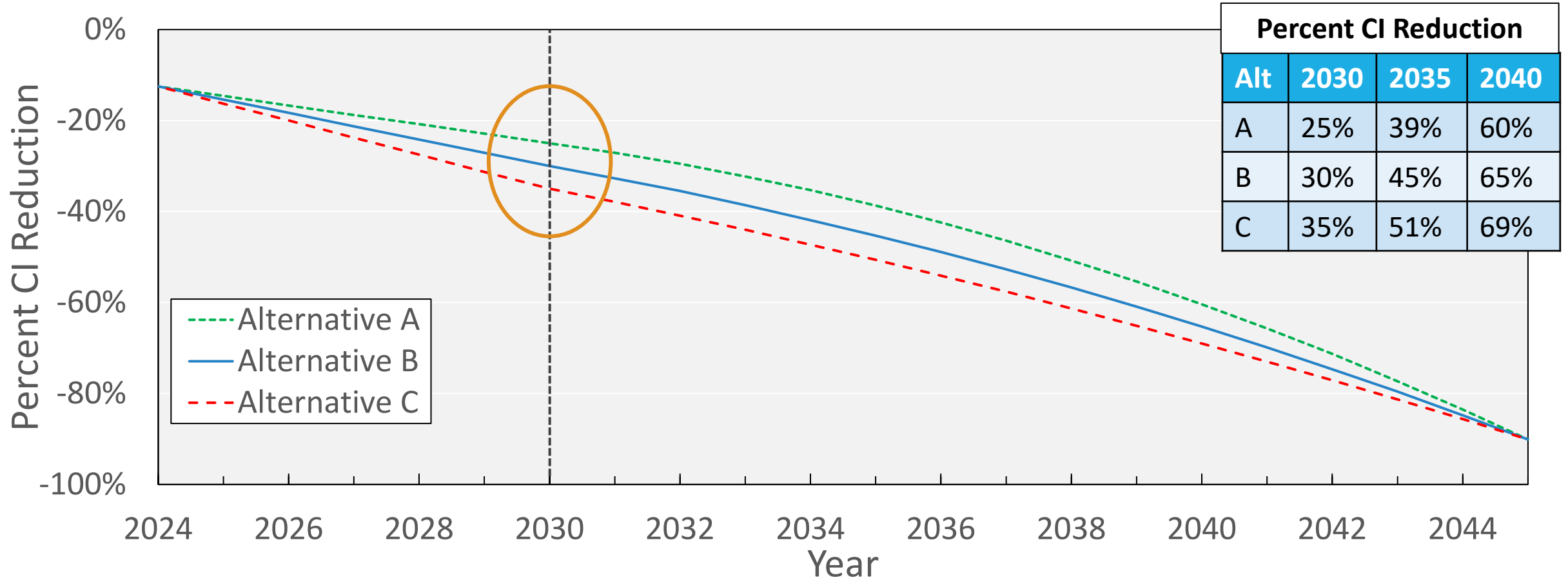
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- **Baseline**
  - Assumes implementation of Advanced Clean Cars II and Advanced Clean Trucks
  - VMT based on EMFAC 2021 v.1.0.2
  - 20% CI Reduction Target in 2030
- **Alternative A**
  - Higher overall transportation energy demand and higher assumed 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



# Staff Preliminary Scenario Design Options

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Component	Alternative A	Alternative B	Alternative C
2030* Target	25% by 2030	30% by 2030	35% by 2030
2045 Target	90% by 2045	90% by 2045	90% by 2045
Gasoline and Diesel Pools Energy Demand	Liquid fuel demand higher than baseline	Liquid fuel demand consistent with baseline	Liquid fuel demand consistent with baseline

\*Compliance targets prior to 2030 are assumed to be enhanced in all scenarios

# Assumptions Affecting Modeling

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- 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

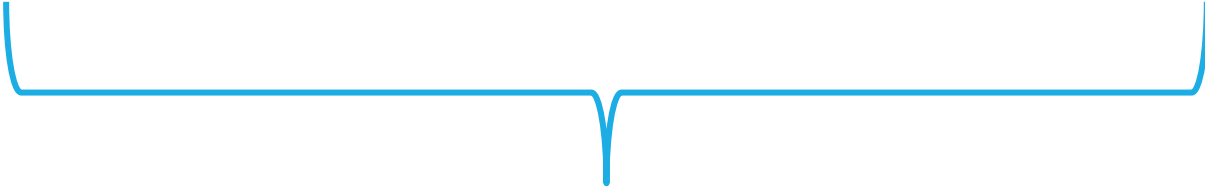
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- Following messaging in the draft 2022 Scoping Plan, comments from the Board and feedback from stakeholders, staff requested feedback on treatment of crop-based biofuels at the July 2022 workshop.
- Staff has received mixed feedback on potential limits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

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Component	Alternative A	Alternative B	Alternative C
Crop-based fuels	Credits for diesel fuels derived from virgin oil feedstock are limited	Credits for diesel fuels derived from virgin oil feedstock are limited	No limit on credits for diesel fuels derived from virgin oil feedstocks



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



Maximum available biomass-based diesel

# Biomethane Crediting Context

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## 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

# Biomethane Crediting – Avoided Methane Credit Assumptions

Component	Alternative A	Alternative B	Alternative C
<b>Certification of fuel pathways with avoided methane credit</b>	<p><b>2030:</b> no new fuel pathways certified with avoided methane</p> <p>Phaseout of eligibility for existing fuel pathways with avoided methane by 2040</p>	<p><b>2030:</b> no new fuel pathways certified with avoided methane</p> <p>Phaseout of eligibility for existing fuel pathways with avoided methane by 2040</p>	<p>Fuel pathways still certified with avoided methane crediting</p>

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

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

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

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- 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

Component	Alternative A	Alternative B	Alternative C
<b>Infrastructure Crediting</b>	Total infrastructure crediting pool: 5% of deficits	Total infrastructure crediting pool: 10% of deficits	Total infrastructure crediting pool: 10% of deficits

Applicable to MHD infrastructure crediting






















More credits provided absent of dispensed fuel and GHG emissions reductions

# Other Modeling Assumptions Under Consideration

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Component	Alternative A	Alternative B	Alternative C
Electric Forklifts	Limited	Limited	Limited
Jet Fuel	Intrastate fossil jet is added as a deficit generator	Intrastate fossil jet is added as a deficit generator	Intrastate fossil jet is added as a deficit generator
Petroleum crediting	No changes to current structure	Phase out by 2040	Phase out by 2025

# Scenario Comparison: Key Metric Ranking

Expected Impact	Alternative A	Alternative B	Alternative C
GHG Reductions			
Pace of ZEV Deployment			
Reliance on Crop-Based Fuels			
Reliance on Biomethane			
Cost to Consumers			
Pace of Direct Air Capture Deployment			
Continued Reliance on Fossil Fuels			

Legend:  Lowest       Medium       Highest

# Future Potential Topics

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- 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

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- 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

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- 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:
  - May yield the same or greater benefits than those associated with the proposed regulation, or
  - May achieve the goals at lower cost

# Break

WE WILL RESUME IN 15 MINUTES



# Workshop Logistics

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

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# Next Steps

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- 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

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ACC2: Advanced Clean Cars Regulations

ACF: Advanced Clean Fleets Regulation

ACT: Advanced Clean Trucks Regulation

B&C: Book-and-Claim Accounting

BD: Biodiesel

EV: Electric Vehicle

EMFAC: EMISSION FACTOR Model

FCI: Fast-Charging Infrastructure

HRI: Hydrogen Refueling Infrastructure

LDV: Light-duty Vehicles

LFG: Landfill Gas

MHD: Medium Heavy-Duty

NG: Natural Gas

RD: Renewable Diesel

RNG: Renewable Natural Gas

VMT: Vehicle Miles Traveled

WWTP: Wastewater Treatment Plants