California’s LCFS: Retrospective and Prospective Insights

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Colin Murphy Ph.D
Deputy Director – UC Davis Policy Institute for Energy, Environment, and the Economy
1. Status of California’s Climate Policy
2. Major Changes to the LCFS
3. The Next Decade in Fuels
4. Lessons from the LCFS
5. Unanswered Questions
California’s Climate Policy Enters its Second Decade

AB 32 and Beyond:

31 March 2020
First, the Good News

Source: CARB GHG Inventory (2019)
Emissions Are Declining

Source: CARB GHG Inventory (2019)
Major Challenges Ahead

Figure 7: Scoping Plan Scenario – Estimated Cumulative GHG Reductions by Measure (2021–2030)\textsuperscript{64}

Source: CARB Scoping Plan (2017)
Too Much of a Good Thing

Large Number of Banked Allowances Increases Risk of Exceeding GHG Target

Million Metric Tons

GHG = green house gas.
The Challenge: Transportation

- Transportation emits over 50% of CA GHG emissions when accounting for emissions at refineries.

- We cannot meet SB 32 target without significant reduction in transportation emissions.

Source: CARB GHG Inventory (2019)
Non-Fuel Policies Can’t Do Enough

- Transportation + Refinery Emissions: ~215 Million Tonnes CO$_2$e in 2017
  - 40% Reduction = 86 million tonnes/year

- Even if all major non-fuel GHG policies yield reductions at the high end of their plausible range, transportation doesn’t reduce emissions 40% by 2030.

Emissions from 2017 GHG Data. All values approximate. Emissions reduction estimates adapted from *Half the Oil: Pathways for Petroleum Reduction on the West Coast*, or author’s estimates (EVs, cap and trade)


31 March 2020
The Role for Fuels Policy

• Near-term emission reductions matter

• EVs are the long-term future, but the fleet turns over slowly

• Biofuels are the dominant (only?) near-term option for existing vehicles

• Without life cycle analysis, easy to get biofuels wrong
  • E.g. European palm oil biodiesel

• Need to balance incremental benefit of 1st gen fuels while providing large incentives for advanced, very low-carbon fuels.
LCFS Sets a CI Target, Measures Fuels Against It

Carbon Intensity (gCO\textsubscript{2}e/MJ)

- LCFS Credits or Deficits

- LCFS Annual Target

- LCFS Credits

- LCFS Deficits

- Gasoline
- Alt Fuel X
- Alt Fuel Y
Changes in the Re-Adopted LCFS
20% CI Reduction Target by 2030

Example uses carbon intensities based on composite of gasoline and diesel fuels
New Credit Pathways

• Refinery Investment Credits
  • Generate reduction credits from investments at petroleum refinery

• Carbon Capture and Sequestration
  • Geological storage, requires long-term monitoring

• ZEV Fueling Infrastructure Capacity
  • Capped at 5% of total program size, will support hydrogen and DC Fast charging

• Sustainable Aviation Fuel
  • Producers can opt in to the program

• Smart Charging and Renewable Electricity Credits
Other Significant Changes

- Third Party Verification of Fuel Pathways
  - Includes conflict-of-interest, rotation provisions.
- Clean Fuel Vehicle Reward
  - Utilities would contribute a fraction of residential EV charging revenue to fund point-of-sale rebates on EVs.
  - Still under development.

2019 Developments

- New cost containment mechanism – borrowing from future residential EV charging credits.
- Biodiesel anti-NOx additives may not be as effective as thought.
LCFS Outlook
LCFS – Projecting the Next Decade

Steady Progress

Source: California’s Clean Fuel Future
Steady Progress Scenario

In 2030:
5 Million Light Duty ZEVs provide over 1/3 of the total credit generation.

Biodiesel, renewable diesel and RNG provide another 1/3
Credit Market Could Tighten by Mid 2020’s

Both CCFF and CARB modeling expect tightening credit market through mid-2020’s, though less so w/ capacity credits.

By late 2020’s, EV deployment drives credit bank recovery.
If several key technologies deploy at the high end of their potential range, CA could greatly exceed reduction targets.

- 5.8 million EVs
- 1-2 billion gallons cellulosic biofuel.
- Lower-carbon conventional biofuels.
## Sensitivity Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Change in Credits 2025</th>
<th></th>
<th>Change in Credits 2030</th>
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<tbody>
<tr>
<td></td>
<td>From Scenario</td>
<td>Net</td>
<td>From Scenario</td>
<td>Net</td>
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<tr>
<td>Baseline “Steady Progress” Scenario</td>
<td></td>
<td>26.5</td>
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<td>36.1</td>
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<td>High Light-Duty ZEV (5.8 million by 2030)</td>
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<td>High MD/HD ZEV Penetration</td>
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<tr>
<td>Cellulosic Breakthrough (800 million gal/year 2030)</td>
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<td>0.9</td>
<td>4.0</td>
<td>3.3</td>
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<tr>
<td>Clean Refineries (CCS on ethanol and SMRs)</td>
<td>3.1</td>
<td>3.9</td>
<td>4.5</td>
<td>6.0</td>
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<tr>
<td>Slow EV and Advanced Biofuel Deployment</td>
<td>-1.6</td>
<td>-1.6</td>
<td>-2.5</td>
<td>-2.5</td>
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<tr>
<td>Higher VMT (3.5% VMT reduction in 2030)</td>
<td>-1.2</td>
<td>-0.5</td>
<td>-1.6</td>
<td>-1.1</td>
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<td>High-ILUC Biodiesel/Renewable Diesel</td>
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<td>-3.4</td>
<td>-2.4</td>
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</table>

Values are million LCFS credits, relative to the Steady Progress scenario. Each credit is one tonne CO₂ equivalent reduction compared to that year’s target. Net emissions changes include reductions in other credit generating pathways. All data from California’s Clean Fuel Future (2018).
Prospects for In-State Production to 2030

- **RNG:** Limited cost-effective supply – 100-500 million dge/year.
  - SB 1383 may increase this
  - Source: Jaffe, et al. (2016) *Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute*

- **Cellulosics:** More likely pilot/pioneer plants than large-scale deployment.
  - 100-150 million dge/year from forest biomass (about ¼ of total biomass could be economically recovered).
  - Similar potential amount from agricultural residue (orchard waste)
  - Possible 10-50 million dge/year from intercropping or marginal land crops.
Other Jurisdictions Following CA

**Oregon, British Columbia** – LCFS operational

**Brazil** – RenovaBio program, liquid-fuel focused, just starting

**Puget Sound Air Quality Management District** – proposal out for public comment

**Washington State** – 2019 Legislative attempts failed, will try again in 2020

**Canada (Federal)** – Draft Regulatory Approach comments received, revised proposal expected, may finalize in 2021.

**Colorado** – Feasibility study under way

**New York** – Bill introduced, coalition working on administrative approach

**Midwestern states** – Early discussions
Key Lessons from the LCFS
First-Generation Fuels Will Have a Role

- Even with rapid ZEV transition, there will still be a significant residual fleet.
  - Likely billions of gallons of liquid fuel demand through 2040

- Optimistic scenarios get to 1 billion gallons of advanced fuels in CA by 2030

- First-gen fuels can reduce GHGs and air pollutants compared to petroleum.
  - Biofuels have potential to incrementally reduce emissions over time.
LCFS Can Support a Broad Coalition

17 In-state biofuel production facilities

14 Businesses receive at least $6.5 million annually in LCFS credits.

20 Utilities receive LCFS credits for household charging.

76 On-road electric fleets, 1600+ electric forklifts

12,000+ EV Charging Stations, 500 CNG Stations

Over $3 Billion in total credit value

43 million metric tons of GHG reduction to date

Source: CARB – LCFS Data Dashboard
Refining Sector at a Crossroads

• To meet statutory, administrative and global climate goals, California must massively cut consumption of petroleum by mid-century.
  • Rest of world needs to follow in a decade or two.
  • In-state petroleum consumption likely to decline significantly by 2030

• LCFS creates competition for conventional refiners, but also opportunity
  • Support for reducing emissions (refinery investment credits, coprocessing, CCS)
  • Strong incentive to deploy advanced, low-carbon fuels
  • Modest incentive to deploy high-volume, incrementally better fuels

• Refiners have infrastructure, market position and capital access to be really competitive in a carbon-conscious market
Questions Seeking Answers
We Still Haven’t Figured Out ILUC

- Estimates of corn ethanol ILUC are pointing to the 15-30 g/MJ range

- Much greater uncertainty about palm/soy ILUC
  - There is clear evidence of cross-oil substitution

- No good way to account for local policies to reduce land conversion

- European approach largely intended to screen out palm oil

- Accurate estimation of ILUC may require much more accurate models of international agricultural commodities.
  - Possible next-best solution: Consumption-based limits?
How Far Can Biomass-Based Diesel Take Us?

- CA consumed 700 Million gal of Biodiesel + Renewable Diesel in year through Q2 2019.
  - Approx: 33% used cooking oil, 30% corn oil, 28% tallow
  - Supply of “waste” oils is limited and not immune from indirect land use change (ILUC)
- Soy and palm are the marginal oils in most of the world, and cheap enough to compete against petroleum, especially w/ GHG policy.
- Tension between estimates of supply and demand
  - ICCT (2016): ~ 1.7 billion gallons total U.S. biomass based diesel capacity from oils through early/mid 2020’s.
  - California’s Clean Fuel Future estimates ~ 1.5 billion gallons/year total renewable distillates (biodiesel + renewable diesel + bio-jet)
  - CARB’s Illustrative Compliance Scenario calculator estimates ~1.7 billion gallons/year
How to Support Sustainable Aviation Fuels

• CORSIA process created targets for airlines to cap total GHG emissions, but compliance is likely to be mostly through offsets.

• Global capacity very small, but rapidly growing and attracting attention.

• LCFS allows sustainable aviation fuel (SAF) providers to opt-in and generate credits. Conventional fuel does not generate deficits.

• Most near-term production pathways compete for feedstock against biomass-based diesel
Thank You!

Colin Murphy Ph.D.
cwmurphy@ucdavis.edu
policyinstitute.ucdavis.edu
Twitter: @scianalysis

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