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October 12, 2023

How US Federal and State Policies Create SAF HUBS

Graham Noyes
Executive Director
Low Carbon Fuels Coalition

Low Carbon Fuels Coalition

U.S.-based cross-industry trade association

Dedicated to promoting and expanding clean fuel standard policies

Actively engaged in States across the U.S. & at the Federal level

Engaged in cooperative international initiatives such as the BioFutures Campaign

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SAF Producer Group

- State Level Policy Expansion- SAF Specific
- Fulcrum, Gevo, LanzaJet, NEXT, Velocys, World Energy
- MSW, Starch and Sugars, Woody Biomass, Lipids
- Gasification, Hydrotreated Esters and Fatty Acids (HEFA), Fermentation

Multiple Policy Structures for SAF

- ✓ Intro to U.S. Policies Supporting SAF
- ✓ Role of Lifecycle Analysis in Fuel Policies
  - ✓ Renewable Fuel Standard (RFS) 101
  - ✓ Low Carbon Fuel Standard (LCFS) 101
- ✓ State Tax Level Tax Incentives
- ✓ Amplified Effects of Policy Stacking
- ✓ Inflation Reduction Act Grants
  - ✓ FAST SAF
  - ✓ FAST TECH
- ✓ Lessons Learned

Key U.S. Carbon Policies to Decarbonize Transportation

Renewable Fuel Standard (RFS)

- Policy to promote biofuels and decarbonize fuel
- Renewable Biomass Content Requirement
- Annual volume mandates of pre-defined biofuels
- Obligates petroleum fuel refiners and importers
- Opt-in for aviation fuels

Low Carbon Fuel Standard (LCFS)

- Technology-neutral policy to decarbonize fuel
- Assessment metric is lifecycle carbon intensity
- Obligates on-road fuels
- Opt-in for sectors like aviation, marine and rail
- CARB Rulemaking in Process

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Fuel Policies Start with Lifecycle Analysis (LCA)

Best practices for lifecycle ("well-to-wheels") analysis uses IPCC-standard models

Quantifies greenhouse gas emissions (GHGs) of full lifecycle: feedstock acquisition/generation, production, transport, and use in vehicles

Lifecycle assessment is essential for decarbonization, but lifecycle model and methodology differs depending on the policy

Lifecycle assessment is a controversial, highly politicized but essential task

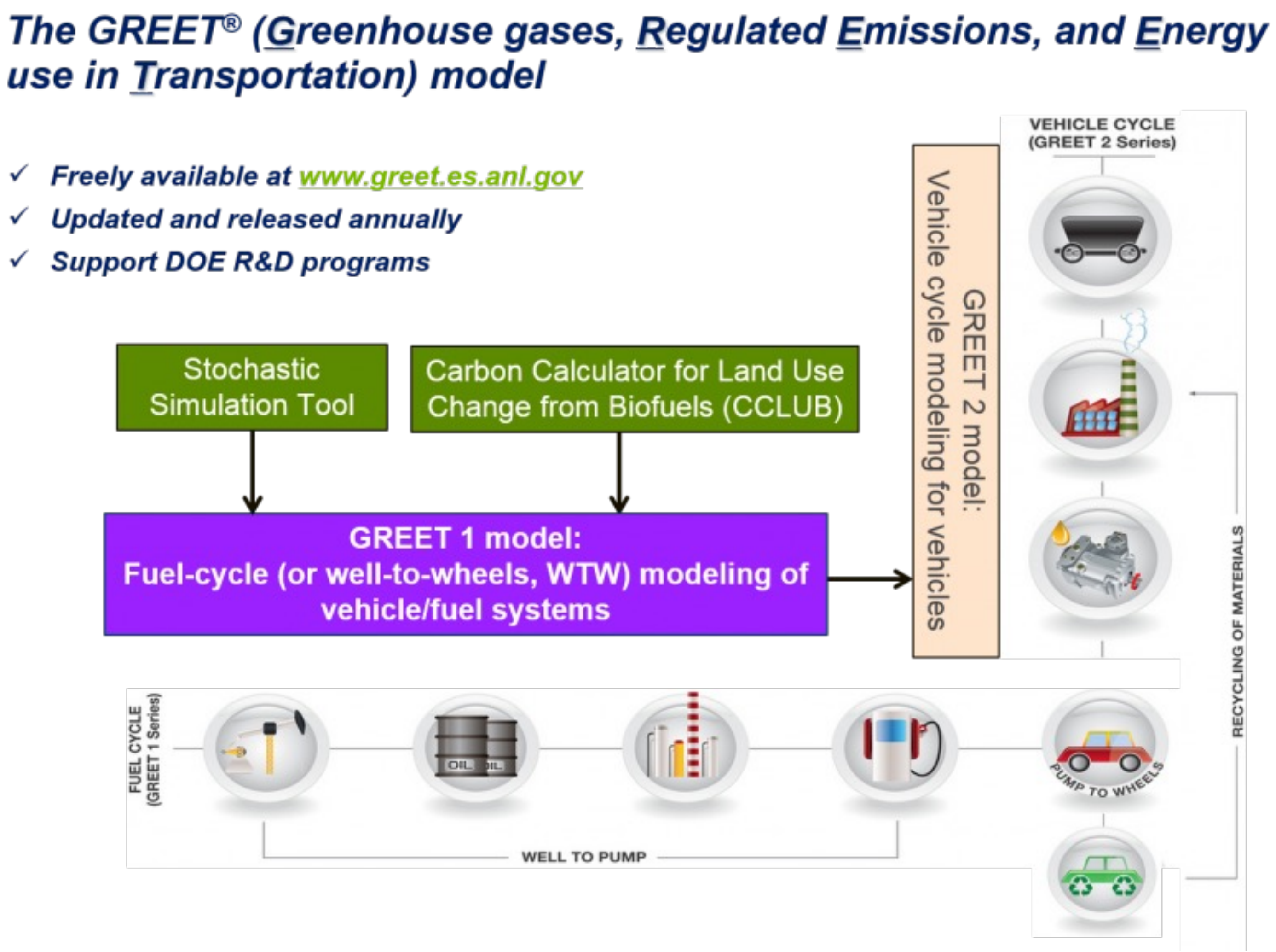
- Evolve based on science and data
- Robust public process

Lifecycle Analysis: The U.S. GREET model

Scientifically rigorous consensus model developed and maintained by the U.S. Dept. of Energy Argonne National Lab

Peer reviewed

Publicly available and regularly updated with evolution of technology and science



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Source: U.S. Dept. of Energy Argonne National Lab

Renewable Fuel Standard (RFS) Basics

Federal policy Introduced in 2005 and updated in 2007

- Initially focused on promoting energy security and U.S. domestic agriculture
- 2007 update (RFS2) required carbon reductions

Mandates annual volumes of biofuels by category

Each gallon of biofuel produced generates a Renewable Identification Number (RIN)

SAF is an opt-in fuel- generates RIN credits but does not generate RFS obligations

U.S. Environmental Protection Agency annually reviews/waives requirements

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RFS Renewable Identification Numbers (RINs)

Renewable Fuel (i.e. corn ethanol)	RIN type D6
Biodiesel, RD, SAF	RIN type D4
Advanced Biofuel	RIN Type D5
Cellulosic Biofuel	RIN Type D3

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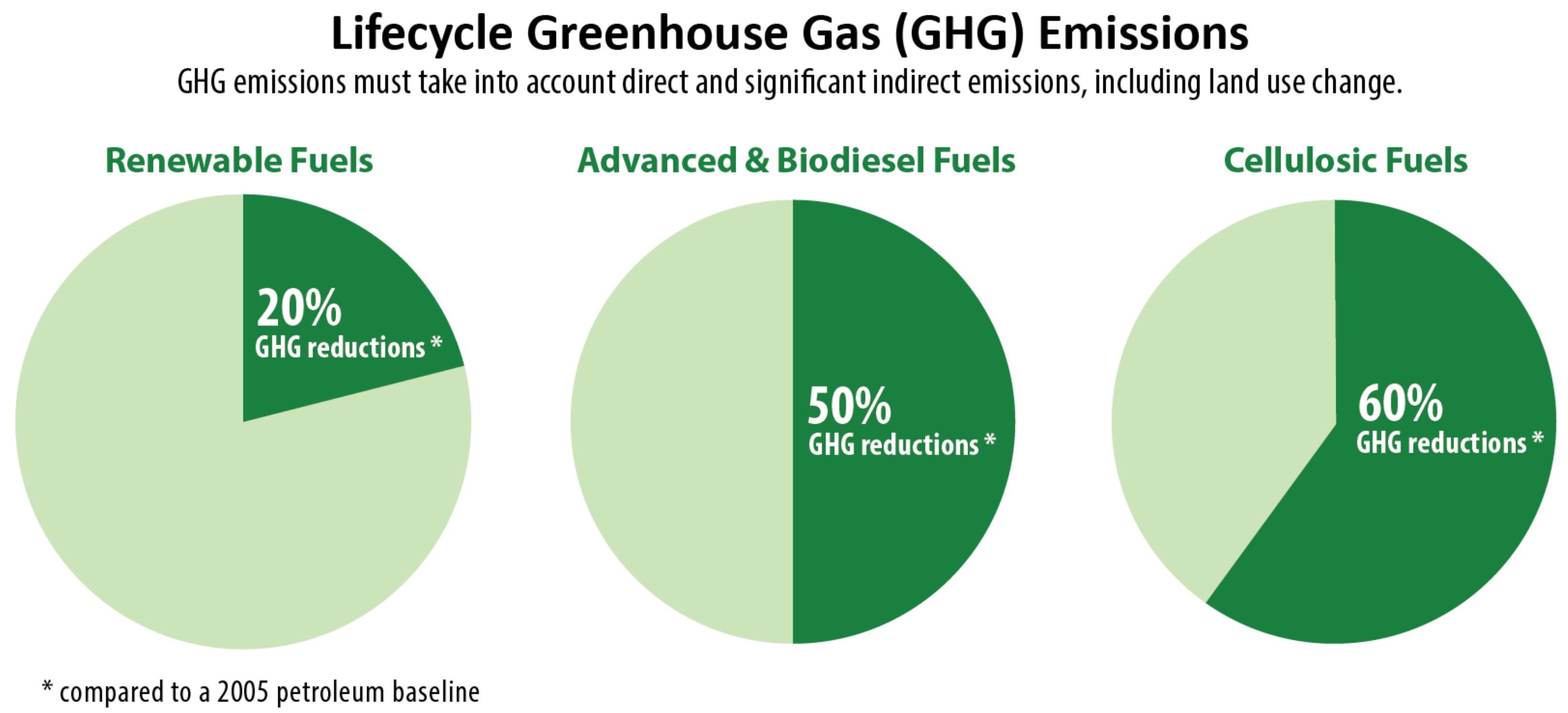
RFS and Lifecycle Analysis

Biofuels are required to reduce carbon in order to receive credit in the RFS program

Mandatory reductions are required to generate RINs

Outside of specific RIN value, no extra credit for lower carbon



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Source: U.S. Environmental Protection Agency
https://www.epa.gov/renewable-fuel-standard-program/overview-renewable-fuel-standard

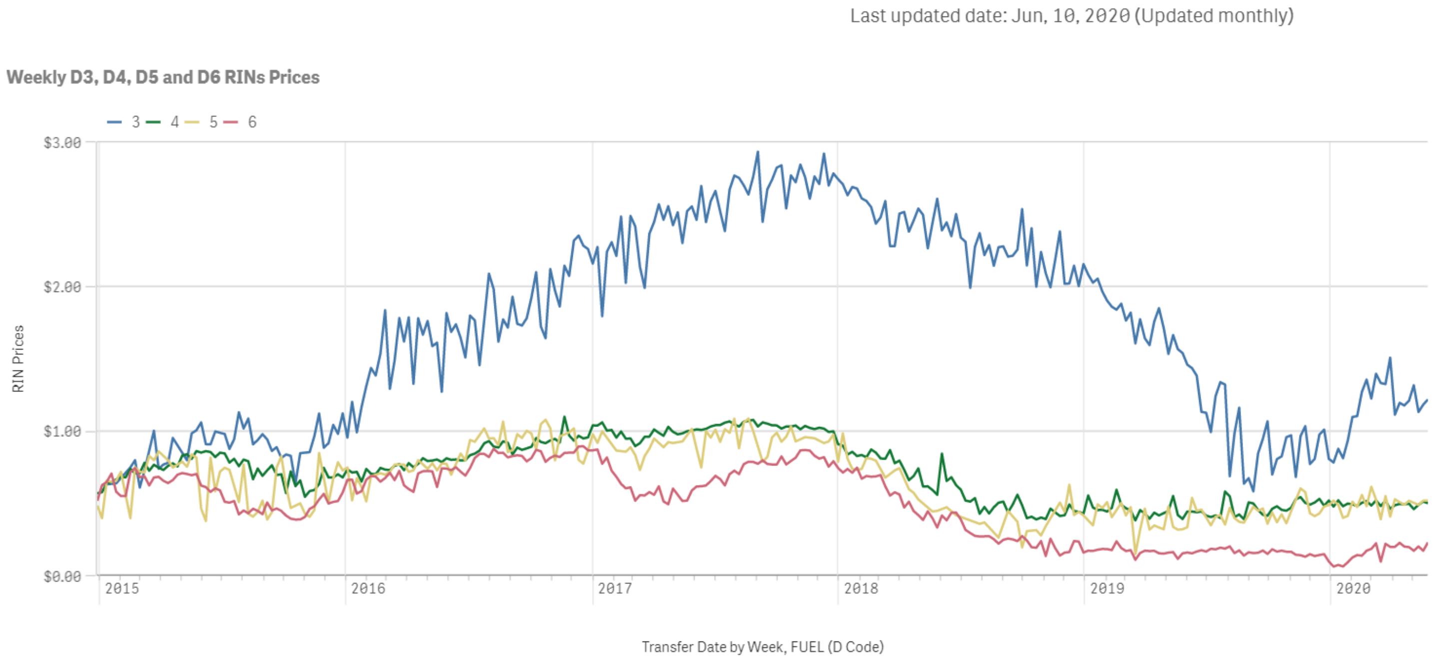
RINs: Generating Value for Biofuel Producers

Tradeable to achieve annual volume requirements

Obligated parties are producers of petroleum-based fuels

Lower-carbon biofuels generate higher value RINs

RIN value fluctuates according to market conditions and RIN supplies



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Source: U.S. Gain

Low Carbon Fuel Standard (LCFS) Basics

- Policy for decarbonizing transportation fuel
- Pioneered by California
- In effect 12+ years
- Complement to vehicle-focused policies like fuel economy standards
- Technology neutral
- Central measure is carbon intensity
- No revenues to or payments by government
- Obligates on-road fuels
- Opt-in for sectors like aviation, marine and rail
- CARB Proposal to obligate intrastate aviation

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LCFS Policy Structure

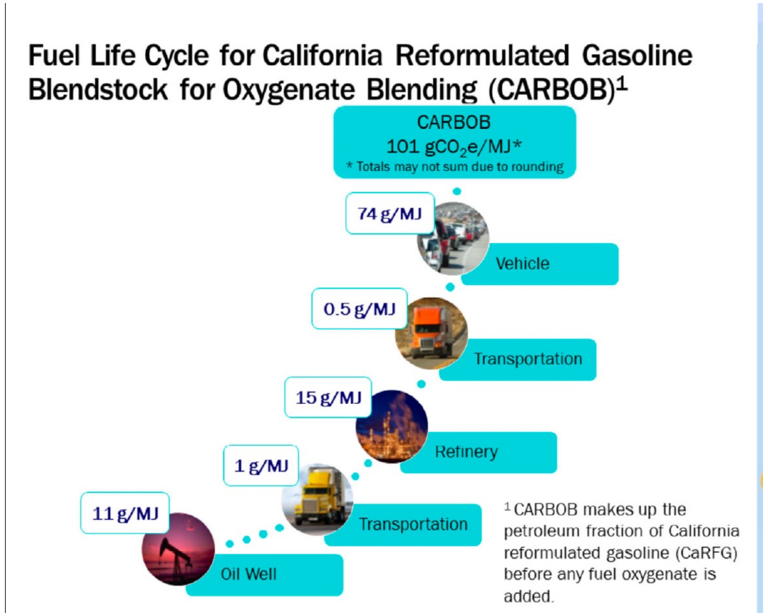
Fundamental metric is **carbon intensity**

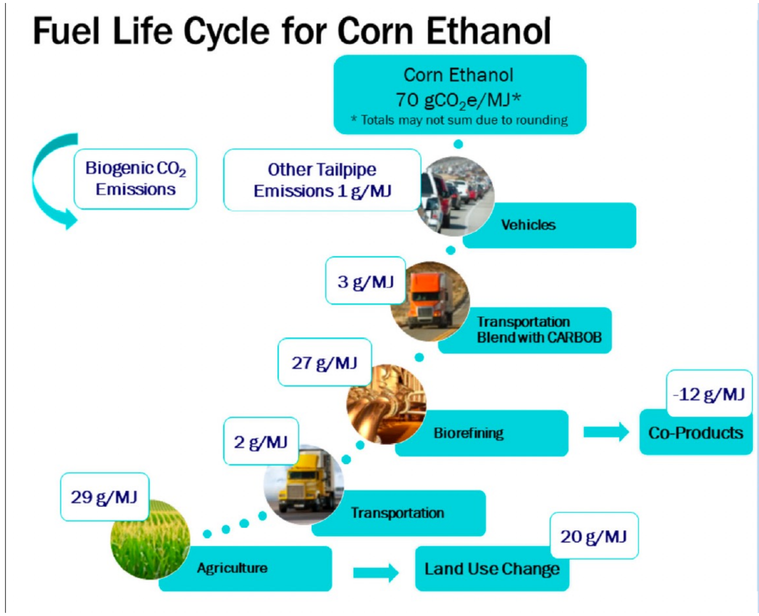
Measured over **full lifecycle** ("well-to-wheels") of a fuel

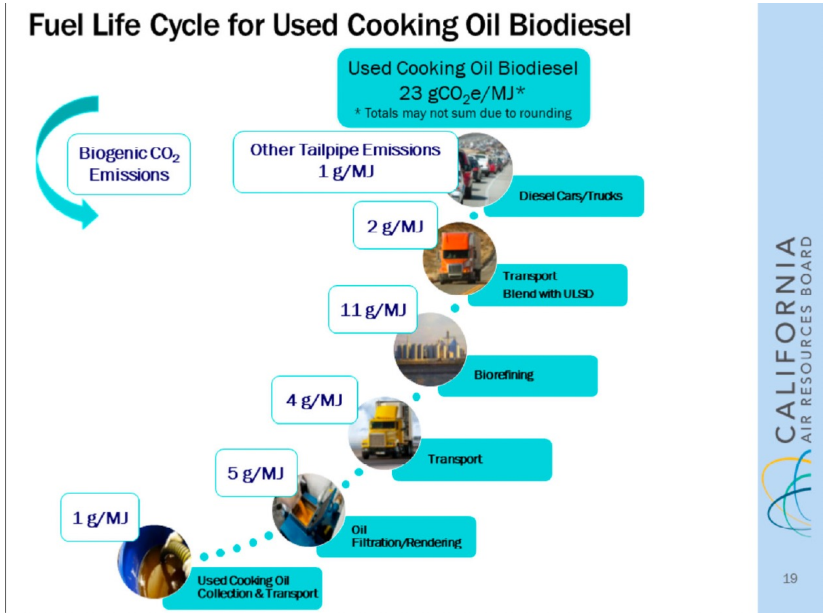
Measuring tool is an IPCC standard model

U.S. model is GREET

CA LCFS uses a modified version CA-GREET







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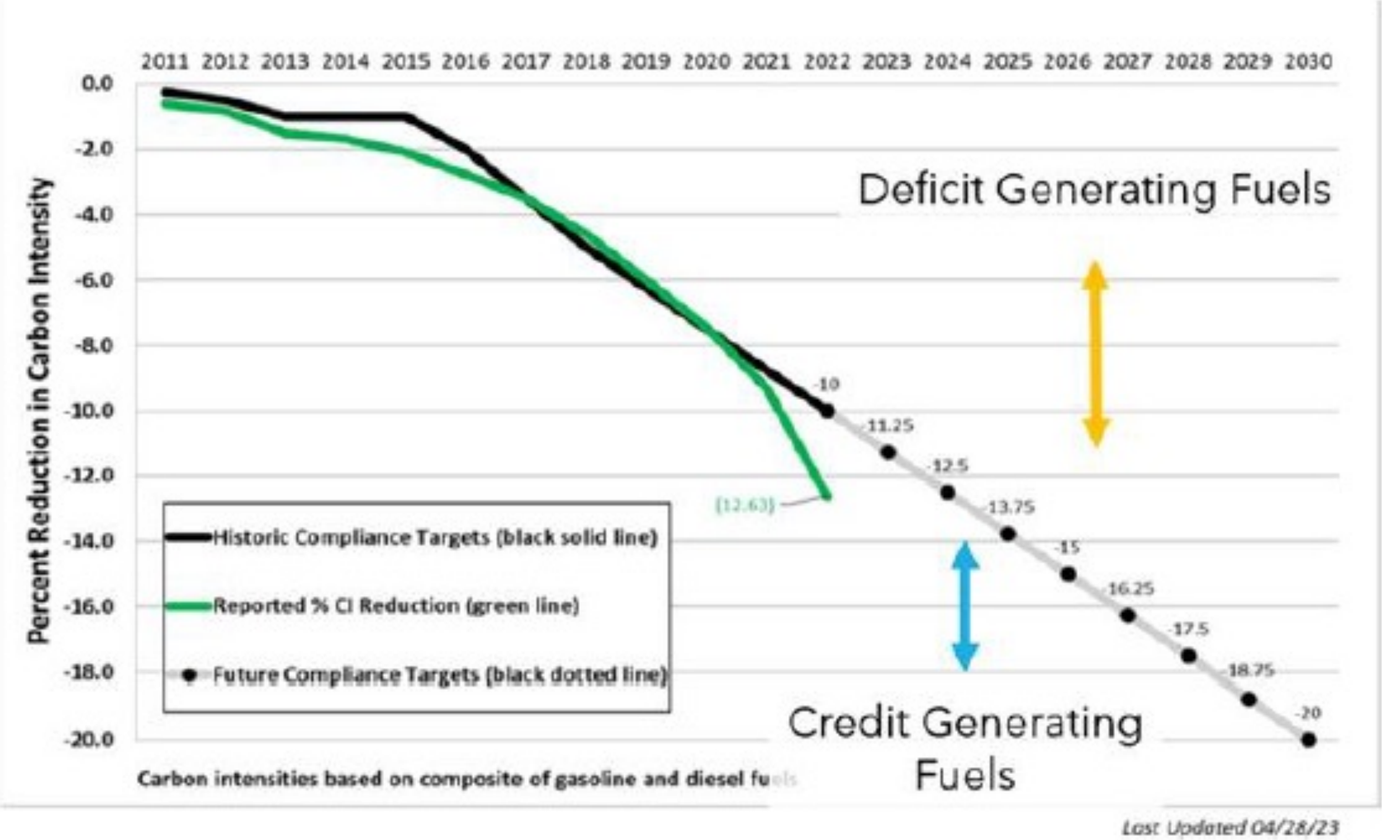
LCFS Performance: Reducing Carbon Intensity

Overachieving the annual target as of 2021

Targets for 2030 and beyond will be increased

Ambitious targets support credit prices and provide a strong market signal



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Source: California Air Resources Board

Comparing LCFS Credit Values

Fuel Pathway	Ex. Carbon Intensity, (gCO_2e/MJ)	Credit value*	Normalized credit value*
Ethanol from Corn Starch	70	$0.30/Gal Etoh	$0.42/GGE
Cellulosic Ethanol from Corn Fiber	28	$0.94/Gal Etoh	$1.33/GGE
Renewable Diesel from Used Cooking Oil	22	$1.66/Gal RD	$1.48/GGE
Electricity from Zero-carbon sources	0	$0.20/kWh	$6.59/GGE
Sustainable Aviation Fuel from Tallow	30	$1.40/Gal Jet Fuel	$1.29/GGE

*Based on 2021 average credit price of $187/MT

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Source: California Air Resources Board

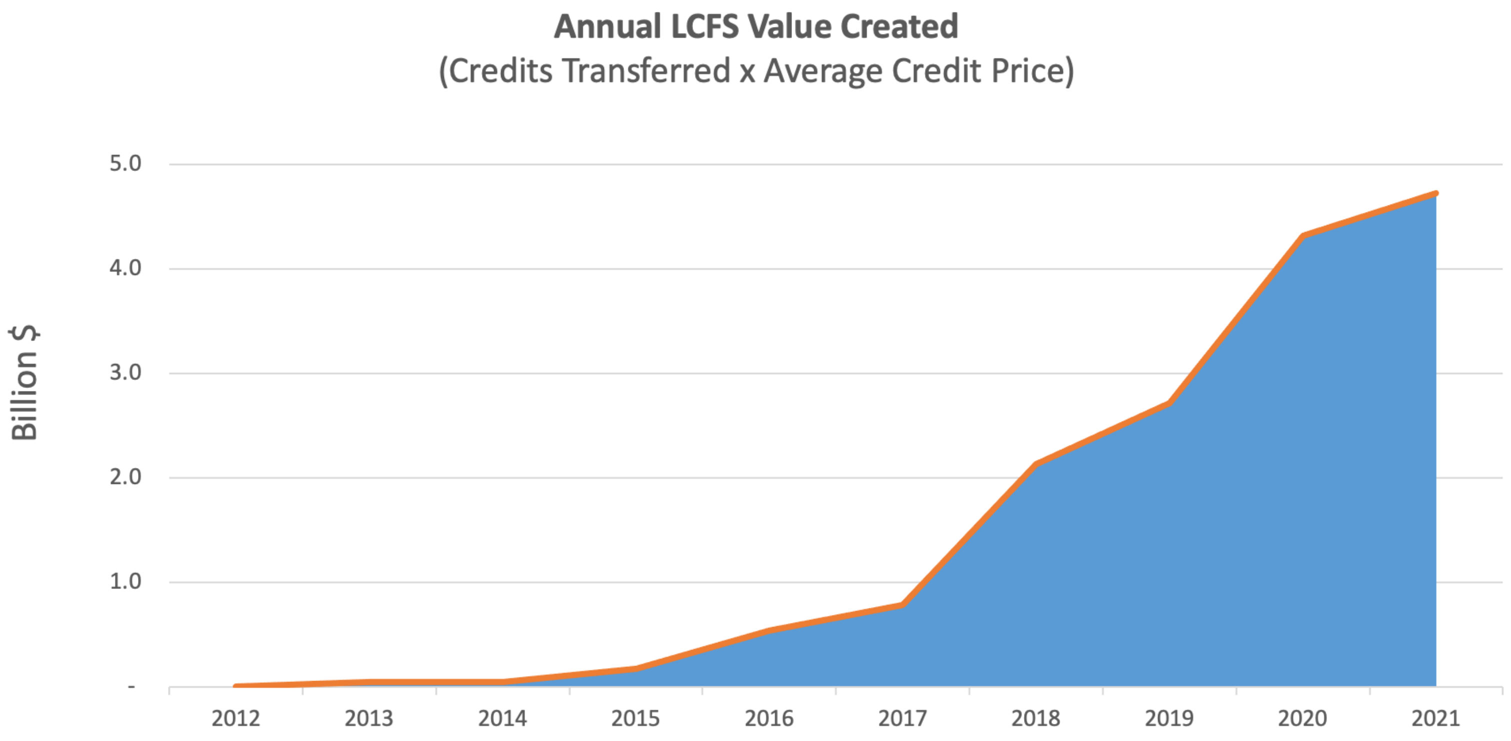
California LCFS Generates Billions in Annual Credit Value

Credit value supports low carbon fuel investments

Offsets cost premiums of clean fuels

Zero subsidies or government funding to industry

Credits can be banked for future sale



Source: LCFS Credit Transfers Activity Reports, 2012-2021

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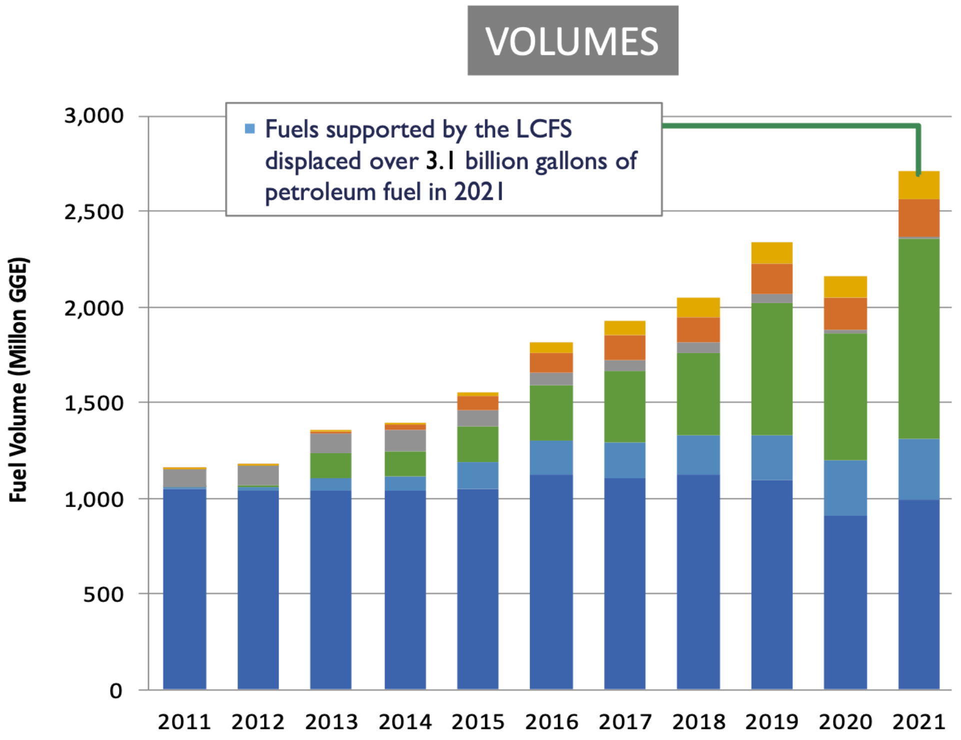
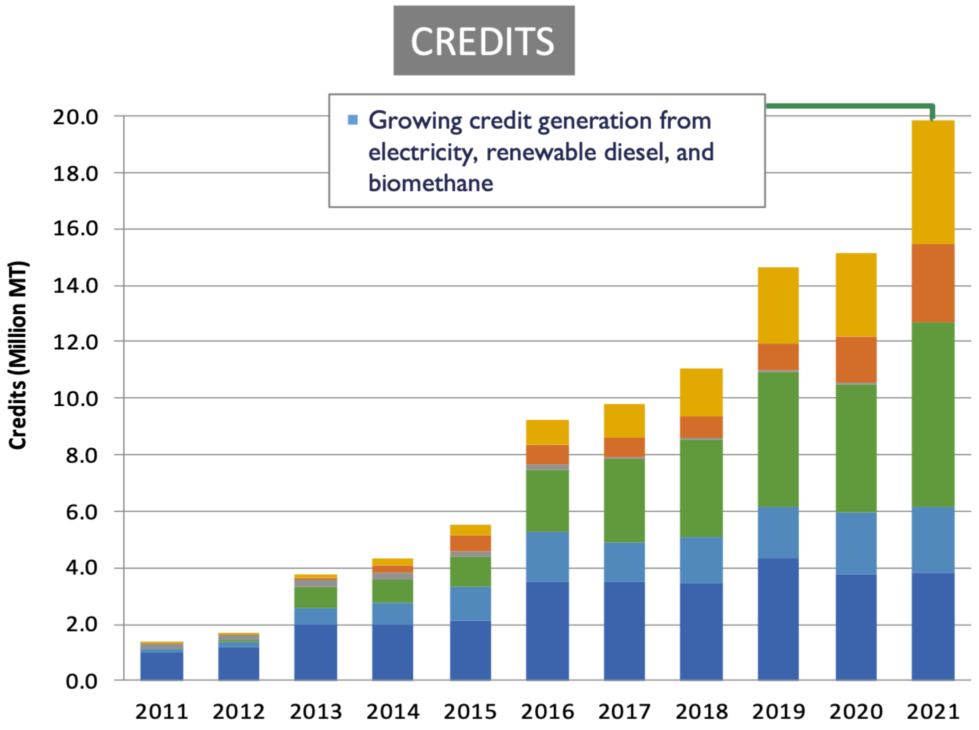
Source: California Air Resources Board

Diversifying the California Fuel Market





Ethanol | Biodiesel | Renewable Diesel | Fossil Natural Gas | Biomethane | Electricity

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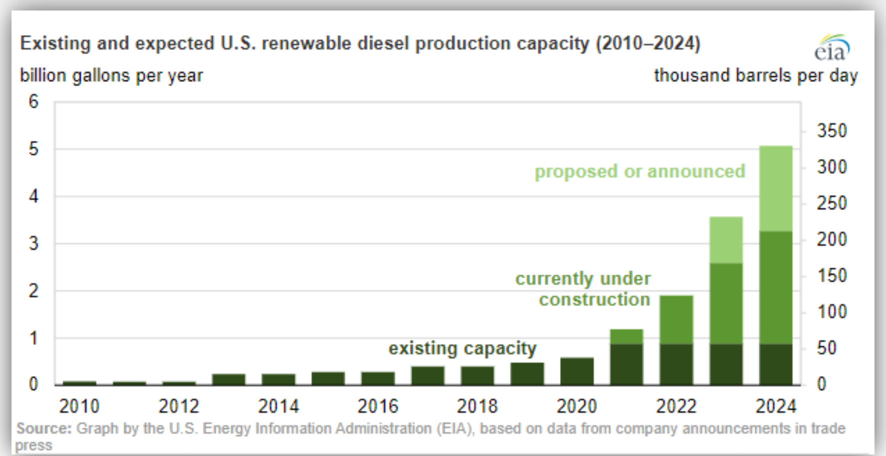
Source: California Air Resources Board

Driving Investments Throughout the U.S.

World Energy invests $350M to expand Paramount biofuel production

By World Energy LLC | October 24, 2018



ExxonMobil expands renewable fuels agreement with Global Clean Energy Holdings

IRVING, Texas – ExxonMobil and Global Clean Energy have expanded their five-year agreement to increase ExxonMobil's purchase of renewable diesel up to 5 million barrels per year.

News
April 22, 2021

Converting Martinez to Renewable Fuels Facility

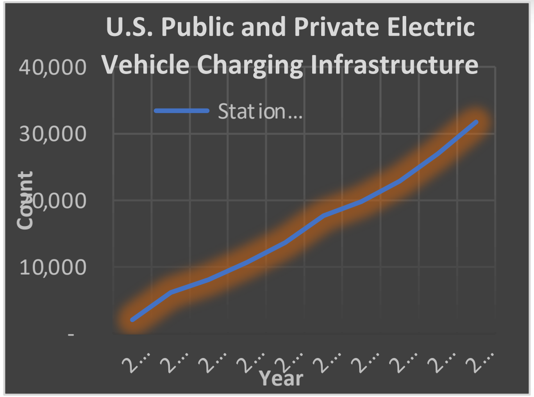
Project: Converting Martinez Refinery into a renewable fuels facility

Location: Martinez, California

Fuels: Renewable diesel and other renewable fuels

Capacity: Approximately 730 million gallons per year

Timeline: Production expected to come online in 2022 and ramp up to full capacity in 2023



Phillips 66 Plans to Transform San Francisco Refinery into World's Largest Renewable Fuels Plant

August 12, 2020

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CARB Draft Proposal RE:
Speeding Carbon Intensity Reductions

Standardized Regulatory Impact Assessment

Intrastate LCFS for Aviation

Speeding CI Reductions out to 2046

Informational Board Hearing September 28th

Board Hearing Spring 2024

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Table 2: CI Benchmarks from 2024-2046

Year	Current Target	Proposed CI Reduction Target
2024	12.5%	12.5%
2025	13.75%	18.75%
2026	15.0%	21.0%
2027	16.25%	23.25%
2028	17.5%	25.5%
2029	18.75%	27.75%
2030	20.0%	30.0%
2031	20.0%	34.5%
2032	20.0%	39.0%
2033	20.0%	43.5%
2034	20.0%	48.0%
2035	20.0%	52.5%
2036	20.0%	57.0%
2037	20.0%	61.5%
2038	20.0%	66.0%
2039	20.0%	70.5%
2040	20.0%	75.0%
2041	20.0%	78.0%
2042	20.0%	81.0%
2043	20.0%	84.0%
2044	20.0%	87.0%
2045	20.0%	90.0%
2046	20.0%	90.0%

Source: California Air Resources Board

Key U.S. State and Federal Tax Policies for SAF

Federal Blender's Tax Credit- Phase I (BTC)

- Policy to promote biofuels and decarbonize fuel
- $1.25-$1.75

Federal Blender's Tax Credit- Phase II (Clean Fuels Production Credit

- Policy to promote biofuels and decarbonize fuel
- $1.00-$2.00

State Tax Credits- Nature of Tax varies

Refundability- Holder-Appropriation

- Illinois= $1.50
- Minnesota = $1.50
- Washington = $1.00-$2.00

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Stacking SAF Policies to Maximize Effectiveness

<u>Washington State (Extreme) Example</u>

RFS RIN Value +

Blender's Credit Value +

WA Clean Fuel Standard Value +

WA Tax Credit

(once 20 MG Facility Trigger Met)

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FAST SAF Funding Opportunities Announced September 25, 2023

Multiple grant awards are contemplated with total funding amounting up to $244.53M for FAST-SAF

For FAST-SAF, the FAA anticipates that individual awards may vary between:

between $100,000 and $300,000 for a Tier 1 award

between $500,000 and $20,000,000 for a Tier 2 award.

Phase 2, which the FAA anticipates will be announced within two years of Phase 1 awards.

https://www.grants.gov/web/grants/view-opportunity.html?oppId=350315

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FAST-SAF's broad range of potential projects include, but are not limited to, the following examples:

Category 1 – SAF Production

- Upgrade existing fuel production facilities for SAF production
- Invest in equipment at renewable diesel facilities to enable SAF production
- Install conversion equipment at ethanol facilities for SAF production via the alcohol-to-jet pathway

Category 2 – SAF Transportation

- Examine barriers and opportunities for SAF delivery, both neat and blended, via existing transportation infrastructure
- Evaluate existing pipeline, freight, and road fuel delivery standards to identify gaps in knowledge and standards development needs to safely integrate SAF, both neat and blended, with the conventional fuel supply
- Optimize SAF delivery, both neat and blended, to further reduce the cost and/or carbon intensity of various pathways by enabling efficient transportation across various networks

Category 3 – SAF Blending

- Identify optimal SAF blending facility sites to enhance supply chain performance
- Identify facility design characteristics, measures, and practices to ensure safe, certified blending of neat SAF with conventional jet fuels
- Establish blending facilities to provide SAF producers with access to blending and fuel users with blended SAF that meets ASTM D1655 specifications

Category 4 – SAF Storage

- Enable SAF storage at on-airport or off-airport facilities to support both neat SAF blending with conventional jet fuel and storage of blended SAF
- Ensure proper testing capabilities at SAF storage facilities to provide required fuel certification for safe use of blended SAF fuel

U.S. Policy Lessons Learned

Decarbonization ambitions need to be backed by strong enabling policies

Market tends to be very creative in innovating and decarbonizing

- Technology-neutral policy builds in flexibility
- “All of the above” approach deploys feedstocks and fuels as they become viable/available

Fundamental umbrella structure like an LCFS is an important foundation to support targeted complementary policies

Carbon intensity modeling/ sustainability metrics vary across jurisdictions and underlie policy

- CORSIA
- California (CA-GREET) vs. U.S. Federal Modeling (GREET)
- ReFuelEU Aviation Proposal, at https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2389

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Thank You for Your Time

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