



California's Diesel Fuel Program

November 29, 2018

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Oil & Gas and GHG Mitigation Branch
California Air Resources Board (CARB)

California Diesel Fuel Requirements

- ASTM D975, Standard Specification for Diesel Fuel Oils (enforced by the California Department of Agriculture's Division of Measurement Standards)
- The California Diesel Fuel Regulations
 - 13 CCR 2281, Sulfur Content of Diesel Fuel
 - 13 CCR 2282, Aromatic Hydrocarbon Content of Diesel Fuel
- 13 CCR 2293, et seq., Commercialization of Alternative Diesel Fuel

ASTM D975 - 2018, Standard Specification for Diesel Fuel Oils, Grade No. 2-D, S15

- Flash Point, minimum, 52 °C (126 °F)
- Kinematic Viscosity at 40 °C, 1.9 - 4.1 mm²/s
- Cetane Number, minimum, 40
- Cetane Index, minimum, or Aromaticity, maximum, 40 or 35 percent by volume
- Lubricity, High-Frequency Reciprocating Rig (HFRR), at 60 °C, maximum, 520 microns
- Conductivity, minimum, 25 pS/m (10^{-12} ohm⁻¹m⁻¹)

13 CCR 2281, Sulfur Content of Diesel Fuel

- Sulfur content maximum of 15 ppmw (mg/kg)
- Applicable to every gallon of vehicular and non-vehicular diesel fuel sold or supplied in California
- Enforced at all points of storage and distribution in California, from production or importation to dispensing

13 CCR 2282, Aromatic Content of Diesel Fuel

- Aromatic hydrocarbon (AHC) content maximum of 10 percent by volume, or
- Certified emission-equivalent formulation established by engine emission testing, or
- Designated equivalent limits:
 - AHC content, maximum, 21.0 percent by weight
 - Polycyclic aromatic hydrocarbon (PAH) content, maximum, 3.5 percent by weight
 - API gravity, minimum, 36.9 (= 0.840 sp. gravity, max.)
 - Cetane number, minimum, 53

13 CCR 2282, Aromatic Hydrocarbon Content of Diesel Fuel (continued)

- Applicable to every gallon of vehicular and non-vehicular California diesel fuel
- Enforced by the FES at production and importation tanks
- Reduces oxides of nitrogen (NO_x) emissions by 6 to 7 percent compared to federal diesel fuel

13 CCR 2293, et seq., Alternative Diesel Fuel Regulation

- “Alternative Diesel Fuel” or “ADF” means any fuel used in a compression ignition engine that is not petroleum-based, does not consist solely of hydrocarbons, and is not subject to [an alternative fuel specification].
- Regulations
 - Establish a comprehensive, multi-stage process governing the commercialization of ADFs in California, ranging from the initial limited sales of an ADF while it undergoes a screening evaluation; through expanded sales governed by enhanced monitoring, testing, and multimedia evaluations; and ending with full-scale commercial sales, as warranted.

13 CCR 2293, et seq., Alternative Diesel Fuel Regulation (continued)

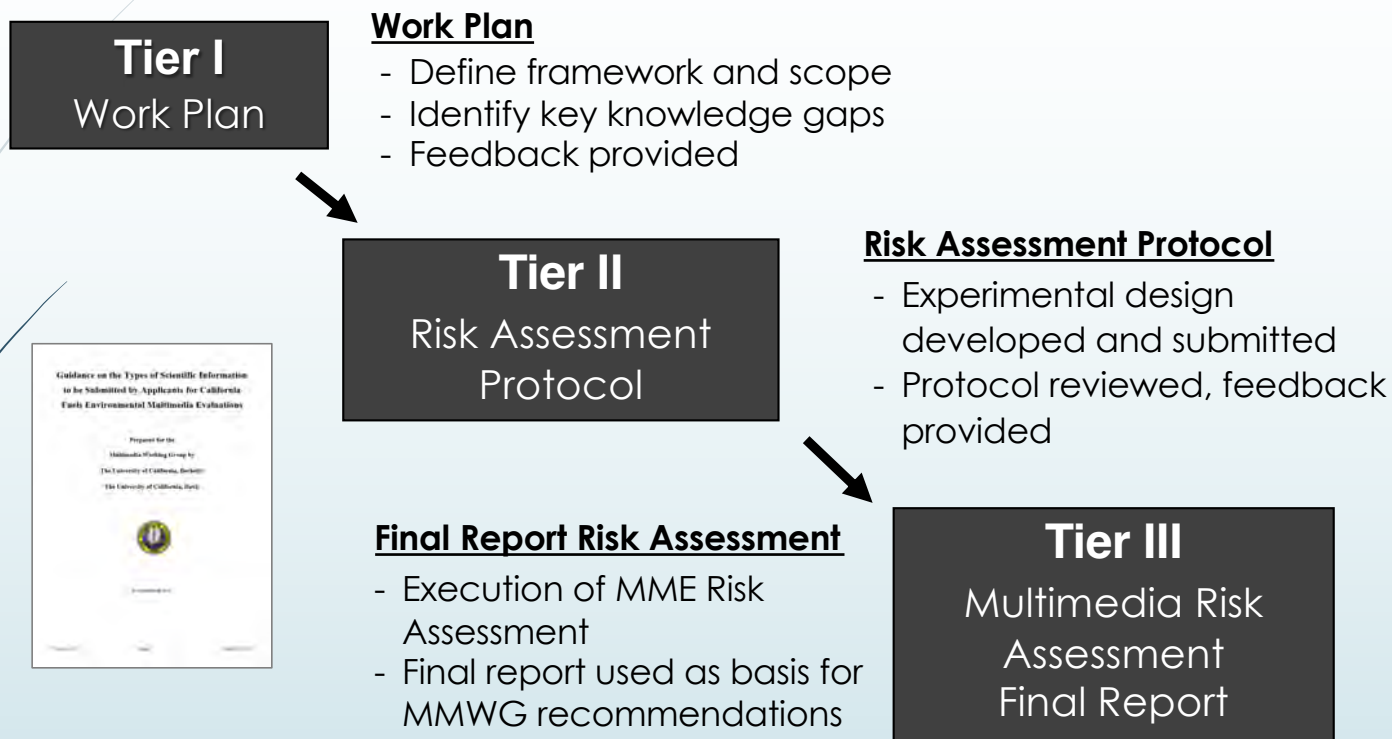
► Regulations (continued)

- Foster the introduction and use of innovative ADFs in California while preserving or enhancing public health, the environment and the emissions benefits of the existing motor vehicle diesel fuel regulations.
- Provide for the use of up to twenty-percent biodiesel (B20) blends with California diesel fuel and containing certified additives which provide emission equivalence, including
 - Up to 1.0 percent di-tertiary butyl peroxide (DTBP)
 - Proprietary additive formulations demonstrated by engine emission testing and approved by Executive Order

Multimedia Media Evaluation (MME)

- MME Definition – Identification and evaluation of **any significant adverse impact** on public health or the environment, including air, water, or soil, that may result from the production, use, or disposal of the motor vehicle fuel that may be used to meet the state board's motor vehicle fuel specifications. (HSC 43830.8)
- MME Requirements
 - Emissions of air pollutants
 - Contamination of surface water, groundwater, and soil
 - Disposal or use of byproducts and waste materials
- Multimedia Working Group (MMWG) Report
- External Scientific Peer Review
- Public Hearing and Determination by the California Environmental Policy Council

Multimedia Evaluation Process



Multimedia Evaluation Guidance Document , March 2016

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Certification Test Fuels

Diesel Fuel Specification	California Limit	Federal Limit
Natural Cetane Number	47-55	40-50
Distillation Range, °F		
IBP	340-420	340-399
10% point	400-490	400-460
50% point	470-560	470-539
90% point	550-610	560-629
EP	580-660	610-690
API Gravity, degrees	33-39	32-37
Total Sulfur, ppmw	7-15	7-15
Nitrogen Content, ppmw	100-500	NA
Total Aromatic Hydrocarbons, vol.%	8-12	10 (wt. %, min.)
Polycyclic Aromatic HC, wt.% (max.)	1.4	NA
Flashpoint, °F (min)	130	130
Viscosity @ 40°C, centistokes	2.0-4.1	2.0-3.2

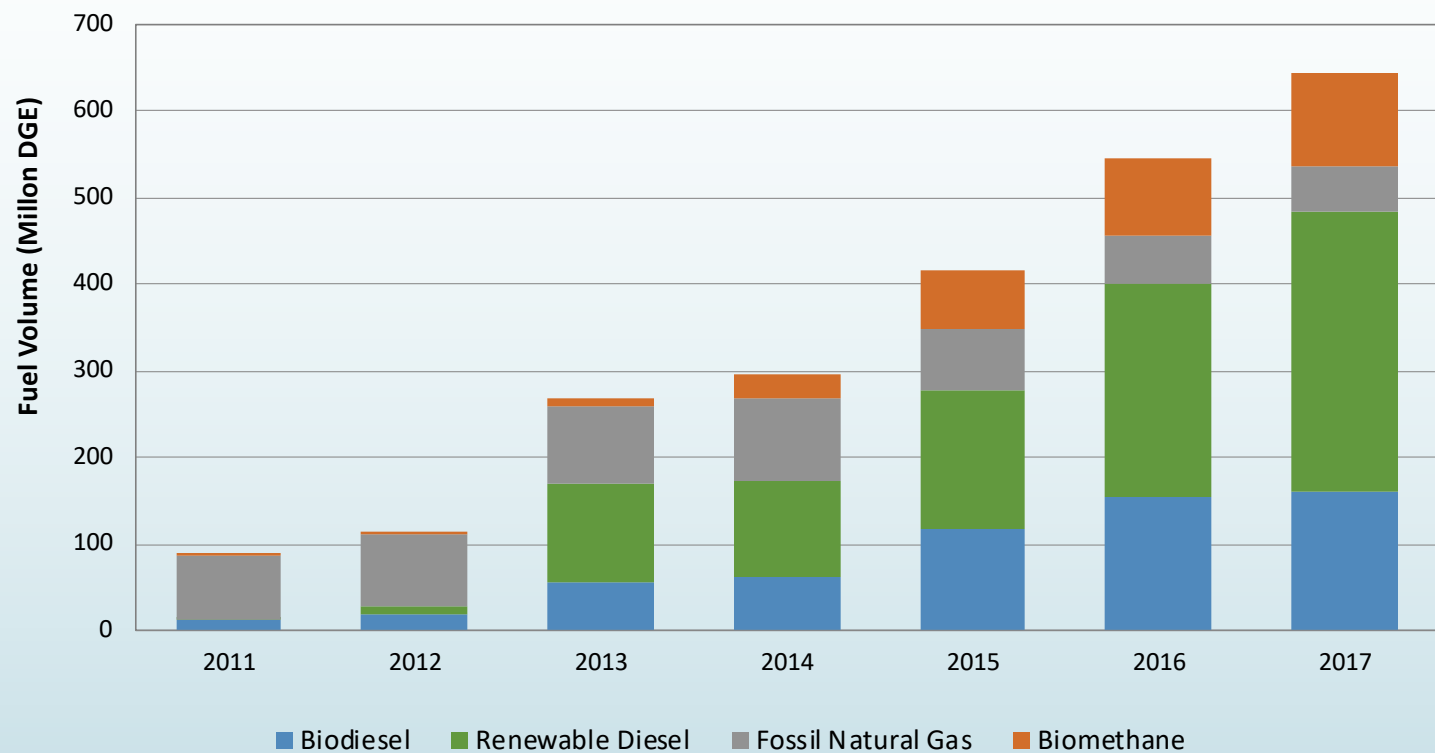
California's Low Carbon Fuel Standard (LCFS) for Diesel Fuel

November 29, 2018

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Transportation Fuels Branch
California Air Resources Board (CARB)

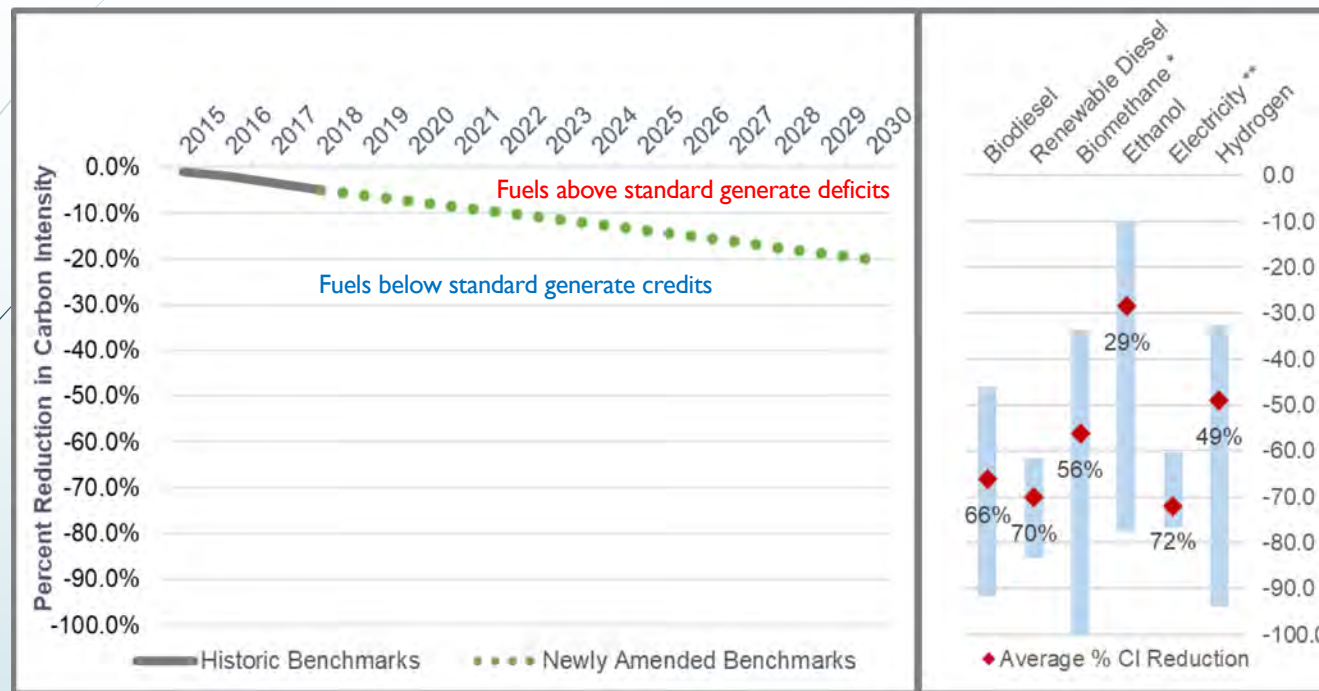
Growth of Diesel Replacements in California



Why are Diesel Replacements Growing?

- Alternative fuel policies at the Federal and State level
 - Federal Renewable Fuel Standard and Blenders Tax Credit
 - California Low Carbon Fuel Standard and State grant programs for alternative fuel production
- California Low Carbon Fuel Standard (LCFS)
 - Sets carbon intensity standards for light duty fuels (gasoline and replacements) and heavy duty fuels (diesel and replacements) which decrease over time
 - Carbon intensity scores determined using “well-to-wheels” life cycle assessment and are expressed in units of $\text{gCO}_2\text{e}/\text{MJ}$
 - Fuels with a carbon intensity above the standard (e.g. gasoline and diesel) generate deficits while fuels with a carbon intensity below the standard (e.g. biofuels) generate credits
 - A credit (or deficit) represents a decrease (or increase) in emissions of one metric ton of carbon dioxide equivalent relative to the standard
 - Providers of deficit-generating fuels must produce or purchase sufficient credits to offset their deficits

Newly Adopted LCFS Promotes 20% Carbon Intensity Reduction by 2030



Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Percent CI Reduction	6.25	7.5	8.75	10	11.25	12.5	13.75	15	16.25	17.5	18.75	20

* Negative CIs have been achieved for some fuel pathways but are not shown.

** The average percent CI reduction for electricity shown represents Light-Duty Electric Vehicle charging.

Current Value of LCFS for Diesel Replacements

- The value of the LCFS for diesel replacements depends on the market price for credits, the carbon intensity of the alternative fuel, and the energy efficiency of the engine
- Table below provides value of LCFS at current market price of \$190 per credit

Fuel	Carbon Intensity (gCO ₂ /MJ)*	LCFS Value (\$/DGE)
Renewable Diesel or Biodiesel from waste oil (e.g. used cooking oil)	20	\$1.96
Renewable Diesel or Biodiesel from vegetable oil (e.g. soy oil)	55	\$1.07
Compressed natural gas from landfill	45	\$1.08
Electricity from grid (for electric bus)	25	\$9.76

*By comparison, the carbon intensity of diesel is approximately 100 gCO₂/MJ