

Comparison matrix of low carbon fuel programs (short), Jun 2018 update ¹⁵ (Julie Witcover, UC Davis PIEEE, with input from jurisdictions)

Components	British Columbia	California	Oregon	EU
Program goal	10% CI reduction in 10 years for gasoline and diesel fuel pools used in transport, commitment to 15% reduction in 20 years.	10% CI reduction in 10 years for gasoline and diesel fuel pools used in transport. Proposal for 7.5% CI reduction in 10 years and 20% CI reduction in 20 years under consideration.	10% CI reduction in 10 years for gasoline and diesel fuel pools used in transport.	6% CI reduction in 10 years in vehicles.
Compliance mechanism	Bankable, tradable credits offsetting deficits, fungible across fuel standards.	Bankable, tradable credits offsetting deficits, fungible across fuel standards.	Bankable, tradable credits offsetting deficits, fungible across fuel standards.	TBD by member states. Germany directly implements; others aim to comply through RED compliance. Eligible fuels meet minimum well-to-wheel GHG reductions. Agricultural-land-based fuels limited to 7% transport energy contribution.
Baseline year	2010	2010	2015	2010
Initial compliance year	2013-14	2011	2016	Sets discretionary intermediate targets that member states may adhere to. Germany imposed CI reduction targets for 2015 (3.5%) and 2017 (4%).
Credit and deficit generation	Based on displaced energy; no reference fuel credit provisions; allow credits to be generated for advancing low carbon fuels by agreement with Ministry of Energy and Mines ('Part 3 Agreements'). Under consideration: refinery credits for GHG emission reductions; inclusion of biojet as opt-in fuel for credit generation.	Based on on-road displaced energy. Reference fuels generate deficits; can generate credits for specific innovative methods in crude oil production and refining. ¹⁶ Reference fuels accrue incremental deficits if the state average fuel CI rating (on 3-year rolling basis) exceeds baseline beyond minimum threshold. Scope expansion: credits for electric rail and forklift (2016); propane, biojet under consideration. Credits for ZEV (zero tailpipe emission vehicle) low carbon fueling infrastructure capacity	Based on on-road displaced energy; no reference fuel credit generation provisions. Expansion to include biojet credits under consideration.	NA. Germany's system allows for carrying forward quota shares that go beyond a current year requirements (banking), and ability to delegate quota requirements to a third party via contracts (trading).

¹⁵ Canada is developing a Clean Fuel Standard; a framework issued in late 2017 provides some information on design elements. The standard will be based on required lifecycle carbon intensity reductions and apply to fuels used in transportation, buildings, and industry throughout the country. The CFS will go into effect in 2019, and have a target of 30 MT CO₂e of emissions reductions per year starting in 2030. Separate reduction requirements will be set for liquid, gaseous, and solid fuels. Compliance credits will be generated and traded within each fuel stream. Fuels used primarily as feedstocks in industrial processes or for non-combustion will be exempt. The lifecycle carbon intensity ratings will not distinguish among crude oil types or sources, or include emissions estimates due to indirect (i.e., market-mediated) land use change (iLUC). Renewable fuel blend mandates for 5% and 2% renewable content in gasoline and diesel/heating distillate oil, respectively, will remain in effect in the short-run (and eventually be replaced by the clean fuel standard). A periodic update and review of the policy will consider CI ratings and GHG emissions, including treatment of iLUC and other sustainability impacts, as well as disposition of the renewable fuel requirements. <http://gazette.gc.ca/rp-pr/p1/2017/2017-12-23/html/notice-avis-eng.html#ne1>. Brazil is developing a transportation carbon intensity standard, RenovaBio, that is modeled after California's LCFS with liquid biofuels and biogas the only credit generators.

¹⁶ Current innovative methods: onsite solar steam or heat generation, onsite carbon capture and storage, solar or wind electricity generation (all consumed onsite or, for electricity, provided directly and not through a utility-owned network).

		under consideration.		
Lifecycle analysis (LCA)	Yes (excludes indirect land use change – ILUC).	Yes (includes ILUC). ¹⁷	Yes (includes ILUC). ¹²	Yes (excludes ILUC, but sets limits on agricultural land-based fuels, see 'Compliance Mechanism' entry, above).
LCA models	GHGenius or other approved model.	CA-GREET, CA-OPGEE for reference fuels, and GTAP+AEZ-EF for ILUC.	OR-GREET, OR-OPGEE for reference fuels, and GTAP+AEZ-EF (CA values) for ILUC (except corn ethanol ILUC uses GTAP+CCLUB).	Approved sustainability certification providers.
Cost containment mechanism	"Part 3 Agreements": alternative credit generation mechanism; can lessen cost pressure thru higher supply of credits. Other cost containment under consideration.	Credit clearance market with price ceiling; deficits uncovered thereafter roll over with 5% penalty into following year (for up to 5 years) (i.e., "soft" price cap).	Credit clearance market with price ceiling ("soft" price cap); DEQ root cause analysis in the presence of specified triggers; DEQ deferral authority.	In Germany, non-fulfillment of obligations involves penalties of ~ 47 EURct/kg CO ₂ e. ¹⁸
Market monitoring function	Ministry displays summary credit trade information on website, issues periodic information bulletins, including on Part 3 Agreements.	Monthly and weekly ARB credit transfer reports and spreadsheet data; various trade media reports.	Monthly credit transfer reports; trade media reporting. DEQ monitors price trends, possible credit shortages that trigger "root cause analysis" (see Cost containment mechanism,). Oregon Dept. of Administrative Services forecasts annual fuel supply for following year.	--
Validation/Verification/Monitoring	Applications reviewed by BC Ministry of Energy and Mines staff. BC may inspect businesses for compliance at any time.	Application reviewed by California Air Resources Board staff. Considering verification provisions. ARB maintains an enforcement webpage and tip line.	Application reviewed by Oregon DEQ staff. Considering verification provisions in future.	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety ¹⁹
Policy review	BC assessed fuel pathways before 2018 stakeholder consultation on 2030 targets and other program amendments. Periodic information bulletins summarize fuel volumes and CI ratings.	ARB staff reviewed program metrics in a 2017 Board presentation. "Data Dashboard" summarizes credit/deficit balance and CI ratings. Issues quarterly summaries and data on fuel volumes and credit/deficits.	DEQ must perform two general reviews during the program (2015-2025). DEQ issues credit market reports, quarterly summaries, and data on fuel volumes and credits/deficits.	--
Policy interactions	<i>In BC.</i> Carbon tax, renewable blend requirements; ZEV & alternative fuel incentives (e.g., Clean Energy Vehicle Program, Greenhouse Gas Reduction Regulation). <i>Elsewhere.</i> Canada Clean Fuel Standard (from 2019); other low carbon fuel programs.	<i>In CA.</i> Carbon cap-and-trade program (fuels in since 2015); ZEV mandate; low carbon fuel and vehicle incentives (e.g., Alt & Renewable Fuel and Vehicle Technology Program; California Climate Investments Program funded by cap-and-trade revenue; air quality targets). <i>Elsewhere.</i> US Renewable Fuel Standard; other low carbon fuel programs.	<i>In OR.</i> Oregon renewable blend requirements, Electric Vehicle Rebate (starting 2018), excise tax waiver for high biomass-based diesel blends from used cooking oil. <i>Elsewhere.</i> Other low carbon fuel programs.	<i>In EU.</i> Renewable Energy Directive (RED); low carbon economy incentives and initiatives. <i>Elsewhere.</i> Other low carbon fuel programs.

¹⁷ ILUC included for corn ethanol, sugarcane ethanol, soy biodiesel, canola biodiesel, sorghum ethanol, and palm biodiesel.

¹⁸ <http://task39.sites.olt.ubc.ca/files/2015/12/IEA-Bioenergy-Task-39-Newsletter-Issue-41-December-2015-FINAL.pdf>.

¹⁹ The law/targets are defined in §37a (BimSchG), "Bundes-Immissionsschutzgesetz" (Federal Emission Protection Law). http://www.lbst.de/download/2016/Hinico-LBST_2016_PtH2-study_Fondation-Tuck.pdf