Calculation of 2024 Crude Average Carbon Intensity Value

Posting: Each year, pursuant to section 95489(b)(3) of the Low Carbon Fuel Standard (LCFS) Regulation,[1] CARB posts the Annual Crude Average carbon intensity calculation at the CARB-LCFS website for public comment. Written comments shall be accepted for 14 days following the date on which the analysis was posted. Only comments related to potential factual or methodological errors in the posted Annual Crude Average carbon intensity value may be considered. CARB will evaluate the comments received and may request, in writing, additional information or clarification from the commenters. Commenters shall have 14 days to respond to these requests. After evaluating the comments[2] and updating the calculation accordingly, CARB is posting the final Annual Crude Average carbon intensity value.

Calculation of 2022, 2023, and 2024 Annual Crude Average Carbon Intensity Values: Table 1 shows California crude volumes and Annual Crude Average carbon intensity values for 2022, 2023, and 2024.[3] Table 2 shows the sources of crude oil supplied to California refineries during 2024 and the carbon intensity values assigned to each source.[4] All crude oil produced in and offshore of California during 2024 was assumed to be refined in California. The volume contributions for California-produced crudes are based on oil production data obtained from the California Department of Conservation.[5] The volume contributions for California federal offshore crudes are based on oil production data obtained from the Bureau of Safety and Environmental Enforcement.[6] The volume contributions of imported crudes are based on oil supply data submitted by refineries as part of annual LCFS reporting. The annual crude average carbon intensity values are a volume-weighted average of the carbon intensities for the crudes supplied in a given year.

[1] The LCFS regulation is published at California Code of Regulations (CCR), title 17, sections 95480-95503. Subsequent section references are to CCR title 17.
[2] Comment Log for Comments on Crude Oil analysis for LCFS (accessed on November 29, 2025)
[3] Carbon intensity values and volumes for 2022 and 2023 are from the 2022 Annual Crude CI final (ca.gov) and 2023 Annual Crude CI final (ca.gov), respectively.
[4] Crude carbon intensity values are from Table 9 of the LCFS regulation Low Carbon Fuel Standard. These carbon intensity values are based on oil field data from the year 2022.
[5] California Department of Conservation, WellSTAR Data Dashboard (ca.gov) (accessed on October 20, 2025).
[6] Bureau of Safety and Environmental Enforcement website BSEE Pacific Production (accessed on October 21, 2025).

Table 1. Crude Volumes and Annual Crude Average Carbon Intensity Values

Year	2022	2023	2024
CI (gCO_2e/MJ)	12.71	12.51	14.08
Volume (bbl)	519,754,097	532,457,677	511,589,231

Note on Differences Between 2022, 2023, and 2024 Annual Crude Average CI Values:
On July 1, 2025 amendments to the Low Carbon Fuel Standard Regulation went into effect. With these amendments in effect, CARB must use OPGEE 3.0b to calculate Annual Crude Average carbon intensity values for 2024 and into the future. The increase in the Annual Crude Average shown for 2024 compared to 2023 is primarily a result of updates made in OPGEE 3.0b, including improvements to more accurately reflect the venting, fugitive, and flaring emissions associated with crude extraction. Notwithstanding those modeling updates, the trend for the Annual Crude Average CI value has stayed relatively flat year-over-year. To illustrate the impact of these modeling updates, CARB staff recalculated past Annual Crude Average CI values using OPGEE 3.0b. Had CARB been able to use OPGEE 3.0b for prior years' Annual Crude Average calculations, the values would have been 14.06, 14.57, 14.00, 14.02, and 13.81 gCO2/MJ, for the years 2019-2023, respectively. The 2022 and 2023 Annual Crude Average CI values used for determining the Three-year California Crude Average shown on this table were calculated using OPGEE 2.0 as required by the version of the LCFS regulations in effect at the time that those calculations were made.

Calculation of California Baseline Crude Average Carbon Intensity:
$CI_{BaselineCrudeAve}$ is the California Baseline Crude Average carbon intensity value, in gCO_2e/MJ, attributed to the production and transport of the crude oil supplied as petroleum feedstock to California refineries during the baseline calendar year, 2010, and is calculated by the following formula for the 2024 compliance period:

$$CI_{BaselineCrudeAve} = \frac{[\,11.78 \times 519{,}754{,}097 + \ 11.78 \times \ 532{,}457{,}677 + 12.61 \times 511{,}589{,}231\,]}{[\,519{,}754{,}097 + 532{,}457{,}677 + 511{,}589{,}231]}$$

$$CI_{BaselineCrudeAve} = 12.05$$

Calculation of Three-Year California Crude Average Carbon Intensity:
$CI_{2024CrudeAve}$ is the Three-year California Crude Average carbon intensity value, in gCO_2e/MJ, attributed to the production and transport of the crude oil supplied as petroleum feedstock to California refineries during the most recent three calendar years (2022, 2023 and 2024), and is calculated by the following formula:

$$CI_{2024CrudeAve} = \frac{[\,12.71 \times 519{,}754{,}097 + \ 12.51 \times \ 532{,}457{,}677 + 14.08 \times 511{,}589{,}231\,]}{[\,519{,}754{,}097 + 532{,}457{,}677 + 511{,}589{,}231]}$$

$$CI_{2024CrudeAve} = 13.09$$

Summary: The Three-year California Crude Average carbon intensity of 13.09 gCO_2e/MJ is greater than the California Baseline Crude Average carbon intensity of 12.05 gCO_2e/MJ plus 0.10 gCO_2e/MJ. Therefore, pursuant to sections 95489(a) and (b) of the LCFS regulation, incremental deficits of $1.04 \times E^{XD} \times C$ for CARBOB or diesel will be added to each affected regulated party's compliance obligation for the annual compliance period of 2026, where E^{XD} is the amount of fuel energy, in MJ, from CARBOB or diesel, as defined in section 95489(a), and $C = 1.0 \times 10^{-6} \frac{MT}{g\ CO2\ e}$.

Table 2. 2024 Refinery Crude Supply

Country/State	Crude Name	CI (g/MJ)	2024 Volume (bbl)
	Annual Crude Average CI	*14.08*	
Angola	Pazflor	9.84	998,065
Argentina	Medanito	15.44	7,606,355
Brazil	Atapu	8.22	400,769
	Bauna	12.61	4,478,378
	Bravo Crude	12.61	680,973
	Buzios	7.08	1,214,452
	Frade	6.95	8,520,926
	Iracema	6.88	10,265,878
	Lapa	7.99	815,673
	Lula	7.55	22,584,652
	Mero	7.89	5,618,304
	Pargo Crude	12.61	988,338
	Roncador	7.19	354,844
	Sepia	12.61	1,022,992
	Sapinhoa	8.75	10,091,178
	Tartaruga Verde	12.61	1,473,035
Canada	Access Western Blend	15.57	480,784
	Cold Lake	19.92	17,263,668
	Mixed Sweet	10.68	2,190,709
	Namer	12.61	154,036
	Suncor Synthetic (all grades)	25.82	1,815,692
	Syncrude Synthetic (all grades)	28.74	6,495,988
Colombia	Chaza	10.00	3,340,104
	South Blend	10.80	403,265
	Vasconia	11.16	8,642,677
Ecuador	Napo	11.06	8,811,192
	Oriente	11.73	35,103,159
Ghana	Jubiliee	12.61	438,446
Guyana	Liza	9.12	5,988,406
	Unity Gold	12.61	26,910,669
	Payara Gold	12.61	17,320,132
Iraq	Basra Medium	13.97	63,526,242
	Basra Heavy	13.95	3,912,588
Kazakhstan	CPC BLEND	12.61	1,992,682
Mexico	Isthmus	14.56	881,952
	Maya	10.50	399,569

	Zapoteco	12.61	4,092,348
Nigeria	Forcados	11.71	942,716
Peru	Bretana	8.63	652,476
Saudi Arabia	Arab Extra Light	12.04	197,290
	Arab Light	11.97	17,211,002
	HSFO Crude Blend	12.61	433,451
Saudi-Kuwait Neutral Zone	Eocene	9.36	772,728
	Ratawi	10.61	202,142
UAE	Das Crude	12.61	994,029
	Murban	12.77	12,853,850
US Alaska	Alaska North Slope	12.28	72,346,305
US North Dakota	Bakken	12.62	790,060
US California*	Aliso Canyon	6.70	57,343
	Ant Hill	10.68	13,736
	Antelope Hills	3.14	38,634
	Antelope Hills, North	19.96	62,198
	Arroyo Grande	43.73	557,110
	Asphalto	10.84	140,672
	Bardsdale	6.20	89,559
	Barham Ranch	6.21	62,988
	Beer Nose	4.35	9,850
	Belgian Anticline	7.40	27,018
	Bellevue	5.99	16,329
	Bellevue, West	3.28	5,935
	Belmont, Offshore	5.51	225,948
	Belridge, North	6.20	1,170,330
	Belridge, South	20.10	13,783,812
	Beverly Hills	6.29	289,843
	Big Mountain	7.38	17,690
	Blackwells Corner	2.60	8,608
	Brea-Olinda	4.40	890,665
	Brentwood	3.02	7,266
	Buena Vista	9.61	1,016,858
	Burrel	13.37	12,647
	Cabrillo	7.49	7,349
	Cal Canal Gas	12.61	16,690
	Canal	6.91	9,180
	Canfield Ranch	4.99	41,460
	Cascade	4.46	78,122
	Casmalia	9.35	72,622

	Castaic Hills	2.50	10,630
	Cat Canyon	19.71	764,052
	Cheviot Hills	4.68	20,290
	Chico-Martinez	67.28	7,194
	Cienaga Canyon	10.75	7,996
	Coalinga	34.89	4,423,691
	Coles Levee, N	5.36	97,084
	Coles Levee, S	9.04	34,335
	Comanche Point	4.63	6,472
	Coyote, East	4.43	51,796
	Cuyama, South	13.26	144,303
	Cymric	18.78	12,196,297
	Deer Creek	4.42	28,151
	Del Valle	5.24	21,322
	Devils Den	3.90	6,751
	Edison	18.61	449,014
	El Segundo	3.96	10,927
	Elk Hills	12.06	5,607,448
	Fruitvale	4.81	351,849
	Greeley	8.21	94,324
	Hasley Canyon	3.40	21,334
	Guijarral Hills	12.61	5,111
	Helm	3.00	36,500
	Holser	6.10	8,623
	Honor Rancho	2.72	16,828
	Huntington Beach	5.63	1,245,073
	Hyperion	1.62	10,198
	Howard Townsite	12.61	5,935
	Inglewood	10.58	1,202,829
	Jacalitos	3.82	90,355
	Jasmin	15.87	96,001
	Kern Bluff	7.41	7,582
	Kern Front	33.38	2,099,856
	Kern River	15.17	13,446,798
	Kettleman Middle Dome	5.77	12,614
	Kettleman North Dome	7.48	85,531
	Las Cienegas	5.00	71,476
	Long Beach	5.27	1,131,142
	Los Alamos	12.61	8,010
	Los Angeles Downtown	4.99	26,078
	Lost Hills	16.02	6,633,836

	Lost Hills, Northwest	18.85	8,360
	Lynch Canyon	34.75	78,989
	McCool Ranch	15.65	5,715
	McDonald Anticline	2.80	33,896
	McKittrick	28.52	3,382,919
	Midway-Sunset	36.59	15,622,257
	Monroe Swell	1.47	5,978
	Montalvo, West	4.18	140,887
	Montebello	12.95	171,070
	Monument Junction	6.86	40,908
	Mount Poso	3.63	1,176,925
	Mountain View	5.03	52,325
	Newport, West	8.90	22,142
	Oak Canyon	3.49	11,704
	Oak Park	5.04	10,491
	Oakridge	5.01	92,522
	Oat Mountain	4.10	20,364
	Ojai	7.95	222,048
	Old Wilmington (ABD)	12.61	11,029
	Olive	2.35	42,714
	Orcutt	23.32	645,406
	Oxnard	8.99	26,173
	Paloma	10.13	8,518
	Placerita	58.44	242,114
	Playa Del Rey	4.93	34,427
	Pleito	3.50	330,951
	Poso Creek	23.70	2,549,360
	Pyramid Hills	6.28	42,946
	Railroad Gap	9.22	61,200
	Raisin City	28.32	47,859
	Ramona	7.81	19,416
	Richfield	3.55	151,141
	Rincon	6.26	153,033
	Rio Bravo	10.44	113,144
	Rio Viejo	2.57	125,698
	Riverdale	4.07	16,600
	Rose	3.32	108,874
	Rosecrans	7.66	55,341
	Rosedale	1.85	25,404
	Rosedale Ranch	9.56	107,021
	Round Mountain	25.21	907,665

	Russell Ranch	9.86	34,315
	Salt Lake	4.35	43,251
	Salt Lake, South	5.12	7,195
	San Ardo	23.72	3,608,374
	San Emidio Nose	3.13	65,974
	San Miguelito	6.85	354,727
	San Vicente	4.16	156,804
	Sansinena	4.49	196,641
	Santa Clara Avenue	4.26	25,252
	Santa Fe Springs	7.75	199,007
	Santa Maria Valley	8.39	111,972
	Santa Susana	9.86	8,450
	Sargent	6.83	14,061
	Saticoy	5.45	27,516
	Sawtelle	4.79	45,734
	Seal Beach	6.06	311,259
	Semitropic	6.43	17,276
	Sespe	7.18	231,401
	Shafter, North	4.14	283,057
	Shiells Canyon	9.13	33,466
	South Mountain	6.40	271,968
	Stockdale	2.42	86,544
	Tapia	3.76	4,939
	Tejon	9.59	73,563
	Tejon, North	8.01	22,570
	Temescal	3.43	28,044
	Ten Section	7.50	38,949
	Timber Canyon	8.68	26,467
	Torrance	4.02	110,244
	Torrey Canyon	6.55	62,320
	Union Avenue	5.55	34,240
	Vallecitos	5.41	8,362
	Ventura	7.72	2,642,341
	Walnut	12.61	6,166
	West Mountain	6.33	6,706
	Wheeler Ridge	4.86	27,532
	White Wolf	2.96	6,489
	Whittier	4.90	95,159
	Wilmington	16.17	7,189,543
	Yowlumne	7.45	116,190
	Zaca	6.43	205,347

US Federal OCS	Beta	3.77	1,719,935
	Carpinteria	6.78	142,861
	Dos Cuadras	6.90	1,570,579
	Hueneme	5.80	59,319
	Santa Clara	5.15	330,321