

Calculation of 2022 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 15 calendar 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 10 days to respond to these requests. After evaluating the comments² and updating the calculation accordingly, CARB is posting the final Annual Crude Average carbon intensity value.

Calculation of 2020, 2021, and 2022 Annual Crude Average Carbon Intensity Values:

Table 1 shows California crude volumes and Annual Crude Average carbon intensity values for 2020, 2021, and 2022.³ Table 2 shows the sources of crude oil supplied to California refineries during 2022 and the carbon intensity values assigned to each source.⁴ All crude oil produced in and offshore of California during 2022 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 20, 2023)

³ Carbon intensity values and volumes for 2020 and 2021 are from [2020 Annual Crude CI final \(ca.gov\)](#) and [2021 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 2015.

⁵ California Department of Conservation, [WellSTAR Data Dashboard \(ca.gov\)](#) (accessed November 20, 2023).

⁶ Bureau of Safety and Environmental Enforcement website [BSEE Pacific Production](#) (accessed July 5, 2023).

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

Year	2020	2021	2022
CI (gCO₂e/MJ)	13.39	12.80	12.71
Volume (bbl)	478,388,940	518,262,620	519,754,097

Calculation of California Baseline Crude Average Carbon Intensity:

$CI_{BaselineCrudeAve}$ is the California Baseline Crude Average carbon intensity value, in gCO₂e/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 2022 compliance period:

$$CI_{BaselineCrudeAve} = 11.78$$

Calculation of Three-Year California Crude Average Carbon Intensity:

$CI_{2022CrudeAve}$ is the Three-year California Crude Average carbon intensity value, in gCO₂e/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 (2020, 2021 and 2022), and is calculated by the following formula:

$$CI_{2022CrudeAve} = \frac{[13.39 \times 478,388,940 + 12.80 \times 518,262,620 + 12.71 \times 519,754,097]}{[478,388,940 + 518,262,620 + 519,754,097]}$$

$$CI_{2022CrudeAve} = 12.96$$

Summary: The Three-year California Crude Average carbon intensity of 12.96 gCO₂e/MJ is greater than the California Baseline Crude Average carbon intensity of 11.78 gCO₂e/MJ plus 0.10 gCO₂e/MJ. Therefore, pursuant to sections 95489(a) and (b) of the LCFS regulation, incremental deficits of $1.18 \times E^{XD} \times C$ for CARBOB or diesel will be added to each affected regulated party's compliance obligation for the annual compliance period of 2024, where E^{XD} is the amount of fuel energy, in MJ, from CARBOB or diesel, as defined in section 95489(a), and

$$C = 1.0 \times 10^{-6} \frac{MT}{g CO_2 e}$$

Table 2. 2022 Refinery Crude Supply

Country/State	Crude Name	CI (g/MJ)	2022 Volume (bbl)
	<i>Annual Crude Average CI</i>	<i>12.71</i>	
Angola	Nemba	9.08	899,741
Argentina	Medanito	10.78	3,670,942
Australia	Vincent	6.83	581,059
Brazil	Atapu	11.78	3,500,465
	Bauna	11.78	2,120,495
	Bravo Crude	11.78	1,572,759
	Frade	5.63	2,444,474
	Iracema (Cernambi)	5.54	1,677,061
	Lapa	11.78	2,538,108
	Lula (Tupi)	6.24	12,163,197
	Sapinhua	6.00	14,615,976
	Sururu	11.78	500,306
Canada	Access Western Blend	15.15	690,830
	Cold Lake	17.87	6,390,635
	Kearl Lake	12.89	572,066
	Mixed Sweet	8.11	862,306
	Suncor Synthetic (all grades)	27.09	360,688
	Synthetic Sweet Blend	29.36	787,772
Colombia	Castilla	10.55	1,297,016
	South Blend	9.25	1,132,197
	Vasconia	9.62	20,275,027
Ecuador	Napo	8.31	13,518,541
	Oriente	10.07	40,834,736
Ghana	Jubilee	11.78	2,522,498
	Sankofa	11.78	892,195
	Ten Blend	8.08	2,014,575
Guyana	Liza	11.78	11,448,157
	Unity Gold	11.78	6,252,967
Iraq	Basra Light	13.45	9,166,135
	Basra Medium	11.78	53,488,469
	Basra Heavy	10.69	2,319,235
Kazakhstan	CPC BLEND	11.78	2,773,480
Libya	El Sharara Crude	11.78	1,258,441
Mexico	Maya	7.85	11,370,200
	Isthmus	11.31	3,852,785
Peru	Bretana	11.78	175,973

	Pirana Blend	8.43	72,738
	Talara	11.78	588,440
Russia	CPC	11.78	3,092,528
	M100	17.35	276,606
Saudi Arabia	Arab Extra Light	9.41	6,128,785
	Arab Light	9.23	40,253,639
	Arab Medium	8.72	4,068,334
Saudi-Kuwait Neutral Zone	Eocene	7.85	888,756
	Ratawi	9.42	2,095,110
Trinidad	Molo	11.78	3,647,279
UAE	Murban	10.01	2,176,591
UK	Clair Crude	11.78	498,985
US Alaska	ANS	15.91	84,195,611
US New Mexico	Four Corners	11.11	220,214
US North Dakota	Bakken	9.73	656,859
US California	Aliso Canyon	4.94	78,156
	Ant Hill	20.81	12,392
	Antelope Hills	2.84	58,023
	Antelope Hills, North	24.75	93,636
	Arroyo Grande	31.11	499,585
	Asphalto	8.01	131,541
	Bandini	3.09	7,962
	Bardsdale	3.47	103,890
	Barham Ranch	4.15	68,400
	Beer Nose	3.98	10,582
	Belgian Anticline	5.01	28,098
	Bellevue	5.95	25,773
	Bellevue, West	6.60	7,003
	Belmont, Offshore	5.12	319,998
	Belridge, North	4.11	1,338,517
	Belridge, South	17.09	16,083,462
	Beverly Hills	5.41	307,980
	Big Mountain	4.65	20,582
	Blackwells Corner	3.07	8,662
	Brea-Olinda	3.59	946,983
	Brentwood	11.78	22,883
	Buena Vista	7.44	1,143,306
	Burrel	29.43	13,797
	Cabrillo	4.14	9,053
	Cal Canal Gas	11.78	18,344
	Canal	4.40	9,330
	Canfield Ranch	4.53	64,809

	Cascade	3.00	71,645
	Casmalia	10.26	96,304
	Castaic Hills	2.68	13,436
	Cat Canyon	7.83	1,575,359
	Cheviot Hills	3.49	26,036
	Chico-Martinez	48.13	8,719
	Cienaga Canyon	5.78	9,583
	Coalinga	25.81	4,696,828
	Coles Levee, N	4.09	99,885
	Coles Levee, S	5.87	39,931
	Comanche	5.03	9,745
	Coyote, East	5.96	64,919
	Cuyama, South	14.7	142,042
	Cymric	15.69	12,892,266
	Deer Creek	11.51	24,872
	Del Valle	5.78	24,280
	Devils Den	7.51	9,907
	Edison	14.53	473,100
	El Segundo	4.38	19,430
	Elk Hills	8.02	6,673,279
	Fruitvale	3.75	392,658
	Greeley	7.91	110,111
	Hasley Canyon	2.25	22,339
	Helm	3.99	20,251
	Holser	3.80	11,280
	Honor Rancho	3.43	30,955
	Huntington Beach	6.62	1,275,696
	Hyperion	1.90	10,429
	Inglewood	10.06	1,479,263
	Jacalitos	2.72	77,007
	Jasmin	16.59	101,530
	Kern Bluff	12.54	5,355
	Kern Front	35.68	2,479,664
	Kern River	15.09	12,297,398
	Kettleman Middle Dome	3.93	19,916
	Kettleman North Dome	3.42	84,649
	Landslide	12.53	4,961
	Las Cienegas	4.96	79,452
	Lompoc	28.45	239,670
	Long Beach	5.48	1,183,791
	Los Angeles City	11.78	8,694
	Los Angeles Downtown	5.89	32,936

	Lost Hills	12.99	7,456,620
	Lost Hills, Northwest	5.36	9,774
	Lynch Canyon	23.10	80,874
	Mahala	4.99	6,106
	McDonald Anticline	4.33	28,501
	McKittrick	25.31	3,304,018
	Midway-Sunset	29.33	17,603,410
	Monroe Swell	11.78	9,649
	Montalvo, West	2.65	138,571
	Montebello	17.03	180,891
	Monument Junction	4.95	38,589
	Mount Poso	3.71	1,559,845
	Mountain View	3.97	58,455
	Newport, West	5.21	26,088
	Oak Canyon	4.04	14,574
	Oak Park	3.01	15,681
	Oakridge	3.46	83,408
	Oat Mountain	3.17	57,933
	Ojai	4.94	245,365
	Olive	1.82	50,560
	Orcutt	11.76	817,738
	Oxnard	5.39	58,909
	Paloma	4.88	12,084
	Placerita	32.78	193,196
	Playa Del Rey	6.87	40,592
	Pleito	2.09	442,239
	Poso Creek	21.96	3,390,352
	Pyramid Hills	3.36	45,326
	Railroad Gap	7.08	53,341
	Raisin City	9.13	56,444
	Ramona	4.47	33,889
	Richfield	4.75	168,847
	Rincon	4.88	122,405
	Rio Bravo	6.98	138,538
	Rio Viejo	2.74	70,246
	Riverdale	3.8	20,496
	Rose	2.91	135,237
	Rosecrans	5.76	64,260
	Rosecrans, South	3.54	12,031
	Rosedale	2.35	19,447
	Rosedale Ranch	8.32	93,527
	Round Mountain	24.04	2,155,146

	Russell Ranch	8.58	37,539
	Salt Lake	3.18	38,718
	Salt Lake, South	6.34	9,778
	San Ardo	26.42	5,021,736
	San Emidio Nose	11.78	6,761
	San Miguelito	5.25	311,193
	San Vicente	3.22	161,164
	Sansinena	3.21	202,845
	Santa Clara Avenue	3.53	24,636
	Santa Fe Springs	12.53	270,419
	Santa Maria Valley	4.80	155,920
	Sargent	4.00	14,767
	Saticoy	3.68	21,794
	Sawtelle	2.56	52,636
	Seal Beach	5.19	349806.1
	Semitropic	4.30	21,064
	Sespe	3.98	271,084
	Shafter, North	3.32	312,549
	Shiells Canyon	5.07	38,570
	South Mountain	3.58	283,761
	Stockdale	2.18	85,486
	Tapia	6.92	9,190
	Tejon	13.77	77,825
	Tejon, North	5.63	20,068
	Temescal	3.40	37,787
	Ten Section	7.50	50,459
	Timber Canyon	4.74	30,530
	Torrance	3.99	151,197
	Torrey Canyon	3.52	49,001
	Union Avenue	5.58	64,058
	Vallecitos	4.53	9,805
	Ventura	4.54	2,994,504
	Wayside Canyon	2.36	5,830
	Wheeler Ridge	2.80	40,637
	White Wolf	1.92	7,666
	Whittier	3.71	99,199
	Wilmington	8.31	8,522,106
	Yowlumne	13.90	137,012
	Zaca	9.53	185,496
US Federal OCS	Carpinteria	3.28	122,359
	Dos Cuadras	4.57	1,112,616
	Hueneme	4.67	68,944

	Point Pedernales	8.26	1,045,964
	Santa Clara	2.46	332,115