

Calculation of 2018 Crude Average Carbon Intensity Value

Posting: Each year, pursuant to section 95489(b)(3) of the Low Carbon Fuel Standard (LCFS) Regulation,¹ the California Air Resources Board (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.

Calculation of 2016, 2017 and 2018 Annual Crude Average Carbon Intensity Values:

Table 1 below shows California crude volumes and Annual Crude Average carbon intensity values for 2016, 2017 and 2018.² Table 2 shows the breakdown of the sources of crude oil supplied to California refineries during 2018 as well as the carbon intensity values assigned to these crude sources.³ All crude oil produced in and offshore of California during 2018 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.⁴ The volume contributions for California federal offshore crudes are based on oil production data obtained from the Bureau of Safety and Environmental Enforcement.⁵ 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.

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

Year	2016	2017	2018
CI (gCO ₂ e/MJ)	12.14	11.93	12.35
Volume (bbl)	582,101,235	621,246,732	624,127,435

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

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 Carbon intensity values for 2016 and 2017 are from Table 9 of the LCFS regulation https://www.arb.ca.gov/fuels/lcfs/fro_oal_approved_clean_unofficial_010919.pdf. Volumes for 2016 and 2017 are from Calculation of the 2017 Crude Average Carbon Intensity Value https://www.arb.ca.gov/fuels/lcfs/crude-oil/2017_crude_average_ci_value_final.pdf

³ Crude carbon intensity values are from Table 9 of the LCFS regulation https://www.arb.ca.gov/fuels/lcfs/fro_oal_approved_clean_unofficial_010919.pdf. These carbon intensity values are based on oil field data from the year 2015.

⁴ California Department of Conservation, 2018 Report of California Oil and Gas Production Statistics. ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2018/2018_Preliminary_Annual_Report.pdf.

⁵ Bureau of Safety and Environmental Enforcement website <https://www.data.bsee.gov/Main/PacificProduction.aspx> (accessed May 2, 2019).

petroleum feedstock to California refineries during the baseline calendar year, 2010, and is calculated by the following formula for the 2018 compliance period:

$$CI_{BaselineCrudeAve} = \frac{[11.98 \times 582,101,235 + 11.98 \times 621,246,732 + 11.78 \times 624,127,435]}{[582,101,235 + 621,246,732 + 624,127,435]}$$

$$CI_{BaselineCrudeAve} = 11.91$$

Calculation of Three-Year California Crude Average Carbon Intensity:

$CI_{2018CrudeAve}$ 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 (2016, 2017 and 2018), and is calculated by the following formula:

$$CI_{2018CrudeAve} = \frac{[12.14 \times 582,101,235 + 11.93 \times 621,246,732 + 12.35 \times 624,127,435]}{[582,101,235 + 621,246,732 + 624,127,435]}$$

$$CI_{2018CrudeAve} = 12.14$$

Summary: The Three-year California Crude Average carbon intensity of 12.14 gCO₂e/MJ is greater than the California Baseline Crude Average carbon intensity of 11.91 gCO₂e/MJ plus 0.10 gCO₂e/MJ. Therefore, pursuant to sections 95489(a) and (b) of the LCFS regulation, incremental deficits of $0.23 \times E^{XD} \times C$ for CARBOB or diesel will be added to each affected regulated party's compliance obligation for the annual compliance period of 2020, 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: 2018 Refinery Crude Supply

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	2018 Volume Weighted Average CI	12.35	624,127,435
Angola	Clov	7.31	15,622
	Dalia	8.90	2,522,982
	Gimboa	8.86	822,027
	Girassol	9.95	93,989
	Greater Plutonio	8.72	1,004,932
	Nemba	9.08	942,080
	Pazflor	8.02	4,821,795
Argentina	Escalante	10.15	1,772,197
Australia	Pyrenees	8.24	6,568
Brazil	Atlanta	11.78	658,824
	Frade	5.63	1,002,884
	Iracema (Cernambi)	5.54	6,031,213
	Lula	6.24	9,290,082
	Mero	11.78	502,121
	Ostra	5.65	3,070,178
	Peregrino	4.16	623,038
	Sapinhua	6.00	7,342,701
	Tubarao Martelo	5.37	727,064
Brunei	Seria Light Export Blend	11.78	194,914
Canada	Access Western Blend	15.15	1,776,677
	Albian Heavy Synthetic (all grades)	23.68	868,227
	Burnaby Blend	11.78	278,000
	Christina Dilbit Blend	12.71	327,314
	Cold Lake	17.87	4,875,687
	Fort Hills	11.78	681,348
	Kearl Lake	12.89	3,046,505
	Mixed Sweet	8.11	79,064
	Peace River Sour	8.11	3,250
	Surmont Heavy Blend	22.48	1,485,537
	Syncrude Synthetic (all grades)	31.62	371,605
	Western Canadian Select	19.04	182,451
Colombia	Acordionero	6.96	325,884
	Castilla	10.55	4,739,922
	Chaza	11.78	1,816,689
	Puerto Bahia	11.78	365,442
	South Blend	9.25	1,347,224
	Vasconia	9.62	37,540,768

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
Ecuador	Napo	8.31	21,851,807
	Oriente	10.07	31,593,153
Equatorial Guinea	Zafiro	20.56	3,850,536
Ghana	Ten Blend	8.08	3,155,969
Iraq	Basra Light	13.45	30,808,908
Kuwait	Kuwait	10.56	19,671,534
Mexico	Maya	7.85	18,504,160
Nigeria	Antan	21.98	2,117
	Bonga	5.06	1,870,925
	Forcados	8.97	1,928,189
Oman	Oman	13.32	112,128
Peru	Pirana	8.43	261,510
Russia	CPC Blend	11.78	1,299,450
	ESPO	11.55	792,718
	Sokol	6.94	3,504,791
	Vityaz	9.60	400,544
Saudi Arabia	Arab Extra Light	9.41	20,059,988
	Arab Light	9.23	87,299,942
	Arab Medium	8.72	21,004,457
	Arab Heavy	7.92	230,100
Trinidad	Calypso	7.41	99,550
	Molo	11.78	551,366
UAE	Upper Zakum	7.96	75,844
UK	North Sea Kraken	11.78	788,353
Venezuela	Hamaca	23.04	547,870
	Hamaca DCO	10.02	669,250
	Santa Barbara	17.32	2,170
US Alaska	ANS	15.91	83,471,217
US New Mexico	Four Corners	11.11	932,754
US Texas	West Texas Intermediate	11.93	467,041
US Utah	Covenant	4.43	52,139
	Utah Sweet	6.92	768,597
US California*	Aliso Canyon	4.94	51,171
	Ant Hill	20.81	21,154
	Antelope Hills	2.84	87,793
	Antelope Hills, North	24.75	245,887
	Arroyo Grande	31.11	533,059
	Asphalto	8.01	165,721
	Bandini	3.09	9,144

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	Bardsdale	3.47	149,900
	Barham Ranch	4.15	80,927
	Beer Nose	3.98	9,164
	Belgian Anticline	5.01	30,930
	Bellevue	5.95	24,666
	Bellevue, West	6.60	53,053
	Belmont, Offshore	5.12	449,731
	Belridge, North	4.11	1,762,905
	Belridge, South	17.09	20,915,436
	Beverly Hills	5.41	316,472
	Big Mountain	4.65	17,665
	Blackwells Corner	3.07	22,741
	Brea-Olinda	3.59	1,037,187
	Brentwood	11.78	22,474
	Buena Vista	7.44	1,298,257
	Burrel	29.43	7,389
	Cabrillo	4.14	18,414
	Cal Canal Gas	11.78	19,940
	Canal	4.40	14,404
	Canfield Ranch	4.53	65,430
	Carneros Creek	4.06	13,633
	Cascade	3.00	91,419
	Casmalia	10.26	122,251
	Castaic Hills	2.68	6,593
	Cat Canyon	7.83	1,434,234
	Cheviot Hills	3.49	37,892
	Chico-Martinez	48.13	33,369
	Cienaga Canyon	5.78	9,661
	Coalinga	25.81	6,340,065
	Coles Levee, N	4.09	83,841
	Coles Levee, S	5.87	51,479
	Comanche	5.03	13,445
	Coyote, East	5.96	172,882
	Cuyama, South	14.70	189,386
	Cymric	15.69	12,970,618
	Deer Creek	11.51	33,822
	Del Valle	5.78	29,471
	Devils Den	7.51	8,381
	Dominguez	3.57	22,334

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	Edison	14.53	588,931
	El Segundo	4.38	20,524
	Elk Hills	8.02	8,574,673
	Fruitvale	3.75	387,402
	Greeley	7.91	148,442
	Hasley Canyon	2.25	27,790
	Helm	3.99	83,493
	Holser	3.80	14,162
	Honor Rancho	3.43	27,292
	Huntington Beach	6.62	1,906,809
	Hyperion	1.90	10,755
	Inglewood	10.06	1,977,358
	Jacalitos	2.72	89,640
	Jasmin	16.59	138,580
	Kern Bluff	12.54	35,641
	Kern Front	35.68	3,471,459
	Kern River	15.09	16,386,354
	Kettleman Middle Dome	3.93	16,740
	Kettleman North Dome	3.42	108,532
	Landslide	12.53	35,544
	Las Cienegas	4.96	173,097
	Livermore	2.66	4,918
	Lompoc	28.45	261,123
	Long Beach	5.48	1,265,165
	Long Beach Airport	4.92	7,660
	Los Angeles Downtown	5.89	41,778
	Los Angeles, East	14.71	182,283
	Lost Hills	12.99	9,658,387
	Lost Hills, Northwest	5.36	6,385
	Lynch Canyon	23.10	215,515
	Mahala	4.99	10,200
	McCool Ranch	9.59	8,624
	McDonald Anticline	4.33	49,495
	McKittrick	25.31	2,619,856
	Midway-Sunset	29.33	20,655,818
	Montalvo, West	2.65	280,077
	Montebello	17.03	394,874
	Monument Junction	4.95	81,423

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	Mount Poso	3.71	1,612,717
	Mountain View	3.97	78,434
	Newhall-Potrero	3.66	52,575
	Newport, West	5.21	76,706
	Oak Canyon	4.04	16,693
	Oak Park	3.01	9,969
	Oakridge	3.46	99,675
	Oat Mountain	3.17	54,744
	Ojai	4.94	245,226
	Olive	1.82	47,657
	Orcutt	11.76	891,061
	Oxnard	5.39	360,708
	Paloma	4.88	13,535
	Placerita	32.78	566,594
	Playa Del Rey	6.87	27,736
	Pleito	2.09	670,322
	Poso Creek	21.96	5,130,861
	Pyramid Hills	3.36	43,176
	Railroad Gap	7.08	113,586
	Raisin City	9.13	135,582
	Ramona	4.47	30,465
	Richfield	4.75	188,696
	Rincon	4.88	235,485
	Rio Bravo	6.98	206,396
	Rio Viejo	2.74	45,767
	Riverdale	3.8	68,126
	Rose	2.91	217,810
	Rosecrans	5.76	123,214
	Rosecrans, South	3.54	8,373
	Rosedale	2.35	13,053
	Rosedale Ranch	8.32	115,156
	Round Mountain	24.04	2,567,799
	Russell Ranch	8.58	46,965
	Salt Lake	3.18	19,627
	Salt Lake, South	6.34	3,696
	San Ardo	26.42	8,173,645
	San Miguelito	5.25	330,190
	San Vicente	3.22	139,819
	Sansinena	3.21	200,496

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	Santa Clara Avenue	3.53	32,746
	Santa Fe Springs	12.53	690,628
	Santa Maria Valley	4.80	80,452
	Santa Susana	5.29	7,167
	Sargent	4.00	19,281
	Saticoy	3.68	34,314
	Sawtelle	2.56	148,911
	Seal Beach	5.19	392,210
	Semitropic	4.30	24,908
	Sespe	3.98	335,009
	Shafter, North	3.32	450,403
	Shiells Canyon	5.07	50,589
	South Mountain	3.58	452,341
	Stockdale	2.18	100,108
	Tapia	6.92	10,651
	Tapo Canyon, South	3.08	7,563
	Tejon	13.77	222,511
	Tejon Hills	9.39	8,026
	Tejon, North	5.63	29,230
	Temescal	3.40	53,416
	Ten Section	7.50	64,685
	Timber Canyon	4.74	16,513
	Torrance	3.99	368,052
	Torrey Canyon	3.52	77,568
	Union Avenue	5.58	9,159
	Vallecitos	4.53	13,421
	Ventura	4.54	4,038,762
	Wayside Canyon	2.36	1,177
	West Mountain	3.53	12,718
	Wheeler Ridge	2.8	57,814
	White Wolf	1.92	11,423
	Whittier	3.71	80,406
	Wilmington	8.31	10,818,132
	Yowlumne	13.9	135,336
	Zaca	9.53	168,052
US Federal OCS	Beta	1.59	1,831,734
	Carpinteria	3.28	298,411
	Dos Cuadras	4.57	891,895
	Hueneme	4.67	56,873

Country/State	Crude Name	CI (g/MJ)*	2018 Volume (bbl)
	Point Pedernales	8.26	1,305,249
	Santa Clara	2.46	488,785

*CI values from Table 9 of the LCFS regulation are based on oil field operational data from the year 2015