

## Calculation of 2019 Crude Average Carbon Intensity Value

Posting: Each year, pursuant to section 95489(b)(3) of the Low Carbon Fuel Standard (LCFS) Regulation,<sup>1</sup> 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 2017, 2018 and 2019 Annual Crude Average Carbon Intensity Values: Table 1 below shows California crude volumes and Annual Crude Average carbon intensity values for 2017, 2018 and 2019.<sup>2</sup> Table 2 shows the breakdown of the sources of crude oil supplied to California refineries during 2019 as well as the carbon intensity values assigned to these crude sources.<sup>3</sup> All crude oil produced in and offshore of California during 2019 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.<sup>4</sup> The volume contributions for California federal offshore crudes are based on oil production data obtained from the Bureau of Safety and Environmental Enforcement.<sup>5</sup> 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                       | 2017        | 2018        | 2019        |
|----------------------------|-------------|-------------|-------------|
| CI (gCO <sub>2</sub> e/MJ) | 11.93       | 12.35       | 12.52       |
| Volume (bbl)               | 621,246,732 | 624,127,435 | 584,313,143 |

<sup>1</sup> The LCFS regulation is published at California Code of Regulations (CCR), title 17, sections 95480-95503. Subsequent section references are to CCR title 17.

<sup>2</sup> Carbon intensity values and volumes for 2017 and 2018 are from [Calculation of 2017 Crude Average Carbon Intensity Value](#) and [Calculation of 2018 Crude Average Carbon Intensity Value](#)

<sup>3</sup> Crude carbon intensity values are from Table 9 of the LCFS regulation [Low Carbon Fuels Standard](#). These carbon intensity values are based on oil field data from the year 2015.

<sup>4</sup> California Department of Conservation, [2019 California Oil and Gas Well Monthly Production](#) (accessed May 11, 2020).

<sup>5</sup> Bureau of Safety and Environmental Enforcement website [BSEE Pacific Production](#) (accessed May 11, 2020).

Calculation of California Baseline Crude Average Carbon Intensity:

$CI_{BaselineCrudeAve}$  is the California Baseline Crude Average carbon intensity value, in gCO<sub>2</sub>e/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 2019 compliance period:

$$CI_{BaselineCrudeAve} = \frac{[11.98 \times 621,246,732 + 11.78 \times 624,127,435 + 11.78 \times 584,313,143]}{[621,246,732 + 624,127,435 + 584,313,143]}$$

$$CI_{BaselineCrudeAve} = 11.85$$

Calculation of Three-Year California Crude Average Carbon Intensity:

$CI_{2019CrudeAve}$  is the Three-year California Crude Average carbon intensity value, in gCO<sub>2</sub>e/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 (2017, 2018 and 2019), and is calculated by the following formula:

$$CI_{2019CrudeAve} = \frac{[11.93 \times 621,246,732 + 12.35 \times 624,127,435 + 12.52 \times 584,313,143]}{[621,246,732 + 624,127,435 + 584,313,143]}$$

$$CI_{2019CrudeAve} = 12.26$$

Summary: The Three-year California Crude Average carbon intensity of 12.26 gCO<sub>2</sub>e/MJ is greater than the California Baseline Crude Average carbon intensity of 11.85 gCO<sub>2</sub>e/MJ plus 0.10 gCO<sub>2</sub>e/MJ. Therefore, pursuant to sections 95489(a) and (b) of the LCFS regulation, incremental deficits of  $0.41 \times E^{XD} \times C$  for CARBOB or diesel will be added to each affected regulated party's compliance obligation for the annual compliance period of 2021, 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: 2019 Refinery Crude Supply**

| <b>Country/State</b> | <b>Crude Name</b>        | <b>CI (g/MJ)</b> | <b>2019 Volume (bbl)</b> |
|----------------------|--------------------------|------------------|--------------------------|
|                      | Annual Crude Average CI  | 12.52            | 584,313,143              |
| Angola               | Clov                     | 7.31             | 3,918                    |
|                      | Dalia                    | 8.90             | 904,908                  |
|                      | Gimboa                   | 8.86             | 6,974                    |
|                      | Greater Plutonio         | 8.72             | 681                      |
|                      | Nemba                    | 9.08             | 945,960                  |
|                      | Pazflor                  | 8.02             | 4,822,092                |
| Argentina            | Escalante                | 10.15            | 3,669,247                |
| Brazil               | Atlanta                  | 11.78            | 547,445                  |
|                      | Bijupira Salema          | 7.18             | 271,972                  |
|                      | Iracema (Cernambi)       | 5.54             | 8,180,807                |
|                      | Lula                     | 6.24             | 6,193,072                |
|                      | Peregrino                | 4.16             | 616,364                  |
|                      | Sapinhua                 | 6.00             | 12,240,467               |
| Canada               | Access Western Blend     | 15.15            | 3,518,916                |
|                      | Burnaby Blend            | 11.78            | 159,680                  |
|                      | Christina Dilbit Blend   | 12.71            | 636,375                  |
|                      | Cold Lake                | 17.87            | 197,964                  |
|                      | Fort Hills               | 11.78            | 2,218,325                |
|                      | Kearl Lake               | 12.89            | 1,937,724                |
|                      | Mixed Sweet              | 8.11             | 149,184                  |
|                      | Peace River Sour         | 8.11             | 102,242                  |
|                      | Premium Albion Synthetic | 29.49            | 164,165                  |
|                      | Surmont Heavy Blend      | 22.48            | 374,449                  |
|                      | Syncrude Synthetic       | 31.62            | 165,594                  |
|                      | Synthetic Sweet Blend    | 29.36            | 670,978                  |
|                      | Western Canadian Select  | 19.04            | 56,885                   |
| Colombia             | Castilla                 | 10.55            | 3,007,404                |
|                      | Chaza                    | 11.78            | 1,070,021                |
|                      | Mares Blend              | 11.78            | 607,005                  |
|                      | South Blend              | 9.25             | 750,952                  |
|                      | Vasconia                 | 9.62             | 26,464,151               |
| Ecuador              | Napo                     | 8.31             | 19,911,014               |
|                      | Oriente                  | 10.07            | 43,548,568               |
| Equatorial Guinea    | Zafiro                   | 20.56            | 2,074,687                |
| Ghana                | Jubilee                  | 11.78            | 902,458                  |
|                      | Sankofa                  | 11.78            | 199,492                  |
|                      | Ten Blend                | 8.08             | 3,421,587                |

| Country/State   | Crude Name                         | CI (g/MJ) | 2019 Volume (bbl) |
|-----------------|------------------------------------|-----------|-------------------|
| Iraq            | Basra Light                        | 13.45     | 54,931,811        |
|                 | Basra Heavy                        | 10.69     | 1,832,776         |
| Kuwait          | Kuwait                             | 10.56     | 8,507,713         |
| Mexico          | Maya                               | 7.85      | 12,256,766        |
| Nigeria         | Agbami                             | 12.04     | 2,568,360         |
|                 | Antan                              | 21.98     | 979,892           |
|                 | Amenam                             | 10.65     | 1,687,404         |
|                 | Bonga                              | 5.06      | 7,602,026         |
|                 | Erha                               | 10.91     | 2,424,978         |
|                 | Forcados                           | 8.97      | 3,050,214         |
|                 | Qua Iboe                           | 11.45     | 907,356           |
| Oman            | Oman                               | 13.32     | 7,275             |
| Peru            | Pirana                             | 8.43      | 175,780           |
|                 | RPS (Residual Peruano de la Selva) | 11.78     | 90,635            |
| Russia          | ESPO                               | 11.55     | 727,720           |
|                 | Sokol                              | 6.94      | 5,224,223         |
| Saudi Arabia    | Arab Extra Light                   | 9.41      | 20,729,323        |
|                 | Arab Light                         | 9.23      | 58,226,178        |
|                 | Arab Medium                        | 8.72      | 9,228,711         |
| Trinidad        | Molo                               | 11.78     | 2,082,311         |
| UAE             | Murban                             | 10.01     | 1,025,936         |
| Venezuela       | Hamaca DCO                         | 10.02     | 772,920           |
| US Alaska       | Alaska North Slope                 | 15.91     | 75,345,560        |
| US New Mexico   | Four Corners                       | 11.11     | 1,146,069         |
| US North Dakota | North Dakota Sweet                 | 9.73      | 328,964           |
| US Texas        | West Texas Intermediate            | 11.93     | 1,420,258         |
| US Utah         | Covenant                           | 4.43      | 82,426            |
|                 | Utah Sweet                         | 6.92      | 1,770             |
| US California*  | Aliso Canyon                       | 4.94      | 55,635            |
|                 | Ant Hill                           | 20.81     | 17,715            |
|                 | Antelope Hills                     | 2.84      | 88,313            |
|                 | Antelope Hills, North              | 24.75     | 232,862           |
|                 | Arroyo Grande                      | 31.11     | 457,737           |
|                 | Asphalto                           | 8.01      | 162,643           |
|                 | Bandini                            | 3.09      | 9,406             |
|                 | Bardsdale                          | 3.47      | 140,884           |
|                 | Barham Ranch                       | 4.15      | 74,657            |
|                 | Beer Nose                          | 3.98      | 9,790             |
|                 | Belgian Anticline                  | 5.01      | 39,256            |

| Country/State | Crude Name        | CI (g/MJ) | 2019 Volume (bbl) |
|---------------|-------------------|-----------|-------------------|
|               | Bellevue          | 5.95      | 29,764            |
|               | Bellevue, West    | 6.60      | 49,495            |
|               | Belmont, Offshore | 5.12      | 425,950           |
|               | Belridge, North   | 4.11      | 1,677,608         |
|               | Belridge, South   | 17.09     | 19,696,894        |
|               | Beverly Hills     | 5.41      | 386,445           |
|               | Big Mountain      | 4.65      | 13,588            |
|               | Blackwells Corner | 3.07      | 14,921            |
|               | Brea-Olinda       | 3.59      | 1,019,426         |
|               | Brentwood         | 11.78     | 127,191           |
|               | Buena Vista       | 7.44      | 969,666           |
|               | Burrel            | 29.43     | 14,068            |
|               | Cabrillo          | 4.14      | 14,643            |
|               | Cal Canal Gas     | 11.78     | 19,084            |
|               | Canal             | 4.40      | 9,645             |
|               | Canfield Ranch    | 4.53      | 90,992            |
|               | Carneros Creek    | 4.06      | 12,203            |
|               | Cascade           | 3.00      | 92,064            |
|               | Casmalia          | 10.26     | 90,160            |
|               | Castaic Hills     | 2.68      | 6,435             |
|               | Cat Canyon        | 7.83      | 1,165,356         |
|               | Cheviot Hills     | 3.49      | 43,890            |
|               | Chico-Martinez    | 48.13     | 85,356            |
|               | Cienaga Canyon    | 5.78      | 12,103            |
|               | Coalinga          | 25.81     | 5,837,627         |
|               | Coles Levee, N    | 4.09      | 60,738            |
|               | Coles Levee, S    | 5.87      | 25,916            |
|               | Comanche          | 5.03      | 11,490            |
|               | Coyote, East      | 5.96      | 176,091           |
|               | Cuyama, South     | 14.70     | 174,690           |
|               | Cymric            | 15.69     | 12,904,635        |
|               | Deer Creek        | 11.51     | 34,710            |
|               | Del Valle         | 5.78      | 24,258            |
|               | Devils Den        | 7.51      | 8,511             |
|               | Dominguez         | 3.57      | 5,818             |
|               | Edison            | 14.53     | 670,084           |
|               | El Segundo        | 4.38      | 20,532            |
|               | Elk Hills         | 8.02      | 7,802,455         |
|               | Fruitvale         | 3.75      | 422,068           |

| Country/State | Crude Name            | CI (g/MJ) | 2019 Volume (bbl) |
|---------------|-----------------------|-----------|-------------------|
|               | Greeley               | 7.91      | 132,616           |
|               | Hasley Canyon         | 2.25      | 24,339            |
|               | Helm                  | 3.99      | 44,991            |
|               | Holser                | 3.80      | 12,762            |
|               | Honor Rancho          | 3.43      | 15,599            |
|               | Huntington Beach      | 6.62      | 1,813,141         |
|               | Hyperion              | 1.90      | 11,163            |
|               | Inglewood             | 10.06     | 1,875,880         |
|               | Jacalitos             | 2.72      | 85,790            |
|               | Jasmin                | 16.59     | 130,462           |
|               | Kern Bluff            | 12.54     | 32,808            |
|               | Kern Front            | 35.68     | 3,282,953         |
|               | Kern River            | 15.09     | 17,748,828        |
|               | Kettleman Middle Dome | 3.93      | 10,731            |
|               | Kettleman North Dome  | 3.42      | 114,355           |
|               | Landslide             | 12.53     | 36,536            |
|               | Las Cienegas          | 4.96      | 137,015           |
|               | Livermore             | 2.66      | 7,266             |
|               | Lompoc                | 28.45     | 235,540           |
|               | Long Beach            | 5.48      | 1,224,456         |
|               | Long Beach Airport    | 4.92      | 7,222             |
|               | Los Angeles Downtown  | 5.89      | 34,434            |
|               | Lost Hills            | 12.99     | 9,057,838         |
|               | Lost Hills, Northwest | 5.36      | 14,284            |
|               | Lynch Canyon          | 23.10     | 194,088           |
|               | Mahala                | 4.99      | 8,181             |
|               | McCool Ranch          | 9.59      | 876               |
|               | McDonald Anticline    | 4.33      | 41,908            |
|               | McKittrick            | 25.31     | 3,309,294         |
|               | Midway-Sunset         | 29.33     | 19,644,832        |
|               | Montalvo, West        | 2.65      | 152,989           |
|               | Montebello            | 17.03     | 331,036           |
|               | Monument Junction     | 4.95      | 73,570            |
|               | Mount Poso            | 3.71      | 1,219,613         |
|               | Mountain View         | 3.97      | 63,595            |
|               | Newhall-Potrero       | 3.66      | 36,885            |
|               | Newport, West         | 5.21      | 69,391            |
|               | Oak Canyon            | 4.04      | 8,841             |
|               | Oak Park              | 3.01      | 8,164             |

| Country/State | Crude Name         | CI (g/MJ) | 2019 Volume (bbl) |
|---------------|--------------------|-----------|-------------------|
|               | Oakridge           | 3.46      | 84,428            |
|               | Oat Mountain       | 3.17      | 46,649            |
|               | Ojai               | 4.94      | 234,153           |
|               | Olive              | 1.82      | 45,991            |
|               | Orcutt             | 11.76     | 869,960           |
|               | Oxnard             | 5.39      | 195,707           |
|               | Paloma             | 4.88      | 12,772            |
|               | Placerita          | 32.78     | 508,182           |
|               | Playa Del Rey      | 6.87      | 50,623            |
|               | Pleito             | 2.09      | 465,048           |
|               | Poso Creek         | 21.96     | 5,301,097         |
|               | Pyramid Hills      | 3.36      | 44,298            |
|               | Railroad Gap       | 7.08      | 98,224            |
|               | Raisin City        | 9.13      | 4,131             |
|               | Ramona             | 4.47      | 27,363            |
|               | Richfield          | 4.75      | 165,826           |
|               | Rincon             | 4.88      | 246,691           |
|               | Rio Bravo          | 6.98      | 202,083           |
|               | Rio Viejo          | 2.74      | 133,522           |
|               | Riverdale          | 3.80      | 21,697            |
|               | Rose               | 2.91      | 192,140           |
|               | Rosecrans          | 5.76      | 217,318           |
|               | Rosecrans, South   | 3.54      | 6,195             |
|               | Rosedale           | 2.35      | 11,857            |
|               | Rosedale Ranch     | 8.32      | 98,191            |
|               | Round Mountain     | 24.04     | 2,583,449         |
|               | Russell Ranch      | 8.58      | 44,581            |
|               | Salt Lake          | 3.18      | 35,709            |
|               | Salt Lake, South   | 6.34      | 4,011             |
|               | San Ardo           | 26.42     | 8,120,413         |
|               | San Emidio Nose    | 11.78     | 56,922            |
|               | San Miguelito      | 5.25      | 351,770           |
|               | San Vicente        | 3.22      | 162,940           |
|               | Sansinena          | 3.21      | 224,686           |
|               | Santa Clara Avenue | 3.53      | 29,551            |
|               | Santa Fe Springs   | 12.53     | 586,534           |
|               | Santa Maria Valley | 4.80      | 86,525            |
|               | Santa Susana       | 5.29      | 3,729             |
|               | Sargent            | 4.00      | 19,040            |

| Country/State  | Crude Name         | CI (g/MJ) | 2019 Volume (bbl) |
|----------------|--------------------|-----------|-------------------|
|                | Saticoy            | 3.68      | 33,297            |
|                | Sawtelle           | 2.56      | 38,354            |
|                | Seal Beach         | 5.19      | 381,607           |
|                | Semitropic         | 4.30      | 21,924            |
|                | Sespe              | 3.98      | 336,170           |
|                | Shafter, North     | 3.32      | 407,252           |
|                | Shiells Canyon     | 5.07      | 45,213            |
|                | South Mountain     | 3.58      | 383,014           |
|                | Stockdale          | 2.18      | 91,673            |
|                | Tapia              | 6.92      | 12,098            |
|                | Tapo Canyon, South | 3.08      | 5,192             |
|                | Tejon              | 13.77     | 208,145           |
|                | Tejon Hills        | 9.39      | 7,281             |
|                | Tejon, North       | 5.63      | 26,599            |
|                | Temescal           | 3.40      | 41,011            |
|                | Ten Section        | 7.50      | 63,082            |
|                | Timber Canyon      | 4.74      | 32,557            |
|                | Torrance           | 3.99      | 344,414           |
|                | Torrey Canyon      | 3.52      | 61,225            |
|                | Union Avenue       | 5.58      | 8,203             |
|                | Vallecitos         | 4.53      | 12,410            |
|                | Ventura            | 4.54      | 3,860,285         |
|                | Wayside Canyon     | 2.36      | 2,301             |
|                | West Mountain      | 3.53      | 7,926             |
|                | Wheeler Ridge      | 2.80      | 57,135            |
|                | White Wolf         | 1.92      | 10,065            |
|                | Whittier           | 3.71      | 99,993            |
|                | Wilmington         | 8.31      | 10,326,945        |
|                | Yowlumne           | 13.90     | 324,343           |
|                | Zaca               | 9.53      | 151,598           |
| US Federal OCS | Beta               | 1.59      | 1,655,673         |
|                | Carpinteria        | 3.28      | 264,883           |
|                | Dos Cuadras        | 4.57      | 976,747           |
|                | Hueneme            | 4.67      | 62,327            |
|                | Point Pedernales   | 8.26      | 1,024,156         |
|                | Santa Clara        | 2.46      | 465,220           |

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