

California Low Carbon Fuel Standard (LCFS) Analysis of Quarterly Summary: 4th Quarter 2022 May 9, 2023

In this quarterly edition...

- ⇒ **Credit Bank:** Net credit of more than 1.6 million MT for 4Q2022 brings credit bank to historic high of 15.07 million MT.
- ⇒ **Volume Trends:** Alternative and renewable fuel volumes fall off from historic high
- ⇒ **Analyses:** 2022 Credit Growth + QTQ & YTY Trends + A closer look at 2022 vs 2021
- ⇒ **New Addition:** Quarterly CI Reduction Trends

The Stillwater LCFS Quarterly Newsletter presents our analysis of the credit and deficit data from the LCFS Reporting Tool and Credit Bank & Transfer System (LRT-CBTS). The LRT-CBTS is the repository of the LCFS transaction and credit/deficit data input by Fuel Reporting Entities. The California Air Resources Board (CARB) uses this data to publish its LRT Quarterly Summary. Analysis of the data provides insight into the trends of credit and deficit generation, the trends in low carbon intensity (CI) fuel use, and potential future trends.

The fourth quarter of 2022 logged a 1,653,123 MT (1.65 million MT) net credit, building on the previous quarter's record 1,762,631 (1.76 million MT) net credit, and nearly twice the size of the 918,047 net credit for the same quarter the previous year (4Q2021). CARB cautions that "these figures are subject to change as regulated parties may correct their quarterly data". We note that with each quarterly release there are at least small revisions to the prior quarter(s).

With the 4Q2022 net credit, the credit bank stands at a record high 15.07 million MT.

We offer three highlight articles in this issue:

1. An overview of the growth in credit generation in 2022
2. An analysis covering the fourth quarter 2022 data comparing to the prior and year-earlier quarters
3. A granular display of the LRT data comparing the full year 2022 to the full year 2021

In addition, we are adding a new chart that tracks the LCFS program's actual CI reduction by quarter and the CI reduction trends of fuels measured against the gasoline and diesel benchmarks. These data help demonstrate where CI reductions are concentrated, and where the opportunities and challenges for LCFS lie.

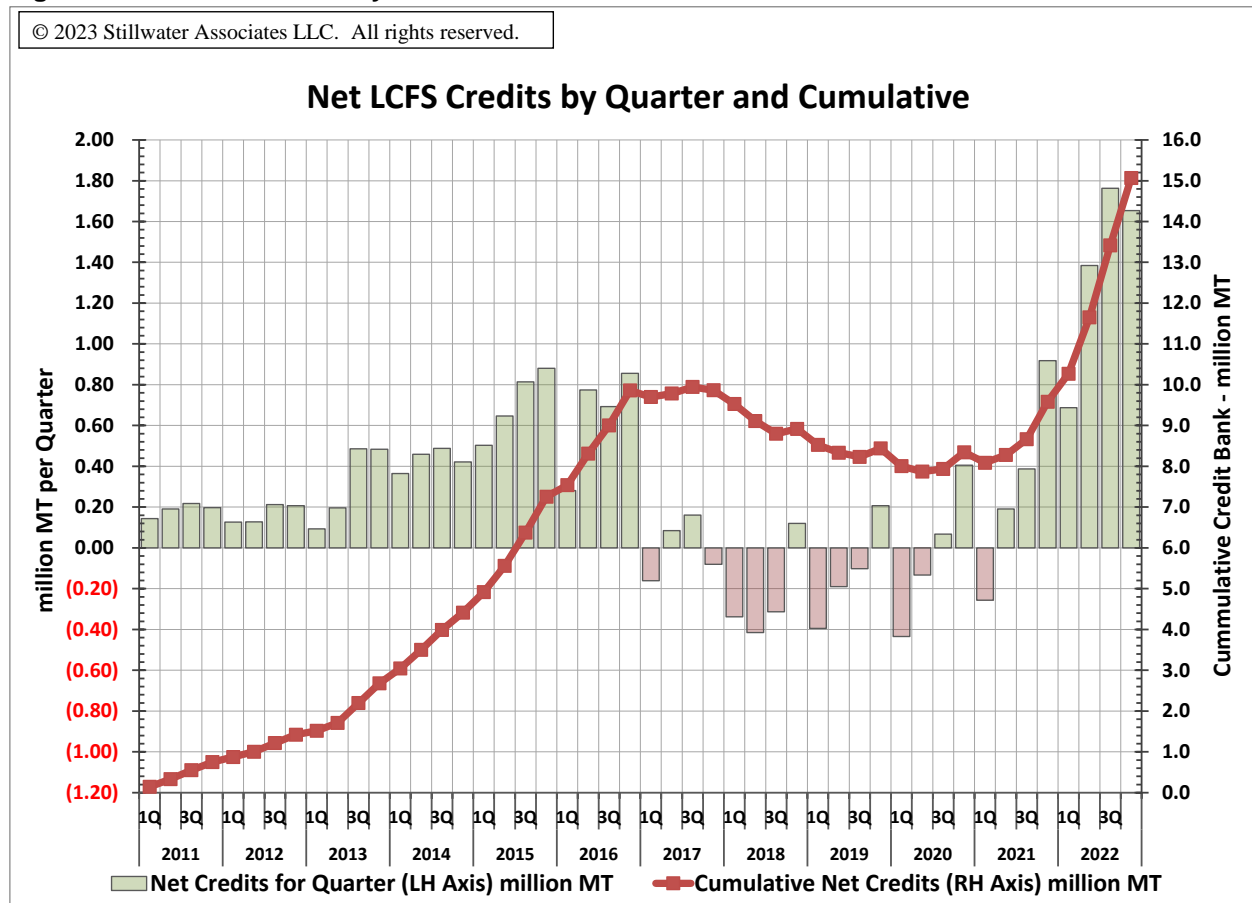
LCFS Credit and Deficit Trends – Credit Bank Grows to New Record High

For the fourth quarter of 2022, 7.13 million MT of gross credits were generated – the largest quarterly gross credit generation under the LCFS program to-date – compared to 6.97 million MT in the third quarter and 5.61 million MT in the fourth quarter of 2021. There were 5.48 million MT of gross deficits for the fourth quarter of 2022 compared to 5.21 million MT and 4.70 million MT for the third quarter of 2022 and fourth quarter of 2021, respectively. At the close of the fourth quarter of 2022, the credit bank stands at 15.07 million MT compared to 13.42 million MT at the close of the third quarter of 2022.

As illustrated in Figure 1, the credit bank previously peaked at 9.95 million MT at the end of the third quarter of 2017 then began trending downward to the second quarter of 2020 as the LCFS standard became more stringent. Since the third quarter of 2021, the credit bank has shown an increasing trend. The 1,653,123 MT fourth quarter 2022 net credit builds on the past six quarters’ credit trend and brings the cumulative credit bank to the highest level since the LCFS program’s inception. Incremental Crude CI deficits, which were triggered for the first time in 2020, more than doubled in 2022 to 0.92 gCO₂e/MJ of CARBOB or ULSD compared to 0.41 gCO₂e/MJ in 2021. These CARBOB and ULSD Incremental Crude deficits for the fourth quarter totaled 0.41 million MT, up from 0.39 million MT for the previous quarter and up 0.19 million MT for the same quarter the prior year.

At the end of the fourth quarter, the cumulative credit bank was equal to 2.75 quarters of deficits at the 4Q2022 rate of deficit generation, meaning that if no credits were generated going forward, the bank would run out in just over eight months.

Figure 1: Net LCFS Credits by Quarter and Cumulative



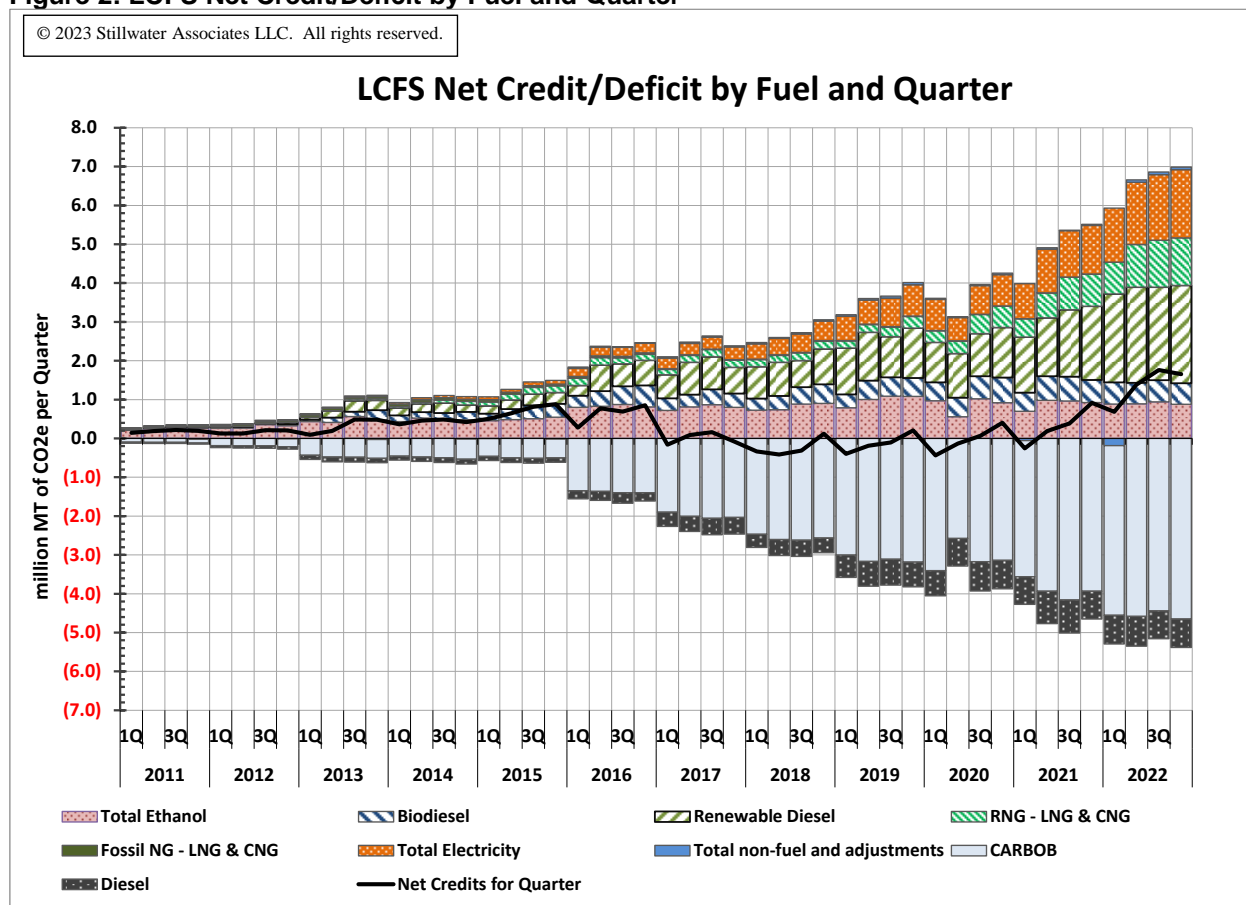
LCFS Credit/Deficit Trends – Deficits Hold Steady as Credit Generation Hits New Record High

Figure 2 shows the quarterly credits and deficits by fuel category as reported by CARB. The total credits (gross credits less adjustments for fuel exports, corrections, etc.) posted for credit-generating fuels increased to a record 7.13 million MT for 4Q2022 from prior record 6.97 million MT for 3Q2022 and 5.61 million MT in 4Q2021.¹

On the deficit side, combined CARBOB and ULSD net deficits grew by over 4% from 5.15 million MT in 3Q2022 to 5.38 million MT in the fourth quarter of 2022. This quarterly total deficit is up 16% from the 4.65 million MT total deficit in the same quarter the previous year (4Q2021).

Taking total credits and total deficits into account produces the black “net credits” line in Figure 2 below, which reflects the quarterly net credit and deficit columns in Figure 1 above.

Figure 2: LCFS Net Credit/Deficit by Fuel and Quarter



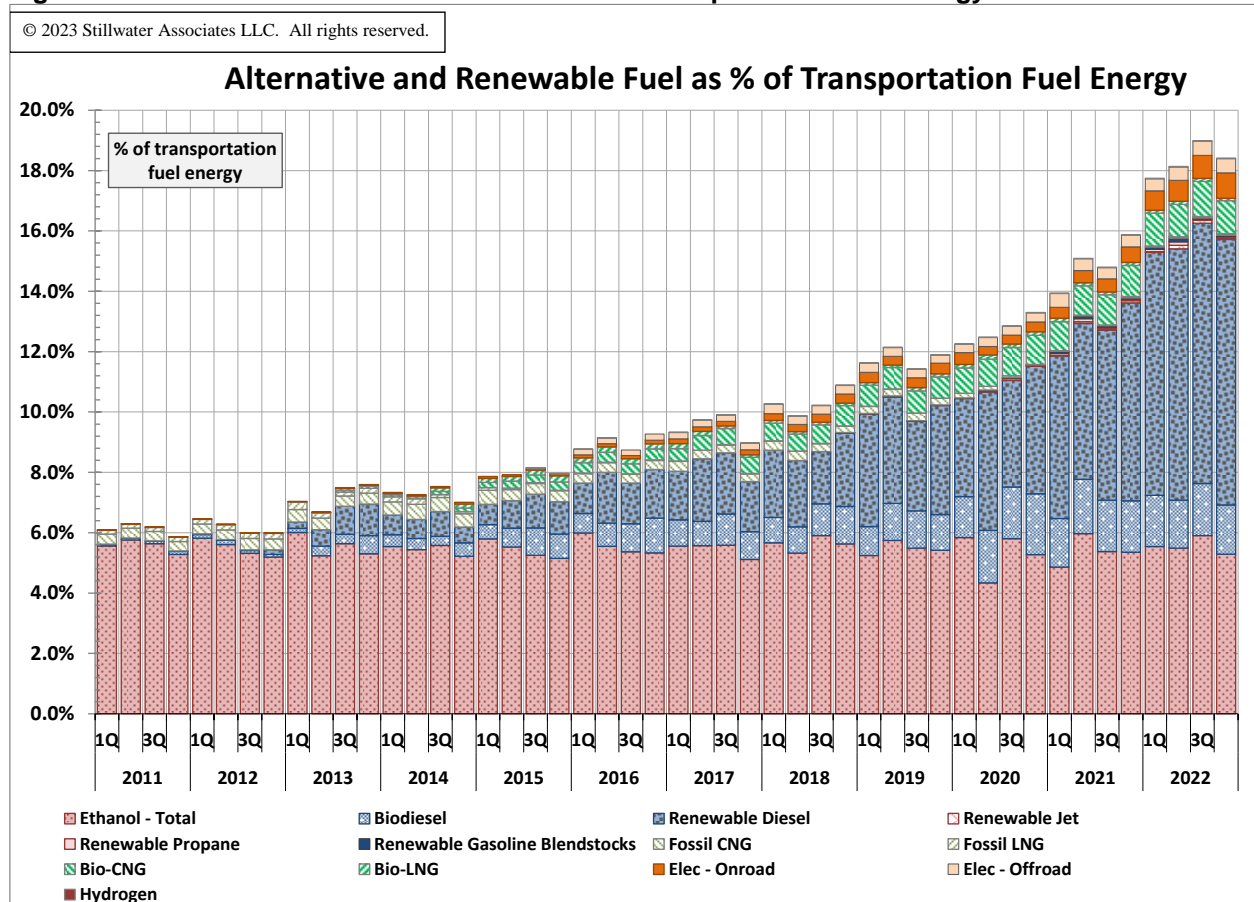
Note: Incremental Crude Deficits are included in the CARBOB and Diesel categories.

¹ Per CARB: “For alternative fuels that displace diesel and CARBOB, credits are generated by low-CI fuels due to production, imports, and purchase, etc. while any deficits generated are either due to a higher carbon intensity (CI) than the CI standard or due to sale of inventories, exports outside of CA, etc.”

Fuel Volume Trends – Alternative and Renewable Fuel Volumes Fall off from Historic High

As shown in Figure 3, alternative and renewable fuels volumes declined from last quarter’s 19.13% of transportation energy to 18.54% in the fourth quarter of 2022. Alternative and Renewable Fuel volume percentage fell as total transportation fuel volume grew by 3.55% in the fourth quarter compared to the previous quarter. Total transportation fuel volume for the fourth quarter was up 1.67% from a year earlier (4Q2021).

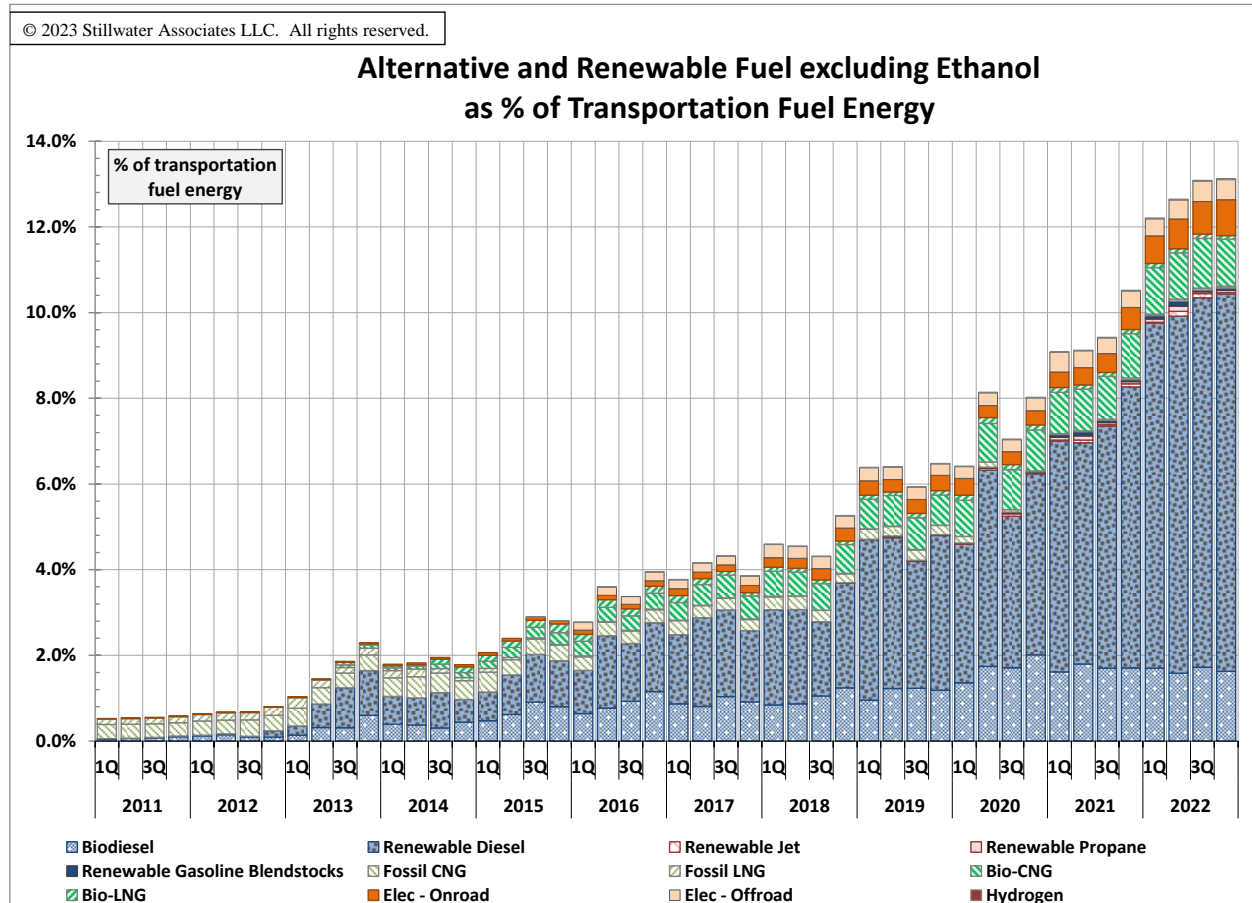
Figure 3: Alternative and Renewable Fuel as % of Transportation Fuel Energy



Alternative and Renewable Fuels Excluding Ethanol at All-time High

Since ethanol is essentially fixed at 10% of the gasoline volume because of CARB gasoline specifications, (except for the volume of E85 which has been small to-date), volumetric use of ethanol is dependent on gasoline use and should vary little independent of CARB gasoline other than changes in inventory. A truer picture of the impact of low-CI fuels on the California transportation energy mix becomes clearer when ethanol is excluded. Figure 4 shows the contribution that non-ethanol alternative and renewable fuels (i.e., those fuels with growth potential) have made to the transportation fuel mix. The total contribution of non-ethanol renewable and alternative fuels rose slightly to 13.25% of transportation fuel energy in the fourth quarter of 2022, up from 13.22% in the third quarter of 2022 and a 10.65% in the fourth quarter of 2021. The fourth quarter of 2022 continues the growth trend in non-ethanol renewable and alternative fuels and brings the total to a new all-time high.

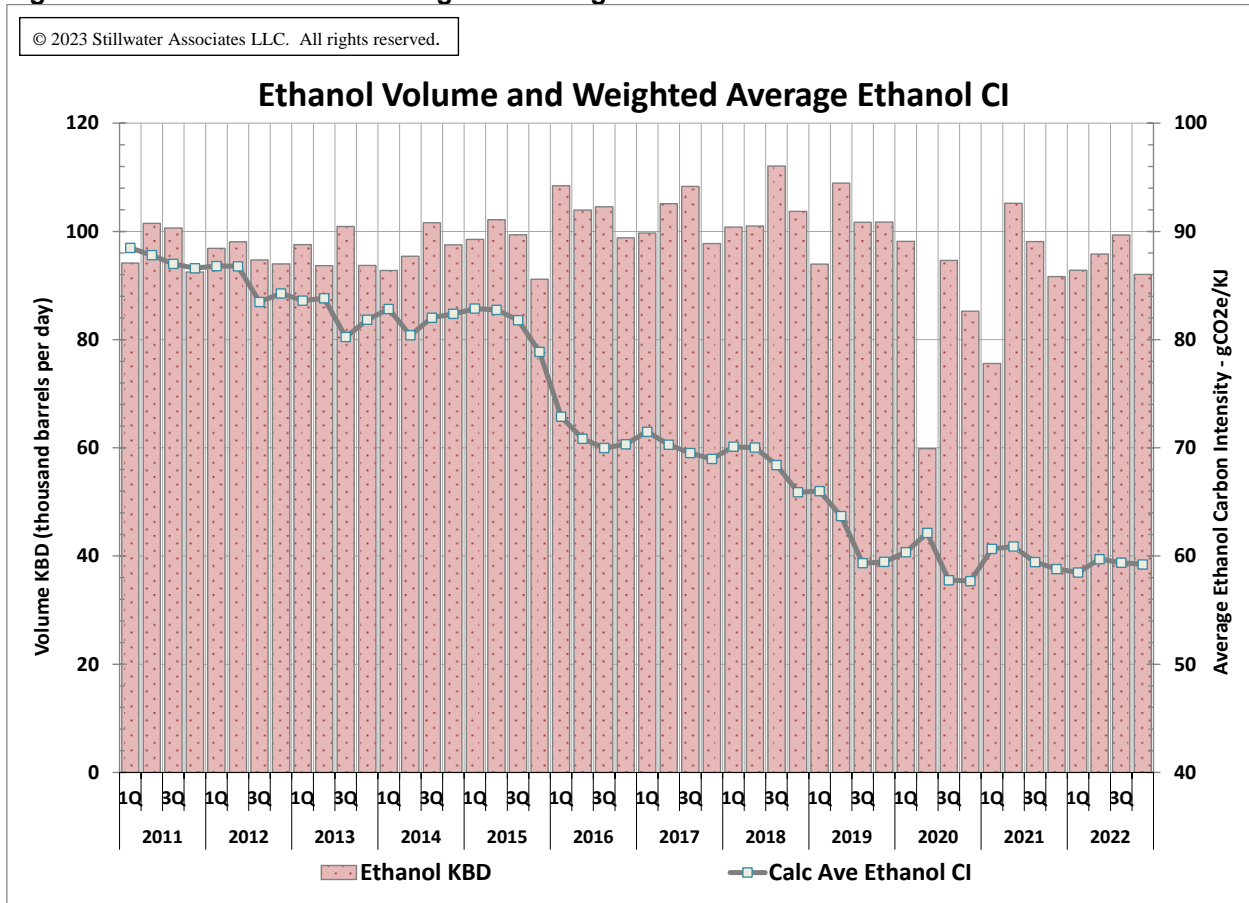
Figure 4: Alternative and Renewable Fuel excluding Ethanol as % of Transportation Fuel Energy



Ethanol CI Trend – Volumes Slightly Down, CI Steady

Figure 5 shows the trend for the weighted average CI for ethanol and the volume of ethanol. The weighted average CI remains significantly lower than 2015 and earlier, since the 2016 indirect land use change (ILUC) value was decreased in the 2015 re-adoption of the LCFS. Since mid-2018, the weighted average ethanol CI began showing a declining trend with increased sugarcane and cellulosic ethanol in the mix. The 59.23 gCO₂e/MJ average CI for the fourth quarter of 2022 is a slight decrease from the 59.39 gCO₂e/MJ in the third quarter of 2022. Ethanol volumes for the fourth quarter fell slightly (7.31%) compared to the previous quarter but grew 0.47% compared to 4Q2021.

Figure 5: Ethanol Volume and Weighted Average Ethanol CI



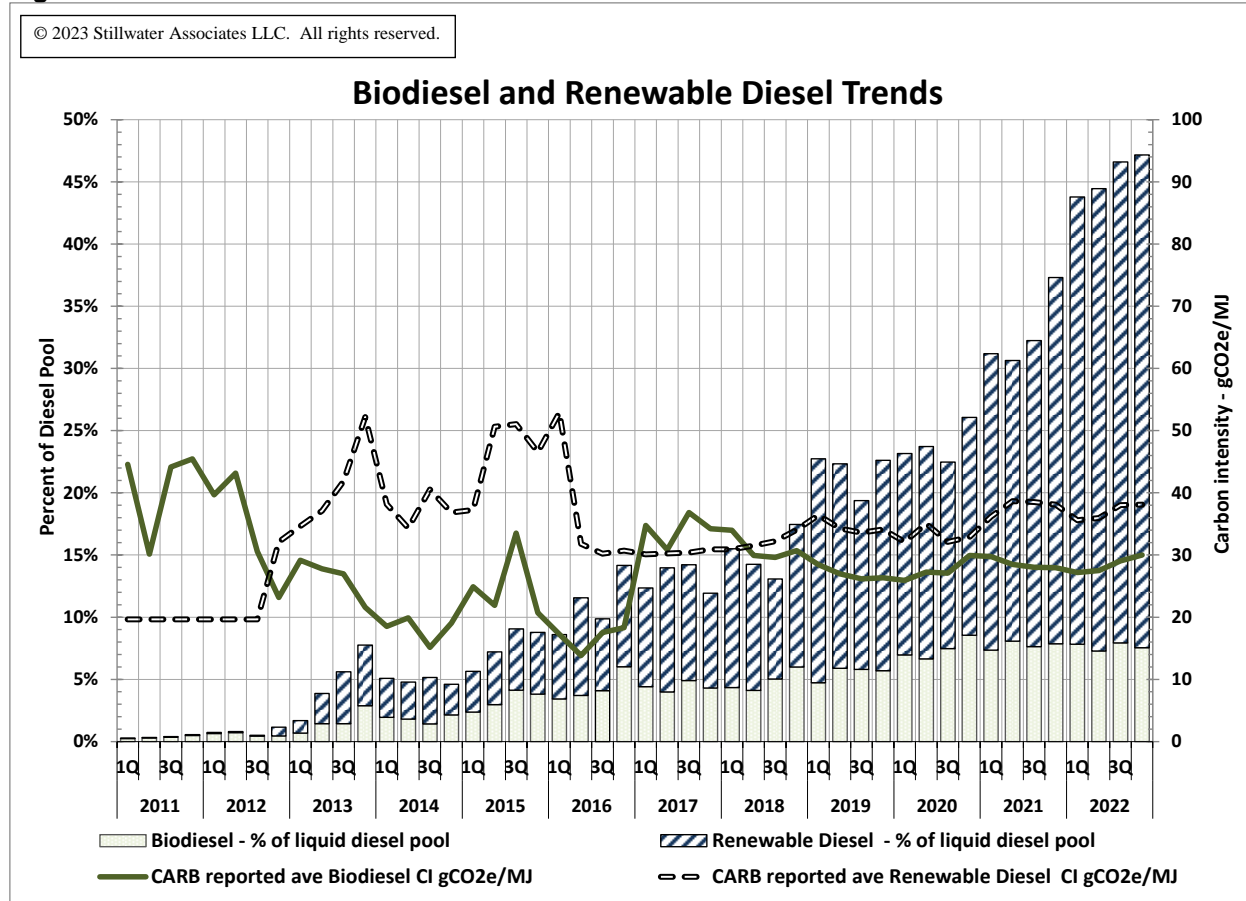
Biodiesel, Renewable Diesel Shares and CI Trends – BD Volume Drops, RD Remains Steady

Figure 6 shows the percentage of BD and RD as a share of the liquid diesel pool (the combined ULSD, BD, and RD pool) and the weighted average CI for each. BD volume fell to 7.55% of the diesel pool in the fourth quarter of 2022 from 7.94% in 3Q2022. Meanwhile, the RD percentage essentially held steady at 39.62 volume % of the diesel pool in the fourth quarter compared to the previous quarter's record of 39.67%. Combined, RD and BD made up 47.16% of the diesel pool in the fourth quarter of 2022, up from 46.61% in the third quarter of 2022.

The weighted average CI for RD has mostly hovered in the mid-to-low 30s since the middle of 2016 but increased several points in 2021 as RD from soybean oil increased in the RD mix.² The CI of RD increased slightly from a CI of 38.01 gCO₂e/MJ in 3Q2022 to 38.10 for 4Q2022, nearly matching the CI of 38.08 observed in 4Q2021.

For its part, the weighted average CI of BD has hovered in the high 20s since 2019. The CI continues to trend in this range with a slight upward trend throughout 2022, increasing from a CI of 29.04 gCO₂e/MJ in 3Q2022 to 29.99 in 4Q2022.

Figure 6: Biodiesel and Renewable Diesel Trends

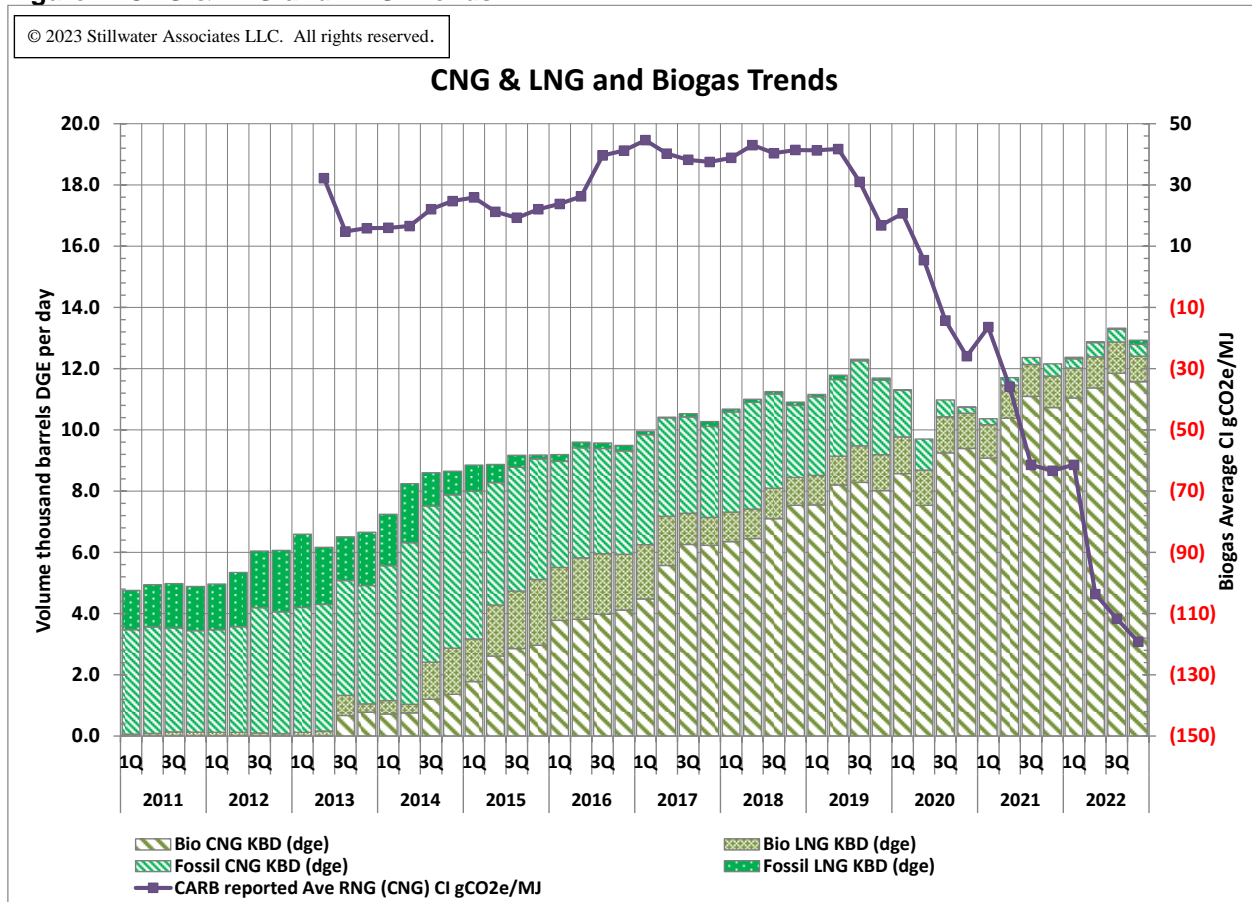


² This increasing RD CI trend was attributable to increasing soybean oil-based RD supplied to California. We note here that there is not projected to be enough waste oil feedstocks to fully supply the RD facilities being constructed in North America, so Stillwater expects average CI of RD to generally increase over the next couple of years as these plants come online and the share of soybean oil in the feedstock mix increases.

CNG/LNG and Renewable Natural Gas Trends

Figure 7 highlights the trends in RNG and fossil natural gas use in CNG and LNG vehicles. The chart shows the volumes in thousand DGE per day of RNG and fossil gas in the CNG and LNG pool, and the weighted average CI of the RNG pool. RNG represents 95.99% of total transportation CNG/LNG volume for the fourth quarter of 2022. Since fossil gas has been virtually completely displaced by RNG, Figure 7 reports the weighted average RNG CI. On the volume side, fourth quarter CNG/LNG usage fell slightly to 12.4 KBD (dge), down 3.88% compared to the all-time high of 12.9 KBD in the third quarter of 2022. The CARB-reported weighted average CI of bio CNG dropped from the previous quarter to -119.22 gCO₂e/MJ in 4Q2022.

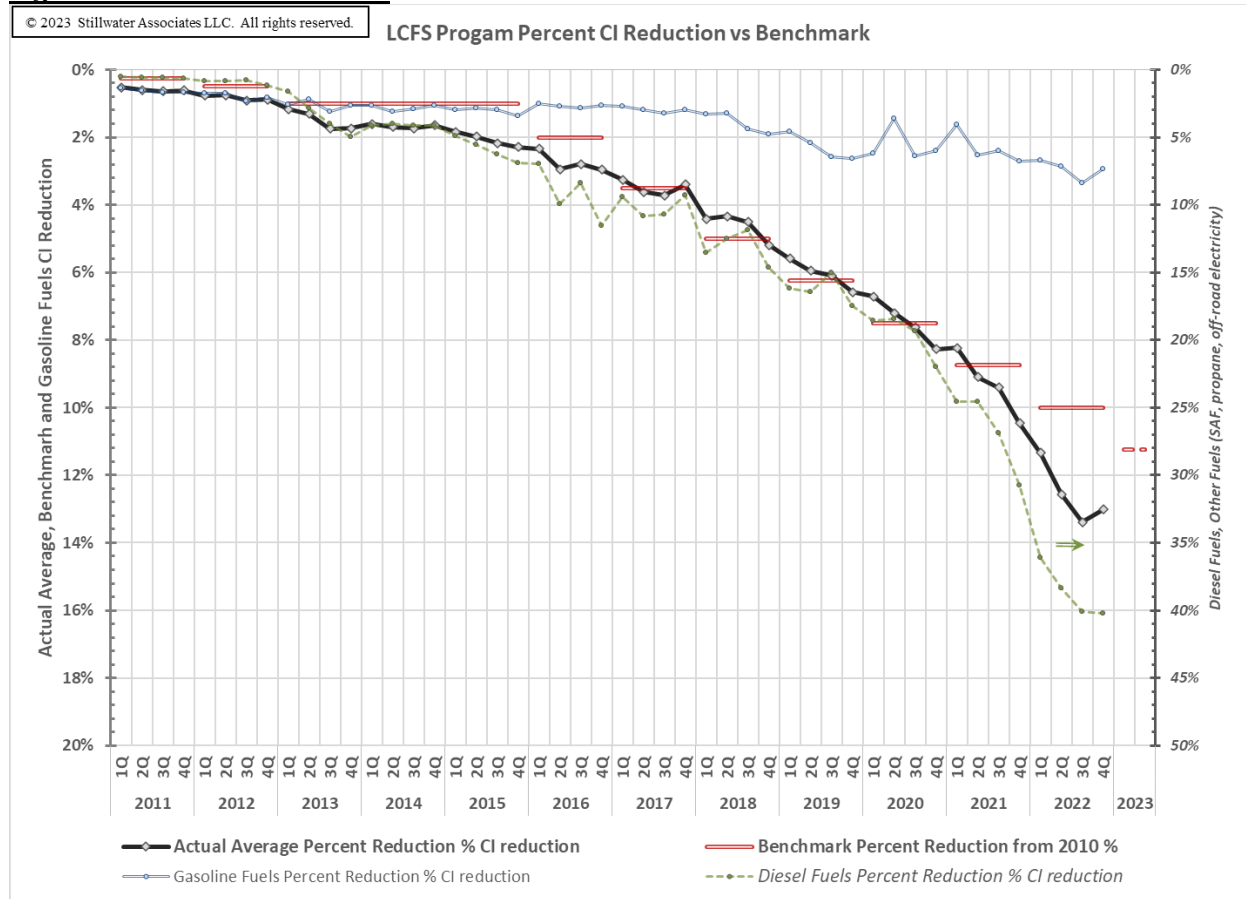
Figure 7: CNG & LNG and RNG Trends



New: CI Reduction Trends

Beginning with this 4Q2022 Newsletter, we are adding in a new figure tracking the actual program CI reductions compared to the regulatory benchmark. This figure also separately tracks the percent reduction for the gasoline fuels (which include alternative fuels with CIs measured against the gasoline benchmark) and the diesel fuels (which include alternative fuels with CIs measured against the diesel benchmark). These data are shown in Figure 8 below. For 2022, the regulatory benchmark for the LCFS program was a 10% CI reduction. In the fourth quarter of 2022, the achieved reduction was 13.0%, a slight decrease in performance compared to the 3Q2022 achieved CI reduction of 13.4%.

Figure 8: CI Reduction Trends

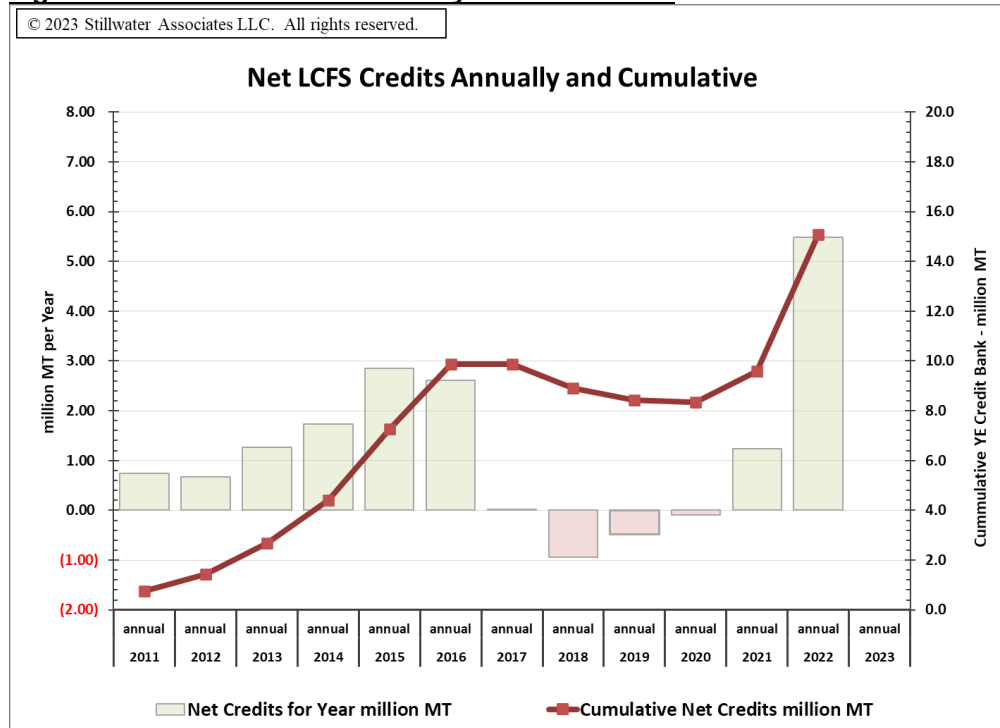


Notably, the diesel fuel reduction curve (which references the right axis and covers the liquid diesel fuels plus LNG/CNG and heavy-duty electricity) has shown a much greater reduction in CI than the gasoline fuels (covering CARBOB, ethanol, hydrogen, and light-duty electricity). There are two factors that have accelerated the diesel fuels' reduction curve relative to the gasoline fuels' reduction curve. The first is the increasing use of BD and RD which has displaced approximately half of the ULSD volume in the liquid diesel pool. The second factor is the increased use of negative CI animal waste digester RNG that has displaced fossil and landfill natural gas used in natural gas vehicles. By contrast, the gasoline pool does not have a comparable substitute liquid fuel to displace high CI CARBOB. For the gasoline pool CI to decline and approach the annual CI-reduction benchmark, the percentage of light- and medium-duty electricity and hydrogen volume will need to greatly increase from its current 1.1 volume% of the gasoline pool.

Highlight 1: 2022 was a Huge Year for Credit Growth

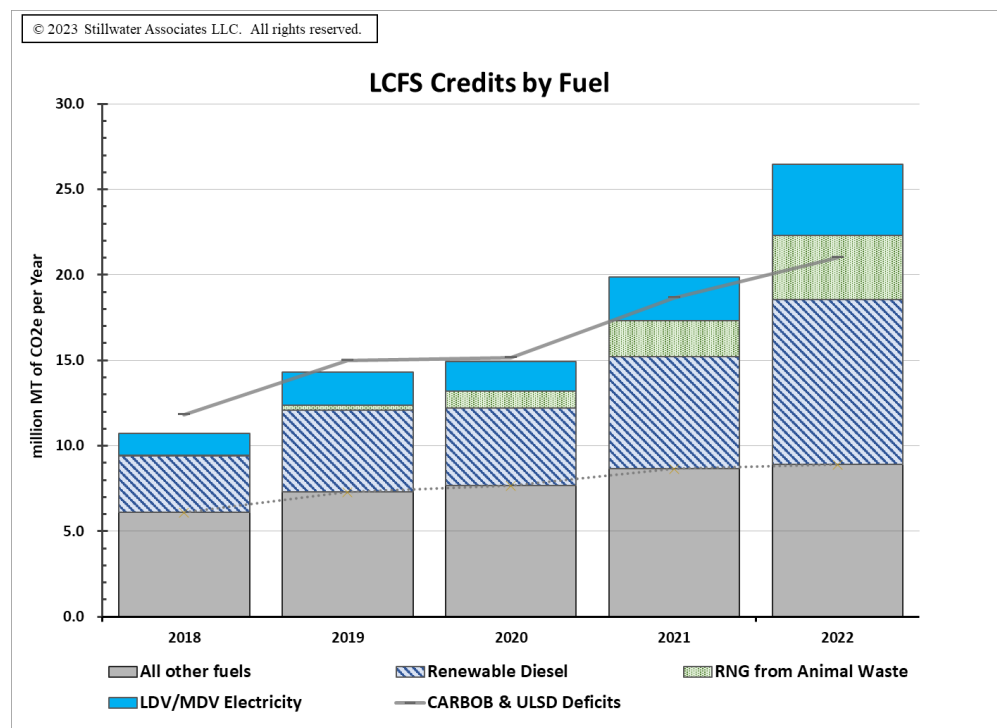
Record credit generation in 2022 resulted in a 57% spike in the credit bank which led to a similar percent decline in LCFS credit prices. The significance of the 2022 jump can be seen in Figure 9. As can be seen, prior to 2022, annual net credits hovered between negative 1 million MT per year to a bit over 1 million MT from 2017 through 2021 resulting in the credit bank remaining in the 8-10 million MT range. With the 5.4 million MT net credit in 2022, however, the credit bank has ballooned to 15.4 million MT.

Figure 9: Net LCFS Credits Annually and Cumulative



The 2022 increase in credits can be attributed to three fuel categories: RD, light- and medium-duty electricity, and RNG. Figure 10 tracks the credit trend over the past five years. As can be seen, the almost flat annual credits from fuels other than RD, electricity, and RNG shows that these fuels account for almost all the increase in credits over the time period.

Figure 10: RD, RNG, and LDV/MDV contribution to Credit Growth



Highlight 2: Quarter-to-Quarter to Prior Year Quarter Detailed Trends

The net credit logged in the fourth quarter of 2022 was slightly down from the record-breaking third quarter net credit because the increase in CARBOB and ULSD deficits exceeded the growth in credits. That being said, the total credits did set a record high in the fourth quarter.

Table 1 below lists credit generation by fuel category and subcategory for the fourth and third quarters of 2022 and the fourth quarter of 2021, highlighting the differences between the fourth quarter of 2022 versus the prior quarter (QTQ), and the same quarter one year prior. Table 2 displays the fuel volume and the average carbon intensities reported by CARB from the LRT.

While there was a 109,500 MT decrease in quarter-to-quarter *net* credits, the 7,129,000 MT of *total* credits generated was a record high for a quarter. The 161,000 MT increase from the third quarter in credits to reach the record was eclipsed by the 270,000 MT increase in CARBOB and ULSD deficits. Compared to the year prior quarter (4Q2021), there was an increase of 1,516,000 MT of credits and 781,000 MT in deficits for a net increase in net credits of 735,000 MT.

In general, the 4Q2022 data reveals that the credit growth was primarily driven by a 5.5% increase (131,000 MT) in RD credits, and the deficits were driven by a 4.7% (209,000 MT) increase for CARBOB and a 2.1% (15,000 MT) increase for ULSD. Decreases in ethanol (64,000 MT), BD (19,000 MT) and SAF (15,000 MT) credits were offset by a number of smaller increases including light- and medium-duty electricity (28,000 MT), eOGV (14,000 MT), eForklifts (20,000 MT), and RNG (16,000 MT) credits.

Compared to the year prior quarter (4Q2021), the credits for low-CI fuels were up significantly except for fossil natural gas, ethanol, BD, SAF, and propane. For the deficit generating fuels, there are significant increases in deficits because of the more stringent benchmark in 2022 compared to 2021.

Table 1: Quarterly Comparison – Credits & Deficits

| Comparison of Reported LRT Data | | | | 4Q 2022 vs 3Q 2022 | | 4Q 2022 vs 4Q 2021 | |
|--|-------------|-------------|-------------|--------------------|----------|--------------------|----------|
| 4Q22 vs 3Q22 and 4Q21 | 4Q 2021 | 3Q 2022 | 4Q 2022 | Qtr to Qtr | % Change | Qtr to Qtr | % Change |
| TOTAL CREDITS - MT | 5,613,192 | 6,968,461 | 7,129,119 | 160,658 | 2.3 % | 1,515,927 | 27.0 % |
| TOTAL DEFICITS - MT | (4,695,145) | (5,205,830) | (5,475,996) | (270,166) | 5.2 % | (780,851) | 16.6 % |
| NET CREDITS - MT | 918,047 | 1,762,631 | 1,653,123 | (109,508) | | 735,076 | |
| COMPARISON BY MAJOR FUEL CATEGORY | | | | | | | |
| NET CREDITS MT | | | | | | | |
| Renewable Natural Gas | 828,570 | 1,204,222 | 1,220,447 | 16,225 | 1.3 % | 391,877 | 47.3 % |
| CNG - RNG | 815,078 | 1,190,200 | 1,208,732 | 18,532 | 1.6 % | 393,654 | 48.3 % |
| LNG - RNG | 13,492 | 14,022 | 11,715 | (2,307) | (16.5%) | (1,777) | (13.2%) |
| Fossil Natural Gas | 856 | 378 | (319) | (697) | (184.4%) | (1,175) | (137.3%) |
| Hydrogen | 11,732 | 16,760 | 16,132 | (628) | (3.7%) | 4,400 | 37.5 % |
| Electricity - TOTAL | 1,253,454 | 1,695,828 | 1,762,703 | 66,875 | 3.9 % | 509,249 | 40.6 % |
| Electricity - Onroad | 771,716 | 1,117,223 | 1,146,892 | 29,669 | 2.7 % | 375,176 | 48.6 % |
| LDV/MDV Electricity | 757,408 | 1,100,421 | 1,128,566 | 28,145 | 2.6 % | 371,158 | 49.0 % |
| Onroad residential grid EV | 516,777 | 717,363 | 835,597 | 118,234 | 16.5 % | 318,820 | 61.7 % |
| Onroad incre Low-CI resi EV | 71,540 | 125,461 | 27,269 | (98,192) | (78.3%) | (44,271) | (61.9%) |
| Onroad non-resi grid – LDV/MDV | 4,850 | 14,832 | 16,150 | 1,318 | 8.9 % | 11,300 | 233.0 % |
| Onroad non-resi low-CI – LDV/MDV | 164,241 | 242,765 | 249,550 | 6,785 | 2.8 % | 85,309 | 51.9 % |
| HDV - On Road Electricity | 14,308 | 16,802 | 18,326 | 1,524 | 9.1 % | 4,018 | 28.1 % |
| Onroad non-resi EV – HDV | 1,292 | 2,255 | 4,426 | 2,171 | 96.3 % | 3,134 | 242.6 % |
| Onroad non-resi low-CI EV – HDV | 13,016 | 14,547 | 13,900 | (647) | (4.4%) | 884 | 6.8 % |
| Electricity - Offroad | 481,738 | 578,605 | 615,811 | 37,206 | 6.4 % | 134,073 | 27.8 % |
| Offroad fixed guideway | 58,408 | 69,093 | 73,779 | 4,686 | 6.8 % | 15,371 | 26.3 % |
| Offroad eOGV | 61,877 | 99,127 | 112,692 | 13,565 | 13.7 % | 50,815 | 82.1 % |
| Offroad eCHE | 11,533 | 14,945 | 14,209 | (736) | (4.9%) | 2,676 | 23.2 % |
| Offroad eForklift | 343,068 | 385,276 | 405,457 | 20,181 | 5.2 % | 62,389 | 18.2 % |
| Offroad eTRU | 6,852 | 10,164 | 9,674 | (490) | (4.8%) | 2,822 | 41.2 % |
| Ethanol | 921,789 | 942,003 | 877,799 | (64,204) | (6.8%) | (43,990) | (4.8%) |
| Biodiesel | 585,055 | 559,721 | 540,295 | (19,426) | (3.5%) | (44,760) | (7.7%) |
| Renewable Diesel | 1,895,539 | 2,393,281 | 2,523,880 | 130,599 | 5.5 % | 628,341 | 33.1 % |
| Alternative Jet Fuel | 19,089 | 24,234 | 9,549 | (14,685) | (60.6%) | (9,540) | (50.0%) |
| Renewable Naphtha | 12,304 | 11,040 | 13,552 | 2,512 | 22.8 % | 1,248 | 10.1 % |
| Propane | 10,979 | 7,437 | 8,759 | 1,322 | 17.8 % | (2,220) | (20.2%) |
| Project Credits | 41,127 | 66,226 | 61,902 | (4,324) | (6.5%) | 20,775 | 50.5 % |
| Admin Adjustments | (11,100) | (644) | 0 | 644 | (100.0%) | 11,100 | (100.0%) |
| NET DEFICITS MT | | | | | | | |
| CARBOB | (3,778,822) | (4,107,198) | (4,300,565) | (193,367) | 4.7 % | (521,743) | 13.8 % |
| ULSD | (686,782) | (656,683) | (670,072) | (13,389) | 2.0 % | 16,710 | (2.4%) |
| CARBOB - incr crude CI deficits | (153,705) | (333,800) | (349,516) | (15,716) | 4.7 % | (195,811) | 127.4 % |
| ULSD - incr crude CI deficits | (32,038) | (60,174) | (61,423) | (1,249) | 2.1 % | (29,385) | 91.7 % |

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Table 2: Quarterly Comparison – Volumes and Average Carbon Intensities

| Comparison of Reported LRT Data | | | | 4Q 2022 vs 3Q 2022 | | 4Q 2022 vs 4Q 2021 | |
|----------------------------------|---------|----------|----------|--------------------|---------|--------------------|----------|
| VOLUMES million gallons | | | | | | | |
| Renewable Natural Gas (DGE) | 45.4 | 49.7 | 48.0 | (1.8) | (3.6%) | 2.5 | 5.6 % |
| CNG - RNG | 41.5 | 45.8 | 44.7 | (1.1) | (2.3%) | 3.3 | 7.9 % |
| LNG - RNG | 4.0 | 4.0 | 3.2 | (0.7) | (18.6%) | (0.7) | (18.7%) |
| Fossil Natural Gas | 1.5 | 1.7 | 2.0 | 0.3 | 14.9 % | 0.5 | 29.7 % |
| CNG - Fossil | 1.5 | 1.6 | 1.5 | (0.1) | (5.8%) | (0.1) | (3.3%) |
| LNG - Fossil | 0.0 | 0.2 | 0.5 | 0.4 | 219.5 % | 0.5 | - |
| Hydrogen (GGE) | 0.6 | 0.8 | 0.8 | 0.0 | 1.2 % | 0.2 | 39.2 % |
| Electricity - TOTAL (GGE) | 41.8 | 56.4 | 62.1 | 5.7 | 10.2 % | 20.3 | 48.4 % |
| Electricity - Onroad (GGE) | 24.0 | 34.8 | 39.7 | 4.9 | 14.1 % | 15.7 | 65.3 % |
| LDV/MDV Electricity | 23.77 | 34.50 | 39.37 | 4.87 | 14.1 % | 15.6 | 65.6 % |
| Onroad EV chrg (leg) – LDV/MDV | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.0 | - |
| Onroad residential grid EV | 19.18 | 27.21 | 31.70 | 4.49 | 16.5 % | 12.5 | 65.3 % |
| Onroad non-resi grid – LDV/MDV | 0.18 | 0.56 | 0.61 | 0.05 | 8.9 % | 0.4 | 240.3 % |
| Onroad non-resi low-CI – LDV/MDV | 4.41 | 6.72 | 7.06 | 0.34 | 5.0 % | 2.7 | 60.1 % |
| HDV - On Road Electricity | 0.26 | 0.32 | 0.37 | 0.04 | 12.7 % | 0.1 | 38.9 % |
| Onroad EV chrg (leg) – HDV | 0.00 | 0.00 | 0.00 | 0.00 | - | 0.0 | - |
| Onroad non-resi EV – HDV | 0.03 | 0.05 | 0.11 | 0.05 | 104.1 % | 0.1 | 262.9 % |
| Onroad non-resi low-CI EV – HDV | 0.23 | 0.27 | 0.26 | (0.01) | (4.7%) | 0.0 | 11.0 % |
| Electricity - Offroad (GGE) | 17.6 | 21.3 | 22.1 | 0.8 | 3.9 % | 4.5 | 25.4 % |
| Offroad fixed guideways | 4.9 | 5.4 | 5.5 | 0.11 | 2.1 % | 0.56 | 11.3 % |
| Offroad eOGV | 2.1 | 4.0 | 4.3 | 0.31 | 7.8 % | 2.25 | 108.5 % |
| Offroad eCHE | 0.3 | 0.3 | 0.2 | (0.04) | (14.9%) | (0.02) | (8.0%) |
| Offroad eForklift | 10.3 | 11.6 | 12.0 | 0.45 | 3.9 % | 1.70 | 16.4 % |
| Offroad eForklifts – EDU | 0.2 | 0.0 | 0.0 | 0.00 | - | (0.16) | (100.0%) |
| Offroad eForklifts – Reported | 10.2 | 11.6 | 12.0 | 0.45 | 3.9 % | 1.86 | 18.3 % |
| Offroad eTRU | 0.2 | 0.3 | 0.3 | (0.03) | (8.8%) | 0.08 | 43.1 % |
| Ethanol | 354.1 | 383.8 | 355.7 | (28.1) | (7.3%) | 1.7 | 0.5 % |
| Biodiesel | 72.9 | 72.3 | 70.9 | (1.4) | (2.0%) | (2.0) | (2.7%) |
| Renewable Diesel | 272.9 | 352.2 | 372.1 | 19.9 | 5.6 % | 99.3 | 36.4 % |
| Alternative Jet Fuel | 3.1 | 4.1 | 1.6 | (2.5) | (60.6%) | (1.5) | (47.7%) |
| Renewable Naphtha | 2.1 | 1.7 | 2.2 | 0.5 | 30.2 % | 0.1 | 4.0 % |
| Propane | 10.9 | 10.3 | 10.9 | 0.5 | 5.3 % | (0.0) | (0.5%) |
| CARBOB | 3,136.3 | 3,035.4 | 3,178.4 | 142.9 | 4.7 % | 42.0 | 1.3 % |
| ULSD | 581.0 | 486.4 | 496.3 | 9.9 | 2.0 % | (84.7) | (14.6%) |
| Average Carbon Intensity | | | | | | | |
| Ethanol | 58.80 | 59.39 | 59.23 | (0.2) | (0.3%) | 0.4 | 0.7 % |
| Biodiesel | 28.01 | 29.04 | 29.99 | 0.9 | 3.3 % | 2.0 | 7.1 % |
| Renewable Diesel | 38.08 | 38.01 | 38.10 | 0.1 | 0.2 % | 0.0 | 0.1 % |
| Bio-CNG | (63.34) | (111.63) | (119.22) | (7.6) | 6.8 % | (55.9) | 88.2 % |
| Bio-LNG | 57.21 | 55.04 | 54.35 | (0.7) | (1.3%) | (2.9) | (5.0%) |
| Electricity | 27.42 | 24.10 | 41.34 | 17.2 | 71.5 % | 13.9 | 50.8 % |
| Alternative Jet Fuel | 40.30 | 42.36 | 42.41 | 0.0 | 0.1 % | 2.1 | 5.2 % |
| Hydrogen | 40.81 | 31.66 | 39.13 | 7.5 | 23.6 % | (1.7) | (4.1%) |

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Highlight 3: 2022 vs 2021 – A Detailed View

We provided overall comparisons of credits and deficits in Highlight 1. In this highlight, we offer a more granular display of the annual LRT data, comparing the full year 2022 to the full year 2021. Table 3 displays the annual credit and deficit data, and Table 4 displays the annual volume and selected average CIs.

In comparing the totals for 2022 and 2021, there was a 6,504,132 MT year-to-year (YTY) total credit increase. The major contributors to the increase were RNG, on-road electricity, and RD. In total, these three fuel types had a net credit increase of 6,312,394 MT compared to 2021. Of the three fuels, RD showed the biggest credit increase with 3,103,975 MT (47%) on a volume increase of 48%. RNG and on-road electricity were not laggards, however, with credit increases of 1,552,516 MT and 1,655,903 MT respectively. RNG continued to show large credit increases even on a smaller volume – YTY credits increased 55.7% on a 9.1% volume decrease as the decrease in average CI outweighed the volume change. For on-road electricity, there were large percent increases in credits and volumes with credits increasing 64.2% on a volume increase of 70.1%. The large (6,504,132 MT) increase in total credits for 2022 was partially offset by the large deficit increase (2,341,585 MT) by CARBOB and ULSD primarily due to the increased stringency in benchmark CI for 2022.

As shown in Table 4, the CARBOB volume in 2022 was down about one-half percent from 2021. This comparison is significant as the first few months of 2021 were impacted by COVID restrictions. This may signal that the impact of new vehicles with higher fuel efficiency in addition to a growing population of EVs, PHEVs, and FCEVs is showing. A decline in CARBOB is the most impacting credit or deficit fuel as the magnitude of CARBOB deficits far exceeds the magnitude of any other fuel credit or deficit.

Table 3: 2022 vs 2021 Detailed Comparison – Credits & Deficits

| Reported LRT Data Annual Results 2022 vs 2021 | 12 mo 2022 | 12 mo. 2021 | 12 mo 2022 vs 12 mo. 2021 | 22 vs 21 % change |
|---|------------------|------------------|------------------------------|----------------------|
| TOTAL CREDITS - MT | 26,712,553 | 20,208,421 | 6,504,132 | 32.2 % |
| TOTAL DEFICITS - MT | (21,225,967) | (18,968,577) | (2,257,390) | 11.9 % |
| NET CREDITS - MT | 5,486,586 | 1,239,844 | (4,246,742) | |
| COMPARISON BY MAJOR FUEL CATEGORY | | | | |
| NET CREDITS MT | | | | |
| Renewable Natural Gas | 4,339,515 | 2,786,999 | 1,552,516 | 55.7 % |
| CNG - RNG | 4,286,135 | 2,738,405 | 1,547,730 | 56.5 % |
| LNG - RNG | 53,380 | 48,594 | 4,786 | 9.8 % |
| Fossil Natural Gas | 739 | 2,505 | (1,766) | (70.5%) |
| Hydrogen | 62,470 | 36,887 | 25,583 | 69.4 % |
| Electricity - TOTAL | 6,451,403 | 4,467,136 | 1,984,267 | 44.4 % |
| Electricity - Onroad | 4,233,832 | 2,577,929 | 1,655,903 | 64.2 % |
| LDV/MDV Electricity | 4,168,956 | 2,529,576 | 1,639,380 | 64.8 % |
| Onroad residential grid EV | 2,857,389 | 1,743,223 | 1,114,166 | 63.9 % |
| Onroad incre Low-CI resi EV | 382,808 | 258,575 | 124,233 | 48.0 % |
| Onroad non-resi grid – LDV/MDV | 40,850 | 15,034 | 25,816 | 171.7 % |
| Onroad non-resi low-CI – LDV/MDV | 887,909 | 512,744 | 375,165 | 73.2 % |
| HDV - On Road Electricity | 64,876 | 48,353 | 16,523 | 34.2 % |
| Onroad non-resi EV – HDV | 9,489 | 5,612 | 3,877 | 69.1 % |
| Onroad non-resi low-CI EV – HDV | 55,387 | 42,741 | 12,646 | 29.6 % |
| Electricity - Offroad | 2,217,571 | 1,889,207 | 328,364 | 17.4 % |
| Offroad fixed guideway | 254,334 | 216,349 | 37,985 | 17.6 % |
| Offroad eOGV | 357,288 | 239,022 | 118,266 | 49.5 % |
| Offroad eCHE | 62,671 | 58,677 | 3,994 | 6.8 % |
| Offroad eForklift | 1,507,455 | 1,346,948 | 160,507 | 11.9 % |
| Offroad eTRU | 35,823 | 28,211 | 7,612 | 27.0 % |
| Ethanol | 3,596,569 | 3,567,887 | 28,682 | 0.8 % |
| Biodiesel | 2,197,541 | 2,309,546 | (112,005) | (4.8%) |
| Renewable Diesel | 9,659,470 | 6,555,495 | 3,103,975 | 47.3 % |
| Alternative Jet Fuel | 69,477 | 52,504 | 16,973 | 32.3 % |
| Renewable Naphtha | 71,125 | 49,425 | 21,700 | 43.9 % |
| Propane | 33,576 | 39,026 | (5,450) | (14.0%) |
| Project Credits and Admin Adj | (235,905) | (130,984) | (104,921) | 80.1 % |
| NET DEFICITS MT | | | | |
| CARBOB | (16,684,788) | (14,932,998) | (1,751,790) | 11.7 % |
| ULSD | (2,706,883) | (2,974,984) | 268,101 | (9.0%) |
| CARBOB - incr crude CI deficits | (1,356,007) | (607,403) | (748,604) | 123.2 % |
| ULSD - incr crude CI deficits | (248,061) | (138,769) | (109,292) | 78.8 % |
| <i>Note: Negative credit values are deficits or an increased deficit position</i> | | | | |
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Table 4: 2022 vs 2021 Detailed Comparison – Volumes & Average CI

| Reported LRT Data Annual Results 2022 vs 2021 | 12 mo 2022 | 12 mo. 2021 | 12 mo 2022 vs | 22 vs 21 |
|---|------------|-------------|---------------|----------|
| | | | 12 mo. 2021 | % change |
| VOLUMES million gallons | | | | |
| Renewable Natural Gas (DGE) | 190.5 | 174.6 | 15.9 | 9.1 % |
| CNG - RNG | 175.7 | 158.3 | 17.4 | 11.0 % |
| LNG - RNG | 14.7 | 16.3 | (1.5) | (9.4%) |
| Fossil Natural Gas | 7.0 | 4.1 | 2.9 | 69.5 % |
| Hydrogen (GGE) | 2.9 | 1.9 | 1.0 | 51.1 % |
| Electricity - Onroad (GGE) | 135.9 | 79.9 | 56.0 | 70.1 % |
| LDV/MDV Electricity | 134.68 | 79.1 | 55.6 | 70.4 % |
| Onroad residential grid EV | 108.40 | 64.7 | 43.7 | 67.5 % |
| Onroad non-resi grid – LDV/MDV | 1.55 | 0.6 | 1.0 | 177.6 % |
| Onroad non-resi low-CI – LDV/MDV | 24.73 | 13.8 | 10.9 | 79.3 % |
| HDV - On Road Electricity | 1.26 | 0.9 | 0.4 | 44.6 % |
| Onroad non-resi EV – HDV | 0.22 | 0.1 | 0.1 | 75.2 % |
| Onroad non-resi low-CI EV – HDV | 1.04 | 0.7 | 0.3 | 39.4 % |
| Electricity - Offroad (GGE) | 81.5 | 72.8 | 8.8 | 12.0 % |
| Offroad fixed guideways | 20.3 | 18.5 | 1.9 | 10.1 % |
| Offroad eOGV | 14.6 | 7.9 | 6.7 | 84.1 % |
| Offroad eCHE | 1.2 | 1.0 | 0.2 | 21.2 % |
| Offroad eForklift | 45.4 | 45.4 | 0.0 | 0.1 % |
| Offroad eTRU | 1.0 | 0.8 | 0.2 | 30.3 % |
| Ethanol | 1,456.7 | 1,420.8 | 35.8 | 2.5 % |
| Biodiesel | 281.2 | 290.1 | (8.9) | (3.1%) |
| Renewable Diesel | 1,394.0 | 941.0 | 453.0 | 48.1 % |
| Alternative Jet Fuel | 11.6 | 8.2 | 3.4 | 41.6 % |
| Renewable Naphtha | 12.2 | 11.1 | 1.1 | 9.5 % |
| Propane | 43.0 | 40.5 | 2.5 | 6.1 % |
| CARBOB | 12,331.0 | 12,393.9 | (63.0) | (0.5%) |
| ULSD | 2,005.0 | 2,516.9 | (511.9) | (20.3%) |
| Average Carbon Intensity | | | | |
| Ethanol | 59.21 | 59.93 | (0.72) | (1.2%) |
| Biodiesel | 28.44 | 28.53 | (0.09) | (0.3%) |
| Renewable Diesel | 36.97 | 37.93 | (0.96) | (2.5%) |
| Bio-CNG | (99.66) | (45.79) | (53.87) | 117.6 % |
| Bio-LNG | 54.45 | 60.28 | (5.83) | (9.7%) |
| Electricity | 30.50 | 26.77 | 3.73 | 13.9 % |
| Alternative Jet Fuel | 42.00 | 38.68 | 3.31 | 8.6 % |
| Hydrogen | 32.34 | 54.43 | (22.09) | (40.6%) |
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