# Agenda Item B

# Supporting Documentation for Calculating Credits and Deficits

State of Oregon Department of Environmental Quality

## Detailed Calculations: Overview and Examples

Credits and deficits will be calculated and expressed as metric tons of $CO_2$ equivalent. For purposes of understanding how credits and deficits would be calculated, we have provided an overview of the steps involved below, as well as six examples of credit and deficit calculation beginning on page 4.

Calculating credits and deficits involves several steps because the LCFS covers fuels with different energy intensities, including liquid and non-liquid fuels. Carbon intensity of fuels is expressed in grams of carbon dioxide equivalent per megajoule (g $CO_2$ E/MJ). This is so that the lifecycle emissions of different types of liquid and non-liquid fuels can be compared. In order to translate a volume of fuel sold at certain carbon intensity into credits and deficits expressed in metric tons of $CO_2$ equivalent, several steps are involved. Oregon's final rule regarding calculation of credits and deficits will address issues such as the number of significant digits and rounding.

## Overview:

### Step 1: Calculate the number of megajoules (MJ) of energy in the fuel sold

Explanation: Because different liquid fuels have different energy densities, or are in non-liquid form, we cannot just use the volume of fuel in gallons. To put all of the liquid and non-liquid fuels on equal footing, megajoules are used instead of gallons, standard cubic feet[1] (scf), or kilowatt-hours (KWh). A table with energy densities in megajoules per unit of fuel is used to calculate the number of megajoules of energy in the fuel sold.

Formula: Multiply the volume [gallons, standard cubic feet (scf) of gas, or kilowatt-hours (KWh) of electricity depending on the fuel type sold] by the energy density of the fuel from the energy density table below.

*Gallons of fuel* (gallon) **X** *energy density* (MJ/gallon) = *Number of MJ* (MJ)

Or

*Standard cubic feet of CNG* (scf) **X** *energy density* (MJ/scf) = *Number of MJ* (MJ)

Or

*Kilowatt-hours of electricity* (KWh) **X** *energy density* (MJ/KWh) = *Number of MJ* (MJ)

[1] A **standard cubic foot** (abbreviated as scf) is a measure of quantity of gas, equal to a cubic foot of volume at 60 degrees Fahrenheit and 14.696 psi of pressure.

| **California Energy Densities of Fuels (**Oregon will be adjusting these as needed for Oregon fuels) | |
|---|---|
| **Fuel (units)** | **Energy Density** |
| California Gasoline blendstock (gallon) | 119.53 (MJ/gallon) |
| California Reformulated Gasoline (gallon) | 115.63 (MJ/gallon) |
| Diesel fuel (gallon) | 134.47 (MJ/gallon) |
| CNG (scf) | 0.98 (MJ/scf) |
| LNG (gallon) | 78.83 (MJ/gallon) |
| Electricity (KWh) | 3.60 (MJ/KWh) |
| Hydrogen (kg) | 120.00 (MJ/kg) |
| Neat denatured Ethanol (gallon) | 80.53 (MJ/gallon) |
| Neat Biomass-based diesel (gallon) | 126.13 (MJ/gallon) |

**Step 2: Account for energy economy ratios, if necessary**

Explanation: Different types of vehicles use the energy in fuel more or less efficiently. For example, on average, an electric car will go three times farther than a gasoline vehicle on the same number of megajoules, while a heavy duty natural gas vehicle will go only 90 percent as far as a diesel heavy duty vehicle on the same number of megajoules. The Energy Economy Ratios (EERs) are used to adjust credits taking these differences into account. Below is California's table of EERs. You can see that for some fuels, such as gasoline, E85, diesel or biomass based diesel, the EER is 1.0, and the adjustment is unnecessary.

Formula: Multiply the number of MJ in the fuel from Step 1 above by the energy economy ratio below.

*Number of MJ from Step 1* (MJ) **X** *EER value from table = Adjusted number of MJ* (MJ)

**California's Energy Economy Ratio (EER) Values for Fuels Used in Light- and Medium-Duty, and Heavy-Duty Applications.**

| **Light/Medium-Duty Applications (Fuels used as gasoline replacement)** | | **Heavy-Duty/Off-Road Applications (Fuels used as diesel replacement)** | |
|---|---|---|---|
| **Fuel/Vehicle Combination** | **EER Values Relative to Gasoline** | **Fuel/Vehicle Combination** | **EER Values Relative to Diesel** |
| Gasoline (incl. E6 and E10)<br>or<br>E85 (and other ethanol blends) | 1.0 | Diesel fuel<br>or<br>Biomass-based diesel blends | 1.0 |
| CNG / ICEV | 1.0 | CNG or LNG | 0.9 |
| Electricity / BEV, or PHEV | 3.0 | Electricity / BEV, or PHEV | 2.7 |
| Hydrogen (H2) / FCV | 2.3 | H2 / FCV | 1.9 |

(BEV = battery electric vehicle, PHEV=plug-in hybrid electric vehicle, FCV = fuel cell vehicle, ICEV = internal combustion engine vehicle)

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

Explanation: Comparing the low carbon fuel standard for the year in question to the carbon intensity of a given fuel will tell us whether selling the fuel will generate credits or deficits, and will also indicate whether selling the fuel will generate a relatively large or small number of credits or deficits.

Formula: Subtract the carbon intensity (CI) of the fuel sold from the carbon intensity required by the low carbon fuel standard.

*CI of standard* ($gCO_2E/MJ$) **–** *CI of fuel sold* ($gCO_2E/MJ$) = *CI difference* ($gCO_2$ $E/MJ$)

Negative numbers mean there is a deficit because the fuel exceeds the standard, while positive numbers mean there are credits because the fuel's carbon intensity is less than the standard.

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

Explanation: Credits and deficits are expressed in volumes of greenhouse gas emissions, where credits show the emissions "saved" by selling a low carbon fuel compared to selling a fuel that exactly meets the low carbon fuel standard for that year. Deficits, by comparison, show the "excess" emissions incurred by selling a fuel whose carbon intensity is higher than the low carbon fuel standard, compared to selling a fuel that exactly meets the standard for that year. In this step, emissions are calculated in grams of $CO_2$ equivalent, while in the next step emissions are converted into metric tons of $CO_2$ equivalent. $CO_2$ equivalent, or $CO_2E$, is a unit of measurement that combines $CO_2$ and other greenhouse gases like methane and nitrous oxide into one number. It describes, for a given mixture and amount of greenhouse gases, the amount of $CO_2$ that would have the same global warming potential.

Formula: Multiply the number of megajoules in the fuel sold (calculated in Step 2) times the carbon intensity difference (calculated in Step 3).

*Number of MJ* (MJ) **X** *CI difference* ($gCO_2E/MJ$) = *number of grams* $CO_2$ *E* ($gCO_2E$)

**Step 5: Convert the grams of $CO_2$ equivalent into metric tons of $CO_2$ equivalent**

Explanation: Greenhouse gas emissions are most commonly expressed in metric ton units. There are 1,000,000 grams per metric ton (g/metric ton), so the final step in the calculation is to divide the result from step 4 by 1,000,000.

Formula: Divide the number of grams of carbon dioxide equivalent in step 4 by 1,000,000.

*Number of grams* $CO_2$ *E* ($gCO_2E$) ÷ *1,000,000* (g/metric ton) = *Number of metric tons* $CO_2E$ (metric tons $CO_2e$)

## Examples

**Example 1: Ethanol**

A regulated party sells 20 million gallons of ethanol with a carbon intensity of 77.40 $gCO_2E/MJ$ in 2014, when the low carbon fuel standard is 91.31 $gCO_2E/MJ$. (*Note: This is just an example. The advisory committee will address a phase-in schedule for Oregon at a later advisory committee meeting.)*

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

Formula: Multiply the gallons of fuel sold by the energy density of the fuel from the energy density table on Page 2.

| | |
|---|---|
| *20,000,000* | *Volume of fuel (gallons)* |
| ***X*** *80.53* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| *= 1,610,600,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary**

Formula: Multiply the number of MJ in the fuel from Step 1 above by the energy economy ratio from table on Page 2.

| | |
|---|---|
| *1,610,600,000* | *Number of MJ from Step 1* (MJ) |
| ***X*** *1.0* | *EER value from table* |
| *= 1,610,600,000* | *Adjusted number of MJ* (MJ) |

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

Formula: Subtract the carbon intensity (CI) of the fuel sold from the carbon intensity required by the standard

| | |
|---|---|
| *91.31* | *CI of standard* ($gCO_2E/MJ$) |
| *– 77.40* | *CI of fuel sold* ($gCO_2E/MJ$) |
| *= 13.91* | *CI difference* ($gCO_2E/MJ$) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

Formula: multiply the number of megajoules in the fuel sold (calculated in Step 2) times the carbon intensity difference (calculated in Step 3)

| | |
|---|---|
| *1,610,600,000* | *Number of MJ* (MJ) |
| **X** *13.91* | *CI difference* ($gCO_2E/MJ$) |
| *= 22,403,446,000* | *Number of grams $CO_2E$* ($gCO_2E$) |

**Step 5: Convert the grams of $CO_2$ equivalent into tons of $CO_2$ equivalent**

Formula: Divide the number of grams of carbon dioxide equivalent in step 4 by 1,000,000 g/ton to convert the number of grams into metric tons.

| | |
|---|---|
| *22,403,446,000* | *Number of grams $CO_2E$* ($gCO_2E$) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= 22,403*** | *Number of metric tons $CO_2E$* (metric tons $CO_2E$) |

The final result is **22,403 metric tons $CO_2$E CREDITS.** Because this number is positive, it is a credit, and can be sold or banked.

**Example 2: Diesel and Renewable Diesel**

In 2014, the low carbon fuel standard is 91.31 g$CO_2$E/MJ *(example only).* A regulated party sells:

- 25 million gallons of **diesel** with a carbon intensity of 93.0 g$CO_2$E/MJ
- 4.5 million gallons of **renewable diesel** with a carbon intensity of 82.16 g$CO_2$E/MJ

The credits and deficits are calculated separately for each fuel.

## Diesel calculations

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *25,000,000* | *Volume of fuel (gallons)* |
| ***X*** *134.47* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| *= 3,361,750,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* (g$CO_2$E/MJ) |
| *– 93.00* | *CI of fuel sold* (g$CO_2$E/MJ) |
| *= -1.69* | *CI difference* (g$CO_2$E/MJ) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

| | |
|---|---|
| *3,361,750,000* | *Number of MJ* (MJ) |
| **X** *-1.69* | *CI difference* (g$CO_2$E/MJ) |
| *= -5,681,357,500* | *Number of grams $CO_2$E* (g$CO_2$E) |

**Step 5: Convert the grams of $CO_2$ equivalent into tons of $CO_2$ equivalent**

| | |
|---|---|
| *-5,681,357,500* | *Number of grams $CO_2$E* (g$CO_2$E) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= -5681*** | *Number of metric tons $CO_2$E* (metric tons $CO_2$E) |

**The final result is -5,681 metric tons $CO_2$E deficit.**

## Renewable diesel calculations

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *4,500,000* | *Volume of fuel (gallons)* |
| ***X*** *126.13* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| *= 567,585,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* ($gCO_2E/MJ$) |
| *– 82.16* | *CI of fuel sold* ($gCO_2E/MJ$) |
| *= 9.15* | *CI difference* ($gCO_2E/MJ$) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

| | |
|---|---|
| *567,585,000* | *Number of MJ* (MJ) |
| **X** *9.15* | *CI difference* ($gCO_2E/MJ$) |
| *= 5,193,402,750* | *Number of grams $CO_2E$* ($gCO_2E$) |

**Step 5: Convert the grams of $CO_2$ equivalent into tons of $CO_2$ equivalent**

| | |
|---|---|
| *5,193,402,750* | *Number of grams $CO_2E$* ($gCO_2E$) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= 5193*** | *Number of metric tons $CO_2E$* (metric tons $CO_2E$) |

**The final result is +5,193 metric tons $CO_2$E of credit.**

**NET RESULT:** The regulated party would then subtract their **5681 metric tons deficit** from their **5193 metric tons credit**, and have a **DEFICIT of 488 metric tons**.

**Example 3: Electric vehicles**

In 2014, the low carbon fuel standard is 91.31 g $CO_2$ E/MJ. *(Note: This is just an example. The advisory committee will address a phase-in schedule for Oregon at a later advisory committee meeting.)* An electric utility supplies electricity to 400 electric light duty cars that used a total of 2,810,000 kilowatt-hours (KWh) of electricity at a carbon intensity (adjusted for drive train efficiencies) of 34.9 g$CO_2$E/MJ.

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *2,810,000* | *Volume of fuel (KWh)* |
| ***X*** *3.60* | *Energy density (MJ/KWh, from California Energy Densities table)* |
| **=** *10,116,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary**

| | |
|---|---|
| *10,116,000* | *Number of MJ from Step 1* (MJ) |
| ***X*** *3.0* | *EER value from table* |
| **=** *30,348,000* | *Adjusted number of MJ* (MJ) |

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* (g$CO_2$E/MJ) |
| *– 34.90* | *CI of fuel sold* (g$CO_2$E/MJ) |
| *= 56.41* | *CI difference* (g$CO_2$E/MJ) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

| | |
|---|---|
| *30,348,000* | *Number of MJ* (MJ) |
| **X** *56.41* | *CI difference* (g$CO_2$E/MJ) |
| *= 1,711,930,680* | *Number of grams $CO_2E$* (g$CO_2$E) |

**Step 5: Convert the grams of $CO_2$ equivalent into metric tons of $CO_2$ equivalent**

| | |
|---|---|
| *1,711,930,680* | *Number of grams $CO_2E$* (g$CO_2$E) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= 1,712*** | *Number of metric tons $CO_2E$* (metric tons $CO_2$E) |

*Final result is* **1,712 metric tons $CO_2$ E CREDIT.** Because this number is positive, it is a credit, and can be sold or banked.

**Example 4: Regulated party excludes fuel sold to exempted uses from credit and deficit calculations**

In 2014, the low carbon fuel standard is 91.31 g $CO_2$ E/MJ. *(Note: This is just an example).* A regulated party sells 28 million gallons of diesel and 560,000 gallons of biodiesel from waste oil in 2014 to both farm and non-farm uses, as indicated below (and sells no other transportation fuels). This is a blend of two percent biodiesel. The credits and deficits are calculated separately for each fuel.

## Diesel calculations

The regulated party sells 28 million gallons of **diesel** with a carbon intensity of 93.0 g$CO_2$E/MJ. However, of those 28 million gallons, 3 million gallons were sold to farm coops, and the regulated party demonstrated the fuel was farm use. (Farm uses of fuel are exempt under HB 2186.) The regulated party would then calculate deficits only on the remaining 25 million gallons of diesel which was not sold for farm use. The final deficit calculation would be **5681 metric tons of deficit** (see diesel calculations for Example 2 on page 5).

## Biodiesel calculations

The regulated party sells 560,000 gallons of **biodiesel from waste oil** with a carbon intensity of 13.70 g$CO_2$E/MJ. Of this amount, 11,200 gallons were sold to exempt farm uses. The regulated party would then only calculate credits for the remaining 548,800 gallons which were not sold for farm use.

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *548,800* | *Volume of fuel (gallons)* |
| ***X*** *126.13* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| **=** *69,220,144* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* (g$CO_2$E/MJ) |
| *– 13.70* | *CI of fuel sold* (g$CO_2$E/MJ) |
| *= 77.61* | *CI difference* (g$CO_2$E/MJ) |

**Step 4: Calculate the grams of CO2 equivalent**

| | |
|---|---|
| *69,220,144* | *Number of MJ* (MJ) |
| **X** *77.61* | *CI difference* (g$CO_2$E/MJ) |
| *= 5,372,175,376* | *Number of grams $CO_2E$* (g$CO_2$E) |

**Step 5: Convert the grams of $CO_2$ equivalent into metric tons of CO2 equivalent**

| | | |
|---|---|---|
| | *5,372,175,376* | *Number of grams $CO_2E$* (g$CO_2$E) |
| | *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| **Credit** | ***= 5,372*** | *Number of metric tons $CO_2E$* (metric tons $CO_2$E) |

NET RESULT: The regulated party would then subtract their **5681 metric tons deficit** from their **5372 metric tons credit**, and have a **DEFICIT of 309 metric tons**.

**Example 5: Diesel and low carbon biodiesel sold to farm uses where a regulated party does not claim any exemptions**

In 2014, the low carbon fuel standard is 91.31 gCO2E/MJ. *(Note: This is just an example).* A regulated party sells 28 million gallons of diesel and 560,000 gallons of biodiesel in 2014, as indicated below (and sells no other transportation fuels). This is a blend of two percent biodiesel. The credits and deficits are calculated separately for each fuel.

## Diesel calculations

The regulated party elects to NOT claim exemptions for fuel sold for farm uses in 2014. Hence, credits/deficits for diesel are calculated on the full 28 million gallons of diesel sold.

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *28,000,000* | *Volume of fuel (gallons)* |
| ***X*** *134.47* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| *= 3,765,160,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* ($gCO_2E/MJ$) |
| *– 93.00* | *CI of fuel sold* ($gCO_2E/MJ$) |
| *= -1.69* | *CI difference* ($gCO_2E/MJ$) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

| | |
|---|---|
| *3,765,160,000* | *Number of MJ* (MJ) |
| **X** *-1.69* | *CI difference* ($gCO_2E/MJ$) |
| *= -6,363,120,400* | *Number of grams $CO_2E$* ($gCO_2E$) |

**Step 5: Convert the grams of $CO_2$ equivalent into tons of $CO_2$ equivalent**

| | |
|---|---|
| *-6,363,120,400* | *Number of grams $CO_2E$* ($gCO_2E$) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= -6363*** | *Number of metric tons $CO_2E$* (metric tons $CO_2E$) |

## Renewable diesel calculations

The regulated party elects to NOT claim exemptions for fuel sold for farm uses in 2014. Hence, credits/deficits for diesel are calculated on the full 560,000 gallons of biodiesel sold.

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *560,000* | *Volume of fuel (gallons)* |
| ***X*** *126.13* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| = *70,632,800* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* ($gCO_2E/MJ$) |
| *– 13.70* | *CI of fuel sold* ($gCO_2E/MJ$) |
| = *77.61* | *CI difference* ($gCO_2E/MJ$) |

**Step 4: Calculate the credits/deficits in grams of $CO_2$ equivalent**

| | |
|---|---|
| *70,632,800* | *Number of MJ* (MJ) |
| **X** *77.61* | *CI difference* ($gCO_2E/MJ$) |
| *= 5,481,811,608* | *Number of grams $CO_2E$* ($gCO_2E$) |

**Step 5: Convert the grams of $CO_2$ equivalent into tons of $CO_2$ equivalent**

| | |
|---|---|
| *5,481,811,608* | *Number of grams $CO_2E$* ($gCO_2E$) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= 5482*** | *Number of metric tons $CO_2E$* (metric tons $CO_2E$) |

The regulated party would then subtract their **6363 metric tons deficit** from their **5482 metric tons credit**, and have a **DEFICIT of 881 metric tons**. Because this deficit is over 10 percent of their total deficit for the year, this regulated party cannot carry over the deficit to the following year (881 metric tons of deficit is 13.8% of 6363 metric tons of deficit). They would need to purchase credits to cover the deficit, or use banked credits from previous years.

**<u>Example 6:  Gasoline</u>**

A regulated party sells 200 million gallons of gasoline with a carbon intensity of 92.7 g$CO_2$E/MJ and 20 million gallons of ethanol with a carbon intensity of 77.40 g$CO_2$E/MJ (and no other transportation fuels).

## Gasoline calculations

The regulated party sells 200 million gallons of **gasoline** with a carbon intensity of 92.7 g$CO_2$E/MJ.

**Step 1: Calculate the number of megajoules of energy in the fuel sold**

| | |
|---|---|
| *200,000,000* | *Volume of fuel (gallons)* |
| ***X*** *115.63* | *Energy density (MJ/gallon, from California Energy Densities table)* |
| **=** *23,126,000,000* | *MJ* |

**Step 2: Account for energy economy ratios, if necessary.** *EER is 1.0, no adjustments necessary*

**Step 3: Calculate the difference in the carbon intensity between the low carbon fuel standard and the fuel sold**

| | |
|---|---|
| *91.31* | *CI of standard* (g$CO_2$E/MJ) |
| *– 92.7* | *CI of fuel sold* (g$CO_2$E/MJ) |
| *= -1.39* | *CI difference* (g$CO_2$E/MJ) |

**Step 4: Calculate the grams of CO2 equivalent**

| | |
|---|---|
| *23,126,000,000* | *Number of MJ* (MJ) |
| **X** *-1.39* | *CI difference* (g$CO_2$E/MJ) |
| *= 32,145,140,000* | *Number of grams $CO_2E$* (g$CO_2$E) |

**Step 5: Convert the grams of $CO_2$ equivalent into metric tons of CO2 equivalent**

| | |
|---|---|
| *32,145,140,000* | *Number of grams $CO_2E$* (g$CO_2$E) |
| *÷ 1,000,000* | *1,000,000 grams = 1 metric ton (g/metric ton)* |
| ***= 32,145*** | *Number of metric tons $CO_2E$* (metric tons $CO_2$E) |

## Ethanol calculations

The regulated party sells 20 million gallons of **ethanol** with a carbon intensity of 77.40 g$CO_2$E/MJ. Which generates **22,403 metric tons of credit in 2014.** (See ethanol calculations for Example 1 on page 4.)

NET RESULT: The regulated party would then subtract their **32,145 metric tons deficit** from their **22,403 metric tons credit**, and have a **DEFICIT of 9,742 metric tons**. To make up the deficit, the company could buy credits generated by other fuel providers (see examples 1 and 3) or could use banked credits.