How to Calculate Greenhouse Gas (GHG) Emissions

> **Average Annual GHG Emissions = Average GHG emissions per mile * Total VMT * 0.001**

KGG (Kg of CO_2e per gallon) =
- Kg CO_2 per gallon of gasoline / Factor to convert CO_2 to CO_2e
  - Kg CO_2 per gallon of gasoline values:
    - 2007-2010: 8.81
    - 2011-2014: 8.92
    - 2015-2018: 8.89
  - Factor to convert CO_2 to CO_2e:
    - 2007-2010: 0.97
    - 2011-2014: 0.98
    - 2015-2018: 0.99

Kg of CO_2e per gallon for 2017-18 = 8.89 / 0.99 = **8.97**

That is, it is estimated that 8.97 kilograms of CO_2e are released from <u>each gallon</u> of gas consumed for the 2017-18 survey cycle.

AKGM (Average Kg of CO_2e per vehicle mile) =
- (1 / Light Duty Vehicle Assumed Fleet MPG) * KGG
  - Light Duty Vehicle Assumed Fleet MPG values:
    - 2007-2010: 20.3
    - 2011-2012: 20.4
    - 2013-2014: 20.56
    - 2015-2018: 21.4
  - KGG values:
    - 2007-2010: 9.08
    - 2011-2014: 9.10
    - 2015-2018: 8.97

Average Kg of CO_2e per vehicle mile for 2017-18 = (1 / 21.4) * 8.97 = **0.419159**

That is, it is estimated that 0.419159 kilograms of CO_2e are released for <u>each mile</u> driven during the 2017-18 cycle.

AWD (Average Weekly Work Days Per Survey Respondent) =
- Potential Trips / Total Number of Survey Respondents

Notes about the calculation's components:
- Both can be found in the aggregate report.
  - Potential Trips is contained under the "Total Weekly Trips" column.
  - Total Survey Respondents is contained under the "Expanded Surveys Returned" column.

This number should usually be between 4.0 and 5.2 and indicates how many trips, on average, each employee made per week to work. Note: Potential Trips include not only trips made to work,

but also days teleworking and days off from a compressed work week. Please see *How to Calculate VMT Per Person* instructions for more information on Potential Trips.

Example:
Site A has a Total Weekly Trips count of 7,770 and 1,918 Expanded Surveys Returned.
AWD = 7,770 / 1,981 = 4.05

On average, employees at Site A made 4.05 trips per week to work.

TVMT (Total Vehicle Miles Traveled) =
- AWD * Vehicle Miles Traveled (VMT) Per Employee * Total Employees * 100

Notes about the calculation's components:
- AWD is calculated as described above.
- VMT Per Employee can be found in the aggregate report under the "VMT/Employee" column.
- Total Employees can be found in the aggregate report under the "Total Employees" column.
- 100 is 50 weeks of trips multiplied by 2 to make them round trips. (Note: It is assumed that employees take on average two weeks of vacation, holidays, or sick leave, per year.)

Please note that VMT is calculated only based on the vehicle miles traveled when driving alone, riding a motorcycle, carpooling, or vanpooling, and the trip distance for the last three is only counted as a fraction of the actual mileage and is based on occupancy. This is why they are called "equivalent miles."

Example:
Site A has an AWD of 4.05, a VMT of 9.8, and 2,420 Total Employees.
TVMT = 4.05 * 9.8 * 2,420 * 100 = 9,604,980 miles

That is, the employees at Site A are estimated to have driven 9,604,980 total miles commuting to and from work in a one-year span.

GHG (Total Annual Greenhouse Gas Emissions for All Employees [Metric Tons CO_2]) =
- AKGM * TVMT * 0.001

Notes about the calculation's components:
- AKGM is calculated as described above.
- TVMT is calculated as described above.
- Multiplying 0.001 is used to convert kilograms to metric tons (i.e., 1,000 KG).

AKGM is the calculation of how many kilograms of CO_2e are released per vehicle mile. Using the values as defined above, for the 2015-16 cycle, this was calculated to be 0.419159 kilograms/mile.

TVMT is the calculation of the total number of miles driven by employees at a worksite.

By multiplying the average kilograms of CO_2e released per vehicle mile by the total number of miles, the result is the total number of kilograms of CO_2e released by all the employees who commute to and from a worksite.

This number is then multiplied by 0.001 to convert kilograms into metric tons.

Example:
Site A has a TVMT of 9,604,980 miles.
GHG = 0.419159 * 9,604,980 * 0.001 = 4,026.0 metric tons CO_2e

That is, 4,026.0 metric tons of CO_2e are estimated to have been released by employees of worksite A traveling to and from work over the last year.

GHGPE (Daily Roundtrip GHG Per Employee [Pounds]) =
- (GHG * 2204.62262) / (50 * AWD * Total Employees)

Notes about the calculation's components:
- GHG is calculated as described above.
- Multiplying by 2204.62262 is used to convert metric tons to pounds.
- Multiplying 50 by AWD (described above) gives the average number of round trips per year.
- Total Employees can be found in the aggregate report under the "Total Employees" column. Multiplying the total number of round trips per year by Total Employees gives the total number of round trips per year.

Example:
Site A has a GHG of 4,026.0, an AWD of 4.05, and 2,420 Total Employees.
GHGPE = ((4,026.0 / 0.001) * 2.20462262) / (50 * 4.05 * 2,420) = 18.11 pounds CO_2e/emp./day

That is, the employees at Site A are estimated to each produce on average 18.11 pounds of CO_2e per day by commuting to and from work.

GHGA (GHG for Aggregate Report [Pounds])
- GHGPE * Expanded Surveys Returned

Notes about the calculation's components:
- GHGPE is calculated as described above.
- Total Number of Survey Respondents is contained under the "Expanded Surveys Returned" column.

This calculation uses the daily roundtrip CO_2e per employee and multiplies it by the number of employees who completed their surveys.

Example:
Site A has an GHGPE of 18.11 and 1,918 Expanded Surveys Returned.
GHGA = 18.11 * 1,918 = 34,734.98 pounds of CO_2e

That is, the respondents at Site A are estimated to release 34,734.98 pounds of CO_2e per day. Please note, that is only survey respondents, not all employees (which would be 18.11 * 2,420 for a product of 43,826.2 pounds of CO_2e per day).

Questions?
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