

Calculation methodology for the carbon calculator

The Natural Capital Partners carbon calculator allows an individual to calculate carbon emissions for flights driving, household emissions and commuting. The methodologies supporting these emission calculations are set out in this paper. General methodological items to note include:

1. Except where stated, factors are provided in carbon dioxide equivalent (CO₂e), and include carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), weighted according to their global warming potentials (GWP).
2. The GWP of CH₄ is 25 and the GWP of N₂O is 298 (in accordance with DEFRA 2013).
3. References to “DEFRA 2016” relate to the UK Government conversion factors for company reporting 2016 dataset, which can be found here:
<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016>

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Calculating emissions from flights

There are two methods for calculating the emissions from flight activity.

1. By choosing airport locations to arrive at an accurate distance travelled. Or
2. By selecting the flight distance category; short medium or long haul.

Method 1 – Selecting airports

This method calculates emissions by measuring the distance between the selected airports selected. The majority of major international and popular destination airports have been included; but the listing is not exhaustive. If your airport is not listed, please choose the closest listed airport.

The class of flight and distance category determines which emission factor is used in our calculations. Where emissions factors for that class do not exist, the most appropriate factor is used. For example, on short haul flights, DEFRA does not supply class specific emissions factors. The following variables determine the outcome of the calculation:

1. The total distance based on the airports selected. The calculation is based on the 'Great Circle' method of calculating distances, where the distance is the shortest between any two points on the surface of a sphere.
2. An uplift factor of 8% applied to allow for take-off, circling and non-direct routes.
3. Whether the flight is a single or return journey.
4. The number of people flying.

The flight classifications in the calculator have been renamed from the DEFRA 2016 classifications, allowing for a global application (see Table 1&2). Note, no adjustment is made for the non-CO₂ components of radiative forcing.

Table 1: Flight classifications

Flight classification	DEFRA 2016 classification	Flight distance
Short	Domestic flights between UK airports	Less than 785km ¹
Medium	International flights to / from UK, typically to Europe	Between 785km and 3,700km
Long	International flights to / from UK, typically to non-European destinations	Flights greater than 3,700km

Source: DEFRA 2016

¹ The 785km figure is based on the midpoint that DEFRA have used for calculating 'domestic' and 'short international' factors, i.e. 463km and 1108km.

Table 2: Flight Emissions factors (kgCO₂e per passenger km)

Flight classification	Average	Economy	Business	First
Short	0.14735	--	--	--
Medium	0.08905	0.08728	0.13091	--
Long	0.10131	0.07761	0.22503	0.31039

Source: DEFRA 2016

Method 2 – Selecting flight distance categories

The second method involves selecting the flight distance based upon the three short, medium and long options, using the distance and average flight emission factors provided by DEFRA 2016. Again the flight classifications listed in the calculator have been renamed from the DEFRA 2016 classifications, allowing for a global application (see Table 3).

Table 3: Flight classifications and emissions factors within the calculator

Flight classification	DEFRA 2016 classification	Assumed flight distance (km)	Emissions factor applied (kg CO ₂ e per passenger km)
Short	Domestic	463	0.14735
Medium	Short-haul international from / to UK	1108	0.08905
Long	Long-haul international from / to UK	6482	0.10131

Source: DEFRA 2016

Notes

1. We do not include the additional (non-CO₂) components of Radiative Forcing.
2. No uplift factor is applied to the specified distances.

Calculating emissions from driving

Pick the closest option from the following vehicle types: Petrol, Diesel, Hybrid, Motorcycle, 4x4 and Sports. The emissions factors for the specified region and vehicle type are listed in Table 4.

Table 4: Regional vehicle databases

Vehicle Type	Default	United States
Petrol	0.19184 kgCO ₂ e/km	0.23606 kgCO ₂ e/km or 0.37982 kgCO ₂ e/mile
Diesel	0.18307kgCO ₂ e/km	0.27361 kgCO ₂ e/km or 0.44024 kgCO ₂ e/mile
Hybrid	0.13226kgCO ₂ e/km	0.16459 kgCO ₂ e/km or 0.26483 kgCO ₂ e/mile
Motorcycle	0.11978 kgCO ₂ e/km	0.12762 kgCO ₂ e/km or 0.20534 kgCO ₂ e/mile
4x4	0.23514 kgCO ₂ e/km	0.23514 kgCO ₂ e/km or 0.37841 kgCO ₂ e/mile
Sports	0.23691 kgCO ₂ e/km	0.23691 kgCO ₂ e/km or 0.3856 kgCO ₂ e/mile

Source: For the "Default" region, emissions factors are provided by DEFRA 2016, as are the United States emissions factors for 4x4 or Sports vehicles. Should region specific factors for those vehicle types become available, those factors will be implemented. For the "United States" region emissions factors for Petrol, Diesel, Hybrid, & Motorcycle are derived from the <http://emissionfactors.com/> service provided by Ecometrica.

Calculating annual household emissions

Emissions from household energy and waste are calculated by entering the amount of energy consumed, and the waste created. Figures entered for household consumption and waste must relate to a specified time period (the default being monthly). The greenhouse gas emissions produced by household energy and waste are then calculated for a period of one year. Household emission factors and units of measurement are detailed in the Table 5; emissions factor derivations are stated in Table 6.

Table5: Household emission factors

	Electricity	Natural Gas	Heating Oil	LPG	Waste
UK	0.41205 kgCO ₂ e/kWh	0.18400 kgCO ₂ e/kWh	2.53232 kgCO ₂ e/litre	1.50502 kgCO ₂ e/litre	0.421 kgCO ₂ e/kg
US	0.51794 kgCO ₂ e/kWh	5.39589 kgCO ₂ e/CCF	9.5859 kgCO ₂ e/gallon	5.69716 kgCO ₂ e/gallon	0.1450 kgCO ₂ e/lb
Asia: Non-OECD Europe and Eurasia	0.47174 kgCO ₂ e/kWh	0.18400 kgCO ₂ e/kWh	2.53232 kgCO ₂ e/litre	1.50502 kgCO ₂ e/litre	0.8421 kgCO ₂ e/kg
Europe (EU)	0.35047 kgCO ₂ e/kWh	0.18400 kgCO ₂ e/kWh	2.53232 kgCO ₂ e/litre	1.50502 kgCO ₂ e/litre	0.8421 kgCO ₂ e/kg
South Africa	0.85728 kgCO ₂ e/kWh	0.18400 kgCO ₂ e/kWh	2.53232 kgCO ₂ e/litre	1.50502 kgCO ₂ e/litre	0.8421 kgCO ₂ e/kg

Source: DEFRA 2016 for all emission factors except non-UK electricity which are from DEFRA's 2015 factors published November 2015 (overseas electricity factors are no longer published by DEFRA).

Table6: Waste emission factors

Region	Methane emitted from landfilled Municipal solid waste(kg CH₄/t)
Default	40.1
Non-UK Europe	38
US	15
UK	22.2

Source: Factors developed by Ecometrica, based on emission factors derived from IPCC 2006, Smith et al 2001 and EPA 2008.

US factors are derived from DEFRA 2016 converted from metric to imperial US units

- 1 kWh = 0.0341 CCF
- 1 litre = 0.26417 US gallons
- 1 kg = 2.205 pounds

Calculating emissions from commuting

This section calculates the emissions related to commuting (travelling to and from work). The distance travelled by each transport type over a particular period (daily, weekly, monthly, annually) is entered. The results are then calculated to give total annual emissions.

Table 7: Commuting emissions factors

Mode of transportation	Defra emissions factor	Emissions factor value
Car	Average petrol car	0.19184 kgCO ₂ e per km
Motorcycle	Average petrol motorbike	0.11978 kgCO ₂ e per km
Train	National rail	0.04885 kgCO ₂ e per km
Light Rail / Tram	Light rail and tram	0.05363 kgCO ₂ e per km
Bus / Coach	Average local bus	0.10172 kgCO ₂ e per km
Tube / Subway	London Underground	0.05789 kgCO ₂ e per km
Ferry	Ferry- Average	0.11606 kgCO ₂ e per km

Source: DEFRA 2016

Notes

1. When daily figures are entered, we assume you commute 239 days/year, to account for annual leave.
2. When weekly figures are entered, we assume your commute 48 weeks of the year, to account for annual leave.
3. When monthly figures are entered, we assume your commute 11 months of the year, to account for annual leave.