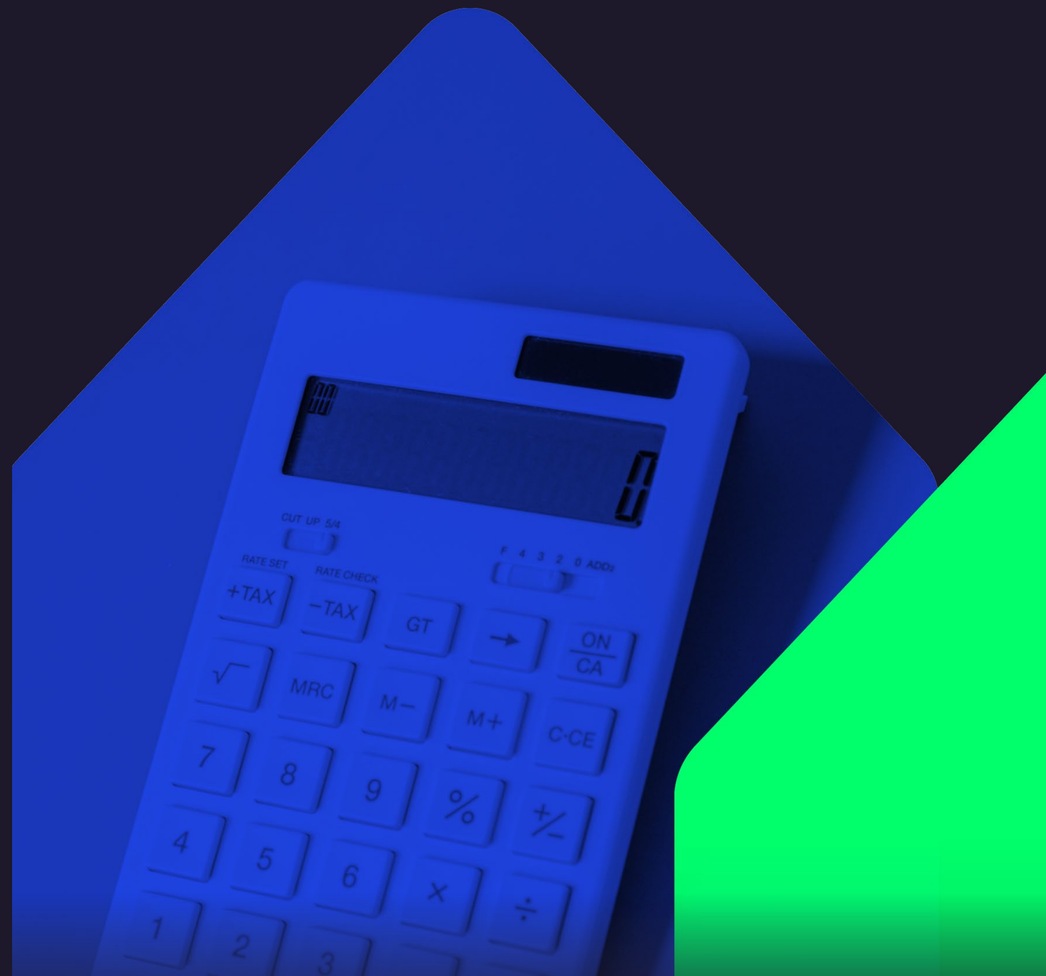
ENERGY AND CARBON CONVERSIONS 2023 UPDATE

CARBON TRUST

Conversion factors



Introduction

This leaflet provides a number of useful conversion factors to help you calculate energy consumption in common units and to work out the greenhouse gas emissions associated with energy use.

Calculating your energy use and carbon emissions can be useful for monitoring energy use internally within a business, and also for public reporting of energy consumption and carbon emissions.

This updated version is based on data published by the Department for Energy Security and Net Zero (DESNZ) in 2023.

Greenhouse gas conversions

The energy conversion factors given in this leaflet are quoted as kilograms carbon dioxide equivalent (kgCO2e) per unit of fuel.

The use of fuels leads to emissions of carbon dioxide (CO2) and small quantities of other greenhouse gases– including methane (CH4) and nitrous oxide (N2O). For a given quantity of a gas, the equivalent quantity of CO2 that would be needed to give the same greenhouse effect can be calculated using its 'global warming potential'. This quantity is quoted in units of kilograms carbon dioxide equivalent (kgCO2e).

The greenhouse gas conversion factor comprises the effect of the CO2, CH4 and N2O combined – this is quoted as kgCO2e per unit of fuel consumed.

The energy conversion factors given in this leaflet are quoted as total direct kgCO2e per unit of fuel. Direct emissions are those emitted at the point of use of a fuel – or at the point of generation for electricity. conversion factors 2023 spreadsheet

The factors in this guide do not account for indirect emissions, for example emissions associated with the extraction of natural gas, refining of oil etc. For conversion factors that include indirect emissions see the Greenhouse gas reporting: conversion factors 2023 spreadsheet.

Conversion factors for energy units

From	to kWh
therms	29.307
Btu	2.931×10^{-4}
MJ	0.2778
toe	1.163×10^{4}

Btu = British thermal unit;

MJ = Megajoule;

toe = tonnes of equivalent oil; Kcal = kilo calorie

Example

Conversion of 100,000 Btu to kWh: 100,000 Btu = 100,000 x 2.931 X 10^{-4} kWh

= 29.31kWh

Common prefixes

The following prefixes are used for multiples of joules, watts and watt-hours:

Kilo (k) = 10^{3}; mega (M) = 10^{6}; giga (G) = 10^{9}; tera (T) = 10^{12}; peta (P) = 10^{15}

= 29.31kWh

Energy conversion factors

The factors given below are taken from UK Government greenhouse gas conversion factors for company reporting, published in June 2023.

[1] Factors given for all fuels are on a gross calorific value (CV) basis, in common with most energy billing.

[2] This figure represents electricity generated (scope 2 under the location-based method). Scope 3 emissions should be reported separately.

[3] For electricity purchased on a 'green tariff', the grid electricity factor above should be used to report under the location-based method of the GHG Protocol Corporate Standard. The Standard requires organisations to also report scope 2 emissions using the market-based method. The relevant factor under this method will be specific to the product supplied by a given electricity supplier. If there are any instances where a supplier specific emission factor cannot be obtained then the country specific residual grid emission factor should be applied.

[4] Standard fuel bought from a local filling station (across the board forecourt fuel typically contains biofuel content).

[5] Conversion factors include the emissions of methane and nitrous oxide that occur during combustion.

Table 1 Energy conversion factors

Fuel[1]	Units	$kgCO_2e$ per unit
UK Grid electricity[2]	kWh	0.20707
Renewable electricity[3]	See footnote [3]	See footnote [3]
Natural gas	kWh	0.18293
	therms	5.36115
	cubic meters	2.03839
LPG	kWh	0.21450
	therms	6.28637
	litres	1.55713
Gas oil	tonnes	3,228.89
	kWh	0.26813
	litres	2.75857
Fuel oil	tonnes	3,229.20
	kWh	0.26816
Burning oil	tonnes	3,165.04
	kWh	0.24677
Diesel[4]	tonnes	3015.65
	kWh	0.23908
	litres	2.51206
Petrol[4]	tonnes	2,806.66
	kWh	0.22166
	litres	2.09747
Industrial coal	tonnes	2,396.48
	kWh	0.32262
Wood pellets[5]	tonnes	51.56192
	kWh	0.01074

Passenger transport conversion factors

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Table 2 Petrol and diesel cars

Car size	Units	kgCO_2e per unit	Car size	Units	kgCO_2e per unit
Small up to 1.4 litre petrol	km	0.1408	Small, up to 1.7 litre diesel	km	0.1393
	miles	0.2266		miles	0.2242
Medium 1.4-2.0 litre petrol	km	0.1782	Medium, 1.7-2.0 litre diesel	km	0.1672
	miles	0.2868		miles	0.2690
Large, over 2.0 litre petrol	km	0.2722	Large, over 2.0 litre diesel	km	0.2086
	miles	0.4381		miles	0.3357
Average petrol car	km	0.1639	Average diesel car	km	0.1698
	miles	0.2638		miles	0.2733

CONVERSION FACTORS

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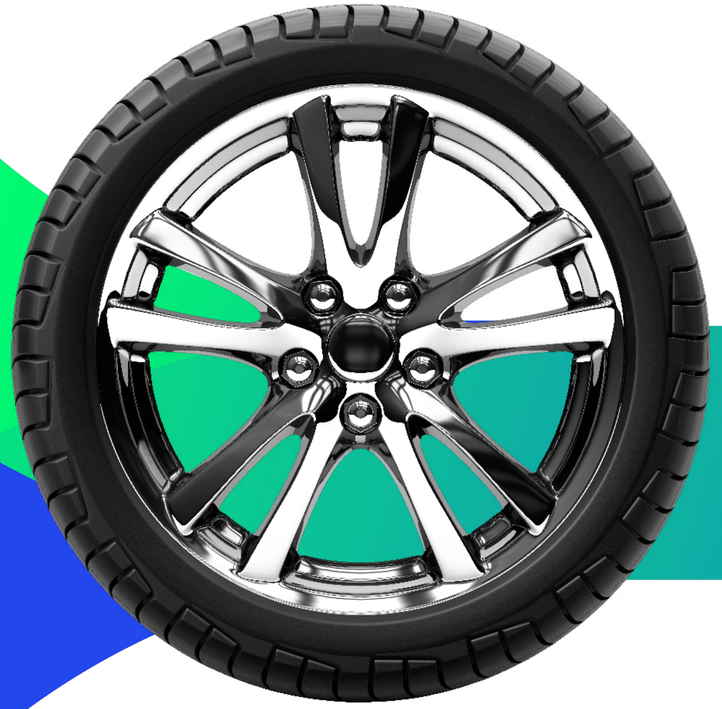
Table 3 Bus, rail and air[6] travel

Mode of transport	Units [7]	$kgCO_2e$ per unit
Regular taxi	pkm	0.14861
Average local bus	pkm	0.10215
Coach	pkm	0.02718
International rail (Eurostar)	pkm	0.00446
National rail	pkm	0.03546
Light rail and tram	pkm	0.0286
Underground	pkm	0.0278
Long haul international flight to/from UK	pkm	0.26128
Long haul international flight to/from non-UK	pkm	0.1758
Short haul international flight to/from UK	pkm	0.18592
Domestic flight	pkm	0.27258

[6] The air travel emission factors include a distance uplift factor of 8%, to take into account non-direct routes and delays/ circling and also includes an uplift factor for radiative forcing. Department for Transport data on passenger cabin class split by flight length (domestic, short haul, long haul) is now used to give better average passenger emissions for each flight length.

[7] pkm stands for passenger kilometres. The associated kgCO2e figures are calculated by taking the total emissions figure for the vehicle and dividing by the average number of passengers.

The conversion factors presented here are just a sample of those published by DESNZ. For a more comprehensive set of factors, and full guidance notes for their use, visit gov.uk.



Heat content of fuels

The default gross calorific values given below can be used when fuel-specific values are not available from your energy supplier. Gross values include the energy needed to evaporate the water in the fuel, and that formed during the combustion process. In the tables below we provide the gross values, in line with those usually provided by the energy suppliers in the UK. Net values exclude this energy.

Table 4 Gross calorific values for solid fuels

Fuel[1]	kWh/tonne
Coal (industrial)	7,428
Wood pellets	5,193
Straw	4,375

Table 5 Gross calorific values for liquid fuels

Mode of transport	kWh/tonne	litres/tonne	kWh/litre
Fuel oil	12,090	1,028	11.85
LPG	13,707	1,883	7.28
Diesel	12,614	1,201	10.51
Gas oil	12,579	1,187	10.60
Burning oil	12,825	1,245	10.30
Petrol	12,660	1,338	9.46

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Table 6 Gross calorific values for gaseous fuels

Gaseous fuels	kWh/tonne	litres/tonne	kWh/m³
Natural gas	14,009	2,257,160	11.00

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