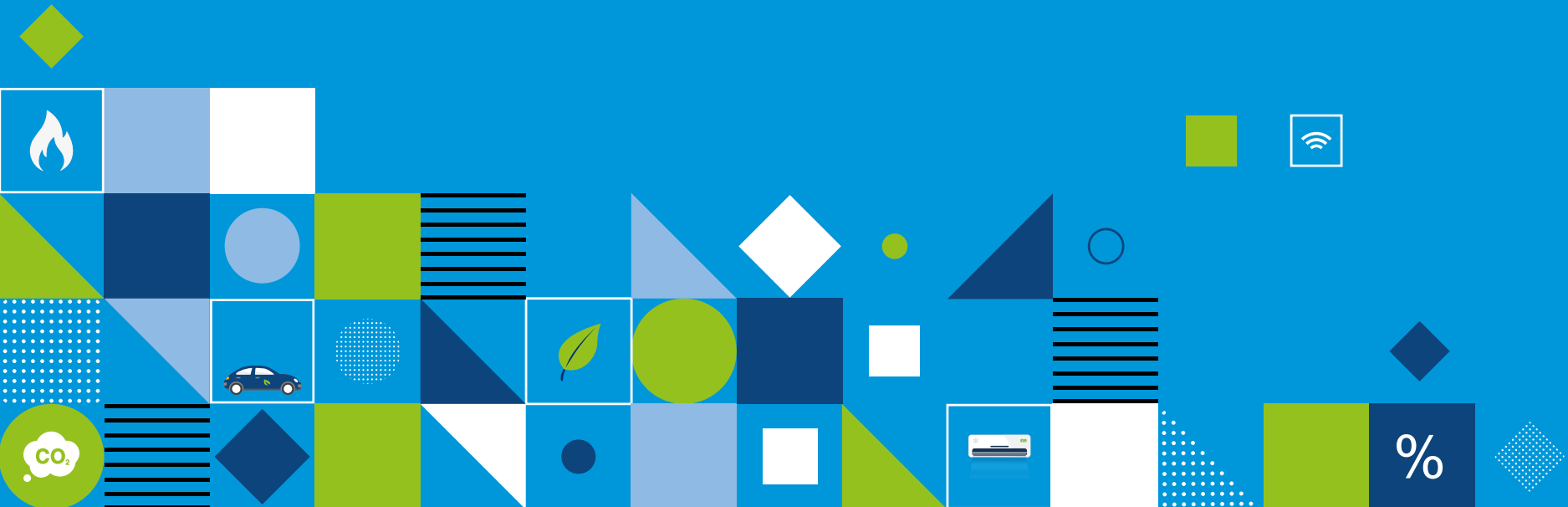


# Conversion factors

## Introductory guide

Energy and carbon conversions 2020 update



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# 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 [BEIS](#) in 2020.



## Conversion factors for energy units

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

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 =  $100,000 \times 2.931 \times 10^{-4}$  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) =  $10^{15}$

# Greenhouse gas conversions

The energy conversion factors given in this leaflet are quoted as kilograms carbon dioxide equivalent ( $\text{kgCO}_2\text{e}$ ) per unit of fuel.

The use of fuels leads to emissions of carbon dioxide ( $\text{CO}_2$ ) and small quantities of other greenhouse gases – including methane ( $\text{CH}_4$ ) and nitrous oxide ( $\text{N}_2\text{O}$ ). For a given quantity of a gas, the equivalent quantity of  $\text{CO}_2$  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 ( $\text{kgCO}_2\text{e}$ ).

The greenhouse gas conversion factor comprises the effect of the  $\text{CO}_2$ ,  $\text{CH}_4$  and  $\text{N}_2\text{O}$  combined – this is quoted as  $\text{kgCO}_2\text{e}$  per unit of fuel consumed.

The energy conversion factors given in this leaflet are quoted as total direct  $\text{kgCO}_2\text{e}$  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.

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 BEIS 2020 greenhouse gas conversion factors.

# Energy conversion factors

The factors given below are taken from BEIS' greenhouse gas conversion factors for company reporting, published in June 2020.

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Table 1 Energy conversion factors

Fuel <sup>1</sup>	Units	kgCO <sub>2</sub> e per unit
UK Grid electricity <sup>2</sup>	kWh	0.23314
Renewable electricity <sup>3</sup>	See footnote 3	See footnote 3
Natural gas	kWh	0.18387
	therms	5.388678
	cubic meters	2.02266
LPG	kWh	0.21448
	therms	6.285765
	litres	1.55537
Gas oil	tonnes	3,229.34
	kWh	0.25672
	litres	2.75776
Fuel oil	tonnes	3,221.37
	kWh	0.26775

Fuel <sup>1</sup>	Units	kgCO <sub>2</sub> e per unit
Burning oil	tonnes	3,165.32
	kWh	0.24666
Diesel <sup>4</sup>	tonnes	3,028.61
	kWh	0.24057
	litres	2.54603
Petrol <sup>4</sup>	tonnes	2,942.05
	kWh	0.22920
	litres	2.16802
Industrial coal	tonnes	2,380.01
	kWh	0.32040
Wood pellets <sup>5</sup>	tonnes	72.29731
	kWh	0.01545

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

<sup>2</sup> This figure represents electricity generated (scope 2 under the location-based method). Scope 3 emissions should be reported separately.

<sup>3</sup> 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.

<sup>4</sup> Standard fuel bought from a local filling station (across the board forecourt fuel typically contains biofuel content).

<sup>5</sup> Conversion factors include the emissions of methane and nitrous oxide that occur during combustion.

# Passenger transport conversion factors

Table 2 Petrol and diesel cars

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Car size	Units	kgCO <sub>2</sub> e per unit	Car size	Units	kgCO <sub>2</sub> e per unit
Small up to 1.4 litre petrol	km	0.14836	Small, up to 1.7 litre diesel	km	0.13721
	miles	0.23877		miles	0.22082
Medium 1.4-2.0 litre petrol	km	0.18659	Medium, 1.7-2.0 litre diesel	km	0.16637
	miles	0.30029		miles	0.26775
Large, over 2.0 litre petrol	km	0.27807	Large, over 2.0 litre diesel	km	0.20419
	miles	0.44752		miles	0.32863
Average petrol car	km	0.1743	Average diesel car	km	0.16844
	miles	0.28052		miles	0.27108



Table 3 Bus, rail and air<sup>6</sup> travel

Mode of transport	Units <sup>7</sup>	kgCO <sub>2</sub> e per unit
Regular taxi	pkm	0.14549
Average local bus	pkm	0.10312
Coach	pkm	0.02732
International rail (Eurostar)	pkm	0.00497
National rail	pkm	0.03694
Light rail and tram	pkm	0.02991
Underground	pkm	0.0275
Long haul international flight to/from UK	pkm	0.19085
Long haul international flight to/from non-UK	pkm	0.18181
Short haul international flight to/from UK	pkm	0.15553
Domestic flight	pkm	0.2443

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The conversion factors presented here are just a sample of those published by Defra.

For a more comprehensive set of factors, and full guidance notes for their use, visit [gov.uk](https://www.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 5 Gross calorific values for liquid fuels

Liquid fuels	kWh/tonne
Coal (industrial)	7,428
Wood pellets	5,080
Straw	4,401

Table 5 Gross calorific values for liquid fuels

Liquid fuels	kWh/tonne	litres/tonne	kWh/litre
Fuel oil	12,031	1,012	11.89
LPG	13,702	1,889	7.25
Diesel	12,589	1,190	10.58
Gas oil	12,579	1,171	10.74
Burning oil	12,833	1,246	10.30
Petrol	12,836	1,357	9.46

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Table 5 Gross calorific values for liquid fuels

Liquid fuels	kWh/tonne	litres/tonne	kWh/litre
Natural gas	13,776	1,252,312.77	11.00

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- measures and certifies the environmental footprint of organisations, products and services;
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