

# Energy and carbon conversions

2008 update



# Calculating your carbon emissions

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

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

This updated leaflet is based on data published by Defra and BERR in 2008.

## Conversion factors for energy units

From	to kWh
therms	29.31
Btu	$2.931 \times 10^{-4}$
MJ	0.2778
toe	$1.163 \times 10^4$
kcal	$1.163 \times 10^{-3}$

<sup>†</sup> Btu = British thermal unit; MJ = Megajoule;  
toe = tonnes of equivalent oil; Kcal = kilo calorie

### Example

Conversion of 100,000 Btu to kWh:  
 $100,000 \text{ Btu} = 100,000 \times 2.931 \times 10^{-4} = 29.31 \text{ kWh}$

## Converting CO<sub>2</sub> to carbon

In certain circumstances you may wish to convert between kg C and kg CO<sub>2</sub>.

- To convert from kg C to kg CO<sub>2</sub>, multiply by 44/12
- To convert from kg CO<sub>2</sub> to kg C, multiply by 12/44

### Example

Conversion of 1,800 kg CO<sub>2</sub> into kg C:  
 $1,800 \text{ kg CO}_2 \times (12/44) = 490.9 \text{ kg C}$

## Common prefixes

The following prefixes are used for multiples of joules, watts and watthours:

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

## Energy conversion factors

The factors given below are taken from Defra's GHG conversion factors<sup>1</sup> for company reporting, published April 2008.



Fuel	Conversion to CO <sub>2</sub> (gross CV basis <sup>2</sup> )	
	Units	kg CO <sub>2</sub> /unit
Grid electricity <sup>3</sup>	kWh	0.537
Renewable electricity	kWh	See footnotes 4 & 5
Natural gas	kWh	0.185
	therms	5.421
LPG	kWh	0.214
	therms	6.277
	litres	1.495
Gas oil	tonnes	3,190
	kWh	0.252
	litres	2.674
Fuel oil	tonnes	3,223
	kWh	0.268
Burning oil <sup>6</sup>	tonnes	3,150
	kWh	0.245
Diesel	tonnes	3,164
	kWh	0.250
	litres	2.630
Petrol	tonnes	3,135
	kWh	0.240
	litres	2.315
Industrial coal	tonnes	2,457
	kWh	0.330
Wood pellets <sup>7</sup>	tonnes	132
	kWh	0.025

<sup>1</sup> <http://www.defra.gov.uk/environment/business/envrp/conversion-factors.htm>

<sup>2</sup> The emissions factors shown are calculated on a gross calorific value (CV basis), as that is generally quoted by energy suppliers. For factors calculated on a net CV basis, visit the Defra website.<sup>1</sup>

<sup>3</sup> This figure represents the average CO<sub>2</sub> emissions from the UK national grid per kWh of electricity delivered to site. The factor presented is the five year rolling average. It is suitable for calculating the emissions associated with a company's electricity use, and savings from a reduction in use.

<sup>4</sup> For electricity purchased on a 'green tariff' the grid electricity factor above should generally be used. This factor incorporates UK renewable generation within it. For further information visit the Defra website.<sup>1</sup>

<sup>5</sup> For electricity generated on-site using renewable energy, a factor of zero may be used, as long as Renewable Obligation Certificates (ROCs) and Levy Exemption Certificates (LECs) are not sold on to a third party. For further information visit the Defra website.<sup>1</sup>

<sup>6</sup> Burning oil is otherwise known as kerosene or paraffin used for heating systems.

<sup>7</sup> Wood pellets used in domestic biomass heating system. Biomass is a low carbon, sustainable renewable energy source, but cannot be classed as 'carbon free'. The carbon emissions associated with any agricultural and transport activities must be taken into account.

## Passenger transport conversion factors

Sourced from Defra's GHG conversion factors for company reporting, 2008.

### Further information

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 Defra's website at:

[www.defra.gov.uk/environment/business/envrp/conversion-factors.htm](http://www.defra.gov.uk/environment/business/envrp/conversion-factors.htm)

Petrol and diesel cars		
Size of car	Units	kg CO <sub>2</sub> per unit
Small, up to 1.4 litre petrol engine	km	0.1809
	miles	0.2912
Medium, 1.4-2.0 litre petrol engine	km	0.2139
	miles	0.3442
Large, over 2.0 litre petrol engine	km	0.2958
	miles	0.4760
Average petrol car	km	0.2070
	miles	0.3332
Small, up to 1.7 litre diesel engine	km	0.1513
	miles	0.2435
Medium, 1.7-2.0 litre diesel engine	km	0.1881
	miles	0.3027
Large, over 2.0 litre diesel engine	km	0.2580
	miles	0.4153
Average diesel car	km	0.1979
	miles	0.3185

Bus, rail and air travel		
Mode of transport	Units <sup>†</sup>	kg CO <sub>2</sub> per unit
Regular taxi	pkm	0.1593
Average bus and coach	pkm	0.0686
International rail (Eurostar)	pkm	0.0177
National rail	pkm	0.0602
Light rail and tram	pkm	0.0780
Underground	pkm	0.0650
Long haul international flight <sup>††</sup>	pkm	0.1206
Short haul international flight <sup>††</sup>	pkm	0.1071
Domestic flight <sup>††</sup>	pkm	0.1911

<sup>†</sup>pkm = passenger kilometres travelled

<sup>††</sup> The air emission factors do not include non-CO<sub>2</sub> climate change impacts, such as Radiative Forcing. However, a 109% uplift factor has been built into the emission factors to take into account non-direct routes and delays/circling.

## Heat content of fuels

The default gross calorific values given on the right can be used when fuel-specific values are not available from your energy supplier.

### Further information

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

**Carbon Footprint Calculator** – Our online calculator will help you calculate your organisation's carbon emissions.

[www.carbontrust.co.uk/carboncalculator](http://www.carbontrust.co.uk/carboncalculator)

**Publications** – We have a library of free publications detailing energy saving techniques for a range of sectors and technologies.

[www.carbontrust.co.uk/publications](http://www.carbontrust.co.uk/publications)

For the complete range of our tools and services available to business, please visit

[www.carbontrust.co.uk](http://www.carbontrust.co.uk)

	By weight		By volume
	kWh/tonne	litres/tonne	kWh/litre
<b>Solid fuels</b>			
<b>Coal (weighted average)</b>	7,472	-	-
<b>Industrial wood</b>	3,806	-	-
<b>Short rotation coppice</b>	3,083	-	-
<b>Straw</b>	4,167	-	-
<b>Liquid fuels</b>			
<b>Fuel oil</b>	12,111	1,014	11.9
<b>LPG</b>	13,750	1,937	7.1
<b>Gas/diesel oil</b>	12,639	1,155	10.9
<b>Burning Oil</b>	12,833	1,244	10.3
<b>Petrol</b>	13,083	1,361	9.6
<b>Gaseous fuels</b>	kWh/tonne	litres/tonne	kWh/m <sup>3</sup>
<b>Natural gas</b>	-	-	10.9

Source: Annex A of the Digest of UK Energy Statistics 2008  
<http://www.berr.gov.uk/whatwedo/energy/statistics/publications/dukes/page45537.html>

The data in this fact sheet has been sourced from:

Defra, [www.defra.gov.uk](http://www.defra.gov.uk),  
 Greenhouse Gas Conversion Factors  
 for company reporting, 2008.

BERR, [www.berr.gov.uk](http://www.berr.gov.uk),  
 Digest of UK Energy Statistics 2008.

**The Carbon Trust was set up by the United Kingdom Government in 2001 as an independent company.**

**Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.**

We do this through five complementary business areas:

**Insights** – explains the opportunities surrounding climate change

**Solutions** – delivers carbon reduction solutions

**Innovations** – develops low carbon technologies

**Enterprises** – creates low carbon businesses

**Investments** – finances clean energy businesses.

[www.carbontrust.co.uk](http://www.carbontrust.co.uk)



ACT ON CO<sub>2</sub> is the Government's initiative to help individuals understand and reduce their carbon footprint. Visit <http://actonco2.direct.gov.uk> for more information.

The Carbon Trust is funded by the Department for Environment, Food and Rural Affairs (Defra), the Department for Business, Enterprise and Regulatory Reform, the Scottish Government, the Welsh Assembly Government and Invest Northern Ireland.

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Printed on paper containing a minimum of 75% recycled, de-inked post-consumer waste.

Published in the UK: December 2008.

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