Defra
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Guidelines for Company Reporting on Greenhouse Gas Emissions
Annexes updated July 2005

Annex 1 - Fuel Conversion Factors

Table 2: Converting fuel types to CO_2

Fuel Type	Amount used per year	Units	x	kg CO_2 per unit	Total kg CO_2
Grid Electricity[1]		kWh	x	0.43	
Natural Gas		kWh	x	0.19	
		therms	x	5.43	
Gas Oil		tonnes	x	3190	
		kWh	x	0.25	
		litres	x	2.69	
Diesel		tonnes	x	3164	
		kWh	x	0.25	
		litres	x	2.63	
Petrol		tonnes	x	3135	
		kWh	x	0.24	
		litres	x	2.30	
Fuel Oil		tonnes	x	3223	
		kWh	x	0.27	
Coal[2]		tonnes	x	2548	
		kWh	x	0.32	
LPG		kWh	x	0.214	
		therms	x	6.27	
		litres	x	1.49	
Coking Coal		tonnes	x	2736	
		kWh	x	0.331	
Aviation Spirit		tonnes	x	3128	
		kWh	x	0.24	
		litres	x	2.24	
Aviation Turbine Fuel		tonnes	x	3150	
		kWh	x	0.25	
		litres	x	2.52	
Other Petroleum Gas		tonnes	x	2897	
		kWh	x	0.21	
Naphtha		tonnes	x	3131	
		kWh	x	0.24	
Lubricants		tonnes	x	3171	
		kWh	x	0.25	
Petroleum Coke		tonnes	x	3410	
		kWh	x	0.34	
Refinery Miscellaneous		kWh	x	0.24	
		therms	x	7.16	
Renewables[3]			x	0	
Aggregate total emissions from energy use					

Source: Based on the National Atmospheric Emissions Inventory for 2003 and the UK Greenhouse Gas Inventory for 2003 developed by Netcen (2005), Digest of UK Energy Statistics DTI 2004

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[1]The factor for electricity has been changed slightly from the previous guidelines to come into line with calculations for the Climate Change Levy Agreements and future requirements for Emissions Trading. It was calculated on the projected fuel mix for the grid 1998-2000. Actual figures may differ from the projections, but to help with year on year comparisons we plan to use a constant value for the purposes of these Guidelines until the year 2010.

[2] Average emission factor for coal used in sources other than power stations and domestic, i.e. industry sources including collieries, Iron & Steel, Autogeneration, Cement production, Lime production, Other industry, Miscellaneous, Public Sector, Stationary combustion - railways and Agriculture. Users who wish to use coal factors for types of coal used in specific industry applications should use the factors given in the UKETS.

[3] A zero conversion factor can only be applied if your company has entered into a renewables source contract with an energy supplier, that has acquired Climate Change Levy Exemption Certificates (LECs) for the electricity supplied to you as a non-domestic electricity consumer.

Annex 2 - Combined Heat and Power – Imports and Exports

If you use all the output of a Combined Heat and Power plant to meet the energy needs of your business, you need not attribute the emissions from the plant between the energy and heat output. You can therefore calculate the total plant emissions from the fuel used with the standard conversion factors at Annex 1.

If, however, you export energy or heat to another business (or import from another business), you will need to split the emissions between the energy and heat before calculating the appropriate proportion of emissions which should be deducted from (or added to) your company total.

Because it is typically roughly twice as efficient to generate heat from fossil fuels as it is to generate electricity, you can attribute the emissions from the CHP plant 1:2 and calculate emissions per kWh of heat or electricity produced by the CHP plant using the appropriate formula below:

Emissions (in $kgCO_2$) per kWh electricity

$$= \frac{\text{twice total emissions (in } kgCO_2\text{)}}{\text{twice total electricity produced + total heat produced (in kWh)}}$$

Emissions (in $kgCO_2$) per kWh heat

$$= \frac{\text{total emissions (in } kgCO_2\text{)}}{\text{twice total electricity produced + total heat produced (in kWh)}}$$

Annex 3 - Electricity Conversion Factors From 1990 to 2003

Table 3: Electricity Conversion Factors from 1990 to 2003 ($kgCO_2$ per kWh)	
1990	0.77
1991	0.75
1992	0.70
1993	0.62
1994	0.61
1995	0.58
1996	0.56
1997	0.51
1998	0.52
1999	0.48
2000	0.51
2001	0.53
2002	0.52
2003	0.54

Source: Based on the National Atmospheric Emissions Inventory for 2003 and the UK Greenhouse Gas Inventory for 2003 developed by Netcen (2005) according to the amount of CO_2 emitted from power stations per unit of electricity consumed.

Annex 4 - Typical Process Emissions
There are six main greenhouse gases that are produced as a by-product by industry:

Carbon Dioxide CO_2
Methane CH_4
Nitrous oxide N_2O
Perfluorocarbons PFC
Sulphur Hexafluoride SF_6
Hydrofluorocarbons HFC

Below is a table that highlights the gases that are likely to be produced by a variety of the industries in the UK that are most likely to have a significant impact on climate change. The dark areas represent the gases that are likely to be produced.

Table 4: Process related emissions[4]

Process		**Emission**					
		CO_2	**CH_4**	**N_2O**	**PFC**	**SF_6**	**HFC**
Mineral Products	Cement Production	■					
	Lime Production	■					
	Limestone Use[5]	■					
	Soda Ash Production and Use	■					
	Fletton Brick Manufacture[6]	■	■				
Chemical Industry	Ammonia	■	■				
	Nitric Acid			■			
	Adipic Acid			■			
	Urea			■			
	Carbides	■	■				
	Caprolactam			■			
	Petrochemicals		■				
Metal production	Iron, Steel and Ferroalloys	■	■				
	Aluminium	■			■		
	Magnesium					■	■
	Other Metals	■					
Energy Industry	Coal mining		■				
	Solid fuel transformation	■					
	Oil production	■	■				
	Gas production and distribution	■	■				
	Venting and flaring from oil/gas production.	■	■				
Other	Production of Halocarbons				■		■

	Use of Halocarbons and SF_6						
	Organic waste management						

[4]These process related emissions refer to the types of processes that are used specifically in the UK. Process emissions might be slightly different for processes operated in other countries.

[5]For use of limestone in Flue Gas Desulphurisation (FGD) and processes such as those in the glass industry. Not all uses of limestone release CO_2.

[6]This is specific to Fletton brick manufacture at the mineral processing stage, a process that uses clay with high organic content. Other types of brick manufacturing in the UK do not release Greenhouse Gas emissions during the processing stage

Source: Greenhouse Gas Inventory Reference Manual, Revised 1996 IPCC Guidelines for National greenhouse Gas Inventories, (1997) IPCC, adapted for UK processes by Netcen.

Annex 5 - Conversion Factors For Greenhouse Gas Process Emissions (Including Emissions From Refrigerants and Air Conditioning Systems)

Table 5: Factors for process emissions				
Emission	**Amount Emitted per Year in tonnes**	**x**	**Conversion Factor**	**Total kg CO_2 equivalent**
CO_2		x	1,000	
Methane		x	21,000	
Nitrous Oxide		x	310,000	
HFC – 125		x	2,800,000	
HFC – 134		x	1,000,000	
HFC – 134a		x	1,300,000	
HFC – 143		x	300,000	
HFC – 143a		x	3,800,000	
HFC – 152a		x	140,000	
HFC – 227ea		x	2,900,000	
HFC – 23		x	11,700,000	
HFC – 236fa		x	6,300,000	
HFC – 245ca		x	560,000	
HFC – 32		x	650,000	
HFC – 41		x	150,000	
HFC – 43 – l0mee		x	1,300,000	
Perfluorobutane		x	7,000,000	
Perfluoromethane		x	6,500,000 *	
Perfluoropropane		x	7,000,000	
Perfluoropentane		x	7,500,000	
Perfluorocyclobutane		x	8,700,000	
Perfluoroethane		x	9,200,000	
Perfluorohexane		x	7,400,000	
SF_6		x	23,900,000	
Aggregate total process emissions				

Source: The conversion factors in the table above incorporate global warming potential (GWP) values published by the IPCC in its Second Assessment Report (Climate Change 1995. The Science of Climate Change. Contribution of Working Group I to the Second Assessment Report of the Intergovernmental Panel on Climate Change. (Eds. J.T Houghton *et al*). Published for the Intergovernmental Panel on Climate Change by Cambridge University Press 1996). Revised GWP values have since been published by the IPCC in the Third Assessment Report (2001) but current UNFCCC Guidelines on Reporting and Review, adopted before the publication of the Third Assessment Report, require emission estimates to be based on the GWPs in the IPCC Second Assessment Report.

Not all refrigerants in use are classified as greenhouse gases for the purposes of the Climate Change Programme (e.g. CFCs, HCFCs). GWP values for refrigerant HFC blends should be calculated on the basis of the percentage blend composition (e.g. the GWP for R404a that comprises is 44% HFC125, 52% HFC143a and 4% HFC134a is 2800x0.44 + 3800x0.52 + 1300x0.04 = 3260).

Annex 6 - Transport Conversion Tables

Table 6: Standard road transport fuel conversion factors					
Fuel used	**Total units used**	**Units**	**x**	**kg CO_2 per unit**	**Total kg CO_2**
Petrol		litres	X	2.30	
Diesel		litres	X	2.63	
Compressed Natural Gas		kg	X	2.65	
Liquid Petroleum Gas		litres	X	1.49	

Source: National Atmospheric Emissions Inventory for 2003 developed by Netcen (2005). UK Greenhouse Gas Inventory for 2003 developed by Netcen (2005), Digest of UK Energy Statistics DTI 2004 and carbon factors for fuels from UKPIA (2004)

Table 7: Passenger Road Transport Conversion Factors: Petrol cars					
Size of car and distance units	**Total units travelled**	**Units**	**x**	**kg CO_2 per unit**	**Total kg CO_2**
Small petrol car Max 1.4 litre engine		miles	x	0.26	
		km	x	0.16	
Medium petrol car From 1.4 – 2.1 litres		miles	x	0.30	
		km	x	0.19	
Large petrol car Above 2.1 litres		miles	x	0.35	
		km	x	0.22	
Average Petrol car		miles	x	0.29	
		km	x	0.18	

These factors are average values for the UK car fleet in 2003 travelling on average trips in the UK. Source: NAEI (Netcen, 2005) based on data from DfT combined with factors from TRL as functions of average speed of vehicle derived from test data under real world testing cycles.

Table 8: Passenger Road Transport Conversion Factors: Diesel cars					
Size of car and distance units	**Total units travelled**	**Units**	**x**	**kg CO_2 per unit**	**Total kg CO_2**
Small diesel car 2.0 litre or under		miles	x	0.26	
		km	x	0.16	

Large diesel car Over 2.0 litre		miles	x	0.31	
		km	x	0.19	
Average diesel car		miles	x	0.27	
		km	x	0.17	

These factors are average values for the UK car fleet in 2003 travelling on average trips in the UK. Source: NAEI (Netcen, 2005) based on data from DfT combined with factors from TRL as functions of average speed of vehicle derived from test data under real world testing cycles.

Table 9: Rail and Air Passenger Transport Conversion Factors				
Method of travel	**Person/kms travelled (pkm)**	**x**	**kg CO_2 per pkm**	**Total kg CO_2**
Rail		x	0.04	
Air[4] long haul		x	0.11	
short haul		x	0.15	

Source: Netcen (2005)

The rail factor refers to an average emission per passenger kilometre for diesel and electric trains weighted by the proportion of electric to diesel train kilometres in 2003. The factor for diesel trains has been calculated based on total diesel consumed by the railways in 2003 provided by ATOC. The factor for electric trains has been calculated based on average kWh per kilometre for a typical electric train and the grid electricity factor in Table 3. The diesel/electric passenger train weighting is based on data for 2003 from AEAT Rail.
Aircraft factors based on factors in IPCC Manual.
Factors for a long haul flight refer to a 5,000 km journey on a typical 450 seat capacity aircraft used for these journeys, with a 70% load factor.
Factors for a short haul flight refer to a 500 km journey on a typical 128 seat capacity aircraft used for these journeys, with a 65% load factor.

Table 10: Diesel Freight Road Mileage Conversion Factors							
Type of lorry	**% weight laden**	**Total km travelled**	**x**	**Litres fuel per km**	**x**	**Fuel conversion factor**	**Total kg CO_2**
Rigid	0%		x	0.236	x	2.63	
	25%		x	0.262	x	2.63	
	50%		x	0.288	x	2.63	
	75%		x	0.314	x	2.63	
	100%		x	0.340	x	2.63	
Articulated	0%		x	0.311	x	2.63	
	25%		x	0.345	x	2.63	
	50%		x	0.379	x	2.63	
	75%		x	0.414	x	2.63	
	100%		x	0.448	x	2.63	

The % weight laden refers to the extent to which the vehicle is loaded to their maximum carrying capacity. So a 0% weight laden means the vehicle is travelling carrying no loads. 100% weight laden means the vehicle is travelling with loads bringing the vehicle to its maximum carrying capacity. If the % weight laden is unknown, an average figure of 50% should be used as a default figure. If the % weight laden is known, a more precise figure for the number of litres fuel per km can be derived as follows:
For rigid lorries: litres fuel per km = 0.236 + 0.104 x (% weight laden)/100
For articulated lorries: litres fuel per km = 0.311 + 0.137 x (% weight laden)/100
These factors refer to vehicles running on diesel fuel.
Source: Continuing Survey of Road Goods Transport 2003; NAEI (Netcen, 2005) based on load correction factors taken from COPERT III.

Table 11: Other Freight Mileage Conversion Factors					
Freight transport mode		**Tonne km**	**x**	**Factor**	**Total kg CO_2**
Rail			x	0.03	
Air	long haul		x	0.57	
	short haul		x	1.58	
Shipping[5]	small ro-ro		x	0.06	
	large ro-ro		x	0.02	
	small tanker		x	0.04	
	large tanker		x	0.003	
	small bulk carrier		x	0.014	
	large bulk carrier		x	0.007	

Source: NETCEN, British Airways, DHL, Railtrack, English, Welsh and Scottish Railways LTD
These factors are being reviewed and are likely to change

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3 revised figure in line with factors used in National Air Emissions Inventory

4 Long haul - Asia, Australasia, the Americas, Middle and Far East Short haul - average 500km

5 Small ro-ro - 1,268 deadweight tonnes, max speed 16.2 knots
Large ro-ro - 4,478 deadweight tonnes, max speed 23.2 knots
Small tanker - 844 deadweight tonnes, max speed 8.2 knots
Large Tanker - 18,371deadweight tonnes, max speed 15 knots
Small Bulk carrier - 1,720 deadweight tonnes, max speed 10.9 knots
Large Bulk carrier - 14,201 deadweight tonnes, max speed 11.2 knots