2010 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting

Produced by AEA for the Department of Energy and Climate Change (DECC) and the Department for Environment, Food and Rural Affairs (Defra)

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Key:

Data fields:

light blue	=	Data entry field
purple	=	Fixed factors used in calculations
yellow	=	Calculation results

Reporting Scope:

Scope 1	=	Emissions fall into Scope 1 as defined by the GHG Protocol
Scope 2	=	Emissions fall into Scope 2 as defined by the GHG Protocol
Scope 3	=	Emissions fall into Scope 3 as defined by the GHG Protocol
All Scopes	=	All emissions from Scope 1 or 2 and Scope 3 as defined by the GHG Protocol
Outside of Scopes	=	Emissions fall outside of the Scopes 1/2/3 as defined by the GHG Protocol (e.g. direct emissions of CO_2 from burning biomass/biofuels)
Scope 1 OR Scope 3	=	Emissions can fall into either Scope 1 or Scope 3 as defined by the GHG Protocol (e.g. depends on ownership of vehicle stock for transport)
Scope 2, 3	=	Includes emissions resulting from electricity supplied to the consumer that are counted in both Scope 2 (electricity GENERATED and supplied to the national grid) and Scope 3 (due to LOSSES in transmission and distribution of electricity through the national grid to the consumer), as defined by the GHG Protocol

Introduction

Last updated:	Oct-10

General Introduction

What are Greenhouse Gas Conversion Factors?

Greenhouse Gases can be measured by recording emissions at source by continuous emissions monitoring **or** by estimating the amount emitted using activity data (such as the amount of fuel used) and applying relevant conversion factors (e.g. calorific values, emission factors, oxidation factors).

These conversion factors allow organisations and individuals to calculate greenhouse gas (GHG) emissions from a range of activities, including energy use, water consumption, waste disposal, recycling and transport activities. For instance, a conversion factor can be used to calculate the amount of greenhouse gases emitted as a result of burning a particular quantity of oil in a heating boiler.

These conversion factors will enable you to convert activity data (e.g. litres of fuel used, number of miles driven, tonnes of waste sent to landfill) into kilograms of carbon dioxide equivalent (CO_2e). Carbon dioxide equivalent is a universal unit of measurement used to indicate the global warming potential of one unit of carbon dioxide. It is used to evaluate the releasing of different greenhouse gases against a common basis.

What are the major changes and updates from the September 2009 version?

Major changes and updates from the September 2009 version are as follows:

i. In previous years, emissions factors have only been provided for direct emissions of CO_2, with the other greenhouse gases methane (CH_4) and nitrous oxide (N_2O) added in 2009.

For the first time in this 2010 update, indirect emission factors (also known as fuel cycle or Well-To-Tank emission factors) associated with the production of fuels have been added for all activities allowing the provision of life-cycle emission factors. Emissions from the production of vehicles or infrastructure are not considered.

Values for CH_4 and N_2O are presented as CO_2 equivalents (CO_2e) using Global Warming Potential (GWP) factors*, consistent with reporting under the Kyoto Protocol and the second assessment report of the Intergovernmental Panel on Climate Change (IPCC).

ii. Lifecycle emissions factors and calculations for waste, biofuels and biomass have been expanded (as well as updated /amended) and include both direct and indirect emissions. For example in the case of biofuels, these emission factors incorporate emissions associated with the production and transportation of the fuel, as well as the direct emissions from fuel combustion. In addition to indirect emissions, the direct/Scope 1 emissions of CH_4 and N_2O resulting from combustion of these fuels have also been separated out.

iii. The single table for water, biofuel and biomass emission factors from 2009 has been split into three. Emission factors for pure biofuels are provided separately (based on UK averages from the Renewable Fuels Agency for 2009) as well as assistance in calculating the emission factors for different blends with conventional petrol, diesel or compressed natural gas (CNG) fuels.

iv. An entirely new table of emission factors for maritime shipping freight transport has been produced for Annex 7, based on information from the International Maritime Organisation's 2009 report on GHG emissions.

v. A supporting methodological paper to explain how all of the emission factors have been derived is being produced. This methodological paper is expected to be available by end August 2010 and will be made available here: http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

* GWP for CH_4 = 21, GWP for N_2O = 310. See Annex 5 for more information on GWP

Note: Care should be taken to use emission factors consistent with each other for comparability of results - i.e. DO NOT mix the use of direct and indirect emission factors or emission factors for different GHG Protocol Scopes (see 'What is the difference between direct and indirect emissions?' below for more information).

Who should use these factors?

These factors are publicly available for use by organisations and individuals within the UK. We **do not recommend** that they are used by organisations or individuals overseas as the emission factors are specific to the UK and many will vary to a very significant degree for other countries. For example, the electricity emission factors are based on the UK grid average mix of different types of generation and average factors for transport are based on the composition of the UK fleet and UK-specific occupancy/loading factors where relevant.

What should I use these factors for?

These conversion factors should be used to measure and report GHG emissions for:

1. Your organisation - Organisations that wish to calculate the greenhouse gas emissions they are responsible for should make use of these conversion factors. Refer to Defra's website for guidance on how to measure and report GHG emissions in a clear and consistent manner: http://www.defra.gov.uk/environment/business/reporting/index.htm

2. Your personal carbon footprint - Individuals who wish to calculate their carbon footprint from their day-to-day activity may be interested in the Government's Act on CO_2 Calculator, (http://carboncalculator.direct.gov.uk/index.html).

3. Other reasons such as project planning and greenhouse gas emission reductions projects.

What should I not use the factors for?

These factors are not for use with mandatory or legal reporting.

For reporting emissions under the EU Emissions Trading Scheme, please refer to: http://www.environment-agency.gov.uk/business/topics/pollution/32232.aspx

For reporting emissions under Climate Change Agreements, please refer to: http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/tackling_clima/ccas/ccas.aspx

For reporting emissions under the new CRC Energy Efficiency Scheme (CRC), please refer to: http://www.environment-agency.gov.uk/business/topics/pollution/116626.aspx

Policymakers in National, Regional and Local Government should consult the document *Greenhouse Gas Policy Evaluation and Appraisal in Government Departments.*

Do I need to update all my calculations using the new conversion factors each year?

Only in certain cases will you need to update previous calculations due to the release of the annual update to the GHG conversion factors. The conversion factors provided in these annexes provide broadly two types of data:

(a) **Emission factors provided in a time-series (e.g. Annex 3 - Electricity Factors):** These **should be updated** for historical reporting with ***each annual update*** - i.e. you should recalculate emissions from previous years using the latest time-series dataset. This is because there can be revisions to earlier emission factor data due to improvements in the calculation methodology or UK GHG inventory datasets they are based upon. For example in this 2010 update:

Electricity consumption year:	EF to use reporting in 2010:	EF used in 2009 reporting:
2010	new 2008*	N/A
2009	new 2008*	2007*
2008	new 2008	2007*
2007	new 2007	2007
2006	new 2006	2006
2005	new 2005	2005
etc.	etc.	etc.

* This is the most recent year for which an emission factor is available for the reporting year

(b) **Other emission factors:** The other factors provided in the annexes are figures produced generally for the *most recent year available* . In the majority of cases this is 2 years behind the update year (i.e. based on 2008 data for the current 2010 update). A company **should not** generally recalculate their emissions for all previous years using the newer factors. The most recent factors should only be applied for reporting on years up to 2 years prior to the most recent dataset.

In most cases (except for natural gas, and perhaps bioenergy due to changing sources) the fuel emission factors in general are unlikely to vary very significantly between different years. However, specific transport factors generally *do* change on an annual basis and the new factors should only be used for the most relevant/recent year of reporting. Earlier versions of the conversion factors from previous updates may therefore be used for older data as necessary/appropriate.

In summary, you should **only** recalculate previous year's emissions using the new factors in the following cases:

A. When calculating emissions from use of electricity or water (both of which are time series emission factors). In this case the updated emission factor time series should be checked to see if they have changed for relevant previous years and time series data updated as necessary in reporting.

B. When recalculating emissions for a year consistent with the data basis of the new update (other than electricity or water emission factor data). For example, if you are now reporting emissions for 2009-10, you should also recalculate the 2008-9 emissions using the 2010 update data, as these are for the most part based on 2008 datasets. Figures reported for 2007 should use emission factors from the 2009 update, which are mostly based on 2007 data.

Which Conversion Factors should I use?

- To calculate emissions from the use of Fuels, see Annex 1
- To calculate emissions from Combined Heat and Power (CHP), see Annex 2
- To calculate emissions from the use of Electricity, see Annex 3
- To understand which industrial processes lead to GHG emissions, see Annex 4
- To convert greenhouse gases into carbon dioxide equivalents, see Annex 5
- To calculate emissions associated with Passenger Transport, see Annex 6
- To calculate emissions associated with Freight Transport, see Annex 7
- To calculate emissions from the use of Refrigeration and Air Conditioning Equipment, see Annex 8
- To calculate life-cycle emissions from the use of Water, Biomass and Biofuels, and from Waste Disposal, see Annex 9
- To calculate emissions from the use of Overseas Electricity, see Annex 10
- For the typical Calorific Values and Densities of UK Fuels, see Annex 11
- To convert between common units of energy, volume, mass and distance, see Annex 12
- To estimate emissions from your supply chain, see Annex 13

Units

All emissions factors are given in units of kg (kilograms) of carbon dioxide (CO_2) equivalent. GHG emissions are sometimes quoted in figures of mass of *Carbon equivalent* , rather than *Carbon Dioxide equivalent* . To convert carbon equivalents into carbon dioxide equivalents (CO_2e), multiply by 44/12.

To convert emissions of greenhouse gases to carbon dioxide equivalent units, see **Annex 5**. For other unit conversions see **Annexes 11** and **12**.

What is the difference between direct and indirect emissions?

The definition used in used in the **GHG Protocol** for direct and indirect emissions is slightly different than for these **Annexes** (which are consistent also with the Government's Act on CO_2 Calculator and Carbon Offsetting Accreditation Scheme). In these **Annexes** direct and indirect emissions are defined as follows:

Direct GHG emissions are those emissions emitted at the point of use of a fuel/energy carrier (or in the case of electricity, at the point of generation).

Indirect GHG emissions are those emissions emitted prior to the use of a fuel/energy carrier (or in the case of electricity, prior to the point of generation), i.e. as a result of extracting and transforming the primary energy source (e.g. crude oil) into the energy carrier (e.g. petrol). Emissions from the production of vehicles or infrastructure are not considered.

The **GHG Protocol** defines direct and indirect emissions slightly differently as follows:

Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity.

Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

What are the GHG Protocol Scopes 1, 2 and 3

The GHG Protocol further categorizes direct and indirect emissions into three broad scopes:

Scope 1: Direct GHG emissions emitted at the point of combustion of fuels.

Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam. (= Direct GHG emissions from the production of electricity, heat or steam.)

Scope 3: Indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Outside of Scopes: Emissions data for direct CO_2 emissions from biologically sequestered carbon (e.g. CO_2 from burning biomass/biofuels) are reported separately from the scopes.

Where applicable, each Annex has a section called **Scopes & Boundaries** which gives a brief outline of what the different emissions factors include. Where possible, links to more detailed source information are also provided in each Annex.

The diagram below summarises the main types of emissions sources under each scope. In some cases direct emissions from transport can fall into either Scope 1 or Scope 3, depending on the ownership/level of control.

In general it is recommended that the 'control' approach is used in order to decide whether to report emissions as Scope 1 or Scope 3. The control approach is itself divided into two methods – financial and operational (where the financial control approach is recommended).

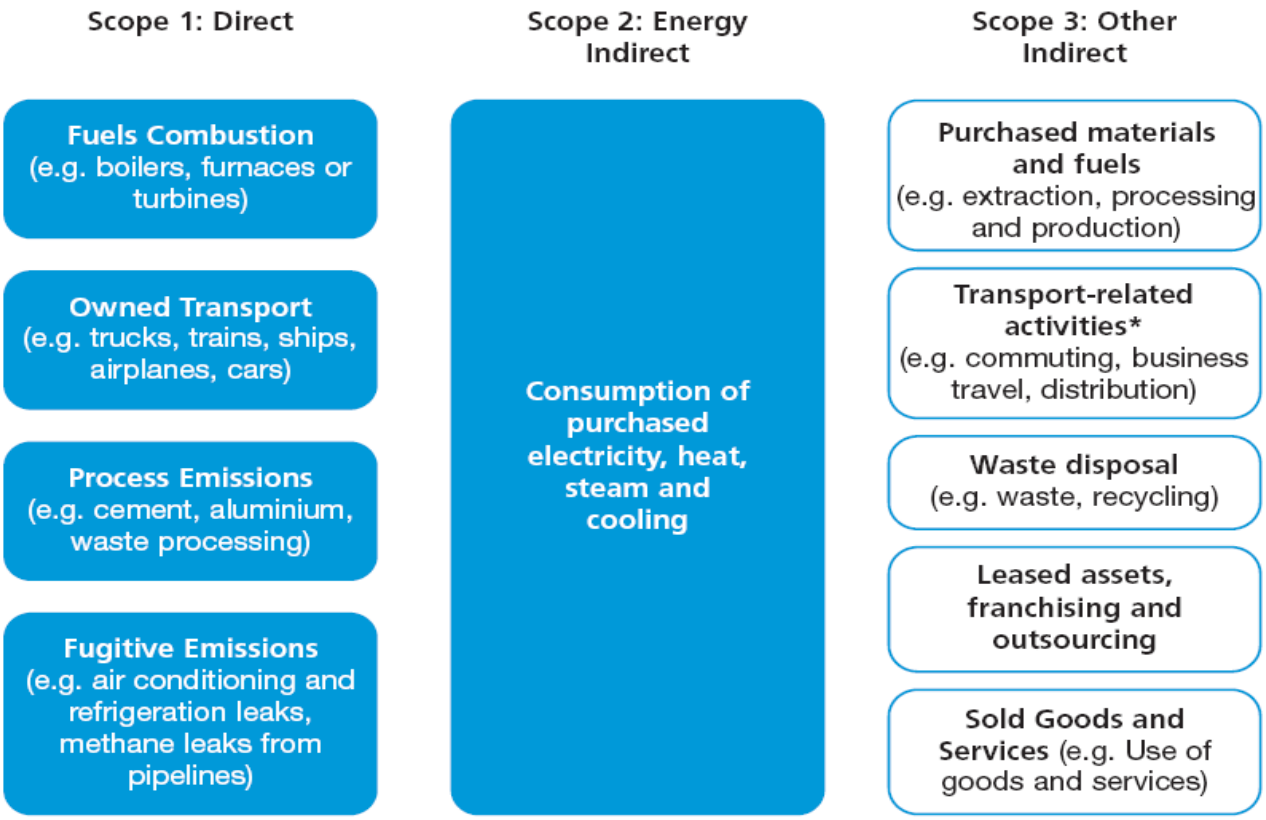
- A company has financial control over an operation if the company has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities.
- A company has operational control over an operation if the company or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation.

In the transport sector, 'open book accounts' provide a very good illustration of the financial and operational control methods. In the case of an open book account, a transport operator provides vehicles to a customer, but the customer pays the fuel bill for those vehicles directly, rather than simply paying the transport operator for the logistics service.
In the open book situation, the customer has financial control, but the transport operator has operational control. The customer and the transport operator will have to decide whether the emissions resulting from these transport operations are the customer's or the transport operator's Scope 1. Whichever method is used, it is very important that it is clearly stated in all reporting, and that it is consistently applied by both organisations.

A further consideration is the treatment of leased assets, which depends on the organisational boundaries set and the control approach.

Further information on scopes, control and leasing is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

Summary of the main types of emissions to be reported under each scope



* From / to point of ownership transfer

Missing factors and additional guidance

If you require GHG conversion factors that you cannot find here, or this guidance is unclear, or you have additional questions, please send us an email at ghgreporting@defra.gsi.gov.uk. We cannot undertake to provide all the conversion factors.

Useful links:

Defra publishes guidance for businesses on how to measure and report their GHG emissions:
http://www.defra.gov.uk/environment/business/reporting/index.htm

The Carbon Trust also provides information about carbon footprinting for companies including a carbon footprint calculator available at www.carbontrust.co.uk/footprinting.

The Publicly Available Specification (PAS): 2050 provides a method for measuring the lifecycle greenhouse gas emissions from goods and services. It is available at http://www.bsigroup.com/en/Standards-and-Publications/Industry-Sectors/Energy/PAS-2050/

The Government's Act on CO_2 Calculator may be used to calculate individual's personal carbon footprint from their day-to-day activity. It is available at: http://carboncalculator.direct.gov.uk/index.html

Changes since Version 1.0 (03/08/10):

Version 1.1: (06/08/10)	Annex 1 - added missing calculation formulae for LNG in Table 1b. Annex 3 - added missing calculation formulae for year 2008 in Tables 3a-c. Annex 6 - coach CO_2 emission factor corrected in Table 6k. Annex 10 - footnotes updated to be more consistent with Annex 3.
Version 1.2: (16/09/10)	Annex 9 - corrected 'Outside of Scopes' emission factors (in $kgCO_2e$ per litre) for biodiesel and bioethanol.
Version 1.2.1: (06/10/10)	Annex 6 - corrected Table 6k footnote (6) on the source of the CO_2 emission factor for national passenger rail. Annex 7 - corrected average load factor for all HGVs (from 56% to 58%) in Table 7d and 7e. No impact on emission factors. Annex 9 - ammended Tables 9a and 9c and their footnotes to more clearly indicate there are zero Scope 1 /Direct emissions for water, biomass and biogas.

Annex 1 - Converting from fuel use to carbon dioxide equivalent emissions

Last updated: Aug-10

How to use this Annex

1) Identify the amount of fuel used for each fuel type
2) Identify the units. Are you measuring fuel use in terms of mass, volume or energy?
3) If you are measuring fuel use in terms of energy is your unit of measurement net energy or gross energy? (Please see paragrpah below on net and gross energy. In the event that this is unclear you should contact your fuel supplier).
4) Identify the appropriate conversion factor that matches the unit you are using. If you cannot find a factor for that unit, Annex 12 gives guidance on converting between different units of mass, volume, length and energy.
5) Multiply the amount of fuel used by the conversion factor to get total emissions in kilograms of carbon dioxide equivalent (kg CO_2e). The excel spreadsheet calculates this automatically following your entry of the amount of fuel used into the appropriate box.

Four tables are presented here, the first of which provides emission factors by unit mass, and the second by unit volume. Tables 1c and 1d provide emission factors for energy on a Gross and Net CV basis respectively; emission factors on a Net CV basis are higher (see definition of Gross CV and Net CV in *italics* below). **It is important to use the correct emission factor**, otherwise emissions calculations will over- or under-estimate the results. If you are making calculations based on energy use, you must check (e.g. with your fuel supplier) whether these values were calculated on a Gross CV or Net CV basis and use the appropriate factor. Natural Gas consumption figures quoted in kWh by suppliers in the UK are generally calculated (from the volume of gas used) on a Gross CV basis - see Transco website: http://www.transco.co.uk/services/cvalue/cvinfo.htm. Therefore the emission factor in Table 1c (Gross CV basis) should be used by default for calculation of emissions from Natural Gas in kWh, unless your supplier specifically states they have used Net CV basis in their calculations instead.

Gross CV or higher heating value (HHV) is the CV under laboratory conditions. Net CV or 'lower heating value (LHV) is the useful calorific value in typical real world conditions (e.g. boiler plant). The difference is essentially the latent heat of the water vapour produced (which can be recovered in laboratory conditions).

Annex 1 Scopes & Boundaries:

Scope 1: Direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel.

Scope 3: Indirect emissions associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels. Emission factors are based on data from the JEC Well-To-Wheels study, for further information see http://ies.jrc.ec.europa.eu/WTW

Further information on scopes is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 1a

				Scope 1				Scope 3	All Scopes	Scope 1				Scope 3	All Scopes
Converting fuel types by unit mass				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel Type	Amount used per year	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Aviation Spirit		tonnes	x	3127.7	33.2	31.0	3191.9	563.2	3755.1						
Aviation Turbine Fuel [1]		tonnes	x	3149.7	1.6	31.0	3182.2	585.4	3767.6						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil [2]		tonnes	x	3149.7	6.7	8.6	3164.9	585.2	3750.1						
CNG [2]		tonnes	x	2712.2	4.0	1.6	2717.8	397.7	3115.5						
Coal (industrial) [3]		tonnes	x	2295.3	1.8	39.4	2336.5	381.7	2718.2						
Coal (electricity generation) [4]		tonnes	x	2251.2	0.4	19.5	2271.2	371.5	2642.7						
Coal (domestic) [5]		tonnes	x	2506.3	329.7	45.5	2881.4	446.1	3327.5						
Coking Coal		tonnes	x	2986.5	29.1	70.6	3086.2	476.8	3563.0						
Diesel		tonnes	x	3164.3	1.8	35.0	3201.1	607.1	3808.2						
Fuel Oil [6]		tonnes	x	3205.5	2.6	11.6	3219.7	546.8	3766.5						
Gas Oil [7]		tonnes	x	3190.0	3.2	290.3	3483.5	607.1	4090.6						
LNG [8]		tonnes	x	2712.2	4.0	1.6	2717.8	951.9	3669.7						
Lubricants		tonnes	x	3171.1	1.9	8.5	3181.5	386.2	3567.7						
Naphtha		tonnes	x	3131.3	2.7	8.0	3142.1	442.9	3585.0						
Other Petroleum Gas		tonnes	x	2894.0	3.3	65.7	2963.1	352.5	3315.6						
Petrol		tonnes	x	3135.0	6.3	21.3	3162.6	559.7	3722.3						
Petroleum Coke		tonnes	x	3193.8	2.3	74.5	3270.5	389.0	3659.5						
Wood	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Total										0	0	0	0	0	0

Annex 1 - Converting from fuel use to carbon dioxide equivalent emissions

Last updated: Aug-10

Table 1b

				Scope 1				Scope 3	All Scopes	Scope 1				Scope 3	All Scopes
Converting fuel types by unit volume				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel Type	Amount used per year	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Aviation Spirit		litres	x	2.2119	0.0235	0.0219	2.2574	0.3983	2.6557						
Aviation Turbine Fuel [1]		litres	x	2.5218	0.0012	0.0248	2.5478	0.4687	3.0165						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil [1]		litres	x	2.5299	0.0054	0.0069	2.5421	0.4700	3.0121						
CNG [2]		litres	x	0.4746	0.0007	0.0003	0.4756	0.0696	0.5452						
Diesel		litres	x	2.6413	0.0015	0.0292	2.6720	0.5067	3.1787						
Gas Oil [7]		litres	x	2.7667	0.0028	0.2517	3.0212	0.5265	3.5477						
LNG [8]		litres	x	1.2272	0.0018	0.0007	1.2297	0.4307	1.6604						
LPG		litres	x	1.4902	0.0006	0.0012	1.4920	0.1866	1.6786						
Natural Gas		cubic metre	x	2.0230	0.0030	0.0012	2.0272	0.1968	2.2240						
Petrol		litres	x	2.3018	0.0046	0.0156	2.3220	0.4109	2.7329						
Wood	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Total										0	0	0	0	0	0

Table 1c

				Scope 1				Scope 3	All Scopes	Scope 1				Scope 3	All Scopes
Converting fuel types on an energy, Gross CV basis [9]				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel Type	Amount used per year	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Aviation Spirit		kWh	x	0.23762	0.00253	0.00236	0.24250	0.04279	0.28529						
Aviation Turbine Fuel [1]		kWh	x	0.24555	0.00012	0.00242	0.24808	0.04564	0.29372						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil [1]		kWh	x	0.24564	0.00052	0.00067	0.24683	0.04564	0.29247						
CNG [2]		kWh	x	0.18485	0.00027	0.00011	0.18523	0.02710	0.21233						
Coal (industrial) [3]		kWh	x	0.31659	0.00025	0.00543	0.32227	0.05265	0.37492						
Coal (electricity generation) [4]		kWh	x	0.31907	0.00006	0.00277	0.32190	0.05265	0.37455						
Coal (domestic) [5]		kWh	x	0.29582	0.03892	0.00537	0.34010	0.05265	0.39275						
Coking Coal		kWh	x	0.32979	0.00321	0.00780	0.34081	0.05265	0.39346						
Diesel		kWh	x	0.25011	0.00014	0.00277	0.25301	0.04798	0.30099						
Electricity	See Annex 3							See Annex 3	See Annex 3	See Annex 3				See Annex 3	See Annex 3
Fuel Oil [6]		kWh	x	0.26475	0.00021	0.00096	0.26592	0.04516	0.31108						
Gas Oil [7]		kWh	x	0.25214	0.00025	0.02294	0.27533	0.04798	0.32331						
LNG [8]		kWh	x	0.18485	0.00027	0.00011	0.18523	0.06488	0.25011						
LPG		kWh	x	0.21419	0.00009	0.00017	0.21445	0.02682	0.24127						
		therms	x	6.2773	0.0026	0.0049	6.2848	0.7861	7.07086						
Lubricants		kWh	x	0.26190	0.00016	0.00070	0.26276	0.03190	0.29466						
Naphtha		kWh	x	0.23654	0.00021	0.00061	0.23735	0.03346	0.27081						
Natural Gas		kWh	x	0.18485	0.00027	0.00011	0.18523	0.01799	0.20322						
		therms	x	5.4174	0.0080	0.0033	5.4286	0.5271	5.9557						
Other Petroleum Gas		kWh	x	0.20568	0.00024	0.00467	0.21059	0.02505	0.23564						
Petrol		kWh	x	0.23965	0.00048	0.00163	0.24176	0.04279	0.28455						
Petroleum Coke		kWh	x	0.32152	0.00023	0.00750	0.32925	0.03916	0.36841						
Refinery Miscellaneous		kWh	x	0.24512	0.00023	0.00067	0.24602	0.02986	0.27588						
		therms	x	7.1839	0.0066	0.0196	7.2102	0.8750	8.0852						
Wood	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Total										0	0	0	0	0	0

Annex 1 - Converting from fuel use to carbon dioxide equivalent emissions

Last updated: Aug-10

Table 1d

Converting fuel types on an energy, Net CV basis [10]				Scope 1				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel Type	Amount used per year	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit
Aviation Spirit		kWh	x	0.25012	0.00266	0.00248	0.25526	0.04504	0.30030
Aviation Turbine Fuel [1]		kWh	x	0.25847	0.00013	0.00254	0.26114	0.04804	0.30918
Biofuels	See Annex 9							See Annex 9	See Annex 9
Burning Oil [1]		kWh	x	0.25857	0.00055	0.00071	0.25982	0.04804	0.30786
CNG [2]		kWh	x	0.20515	0.00030	0.00012	0.20558	0.03008	0.23566
Coal (industrial) [3]		kWh	x	0.33325	0.00026	0.00572	0.33923	0.05542	0.39465
Coal (electricity generation) [4]		kWh	x	0.33587	0.00006	0.00291	0.33884	0.05542	0.39426
Coal (domestic) [5]		kWh	x	0.31139	0.04096	0.00565	0.35800	0.05542	0.41342
Coking Coal		kWh	x	0.34715	0.00338	0.00821	0.35874	0.05542	0.41416
Diesel		kWh	x	0.26607	0.00015	0.00294	0.26916	0.05105	0.32021
Electricity	See Annex 3							See Annex 3	See Annex 3
Fuel Oil [6]		kWh	x	0.28164	0.00023	0.00102	0.28289	0.04804	0.33093
Gas Oil [7]		kWh	x	0.26823	0.00027	0.02441	0.29291	0.05105	0.34396
LNG [8]		kWh	x	0.20515	0.00030	0.00012	0.20558	0.07200	0.27758
LPG		kWh	x	0.22999	0.00010	0.00018	0.23027	0.02880	0.25907
		therms	x	6.7404	0.0028	0.0052	6.7485	0.8441	7.59255
Lubricants		kWh	x	0.27862	0.00017	0.00074	0.27953	0.03394	0.31347
Naphtha		kWh	x	0.24899	0.00022	0.00064	0.24984	0.03522	0.28506
Natural Gas		kWh	x	0.20515	0.00030	0.00012	0.20558	0.01996	0.22554
		therms	x	6.0125	0.0089	0.0036	6.0250	0.5850	6.61004
Other Petroleum Gas		kWh	x	0.22357	0.00026	0.00508	0.22890	0.02723	0.25613
Petrol		kWh	x	0.25227	0.00051	0.00171	0.25449	0.04504	0.29953
Petroleum Coke		kWh	x	0.33845	0.00024	0.00789	0.34658	0.04122	0.38780
Refinery Miscellaneous		kWh	x	0.25802	0.00024	0.00071	0.25897	0.03143	0.29040
		therms	x	7.5620	0.0070	0.0207	7.5896	0.9211	8.51067
Wood	See Annex 9							See Annex 9	See Annex 9
Total									

Scope 1				Scope 3	All Scopes
CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
See Annex 9				See Annex 9	See Annex 9
See Annex 3				See Annex 3	See Annex 3
See Annex 9				See Annex 9	See Annex 9
0	**0**	**0**	**0**	**0**	**0**

Sources

UK Greenhouse Gas Inventory for 2008 (AEA)
Digest of UK Energy Statistics 2009 (DECC), available at:
http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

Notes

[1] Burning oil is also known as kerosene or paraffin used for heating systems. Aviation Turbine fuel is a similar kerosene fuel specifically refined to a higher quality for aviation.

[2] CNG = Compressed Natural Gas is usually stored at 200 bar in the UK for use as an alternative transport fuel.

[3] 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 UK ETS.

[4] This emission factor should only be used for coal supplied for electricity generation (power stations). Coal supplied for domestic or industrial purposes have different emission factors.

[5] This emission factor should only be used for coal supplied for domestic purposes. Coal supplied to power stations or for industrial purposes have different emission factors.

[6] Fuel oil is used for stationary power generation. Also use these emission factors for similar marine fuel oils.

[7] Gas oil is used for stationary power generation and 'diesel' rail in the UK. Also use these emission factors for similar marine diesel oil and marine gas oil fuels.

[8] LNG = Liquefied Natural Gas, usually shipped into the UK by tankers. LNG is usually used within the UK gas grid, however it can also be used as an alternative transport fuel.

[9] Emission factors calculated on a Gross Calorific Value basis

[10] Emission factors calculated on a Net Calorific Value basis.

Annex 2 - Combined Heat and Power - Imports and Exports

Last updated:	Jun-09

How to use this Annex

If you use all the output of a Combined Heat and Power (CHP) plant to meet the energy needs of your business (i.e. you are not exporting any of the electricity or heat for others to use), there is no need for you to attribute the emissions from the CHP plant between the electricity and heat output in your reporting. This is because you are in this case responsible for the full emissions resulting from the fuel used for CHP. You can calculate the total CHP plant emissions from the fuel used with the standard conversion factors at **Annex 1.**

If the *heat user* and the *electricity user* are different individuals/installations, greenhouse gas emissions should be calculated as per **Annex 1** (i.e. calculate fuel consumption then apply the appropriate conversion factor for that fuel) and then divided between the *heat user* and the *electricity user* .

It is typically roughly twice as efficient to generate heat from fossil fuels as it is to generate electricity. Therefore you can attribute the greenhouse gas emissions from the CHP plant in the ratio 1:2 respectively per kWh of heat and electricity generated. Emissions per kWh of heat or electricity produced by the CHP plant may be calculated in this way using the appropriate formula below:

$$\text{Emissions (in kg}CO_2\text{e) per kWh electricity} = \frac{\text{2 x total emissions (in kg}CO_2\text{e)}}{\text{2 x total electricity produced + total heat produced (in kWh)}}$$

$$\text{Emissions (in kg}CO_2\text{e) per kWh heat} = \frac{\text{total emissions (in kg}CO_2\text{e)}}{\text{2 x total electricity produced + total heat produced (in kWh)}}$$

Table 2a

Calculate emissions per kWh electricity			
Total emissions (kg CO_2e)	Total electricity produced	Total heat produced	kg CO_2e/kWh electricity

Table 2b

Calculate emissions per kWh heat			
Total emissions (kg CO_2e)	Total electricity produced	Total heat produced	kgCO_2e/kWh heat

I buy my electricity from a producer/plant that I know is CHP. Which factor should I use?

If you purchase electricity for own consumption from a CHP plant, you should use the 'Grid Rolling Average' factor in **Annex 3.**

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/conversion-factors.htm

Annex 3 - Converting from purchased electricity use to carbon dioxide equivalent emissions

Last updated: Aug-10

How to use this Annex

The factors presented in the three tables below are a timeseries of electricity CO_2 emission factors per kWh GENERATED (Table 3a, i.e. before losses in transmission/distribution), electricity CO_2 emission factors per kWh LOSSES in transmission/distribution (Table 3b) and per kWh CONSUMED (Table 3c, i.e. for the final consumer, including transmission/distribution losses).

To calculate emissions of carbon dioxide associated with use of UK grid *electricity* :

1) Identify the amount electricity used, in units of kWh;

2) Multiply this value by the conversion factor for UK Grid Rolling Average electricity. Use **Table 3c** for calculating GHG emissions resulting from electricity provided from the national/local grid.

Annex 3 Scopes & Boundaries:

Scope 2 : Direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel in power stations to generate electricity (Table 3a Direct GHG, i.e. excludes losses in transmission and distribution).

Scope 3: In electricity generation, this includes indirect GHG emissions associated with the extraction and transport of primary fuels as well as the refining, distribution and storage of finished fuels (Table 3a, 3b and 3c). The Greenhouse Gas Protocol also attributes direct GHG emissions associated with losses from electricity transmission and distribution (Table 3b) to Scope 3.

Direct GHG emissions given in Table 3c are a combination of (Scope 2) Direct GHG emissions from Table 3a and (Scope 3) Direct GHG emissions from Table 3b.

Further information on scopes is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm

OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How are the factors calculated?

The electricity conversion factors given in Table 3c represent the average carbon dioxide emission from the UK national grid per kWh of electricity used at the point of final consumption (i.e. electricity grid transmission and distribution losses are included). This represents a combination of the emissions directly resulting from electricity generation (Table 3a) and from electricity grid losses (Table 3b). The Direct GHG emission factors include only carbon dioxide, methane and nitrous oxide emissions at UK power stations, with the Indirect GHG emission factors including the emissions resulting from production and delivery of fuel to these power stations (i.e. from gas rigs, refineries and collieries, etc).

This factor changes from year to year, as the fuel mix consumed in UK power stations changes. Because these annual changes can be large (the factor depends very heavily on the relative prices of coal and natural gas), and to assist companies with year to year comparability, a 'grid rolling average' factor is presented which is the *average* of the grid Conversion factor over the last 5 years. This factor is updated annually.

I generate my electricity onsite. How do I calculate emissions from this?

If you generate electricity from 'owned or controlled' renewable sources backed by Renewable Energy Guarantee of Origin (REGOs) within the UK, you should account for these emissions using the 'Renewables' factor. Please see Annex G in Defra's Guidance on how to measure and report your GHG emissions for an explanation of how to report on-site generated renewable energy:
http://www.defra.gov.uk/environment/business/reporting/index.htm

How should I report the carbon emissions from my use of green tariffs?

You should account for all electricity purchased for own consumption from the national grid or a third party using the 'Grid Rolling Average' factor (irrespective of the source of the electricity). Please refer to Annex G of the Defra Guidance for further guidance on reporting green tariffs:
http://www.defra.gov.uk/environment/business/reporting/index.htm

How should I report the carbon emissions from my use of CHP-backed tariff?

You should account for all electricity purchased for own consumption from the national grid or a third party using the 'Grid Rolling Average' factor (irrespective of the source of the electricity).

Do I need to update all my calculations using the new conversion factors each year?

Emission factors for electricity are provided in time-series (e.g. for grid electricity) and **should** be updated for historical reporting with the annual update. This is because there can be revisions for earlier data due to the improvements in the calculation methodology or UK GHG inventory datasets they are based upon. Please refer to the general introduction for further details.

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here: http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

NOTE: Please use EITHER Table 3a + Table 3b, OR Table 3c to calculate emmissions to avoid double-counting.
(More information is also provided on the use of these tables in the introduction to the Annex.)

Annex 3 - Converting from purchased electricity use to carbon dioxide equivalent emissions

Table 3a

Electricity emission factors from 1990 to 2008 per kWh (electricity GENERATED):	CO_2	CH_4	N_2O	Total GHG
UK Grid Electricity Year	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh
1990	0.71225	0.00019	0.00583	0.71827
1991	0.69375	0.00018	0.00566	0.69959
1992	0.64750	0.00018	0.00528	0.65295
1993	0.57350	0.00017	0.00437	0.57804
1994	0.56425	0.00018	0.00421	0.56864
1995	0.53650	0.00018	0.00392	0.54060
1996	0.52224	0.00018	0.00355	0.52596
1997	0.48185	0.00017	0.00304	0.48507
1998	0.48316	0.00018	0.00305	0.48640
1999	0.45369	0.00019	0.00262	0.45650
2000	0.48045	0.00019	0.00289	0.48353
2001	0.49512	0.00020	0.00308	0.49840
2002	0.47990	0.00020	0.00289	0.48299
2003	0.49466	0.00020	0.00309	0.49796
2004	0.49461	0.00020	0.00299	0.49781
2005	0.48840	0.00022	0.00308	0.49171
2006	0.51613	0.00023	0.00340	0.51976
2007	0.50537	0.00023	0.00315	0.50875
2008	0.49927	0.00025	0.00297	0.50249
Other electricity factor				
Renewables [2]	0	0	0	0
Total				

Grid Rolling Average [1]:	Scope 2				Scope 3	All Scopes
	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Amount USED per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh
	0.71225	0.00019	0.00583	0.71827	0.10224	0.82051
	0.70300	0.00019	0.00574	0.70893	0.10091	0.80984
	0.68450	0.00018	0.00559	0.69027	0.09825	0.78852
	0.65675	0.00018	0.00528	0.66221	0.09427	0.75648
	0.63825	0.00018	0.00507	0.64350	0.09161	0.73511
	0.60310	0.00018	0.00469	0.60797	0.08657	0.69454
	0.56880	0.00018	0.00426	0.57324	0.08164	0.65488
	0.53567	0.00018	0.00382	0.53966	0.07627	0.61593
	0.51760	0.00018	0.00355	0.52133	0.07298	0.59431
	0.49549	0.00018	0.00324	0.49890	0.06867	0.56757
	0.48428	0.00018	0.00303	0.48749	0.06600	0.55349
	0.47885	0.00019	0.00294	0.48198	0.06434	0.54632
	0.47846	0.00019	0.00291	0.48156	0.06385	0.54541
	0.48077	0.00020	0.00291	0.48388	0.06397	0.54785
	0.48895	0.00020	0.00299	0.49214	0.06521	0.55735
	0.49054	0.00021	0.00303	0.49377	0.06558	0.55935
	0.49474	0.00021	0.00309	0.49804	0.06637	0.56441
	0.49984	0.00022	0.00314	0.50320	0.06710	0.57030
	0.50076	0.00023	0.00312	0.50410	0.06688	0.57098
	0	0	0	0	0	0

Scope 2				Scope 3	All Scopes	
CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	% Transmission and Distribution Losses
Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	
						7.5%
						7.5%
						7.5%
						7.5%
						7.5%
						7.5%
						8.1%
						8.1%
						8.1%
						8.1%
						8.3%
						8.5%
						8.3%
						8.2%
						8.3%
						7.4%
						7.4%
						7.2%
						7.4%
0	0	0	0	0	0	

Table 3b

Electricity emission factors from 1990 to 2008 per kWh (electricity LOSSES):	CO_2	CH_4	N_2O	Total GHG
UK Grid Electricity Year	kg CO_2 per kWh	kg CO_2eq per kWh	kg CO_2eq per kWh	kg CO_2eq per kWh
1990	0.05775	0.00002	0.00047	0.05824
1991	0.05625	0.00002	0.00045	0.05672
1992	0.05250	0.00001	0.00042	0.05294
1993	0.04650	0.00002	0.00036	0.04687
1994	0.04575	0.00002	0.00034	0.04611
1995	0.04350	0.00002	0.00032	0.04383
1996	0.04625	0.00002	0.00031	0.04658
1997	0.04267	0.00002	0.00027	0.04295
1998	0.04279	0.00002	0.00027	0.04307
1999	0.03978	0.00001	0.00023	0.04002
2000	0.04324	0.00002	0.00026	0.04352
2001	0.04598	0.00002	0.00028	0.04629
2002	0.04316	0.00002	0.00026	0.04344
2003	0.04394	0.00002	0.00027	0.04422
2004	0.04484	0.00002	0.00028	0.04513
2005	0.03901	0.00002	0.00025	0.03927
2006	0.04110	0.00001	0.00027	0.04137
2007	0.03918	0.00002	0.00025	0.03945
2008	0.04009	0.00002	0.00024	0.04035
Other electricity factor				
Renewables [2]	0	0	0	0
Total				

Grid Rolling Average [1]:	Scope 3				Scope 3	All Scopes
	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Amount USED per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh
	0.05775	0.00002	0.00047	0.05824	0.00767	0.06591
	0.05700	0.00001	0.00047	0.05748	0.00757	0.06505
	0.05550	0.00002	0.00045	0.05597	0.00737	0.06334
	0.05325	0.00002	0.00043	0.05370	0.00707	0.06077
	0.05175	0.00002	0.00041	0.05218	0.00687	0.05905
	0.04890	0.00001	0.00038	0.04929	0.00649	0.05578
	0.04690	0.00001	0.00036	0.04727	0.00664	0.05391
	0.04493	0.00001	0.00032	0.04527	0.00621	0.05148
	0.04419	0.00002	0.00031	0.04451	0.00594	0.05045
	0.04300	0.00002	0.00028	0.04330	0.00554	0.04884
	0.04294	0.00002	0.00027	0.04323	0.00545	0.04868
	0.04290	0.00001	0.00026	0.04317	0.00547	0.04864
	0.04299	0.00002	0.00026	0.04327	0.00527	0.04854
	0.04321	0.00001	0.00027	0.04349	0.00522	0.04871
	0.04423	0.00002	0.00027	0.04452	0.00542	0.04994
	0.04338	0.00001	0.00026	0.04367	0.00485	0.04852
	0.04241	0.00002	0.00026	0.04269	0.00489	0.04758
	0.04161	0.00001	0.00026	0.04189	0.00483	0.04672
	0.04084	0.00001	0.00025	0.04112	0.00497	0.04609
	0	0	0	0	0	0

Scope 3				Scope 3	All Scopes	
CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	% Transmission and Distribution Losses
Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	
						7.5%
						7.5%
						7.5%
						7.5%
						7.5%
						7.5%
						8.1%
						8.1%
						8.1%
						8.1%
						8.3%
						8.5%
						8.3%
						8.2%
						8.3%
						7.4%
						7.4%
						7.2%
						7.4%
0	0	0	0	0	0	

Annex 3 - Converting from purchased electricity use to carbon dioxide equivalent emissions

Table 3c

Electricity emission factors from 1990 to 2008 per kWh (electricity CONSUMED):	CO_2	CH_4	N_2O	Total GHG
UK Grid Electricity Year	kg CO_2 per kWh	kg CO_2eq per kWh	kg CO_2eq per kWh	kg CO_2eq per kWh
1990	0.77000	0.00021	0.00630	0.77651
1991	0.75000	0.00020	0.00611	0.75631
1992	0.70000	0.00019	0.00570	0.70589
1993	0.62000	0.00019	0.00473	0.62491
1994	0.61000	0.00020	0.00455	0.61475
1995	0.58000	0.00020	0.00424	0.58443
1996	0.56849	0.00020	0.00386	0.57254
1997	0.52452	0.00019	0.00331	0.52802
1998	0.52595	0.00020	0.00332	0.52947
1999	0.49347	0.00020	0.00285	0.49652
2000	0.52369	0.00021	0.00315	0.52705
2001	0.54110	0.00022	0.00336	0.54469
2002	0.52306	0.00022	0.00315	0.52643
2003	0.53860	0.00022	0.00336	0.54218
2004	0.53945	0.00022	0.00327	0.54294
2005	0.52741	0.00024	0.00333	0.53098
2006	0.55723	0.00024	0.00367	0.56113
2007	0.54455	0.00025	0.00340	0.54820
2008	0.53936	0.00027	0.00321	0.54284
Other electricity factor				
Renewables [2]	0	0	0	0
Total				

Grid Rolling Average [1]:	Scope 2, 3 [3]				Scope 3	All Scopes
	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Amount USED per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh
	0.77000	0.00021	0.00630	0.77651	0.10991	0.88642
	0.76000	0.00020	0.00621	0.76641	0.10848	0.87489
	0.74000	0.00020	0.00604	0.74624	0.10562	0.85186
	0.71000	0.00020	0.00571	0.71591	0.10134	0.81725
	0.69000	0.00020	0.00548	0.69568	0.09848	0.79416
	0.65200	0.00019	0.00507	0.65726	0.09306	0.75032
	0.61570	0.00019	0.00462	0.62051	0.08828	0.70879
	0.58060	0.00019	0.00414	0.58493	0.08248	0.66741
	0.56179	0.00020	0.00386	0.56584	0.07892	0.64476
	0.53849	0.00020	0.00352	0.54220	0.07421	0.61641
	0.52722	0.00020	0.00330	0.53072	0.07145	0.60217
	0.52175	0.00020	0.00320	0.52515	0.06981	0.59496
	0.52145	0.00021	0.00317	0.52483	0.06912	0.59395
	0.52398	0.00021	0.00318	0.52737	0.06919	0.59656
	0.53318	0.00022	0.00326	0.53666	0.07063	0.60729
	0.53392	0.00022	0.00329	0.53744	0.07043	0.60787
	0.53715	0.00023	0.00335	0.54073	0.07126	0.61199
	0.54145	0.00023	0.00340	0.54509	0.07193	0.61702
	0.54160	0.00024	0.00337	0.54522	0.07185	0.61707
	0	0	0	0	0	0

	Scope 2, 3 [3]				Scope 3	All Scopes	
	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	% Transmission and Distribution Losses
	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	
							7.5%
							7.5%
							7.5%
							7.5%
							7.5%
							7.5%
							8.1%
							8.1%
							8.1%
							8.1%
							8.3%
							8.5%
							8.3%
							8.2%
							8.3%
							7.4%
							7.4%
							7.2%
							7.4%
	0	0	0	0	0	0	

Sources

Based on UK Greenhouse Gas Inventory for 2008 (AEA) according to the amount of CO_2, CH_4 and N_2O emitted from major power stations per unit of electricity consumed from the DECC's Digest of UK Energy Statistics (DUKES) 2009 Table 5.6, available at:
http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

Notes

Emission Factor (Electricity CONSUMED) = Emission Factor (Electricity GENERATED) + Emission Factor (Electricity LOSSES)

[1] The electricity conversion factors given represent the average carbon dioxide emission from the UK national grid per kWh of electricity generated (supplied to grid) in Table 3a, and in Table 3c for kWh electricity used at the point of final consumption (i.e. transmission and distribution losses are included, from Table 3b). These factors include only direct carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions at UK power stations and do not include emissions resulting from production and delivery of fuel to these power stations (i.e. from gas rigs, refineries and collieries, etc.).

This factor changes from year to year, as the fuel mix consumed in UK power stations changes. Because these annual changes can be large (the factor depends very heavily on the relative prices of coal and natural gas), and to assist companies with year to year comparability, the factor presented is the grid rolling average of the grid conversion factor over the previous 5 years. This factor is updated annually.

[2] Organisations should only use the 'Renewables' factor for reporting emissions from electricity generated from owned or controlled renewable sources backed by Renewable Energy Guarantee of Origin (REGOs) certificates. Please refer to Annex G of the Defra Guidance for further guidance on reporting renewable energy:
http://www.defra.gov.uk/environment/business/reporting/index.htm

[3] Includes both Direct GHG emissions per kWh (electricity GENERATED), which are counted as Scope 2, as well as Direct GHG emissions per kWh (electricity LOSSES), which are counted as Scope 3. This does not include indirect GHG emissions, which are different and accounted separately, but also fall into Scope 3 for reporting.

Annex 4 - Typical Process Emissions

Last updated:	Jun-09

How to use this Annex

The Kyoto protocol seeks to reduce emissions of the following six greenhouse gases.

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 [1]								
Process		Emission						
		CO_2	CH_4	N_2O	PFC	SF_6	HFC
Mineral Products	Cement Production	■					
	Lime Production	■					
	Limestone Use [2]	■					
	Soda Ash Production and Use	■					
	Fletton Brick Manufacture [3]	■	■				
Chemical Industry	Ammonia	■	■				
	Nitric Acid			■			
	Adpic 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	■	■				

If you have identified process emissions of greenhouse gases other than those covered in this Annex these may be converted to carbon dioxide equivalents by using the factors provided in **Annex 5**.

Sources

Greenhouse Gas Inventory Reference Manual, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997)

adapted for UK processes by AEA

Notes

[1] 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.

[2] 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.

[3] 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 Gases during the processing stage.

Annex 5 - Emission Factors for converting Greenhouse Gas Emissions into Carbon Dioxide Equivalents (including emissions from refrigerants and air conditioning systems)

Last updated: May-10

How to use this Annex

Global Warming Potentials (GWPs) are used to compare the impact of the emission of equivalent masses of different GHGs relative to carbon dioxide. For example, it is estimated that the emission of 1 kilogram of methane will have the same warming impact [1] as 21 kilograms of carbon dioxide. Therefore the GWP of methane is 21. The GWP of carbon dioxide is, by definition, 1.

The conversion factors in **Table 5a** incorporate (GWP) values relevant to reporting under UNFCCC, as 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, 1996)* .

Revised GWP values have since been published by the IPCC in the Fourth Assessment Report (2007) but current UNFCCC Guidelines on Reporting and Review, adopted before the publication of the Fourth Assessment Report, require emission estimates to be based on the GWPs in the IPCC Second Assessment Report. A second table, **Table 5b**, includes other greenhouse gases not listed in the Kyoto protocol or covered by reporting under UNFCCC. These GWP conversion factors have been taken from the IPCC's Fourth Assessment Report (2007).

CFCs and HCFCs

Not all refrigerants in use are classified as greenhouse gases for the purposes of the UNFCCC and Kyoto Protocol (e.g. CFCs, HCFCs). These gases are controlled under the Montreal Protocol and as such GWP values are listed in **Table 5b**

Mixed/Blended gases

GWP values for refrigerant 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 [2800 x 0.44] + [3800 x 0.52] + [1300 x 0.04] = 3260). A limited selection of common blends is presented in Tables 5a and 5b.

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here: http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 5a

Factors for Process Emissions - Greenhouse Gases Listed in the Kyoto Protocol								
Emission	Chemical formula	Amount Emitted per Year in tonnes	x	Conversion Factor (GWP)	x	Unit conversion tonnes to kg	Total kg CO_2 equivalent
Carbon Dioxide	CO_2		x	1	x	1,000	
Methane	CH_4		x	21	x	1,000	
Nitrous Oxide	N_2O		x	310	x	1,000	
HFC-23	CHF_3		x	11,700	x	1,000	
HFC-32	CH_2F_2		x	650	x	1,000	
HFC-41	CH_3F		x	150	x	1,000	
HFC-125	CHF_2CF_3		x	2,800	x	1,000	
HFC-134	CHF_2CHF_2		x	1,000	x	1,000	
HFC-134a	CH_2FCF_3		x	1,300	x	1,000	
HFC-143	CH_3CF_3		x	300	x	1,000	
HFC-143a	CH_3CHF_2		x	3,800	x	1,000	
HFC-152a	CF_3CHFCF_3		x	140	x	1,000	
HFC-227ea	$CF_3CH_2CF_3$		x	2,900	x	1,000	
HFC-236fa	$CHF_2CH_2CF_3$		x	6,300	x	1,000	
HFC-245fa	$CH_3CF_2CH_2CF_3$		x	560	x	1,000	
HFC-43-I0mee	$CF_3CHFCHFCF_2CF_3$		x	1,300	x	1,000	
Perfluoromethane (PFC-14)	CF_4		x	6,500	x	1,000	
Perfluoroethane (PFC-116)	C_2F_6		x	9,200	x	1,000	
Perfluoropropane (PFC-218)	C_3F_8		x	7,000	x	1,000	
Perfluorocyclobutane (PFC-318)	$c\text{-}C_4F_8$		x	8,700	x	1,000	
Perfluorobutane (PFC-3-1-10)	C_4F_{10}		x	7,000	x	1,000	
Perfluoropentane (PFC-4-1-12)	C_5F_{12}		x	7,500	x	1,000	
Perfluorohexane (PFC-5-1-14)	C_6F_{14}		x	7,400	x	1,000	
Sulphur hexafluoride	SF_6		x	23,900	x	1,000	
Blends							
R404A	52:44:4 blend of HFC-143a, -125 and -134a		x	3,260	x	1,000	
R407C	23:25:52 blend of HFC-32, -125 and -134a		x	1,526	x	1,000	
R408A	47:7:46 blend HCFC-22, HFC-125 and HFC-143a		x	2,795	x	1,000	
R410A	50:50 blend of HFC-32 and -125		x	1,725	x	1,000	
R507	50:50 blend of HFC-125 and HFC-143a		x	3,300	x	1,000	
R508B	46:54 blend of HFC-23 and PFC-116		x	10,350	x	1,000	
Total							**0**

[1] Over the period of one century. The length of time a GWP is referenced to is important. 100 year GWPs were adopted for use under the UNFCCC and Kyoto Protocol.

Annex 5 - Emission Factors for converting Greenhouse Gas Emissions into Carbon Dioxide Equivalents (including emissions from refrigerants and air conditioning systems)

Last updated: May-10

Table 5b

Factors for Process Emissions - Other Greenhouse Gases (e.g. other refrigerants)								
Emission		Amount Emitted per Year in tonnes	x	Conversion Factor (GWP)	x	Unit conversion tonnes to kg	Total kg CO_2 equivalent
Substances controlled by the Montreal Protocol							
CFC-11/R11 = Trichlorofluoromethane	CCl_3F		x	4,750	x	1,000	
CFC-12/R12 = Dichlorodifluoromethane	CCl_2F_2		x	10,900	x	1,000	
CFC-13	$CClF_3$		x	14,400	x	1,000	
CFC-113	CCl_2FCClF_2		x	6,130	x	1,000	
CFC-114	$CClF_2CClF_2$		x	10,000	x	1,000	
CFC-115	$CClF_2CF_3$		x	7,370	x	1,000	
Halon-1211	$CBrClF_2$		x	1,890	x	1,000	
Halon-1301	$CBrF_3$		x	7,140	x	1,000	
Halon-2402	$CBrF_2CBrF_2$		x	1,640	x	1,000	
Carbon tetrachloride	CCl_4		x	1,400	x	1,000	
Methyl bromide	CH_3Br		x	5	x	1,000	
Methyl chloroform	CH_3CCl_3		x	146	x	1,000	
HCFC-22/R22 = Chlorodifluoromethane	$CHClF_2$		x	1,810	x	1,000	
HCFC-123	$CHCl_2CF_3$		x	77	x	1,000	
HCFC-124	$CHClFCF_3$		x	609	x	1,000	
HCFC-141b	CH_3CCl_2F		x	725	x	1,000	
HCFC-142b	CH_3CClF_2		x	2,310	x	1,000	
HCFC-225ca	$CHCl_2CF_2CF_3$		x	122	x	1,000	
HCFC-225cb	$CHClFCF_2CClF_2$		x	595	x	1,000	
Other Perfluorinated compounds							
Nitrogen trifluoride	NF_3		x	17,200	x	1,000	
PFC-4-1-12	C_5F_{12}		x	9,160	x	1,000	
PFC-9-1-18	$C_{10}F_{18}$		x	7,500	x	1,000	
trifluoromethyl sulphur pentafluoride	SF_5CF_3		x	17,700	x	1,000	
Fluorinated ethers							
HFE-125	CHF_2OCF_3		x	14,900	x	1,000	
HFE-134	CHF_2OCHF_2		x	6,320	x	1,000	
HFE-143a	CH_3OCF_3		x	756	x	1,000	
HCFE-235da2	$CHF_2OCHClCF_3$		x	350	x	1,000	
HFE-245cb2	$CH_3OCF_2CHF_2$		x	708	x	1,000	
HFE-245fa2	$CHF_2OCH_2CF_3$		x	659	x	1,000	
HFE-254cb2	$CH_3OCF_2CHF_2$		x	359	x	1,000	
HFE-347mcc3	$CH_3OCF_2CF_2CF_3$		x	575	x	1,000	
HFE-347pcf2	$CHF_2CF_2OCH_2CF_3$		x	580	x	1,000	
HFE-356pcc3	$CH_3OCF_2CF_2CHF_2$		x	110	x	1,000	
HFE-449sl (HFE-7100)	$C_4F_9OCH_3$		x	297	x	1,000	
HFE-569sf2 (HFE-7200)	$C_4F_9OC_2H_5$		x	59	x	1,000	
HFE-43-10pccc124 (H-Galden1040x)	$CHF_2OCF_2OC_2F_4OCHF_2$		x	1,870	x	1,000	
HFE-236ca12 (HG-10)	$CHF_2OCF_2OCHF_2$		x	2,800	x	1,000	
HFE-338pcc13 (HG-01)	$CHF_2OCF_2CF_2OCHF_2$		x	1,500	x	1,000	
Others							
PFPMIE	$CF_3OCF(CF_3)CF_2OCF_2OCF_3$		x	10,300	x	1,000	
Dimethylether	CH_3OCH_3		x	1	x	1,000	
Methylene chloride	CH_2Cl_2		x	8.7	x	1,000	
Methyl chloride	CH_3Cl		x	13	x	1,000	
R290 = Propane	C_3H_8		x	3.3	x	1,000	
R600A = Isobutane	C_4H_{10}		x	0.001	x	1,000	
Blends							
R406A	55:41:4 blend of HCFC-22, HCFC-142b and R600A		x	1,943	x	1,000	
R409A	60:25:15 blend of HCFC-22, HCFC-124 and HCFC-142b		x	1,585	x	1,000	
R502	48.8:51.2 blend of HCFC-22 and CFC-115		x	4,657	x	1,000	
Total							**0**

Sources

The conversion factors in Table 4a 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) and Fourth Assessment Report (2007) but current UNFCCC Guidelines on Reporting and Review, adopted before the publication of the Third and Fourth Assessment Report, require emission estimates to be based on the GWPs in the IPCC Second Assessment Report.

The conversion factors in Table 5b above incorporate (GWP) values published by the IPCC in its Fourth Assessment Report (Working Group I Report "The Physical Science Basis", 2007, available at: http://www.ipcc.ch/ipccreports/ar4-wg1.htm).

Notes

Not all refrigerants in use are classified as greenhouse gases for the purposes of the Climate Change Programme (e.g. CFCs, HCFCs, other substances listed in Table 5b). GWP values for refrigerant HFC blends should be calculated on the basis of the percentage blend composition. For example, the GWP for R404A that comprises is 44% HFC125, 52% HFC143a and 4% HFC134a is 2800 x 0.44 + 3800 x 0.52 + 1300 x 0.04 = 3260. Similarly R407C is a blend of 23% of R32, 25% of R125 and 52% of R134a = 650 x 0.23 + 2800 x 0.25 + 1300 x 0.52 = 1526. Information on blends is based largely on information from the UK Institute of Refrigeration website: http://www.ior.org.uk/index.php

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

How to use this Annex

Emissions can be calculated *either* from fuel use (see Table 6a), which is the most accurate method of calculation, or estimated from *distance* travelled using UK average emission factors for different modes of transport (other Tables 6b - 6j). For public transport (Tables 6k and 6l) emissions are presented per passenger, rather than per vehicle. Therefore enter *passenger kilometres travelled* to calculate emissions (e.g. if one person travels 500km, then *passenger kilometres travelled* are 500. If three people travel the same distance *passenger kilometres travelled* are 1500).

Simply multiply activity (either fuel used, kilometres travelled or passenger kilometres travelled) by the appropriate conversion factor. An excel spreadsheet is provided for ease of use.

Annex 6 Scopes & Boundaries:

Scope 1: Direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel from owned/controlled transport.

Scope 3: Indirect emissions associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels. Emission factors are based on data from the JEC Well-To-Wheels study, for further information see: http://ies.jrc.ec.europa.eu/WTW

Scope 1 OR Scope 3: Direct emissions from transport can fall into either Scope 1 or Scope 3, depending on the vehicle ownership/level of control. For vehicles owned or directly controlled by a reporting company, direct emissions should be reported under Scope 1. However, emissions resulting from transport-related activities in vehicles not owned or controlled by the reporting entity should be reported under Scope 3. Examples of direct emissions from passenger transport that would be reported under Scope 3 include:

- Employee business travel by non-owned means, i.e. public transport such as: bus, rail, ferry and taxi and air travel (except for the companies actually owning/controlling the fleet / operating the services);
- Employees commuting to and from work;

In general it is recommended that the 'control' approach is used in order to decide whether to report emissions as Scope 1 or Scope 3. The control approach is itself divided into two methods – financial and operational (where the financial control approach is the one most commonly recommended).

- A company has financial control over an operation if the company has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities.
- A company has operational control over an operation if the company or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation.

In the transport sector, 'open book accounts' provide a very good illustration of the financial and operational control methods. In the case of an open book account, a transport operator provides vehicles to a customer, but the customer pays the fuel bill for those vehicles directly, rather than simply paying the transport operator for the logistics service.
In the open book situation, the customer has financial control, but the transport operator has operational control. The customer and the transport operator will have to decide whether the emissions resulting from these transport operations are the customer's or the transport operator's Scope 1. Whichever method is used, it is very important that it is clearly stated in all reporting, and that it is consistently applied by both organisations.

A further consideration is the treatment of leased assets (e.g. vehicles), which depends on the organisational boundaries set and the control approach. Further information on scopes, control and leased assets is available in the Introduction to these Annexes, and from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How do I determine UK rail travel distances (in miles) where start and destination stations are known?

1. Click on web link: http://www.networkrail.co.uk/aspx/3828.aspx
2. Select the Route Index under Train Timetables
3. Use your mouse cursor to click on the appropriate train route in the 'Table' column that matches your starting and destination stations. This should open a corresponding timetable with rail distances.
4. In the timetable, refer to the 'Miles' columns on the left to determine mileage between your starting and destination stations.

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 6a

Standard Road Transport Fuel Conversion Factors				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel used	Total units used	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Petrol		litres		2.3018	0.0046	0.0156	2.3220	0.4109	2.7329						
Diesel		litres		2.6413	0.0015	0.0292	2.6720	0.5067	3.1787						
Compressed Natural Gas (CNG)		kg		2.7122	0.0040	0.0016	2.7178	0.3977	3.1155						
Liquid Petroleum Gas (LPG)		litres		1.4902	0.0006	0.0012	1.4920	0.1866	1.6786						
Total										**0**	**0**	**0**	**0**	**0**	**0**

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Sources
UK Greenhouse Gas Inventory for 2008 (AEA, 2010)
Digest of UK Energy Statistics 2009 (DECC), available at:
http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx
Carbon factors for fuels (UKPIA, 2004)

Notes
1 imperial gallon (UK) = 4.546 litres

Table 6b

Passenger Road Transport Conversion Factors: Petrol Cars				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Size of car	Total units travelled	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Small petrol car, up to 1.4 litre engine		miles	x	0.27837	0.00029	0.00154	0.28020	0.04970	0.32990						
		km	x	0.17297	0.00018	0.00096	0.17411	0.03088	0.20499						
Medium petrol car, from 1.4 - 2.0 litres		miles	x	0.34578	0.00029	0.00154	0.34762	0.06173	0.40935						
		km	x	0.21486	0.00018	0.00096	0.21600	0.03836	0.25436						
Large petrol cars, above 2.0 litres		miles	x	0.48179	0.00029	0.00154	0.48362	0.08602	0.56964						
		km	x	0.29937	0.00018	0.00096	0.30051	0.05345	0.35396						
Average petrol car		miles	x	0.33910	0.00029	0.00154	0.34094	0.06054	0.40148						
		km	x	0.21071	0.00018	0.00096	0.21185	0.03762	0.24947						
Total for petrol cars										0	0	0	0	0	0

Table 6c

Passenger Road Transport Conversion Factors: Diesel Cars				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Size of car	Total units travelled	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Small diesel car, up to 1.7 litre or under		miles	x	0.23364	0.00008	0.00267	0.23640	0.04482	0.28122						
		km	x	0.14518	0.00005	0.00166	0.14689	0.02785	0.17474						
Medium diesel car, from 1.7 to 2.0 litre		miles	x	0.29124	0.00008	0.00267	0.29399	0.05588	0.34987						
		km	x	0.18097	0.00005	0.00166	0.18268	0.03472	0.21740						
Large diesel car, over 2.0 litre		miles	x	0.39503	0.00008	0.00267	0.39778	0.07578	0.47356						
		km	x	0.24546	0.00005	0.00166	0.24717	0.04709	0.29426						
Average diesel car		miles	x	0.31374	0.00008	0.00267	0.31649	0.06019	0.37668						
		km	x	0.19495	0.00005	0.00166	0.19666	0.03740	0.23406						
Total for diesel cars										0	0	0	0	0	0

Table 6d

Passenger Road Transport Conversion Factors: Alternative Fuel Cars				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Type of alternative fuel car	Total units travelled	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Medium petrol hybrid car		miles	x	0.19174	0.00016	0.00154	0.19344	0.03423	0.22767						
		km	x	0.11914	0.00010	0.00096	0.12020	0.02127	0.14147						
Large petrol hybrid car		miles	x	0.34965	0.00021	0.00154	0.35140	0.06243	0.41383						
		km	x	0.21726	0.00013	0.00096	0.21835	0.03879	0.25714						
Average petrol hybrid car		miles	x	0.26506	0.00023	0.00154	0.26683	0.04731	0.31414						
		km	x	0.16470	0.00014	0.00096	0.16580	0.02940	0.19520						
Medium LPG car		miles	x	0.31120	0.00060	0.00198	0.31377	0.03896	0.35274						
		km	x	0.19337	0.00037	0.00123	0.19497	0.02421	0.21918						
Large LPG car		miles	x	0.43361	0.00060	0.00198	0.43618	0.05430	0.49048						
		km	x	0.26943	0.00037	0.00123	0.27103	0.03374	0.30477						
Average LPG car		miles	x	0.34471	0.00060	0.00198	0.34728	0.04316	0.39044						
		km	x	0.21419	0.00037	0.00123	0.21579	0.02682	0.24261						
Medium CNG car		miles	x	0.27663	0.00145	0.00198	0.28006	0.04056	0.32061						
		km	x	0.17189	0.00090	0.00123	0.17402	0.02520	0.19922						
Large CNG car		miles	x	0.38542	0.00145	0.00198	0.38885	0.05650	0.44535						
		km	x	0.23949	0.00090	0.00123	0.24162	0.03511	0.27673						
Average CNG car		miles	x	0.30640	0.00145	0.00198	0.30983	0.04492	0.35475						
		km	x	0.19039	0.00090	0.00123	0.19252	0.02791	0.22043						
Total for alternative fuel cars										0	0	0	0	0	0

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Table 6e

Passenger Road Transport Conversion Factors: Cars (unknown fuel)

Size of car	Total units travelled	Units	x	Scope 1 OR Scope 3: CO_2 kg CO_2 per unit	CH_4 kg CO_2e per unit	N_2O kg CO_2e per unit	Total Direct GHG kg CO_2e per unit	Scope 3 Total Indirect GHG kg CO_2e per unit	All Scopes Grand Total GHG kg CO_2e per unit	CO_2 Total kg CO_2	CH_4 Total kg CO_2e	N_2O Total kg CO_2e	Total Direct GHG Total kg CO_2e	Scope 3 Total Indirect GHG Total kg CO_2e	All Scopes Grand Total GHG Total kg CO_2e
Average small car (unknown fuel)		miles	x	0.27220	0.00026	0.00177	0.27423	0.04875	0.32298						
		km	x	0.16914	0.00016	0.00110	0.17040	0.03029	0.20069						
Average medium car (unknown fuel)		miles	x	0.32790	0.00021	0.00196	0.33008	0.05955	0.38963						
		km	x	0.20375	0.00013	0.00122	0.20510	0.03700	0.24210						
Average large car (unknown fuel)		miles	x	0.43842	0.00018	0.00216	0.44075	0.08042	0.52117						
		km	x	0.27242	0.00011	0.00134	0.27387	0.04997	0.32384						
Average car (unknown fuel)		miles	x	0.33297	0.00023	0.00195	0.33515	0.06041	0.39556						
		km	x	0.20690	0.00014	0.00121	0.20825	0.03754	0.24579						
Total for average cars										0	0	0	0	0	0

Sources
Notes

Factors developed by AEA and agreed with Department for Transport (2010)

These factors are estimated average values for the UK car fleet in 2009 travelling on average trips in the UK. They are calculated based on data from SMMT on new car CO_2 emissions from 1997 to 2009 combined with factors from TRL as functions of average speed of vehicle derived from test data under real world testing cycles and an uplift of 15% agreed with DfT to take into account further real-world driving effects on emissions relative to test-cycle based data. Further work is ongoing to understand this figure in more detail and revise it if necessary in the future.

The hybrid car factors are calculated based on data new car CO_2 emissions averaged across the main 4 hybrid vehicles currently available on the market and an uplift of 15% agreed with DfT to take into account real-world driving effects on emissions relative to test-cycle based data.

According to the Energy Savings Trust (EST), LPG and CNG cars results in 10-15% reduction in CO_2 relative to petrol cars, similar to diesel vehicles. New factors for LPG and CNG cars were calculated based on an average 12.5% reduction in CO_2 emissions relative to the emission factors for petrol cars from Table 6b. Due to the significant size and weight of the LPG and CNG fuel tanks only medium and large sized vehicles are available.

Real world effects not covered in regular test cycles include use of accessories (air con, lights, heaters, etc), vehicle payload (only driver +25kg is considered in tests, no passengers or further luggage), poor maintenance (tyre under inflation, maladjusted tracking, etc), gradients (tests effectively assume a level road), weather, harsher driving style, etc.

More accurate calculation of emissions can be made using the actual fuel consumed, where available, and the emission factors in Table 6a. Alternatively if a figure for a specific car's fuel consumption (e.g. in miles per gallon, mpg) is known, then the CO_2 can be calculated from the total mileage and the Table 6a

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Table 6f

Passenger Road Transport Conversion Factors: Petrol Cars by Market Segment

Market segment of car	Total units travelled	Units	x	Scope 1 OR Scope 3: CO_2 kg CO_2 per unit	CH_4 kg CO_2e per unit	N_2O kg CO_2e per unit	Total Direct GHG kg CO_2e per unit	Scope 3 Total Indirect GHG kg CO_2e per unit	All Scopes Grand Total GHG kg CO_2e per unit	CO_2 Total kg CO_2	CH_4 Total kg CO_2e	N_2O Total kg CO_2e	Total Direct GHG Total kg CO_2e	Scope 3 Total Indirect GHG Total kg CO_2e	All Scopes Grand Total GHG Total kg CO_2e
A. Mini		miles	x	0.25727	0.00029	0.00154	0.25910	0.04593	0.30503						
		km	x	0.15986	0.00018	0.00096	0.16100	0.02854	0.18954						
B. Supermini		miles	x	0.27755	0.00029	0.00154	0.27938	0.04955	0.32893						
		km	x	0.17246	0.00018	0.00096	0.17360	0.03079	0.20439						
C. Lower Medium		miles	x	0.32589	0.00029	0.00154	0.32773	0.05818	0.38591						
		km	x	0.20250	0.00018	0.00096	0.20364	0.03615	0.23979						
D. Upper Medium		miles	x	0.37017	0.00029	0.00154	0.37200	0.06608	0.43808						
		km	x	0.23001	0.00018	0.00096	0.23115	0.04106	0.27221						
E. Executive		miles	x	0.43884	0.00029	0.00154	0.44067	0.07834	0.51901						
		km	x	0.27268	0.00018	0.00096	0.27382	0.04868	0.32250						
F. Luxury		miles	x	0.55921	0.00029	0.00154	0.56105	0.09984	0.66089						
		km	x	0.34748	0.00018	0.00096	0.34862	0.06204	0.41066						
G. Sports		miles	x	0.41013	0.00029	0.00154	0.41196	0.07323	0.48519						
		km	x	0.25484	0.00018	0.00096	0.25598	0.04550	0.30148						
H. Duel Purpose 4x4		miles	x	0.46660	0.00029	0.00154	0.46843	0.08330	0.55173						
		km	x	0.28993	0.00018	0.00096	0.29107	0.05176	0.34283						
I. MPV		miles	x	0.38006	0.00029	0.00154	0.38190	0.06785	0.44975						
		km	x	0.23616	0.00018	0.00096	0.23730	0.04216	0.27946						
Total for petrol cars										0	0	0	0	0	0

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Table 6g

Passenger Road Transport Conversion Factors: Diesel Cars by Market Segment

Market segment of car	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	Scope 1 OR Scope 3: kg CO_2eq per unit (CH_4)	Scope 1 OR Scope 3: kg CO_2eq per unit (N_2O)	Scope 1 OR Scope 3: Total Direct GHG kg CO_2eq per unit	Scope 3: Total Indirect GHG kg CO_2eq per unit	All Scopes: Grand Total GHG kg CO_2eq per unit	Scope 1 OR Scope 3: Total kg CO_2	Scope 1 OR Scope 3: Total kg CO_2eq (CH_4)	Scope 1 OR Scope 3: Total kg CO_2eq (N_2O)	Scope 1 OR Scope 3: Total Direct GHG Total kg CO_2eq	Scope 3: Total Indirect GHG Total kg CO_2eq	All Scopes: Grand Total GHG Total kg CO_2eq
A. Mini		miles	x	0.16626	0.00008	0.00267	0.16901	0.03190	0.20091						
		km	x	0.10331	0.00005	0.00166	0.10502	0.01982	0.12484						
B. Supermini		miles	x	0.23348	0.00008	0.00267	0.23624	0.04479	0.28103						
		km	x	0.14508	0.00005	0.00166	0.14679	0.02783	0.17462						
C. Lower Medium		miles	x	0.26763	0.00008	0.00267	0.27039	0.05134	0.32173						
		km	x	0.16630	0.00005	0.00166	0.16801	0.03190	0.19991						
D. Upper Medium		miles	x	0.29208	0.00008	0.00267	0.29483	0.05604	0.35087						
		km	x	0.18149	0.00005	0.00166	0.18320	0.03482	0.21802						
E. Executive		miles	x	0.34599	0.00008	0.00267	0.34874	0.06639	0.41513						
		km	x	0.21499	0.00005	0.00166	0.21670	0.04125	0.25795						
F. Luxury		miles	x	0.40770	0.00008	0.00267	0.41045	0.07821	0.48866						
		km	x	0.25333	0.00005	0.00166	0.25504	0.04860	0.30364						
G. Sports		miles	x	0.28748	0.00008	0.00267	0.29023	0.05515	0.34538						
		km	x	0.17863	0.00005	0.00166	0.18034	0.03427	0.21461						
H. Duel Purpose 4x4		miles	x	0.43562	0.00008	0.00267	0.43837	0.08357	0.52194						
		km	x	0.27068	0.00005	0.00166	0.27239	0.05193	0.32432						
I. MPV		miles	x	0.33561	0.00008	0.00267	0.33836	0.06439	0.40275						
		km	x	0.20854	0.00005	0.00166	0.21025	0.04001	0.25026						
Total for diesel cars										0	0	0	0	0	0

Table 6h

Passenger Road Transport Conversion Factors: Cars (unknown fuel) by Market Segment

Market segment of car	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	Scope 1 OR Scope 3: kg CO_2e per unit (CH_4)	Scope 1 OR Scope 3: kg CO_2e per unit (N_2O)	Scope 1 OR Scope 3: Total Direct GHG kg CO_2e per unit	Scope 3: Total Indirect GHG kg CO_2e per unit	All Scopes: Grand Total GHG kg CO_2e per unit	Scope 1 OR Scope 3: Total kg CO_2	Scope 1 OR Scope 3: Total kg CO_2e (CH_4)	Scope 1 OR Scope 3: Total kg CO_2e (N_2O)	Scope 1 OR Scope 3: Total Direct GHG Total kg CO_2e	Scope 3: Total Indirect GHG Total kg CO_2e	All Scopes: Grand Total GHG Total kg CO_2e
A. Mini		miles	x	0.25637	0.00029	0.00163	0.25828	0.04497	0.30325						
		km	x	0.15930	0.00018	0.00101	0.16049	0.02794	0.18843						
B. Supermini		miles	x	0.27309	0.00026	0.00177	0.27512	0.04862	0.32374						
		km	x	0.16969	0.00016	0.00110	0.17095	0.03021	0.20116						
C. Lower Medium		miles	x	0.30920	0.00024	0.00187	0.31131	0.05625	0.36756						
		km	x	0.19213	0.00015	0.00116	0.19344	0.03495	0.22839						
D. Upper Medium		miles	x	0.33717	0.00021	0.00196	0.33935	0.06235	0.40170						
		km	x	0.20951	0.00013	0.00122	0.21086	0.03874	0.24960						
E. Executive		miles	x	0.39910	0.00018	0.00216	0.40143	0.07179	0.47322						
		km	x	0.24799	0.00011	0.00134	0.24944	0.04461	0.29405						
F. Luxury		miles	x	0.52468	0.00018	0.00216	0.52701	0.08800	0.61501						
		km	x	0.32602	0.00011	0.00134	0.32747	0.05468	0.38215						
G. Sports		miles	x	0.40729	0.00018	0.00216	0.40963	0.06333	0.47296						
		km	x	0.25308	0.00011	0.00134	0.25453	0.03935	0.29388						
H. Duel Purpose 4x4		miles	x	0.44807	0.00018	0.00216	0.45041	0.08344	0.53385						
		km	x	0.27842	0.00011	0.00134	0.27987	0.05185	0.33172						
I. MPV		miles	x	0.35697	0.00019	0.00206	0.35922	0.06626	0.42548						
		km	x	0.22181	0.00012	0.00128	0.22321	0.04117	0.26438						
Total for cars (unknown fuel)										0	0	0	0	0	0

Sources: Factors developed by AEA and agreed with Department for Transport (2010)

Notes: The market segment categories are the standard segments as defined by SMMT (UK Society of Motor Manufacturers and Traders). These factors are estimated average values for the UK car fleet in 2009 travelling on average trips in the UK. They are calculated based on data from SMMT on new car CO_2 emissions from 1997 to 2009 by SMMT. An uplift of 15% agreed with DfT to take into account further real-world driving effects on emissions relative to test-cycle based data (as under Tables 6b-6e). Further work is ongoing to understand this figure in more detail and revise it if necessary in the future.

There is a substantial variation in emission factors across market classes due to significant variations in engine size and vehicle weight. The Department for Transport consider the emission factors by fuel and engine size to often be a closer match to actual emissions. It is preferable to use the emission factors by engine size provided in Tables 6b and 6c over the market class based factors where possible.

Annex 6 - Passenger Transport Conversion Tables

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More accurate calculation of emissions can be made using the actual fuel consumed, where available, and the emission factors in Table 6a. Alternatively if a figure for a specific car's fuel consumption (e.g. in miles per gallon, mpg) is known, then the CO_2 can be calculated from the total mileage and the Table 6a factors.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA,

Table 6i

Passenger Road Transport Conversion Factors: Vans (Light Commercial Vehicles)				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Type of van	Total units travelled	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Petrol van (Class I), up to 1.305 tonne		miles	x	0.31233	0.00039	0.00134	0.31406	0.06025	0.37431						
		km	x	0.19407	0.00024	0.00084	0.19515	0.03744	0.23259						
Petrol van (Class II), 1.305 to 1.74 tonne		miles	x	0.33975	0.00039	0.00134	0.34148	0.06552	0.40700						
		km	x	0.21111	0.00024	0.00084	0.21218	0.04071	0.25289						
Petrol van (Class III), 1.74 to 3.5 tonne		miles	x	0.41160	0.00041	0.00294	0.41495	0.07961	0.49456						
		km	x	0.25575	0.00026	0.00183	0.25784	0.04947	0.30731						
Petrol van up to 3.5 tonne		miles	x	0.38697	0.00040	0.00243	0.38981	0.07479	0.46460						
		km	x	0.24045	0.00025	0.00151	0.24222	0.04647	0.28869						
Diesel van (Class I), up to 1.305 tonne		miles	x	0.25271	0.00010	0.00172	0.25453	0.04883	0.30336						
		km	x	0.15703	0.00006	0.00107	0.15816	0.03034	0.18850						
Diesel van (Class II), 1.305 to 1.74 tonne		miles	x	0.36178	0.00010	0.00246	0.36434	0.06989	0.43423						
		km	x	0.22480	0.00006	0.00153	0.22639	0.04343	0.26982						
Diesel van (Class III), 1.74 to 3.5 tonne		miles	x	0.43314	0.00010	0.00295	0.43619	0.08369	0.51988						
		km	x	0.26914	0.00006	0.00183	0.27103	0.05200	0.32303						
Diesel van up to 3.5 tonne		miles	x	0.40363	0.00010	0.00275	0.40647	0.07799	0.48446						
		km	x	0.25080	0.00006	0.00171	0.25257	0.04846	0.30103						
LPG van up to 3.5 tonne		miles	x	0.42381	0.00083	0.00312	0.42776	0.05356	0.48132						
		km	x	0.26334	0.00052	0.00194	0.26580	0.03328	0.29908						
CNG van up to 3.5 tonne		miles	x	0.38345	0.00202	0.00312	0.38859	0.05697	0.44556						
		km	x	0.23826	0.00126	0.00194	0.24146	0.03540	0.27686						
Average van up to 3.5 tonne		miles	x	0.40259	0.00012	0.00273	0.40544	0.07778	0.48322						
		km	x	0.25016	0.00007	0.00169	0.25193	0.04833	0.30026						
Total for vans										0	0	0	0	0	0

Sources Notes

Factors developed by AEA and agreed with Department for Transport (2010)

Emission factors for petrol and diesel light good vehicles (vans up to 3.5 tonnes) were calculated based on the new emission factors used in the National Atmospheric Emissions Inventory (NAEI) and Greenhouse Gas Inventory for 2008 (AEA, 2010). These test cycle based emission factors were then uplifted by 15% to represent 'real-world' emissions, consistent with the approach used for cars agreed with DfT. Emission factors for LPG and CNG vans were estimated to be similar to diesel vehicles, as indicated by EST for cars. The average van emission factor was calculated on the basis of the relative NAEI vehicle km for petrol and diesel LGVs for 2008.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Table 6j

Passenger Road Transport Conversion Factors: Motorcycles				Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Size of motorcycle	Total units travelled	Units	x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Small petrol motorbike (mopeds/scooters up to 125cc)		miles	x	0.13678	0.00412	0.00056	0.14146	0.02441	0.16587						
		km	x	0.08499	0.00256	0.00035	0.08790	0.01517	0.10307						
Medium petrol motorbike (125-500cc)		miles	x	0.16602	0.00465	0.00100	0.17167	0.02964	0.20131						
		km	x	0.10316	0.00289	0.00062	0.10667	0.01842	0.12509						
Large petrol motorbike (over 500cc)		miles	x	0.22087	0.00360	0.00100	0.22547	0.03943	0.26490						
		km	x	0.13724	0.00224	0.00062	0.14010	0.02450	0.16460						
Average petrol motorbike (unknown engine size)		miles	x	0.18678	0.00425	0.00097	0.19199	0.03335	0.22534						
		km	x	0.11606	0.00264	0.00060	0.11930	0.02072	0.14002						
Total for motorcycles										0	0	0	0	0	0

Sources Notes

Factors developed by AEA and agreed with Department for Transport (2010)

These factors are based on calculations of average emissions data by size category, based data provided by Clear (http://www.clear-offset.com/) of almost 1200 datapoints, over 300 different bikes from 50-1500cc, and from 25 manufacturers from a mix of magazine road test reports and user reported data.

More accurate calculation of emissions can be made using the actual fuel consumed, where available, and the emission factors in Table 5a. Alternatively if a figure for a specific motorbike's fuel consumption (e.g. in miles per gallon, mpg) is known, then the CO_2 can be calculated from the total mileage and the Table 6a factors.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Table 6k

Taxi, Bus, Rail and Ferry Passenger Transport Conversion Factors				Scope 3				Scope 3	All Scopes	Scope 3				Scope 3	All Scopes
				CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Method of travel		Vehicle kms travelled (vkm)[1]	x	kg CO_2 per vkm[1]	kg CO_2e per vkm[1]	kg CO_2e per vkm[1]	kg CO_2e per vkm[1]	kg CO_2e per vkm[1]	kg CO_2e per vkm[1]	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Taxi [2]	Regular taxi		x	0.21322	0.00005	0.00166	0.21493	0.02473	0.23966						
	Black cab		x	0.24546	0.00005	0.00166	0.24717	0.04709	0.29426						
Method of travel		Passenger kms travelled (pkm)	x	kg CO_2 per pkm	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Taxi [2]	Regular taxi		x	0.15230	0.00004	0.00119	0.15352	0.02922	0.18274						
	Black cab		x	0.19958	0.00012	0.00064	0.20034	0.03563	0.23597						
Bus	Local bus (not London) [3]		x	0.15726	0.00020	0.00128	0.15874	0.03017	0.18891						
	Local London bus [4]		x	0.08847	0.00009	0.00056	0.08912	0.01697	0.10609						
	Average local bus		x	0.13394	0.00016	0.00104	0.13514	0.02570	0.16084						
	Coach [5]		x	0.03000	0.00008	0.00057	0.03065	0.00576	0.03641						
Rail	National rail [6]		x	0.05340	0.00006	0.00305	0.05651	0.00859	0.06510						
	International rail (Eurostar) [7]		x	0.01502	0.00001	0.00009	0.01512	0.00202	0.01714						
	Light rail and tram [8]		x	0.07680	0.00004	0.00046	0.07730	0.01031	0.08761						
	London Underground [9]		x	0.07414	0.00004	0.00044	0.07462	0.00995	0.08457						
Ferry (Large RoPax) [10]	Foot passengers		x	0.01912	0.00001	0.00015	0.01928	0.00326	0.02254						
	Car passengers		x	0.13216	0.00004	0.00102	0.13322	0.02254	0.15576						
	Average (all passengers)		x	0.11516	0.00004	0.00088	0.11608	0.01964	0.13572						
Total										**0**	**0**	**0**	**0**	**0**	**0**

Sources: Department for Transport, Transport for London and AEA (2010)

Notes

[1] vkm (vehicle-km) is a measure of vehicle activity, representing the movement of a vehicle over a distance; pkm (passenger-km) is a measure of the total distance travelled by passengers on a vehicle and is calculated by multiplying the number of passengers by the vehicle-km.

[2] Emission factors for taxis were estimated on the basis of an average of the emission factors of medium and large cars from Table 6c and occupancy of 1.4 (CfIT, 2002). The emission factors for black cabs are based on the large car emission factor (consistent with the VCA dataset for London Taxis International vehicles) and an average passenger occupancy of 1.5 (average 2.5 people per cab from LTI website, 2008).

[3] The factor for local buses was calculated based on actual fuel consumption data submitted by bus operators to the DfT as part of their Bus Service Operators Grant (BSOG) claims and DfT bus statistics.

[4] The London bus factor is calculated using the same methodology as for other local busses using DfT's BSOG dataset and statistics.

[5] The emission factor for coach transport is the figure from the National Express Group's Corporate Responsibility Report, available at: http://www.nationalexpressgroup.com/nx1/corporate/environment/climate/. National Express are responsible for the majority of long-distance coach services in the UK, so this figure is expected to be broadly representative of the overall average.

[6] The national rail factor refers to an average emission per passenger kilometre for diesel and electric trains in 2007. The CO_2 value for passenger rail is based on currently available information on CO_2 emissions by diesel and electric passenger trains in the UK in 2007 produced by ORR (Office of the Rail Regulator) and is available at the link below. Emission factors for freight rail (from the same source) are provided in Annex 7, Table 7f.

http://www.rail-reg.gov.uk/upload/pdf/rolling-c9-environ.pdf

[7] The emission factor for international rail is based on figures provided by Eurostar in kgCO_2/pkm based on electricity grid average emission factors. Eurostar's published figure is 0.00771 kgCO_2/pkm. This differs from the figure quoted in the table above as it is calculated using the individual conversion factors as specified by each electricity supplier across each network section upon which they operate. For further information please visit: http://www.eurostar.com/UK/uk/leisure/about_eurostar/environment/greener_than_flying.jsp

[8] The light rail and tram factors were based on an average of factors for the Docklands Light Rail (DLR) service, the Manchester Metrolink, Tyne and Wear Metro, Glasgow Underground, Supertram, Midland Metro and the Croydon Tramlink. The factors for the Tyne and Wear, Glasgow, Midland, Supertram and Manchester tram and light rail systems were based on annual electricity consumption and passenger km data provided by the network operators in 2008 (referring mostly to consumption in 2007/08) and a CO_2 emission factor for grid rolling average electricity from Table 3c. DLR and Croydon Tramlink figures were recalculated using the updated 2008 grid rolling average from those available in the Transport for London 2009 environmental report available at: http://www.tfl.gov.uk/corporate/about-tfl/publications/1478.aspx

[9] The London Underground rail factor is recalculated using the updated 2008 grid rolling average from figures in the Transport for London 2009 environmental report available at: http://www.tfl.gov.uk/corporate/about-tfl/publications/1478.aspx

[10] The factors for RoPax ferries (Roll-on Roll-off ferries with additional passenger capacity) are based on data provided by Best Foot Forward from work for the Passenger Shipping Association (PSA) carried out in 2007/8. The calculated figure is based on ferry service operator provided data on fuel consumption and passengers transported, but does not include any data for passenger only ferry services, which would be expected to have significantly higher emission

All: Emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Table 6l

Air Passenger Transport Conversion Factors[10]						Scope 3				Scope 3	All Scopes							Scope 3	All Scopes
						CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Method of travel		Passenger kms travelled (pkm)	x	km uplift factor [12]	x	kg CO_2 per pkm [13]	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	kg CO_2e per pkm	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Flight type [14]	*Cabin class* [11]																
Domestic[14]	**Average**		x	109%	x	0.17147	0.00013	0.00169	0.17328	0.03187	0.20515						
Short-haul international[14]	**Average**		x	109%	x	0.09700	0.00001	0.00095	0.09797	0.01803	0.11600						
	Economy class		x	109%	x	0.09245	0.00001	0.00091	0.09336	0.01718	0.11054						
	Business class		x	109%	x	0.13867	0.00001	0.00136	0.14004	0.02577	0.16581						
Long-haul international[14]	**Average**		x	109%	x	0.11319	0.00001	0.00111	0.11431	0.02104	0.13535						
	Economy class		x	109%	x	0.08263	0.00000	0.00081	0.08345	0.01536	0.09881						
	Premium economy class		x	109%	x	0.13221	0.00001	0.00130	0.13352	0.02457	0.15809						
	Business class		x	109%	x	0.23963	0.00001	0.00236	0.24200	0.04454	0.28654						
	First class		x	109%	x	0.33052	0.00002	0.00325	0.33380	0.06143	0.39523						
Total												**0**	**0**	**0**	**0**	**0**	**0**

Source: Developed by AEA (2010) using the methodology developed in discussion with the Department for Transport and the airline industry, 2008.
EMEP/CORINAIR Emissions Inventory Guidebook (EIG), EEA (2009)
Civil Aviation Authority (2010)

Notes: These emissions factors are intended to be an aggregate representation of the typical emissions per passenger km from illustrative types of aircraft for the 3 types of air services. Actual emissions will vary significantly according to the type of aircraft in use, the load, cabin class, specific conditions of the flight route, etc.

[10] The emission factors refer to aviation's direct carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions only. There is currently uncertainty over the other non-CO_2 climate change effects of aviation (including water vapour, contrails, NOx etc) which may indicatively be accounted for by applying a multiplier. The appropriate factor to apply is subject to uncertainty but was estimated by the IPCC in 1999 to be in the range 2-4, with current best scientific evidence suggesting a factor of 1.9.
If used, this factor would be applied to the emissions factors set out here.

[11] The indicative emissions factors by passenger seating class have been produced to allow passengers to build an understanding of how emissions per passenger km are affected by load factors and seat configurations. This is in response to feedback on the previous version of the Act on CO_2 calculator.
Emission factors by passenger seating class were developed on the basis of detailed analysis of the seating configurations of 24 aircraft model variants from 16 major airlines providing services within/to/from the UK. Indicative emission factors were calculated via the relative area on the aircraft occupied by different seating classes compared to an economy class equivalent per passenger. Figures are only indicative averages and will vary considerably between different specific airline and aircraft configurations.

These indicative factors will be updated as further evidence comes to light on how these factors could more accurately be estimated. There are several ways in which these factors could be estimated, which will be kept under review.

[12] The 9% uplift factor comes from the IPCC Aviation and the global Atmosphere 8.2.2.3 , which states that 9-10% should be added to take into account non-direct routes (i.e. not along the straight line great circle distances between destinations) and delays/circling. Airline industry representatives have indicated that the percentage uplift for short-haul flights will be higher and for long-haul flights will be lower, however specific data is not currently available to provide separate factors. This is under investigation for future versions of these guidelines.

[13] The emissions factors are based on typical aircraft fuel burn over illustrative trip distances listed in the EMEP/CORINAIR Emissions Inventory Guidebook (EIG 2007) – available at the EEA website at: http://reports.eea.europa.eu/EMEPCORINAIR5/en/B851vs2.4.pdf and http://reports.eea.europa.eu/EMEPCORINAIR5/en/B851_annex.zip. This information is combined with data from the Civil Aviation Authority (CAA) on average aircraft seating capacity, loading factors, and annual passenger-km and aircraft-km for 2007 (most recent full-year data available). The provisional evidence to date suggests an uplift in the region of 10-12% to climb/cruise/descent factors derived by the CORINAIR approach is appropriate in order to ensure consistency with estimated UK aviation emissions as reported in line with the UN Framework on Climate Change, covering UK domestic flights and departing international flights. This uplift has already been included in these emissions factors.
These emissions are based on bunker fuel consumption and are closely related to fuel on departing flights. This uplift is therefore based on comparisons of national aviation fuel consumption from this reported inventory, with detailed bottom up calculations in DfT modelling along with the similar NAEI approach, which both use detailed UK activity data (by aircraft and route) from CAA, and the CORINAIR fuel consumption approach. Therefore for this version of the Defra CO_2 emission factors an uplift of 10% is applied to the emissions from the Cruise, Climb and Decent of the aircraft based on provisional evidence. The CORINAIR uplift is in addition to the assumption that Great Circle Distances are increased by 9% to allow for sub-optimal routing and stacking at airports during periods of heavy congestion. It should be noted that work will continue to determine a more robust reconciliation and this will be accounted for in future versions of these factors.

[14] The long haul estimate is based on a flight length from the Guidebook of 6482 km, short haul 1108km and domestic 463km. Actual flight distances do however vary significantly, as demonstrated in the examples in the following tables. Domestic flights are between UK airports, short haul international flights are typically to Europe (up to 3700km distance), and long haul international flights are typically to non-European destinations (or all other international flights over 3700km distance).

Annex 6 - Passenger Transport Conversion Tables

Last updated: Oct-10

Illustrative long haul flight distances

From London to:		
Area	***Airport***	***Distance (km)***
North Africa	Abu Simbel/Sharm El Sheikh, Egypt	3300
Southern Africa	Johannesburg/Pretoria, South Africa	9000
Middle East	Dubai, UAE	5500
North America	New York (JFK), USA	5600
North America	Los Angeles California, USA	8900
South America	Sao Paulo, Brazil	9400
Indian sub-continent	Bombay/Mumbai, India	7200
Far East	Hong Kong	9700
Australasia	Sydney, Australia	17000

Source Distances based on International Passenger Survey (Office for National Statistics) calculations using airport geographic information.

Illustrative short haul flight distances

From London to:		
Area	***Airport***	***Distance (km)***
Europe	Amsterdam, Netherlands	400
Europe	Prague (Ruzyne), Czech Rep	1000
Europe	Malaga, Spain	1700
Europe	Athens, Greece	1500

Source Distances based on International Passenger Survey (Office for National Statistics) calculations using airport geographic information.

New emission factors for CH_4 and N_2O are based on the UK Greenhouse Gas Inventory for 2008 (AEA, 2010)

Annex 7 - Freight Transport Conversion Tables

Last updated: Oct-10

How to use this Annex

A tonne-km is a measure of transported goods representing the movement of one tonne over one km. To use the tables below you will need to multiply the weight of goods (in tonnes) by the distance travelled by that mode (in km).

If you know how much of a particular fuel type is consumed, emissions can be calculated using **Table 7a**. This is the most accurate way to calculate emissions.

Table 7b gives emissions for distance travelled for vans and small trucks

Table 7c gives emissions *per tonne freight carried* for vans and small trucks. Emission factors for vans in tonne km were calculated from the emission factors per vehicle km provided in Table 6i (Annex 6) and an average load factor of 40%. The average cargo capacity was taken to be 0.6 tonnes for vans up to 1.305 tonnes gross vehicle weight, 1 tonne for vans between 1.305-1.740 tonnes gross vehicle weight and 2 tonnes for vans up to 3.5 tonnes gross vehicle weight.

Table 7d gives emissions *per vehicle kilometre travelled* for a range of HGV sizes with a range of different loads. Use this table if you know the distance the *vehicle* has travelled. If you do not know the load capacity of your vehicle, apply the *UK average load* which is given for a range of vehicle classes.

Table 7e gives emissions *per tonne kilometre travelled* for a range of HGV sizes with a range of different loads. Use this table if you know the distance the *freight* has travelled and what the mass (in tonnes) of the freight was.

Table 7f gives emissions factors for *tonne kilometres* of freight for *rail* , and *air freight*

Table 7g gives emissions factors for *tonne kilometres* of freight for *shipping*

Annex 7 Scopes & Boundaries:

Scope 1: Direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel from owned/controlled transport.
Scope 3: Indirect emissions associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels. Emission factors are based on data from the JEC Well-To-Wheels study, for further information see: http://ies.jrc.ec.europa.eu/WTW

Scope 1 OR Scope 3: Direct emissions from transport can fall into either Scope 1 or Scope 3, depending on the vehicle ownership/level of control. For vehicles owned or directly controlled by a reporting company, direct emissions should be reported under Scope 1. However, emissions resulting from transport-related activities in vehicles not owned or controlled by the reporting entity should be reported under Scope 3.

In general it is recommended that the 'control' approach is used in order to decide whether to report emissions as Scope 1 or Scope 3. The control approach is itself divided into two methods – financial and operational (where the financial control approach is the one most commonly recommended).

- A company has *financial control* over an operation if the company has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities.
- A company has *operational control* over an operation if the company or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation.

In the transport sector, 'open book accounts' provide a very good illustration of the financial and operational control methods. In the case of an open book account, a transport operator provides vehicles to a customer, but the customer pays the fuel bill for those vehicles directly, rather than simply paying the transport operator for the logistics service.
In the open book situation, the customer has financial control, but the transport operator has operational control. The customer and the transport operator will have to decide whether the emissions resulting from these transport operations are the customer's or the transport operator's Scope 1. Whichever method is used, it is very important that it is clearly stated in all reporting, and that it is consistently applied by both organisations.

A further consideration is the treatment of leased assets (e.g. vehicles), which depends on the organisational boundaries set and the control approach.
Further information on scopes, control and leased assets is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How do I determine UK rail travel distances (in miles) where start and destination stations are known?
1. Click on web link: http://www.networkrail.co.uk/aspx/3828.aspx
2. Select the Route Index under Train Timetables
3. Use your mouse cursor to click on the appropriate train route in the 'Table' column that matches your starting and destination stations. This should open a corresponding timetable with rail distances.
4. In the timetable, refer to the 'Miles' columns on the left to determine mileage between your starting and destination stations.

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 7a

					Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
Standard Road Transport Fuel Conversion Factors					CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Fuel used	Total units used	Units		x	kg CO_2 per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Petrol		litres		x	2.3018	0.00460	0.01560	2.32200	0.41090	2.7329						
Diesel		litres		x	2.6413	0.00150	0.02920	2.67200	0.50670	3.1787						
Compressed Natural Gas (CNG)		kg		x	2.7122	0.00400	0.00160	2.71780	0.39770	3.1155						
Liquid Petroleum Gas (LPG)		litres		x	1.4902	0.00060	0.00120	1.49200	0.18660	1.6786						
Total											0	0	0	0	0	0

Sources UK Greenhouse Gas Inventory for 2008 (AEA, 2010)
Digest of UK Energy Statistics 2009 (DECC), available at:
http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx
Carbon factors for fuels (UKPIA, 2004)

Notes 1 imperial gallon (UK) = 4.546 litres

Annex 7 - Freight Transport Conversion Tables

Last updated: Oct-10

Table 7b

Van/Light Commercial Vehicle Road Freight Conversion Factors: Vehicle km Basis

Type of van	Gross Vehicle Weight (tonnes)	% weight laden	UK av. payload (tonnes goods carried per vehicle)	Total vehicle km travelled		x	Scope 1 OR Scope 3: CO_2 kg CO_2 per vehicle km	Scope 1 OR Scope 3: CH_4 kg CO_2e per vehicle km	Scope 1 OR Scope 3: N_2O kg CO_2e per vehicle km	Scope 1 OR Scope 3: Total Direct GHG kg CO_2e per vehicle km	Scope 3 Total Indirect GHG kg CO_2e per vehicle km	All Scopes Grand Total GHG kg CO_2e per vehicle km	Scope 1 OR Scope 3: CO_2 Total kg CO_2	Scope 1 OR Scope 3: CH_4 Total kg CO_2e	Scope 1 OR Scope 3: N_2O Total kg CO_2e	Scope 1 OR Scope 3: Total Direct GHG Total kg CO_2e	Scope 3 Total Indirect GHG Total kg CO_2e	All Scopes Grand Total GHG Total kg CO_2e
Petrol (Class I)	up to 1.305t	37%	0.17			x	0.19407	0.00024	0.00084	0.19515	0.03744	0.23259						
Petrol (Class II)	1.305t to 1.74t	37%	0.26			x	0.21111	0.00024	0.00084	0.21218	0.04071	0.25289						
Petrol (Class III)	1.74t to 3.5t	41%	0.52			x	0.25575	0.00026	0.00183	0.25784	0.04947	0.30731						
Petrol (average)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.24045***	***0.00025***	***0.00151***	***0.24222***	***0.04647***	***0.28869***						
Diesel (Class I)	up to 1.305t	37%	0.17			x	0.15703	0.00006	0.00107	0.15816	0.03034	0.18850						
Diesel (Class II)	1.305t to 1.74t	37%	0.26			x	0.22480	0.00006	0.00153	0.22639	0.04343	0.26982						
Diesel (Class III)	1.74t to 3.5t	41%	0.52			x	0.26914	0.00006	0.00183	0.27103	0.05200	0.32303						
Diesel (average)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.25080***	***0.00006***	***0.00171***	***0.25257***	***0.04846***	***0.30103***						
LPG	up to 3.5t	40%	0.43			x	0.26334	0.00052	0.00194	0.26580	0.03328	0.29908						
CNG	up to 3.5t	40%	0.43			x	0.23826	0.00126	0.00194	0.24146	0.03540	0.27686						
Average (all vehicles)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.25016***	***0.00007***	***0.00169***	***0.25193***	***0.04833***	***0.30026***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Table 7c

Van/Light Commercial Vehicle Road Freight Conversion Factors (UK Average Vehicle Loads): Tonne.km Basis

	Gross Vehicle Weight (tonnes)	% weight laden	UK av. payload (tonnes goods carried per vehicle)	Total tonne km travelled		x	Scope 1 OR Scope 3: CO_2 kg CO_2 per tonne.km	Scope 1 OR Scope 3: CH_4 kg CO_2e per vehicle km	Scope 1 OR Scope 3: N_2O kg CO_2e per vehicle km	Scope 1 OR Scope 3: Total Direct GHG kg CO_2e per vehicle km	Scope 3 Total Indirect GHG kg CO_2e per vehicle km	All Scopes Grand Total GHG kg CO_2e per vehicle km	Scope 1 OR Scope 3: CO_2 Total kg CO_2	Scope 1 OR Scope 3: CH_4 Total kg CO_2e	Scope 1 OR Scope 3: N_2O Total kg CO_2e	Scope 1 OR Scope 3: Total Direct GHG Total kg CO_2e	Scope 3 Total Indirect GHG Total kg CO_2e	All Scopes Grand Total GHG Total kg CO_2e
Petrol (Class I)	up to 1.305t	37%	0.17			x	1.17351	0.00145	0.00505	1.18002	0.22639	1.40641						
Petrol (Class II)	1.305t to 1.74t	37%	0.26			x	0.82063	0.00093	0.00325	0.82481	0.15824	0.98305						
Petrol (Class III)	1.74t to 3.5t	41%	0.52			x	0.49601	0.00050	0.00355	0.50005	0.09593	0.59598						
Petrol (average)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.56375***	***0.00059***	***0.00355***	***0.56788***	***0.10895***	***0.67683***						
Diesel (Class I)	up to 1.305t	37%	0.17			x	0.94952	0.00038	0.00646	0.95636	0.18348	1.13984						
Diesel (Class II)	1.305t to 1.74t	37%	0.26			x	0.87386	0.00024	0.00594	0.88004	0.16884	1.04888						
Diesel (Class III)	1.74t to 3.5t	41%	0.52			x	0.52197	0.00012	0.00355	0.52564	0.10084	0.62648						
Diesel (average)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.58802***	***0.00015***	***0.00400***	***0.59216***	***0.11361***	***0.70577***						
LPG	up to 3.5t	40%	0.43			x	0.61742	0.00121	0.00454	0.62317	0.11956	0.74273						
CNG	up to 3.5t	40%	0.43			x	0.55862	0.00295	0.00454	0.56610	0.10861	0.67471						
Average (all vehicles)	***up to 3.5t***	***40%***	***0.43***			***x***	***0.58651***	***0.00017***	***0.00397***	***0.59065***	***0.11332***	***0.70397***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources: Factors developed by AEA and agreed with Department for Transport (2010)

Notes: Emission factors for vans in tonne km were calculated from the emission factors per vehicle km provided in Table 6i and an average load factor of 40% (37% for vehicles up to 1.8 tonnes, 41% for vehicles 1.8 - 3.5 tonnes, estimated on the basis of DfT statistics for Vans for 2005). The average cargo capacity was taken to be 0.45 tonnes for Class I vans, 0.7 tonne for Class II vans and 1.25 tonnes for vans up to 3.5 tonnes gross vehicle weight.

The *'% weight laden'* refers to the extent to which the vehicle is loaded to its maximum carrying capacity (also known as the payload capacity). A 0% weight laden HGV 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.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Annex 7 - Freight Transport Conversion Tables

Last updated: Oct-10

Table 7d

Diesel HGV Road Freight Conversion Factors: Vehicle km Basis							Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
							CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
	Gross Vehicle Weight (tonnes)	% weight laden		Total vehicle km travelled		x	kg CO_2 per vehicle km	kg CO_2e per vehicle km	kg CO_2e per vehicle km	kg CO_2e per vehicle km	kg CO_2e per vehicle km	kg CO_2e per vehicle km	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Rigid	>3.5-7.5t	0%				x	0.52763	0.00030	0.00587	0.53380	0.10241	0.63621						
		50%				x	0.57351	0.00030	0.00587	0.57968	0.11121	0.69089						
		100%				x	0.61939	0.00030	0.00587	0.62556	0.12001	0.74557						
		41%	*(UK average load)*			*x*	*0.56525*	*0.00030*	*0.00587*	*0.57142*	*0.10963*	*0.68105*						
Rigid	>7.5-17t	0%				x	0.67125	0.00040	0.00779	0.67944	0.13035	0.80979						
		50%				x	0.76714	0.00040	0.00779	0.77533	0.14875	0.92408						
		100%				x	0.86303	0.00040	0.00779	0.87122	0.16714	1.03836						
		41%	*(UK average load)*			*x*	*0.74988*	*0.00040*	*0.00779*	*0.75807*	*0.14543*	*0.90350*						
Rigid	>17t	0%				x	0.79814	0.00052	0.01022	0.80888	0.15518	0.96406						
		50%				x	0.97334	0.00052	0.01022	0.98408	0.18880	1.17288						
		100%				x	1.14854	0.00052	0.01022	1.15928	0.22241	1.38169						
		53%	*(UK average load)*			*x*	*0.98379*	*0.00052*	*0.01022*	*0.99453*	*0.19080*	*1.18533*						
All rigids	***UK average***					***x***	***0.82903***	***0.00044***	***0.00861***	***0.83808***	***0.16079***	***0.99887***						
Articulated	>3.5-33t	0%				x	0.69214	0.00095	0.00881	0.70189	0.13466	0.83655						
		50%				x	0.86518	0.00095	0.00881	0.87493	0.16786	1.04279						
		100%				x	1.03822	0.00095	0.00881	1.04797	0.20105	1.24902						
		45%	*(UK average load)*			*x*	*0.84788*	*0.00095*	*0.00881*	*0.85763*	*0.16454*	*1.02217*						
Articulated	>33t	0%				x	0.69793	0.00109	0.01020	0.70922	0.13606	0.84528						
		50%				x	0.93057	0.00109	0.01020	0.94186	0.18070	1.12256						
		100%				x	1.16321	0.00109	0.01020	1.17450	0.22533	1.39983						
		61%	*(UK average load)*			*x*	*0.98175*	*0.00109*	*0.01020*	*0.99304*	*0.19051*	*1.18355*						
All artics	***UK average***	***60%***				***x***	***0.96900***	***0.00108***	***0.01007***	***0.98015***	***0.18804***	***1.16819***						
ALL HGVs	***UK average***	***58%***				***x***	***0.89522***	***0.00077***	***0.00930***	***0.90529***	***0.17368***	***1.07897***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources

Factors developed by AEA and agreed with Department for Transport (2010)
UK Greenhouse Gas Inventory for 2008 (AEA, 2010)
Transport Statistics Bulletin: Road Freight Statistics 2007, DfT SB (06) 27 (DfT, 2008)
http://www.dft.gov.uk/pgr/statistics/datatablespublications/freight/goodsbyroad/roadfreightstatistics2008

Notes

Factors are provided in kgCO_2/vehicle.km for 3 different gross vehicle weight ranges of rigid-axled HGVs and 2 different gross vehicle weight ranges of articulated HGVs. A vehicle km is the distance travelled by the HGV.

The '*% weight laden*' refers to the extent to which the vehicle is loaded to its maximum carrying capacity (also known as the payload capacity). A 0% weight laden HGV 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.

Factors are based on road freight statistics from the Department for Transport (DfT, 2008), from a survey on the average miles per gallon and average loading factor for different sizes of rigid and artic HGVs in the 2007 fleet, combined with test data from the European ARTEMIS project showing how fuel efficiency, and hence CO_2 emissions, varies with vehicle load.

The miles per gallon figures in Table 1.9 of DfT (2008) were converted into CO_2 factors using the diesel fuel conversion factors. Then using the ARTEMIS data, these were corrected to CO_2 factors corresponding to 0%, 50% and 100% loading in Table 7d. The correction was based on the current percent lading for different sizes of HGVs in the national fleet in 2007 given in Table 1.16 of DfT (2008).

As well as CO_2 factors for 0, 50 and 100% loading, CO_2 factors are shown for the average loading of each weight class of HGV in the UK fleet in 2005. These should be used as default values if the user does not know the loading factor to use and are based on the actual laden factors and mpg figures from tables 1.16 and 1.9 in DfT (2008).

UK average factors for all rigid and articulated HGVs are also provided in Table 7d if the user requires aggregate factors for these main classes of HGVs, perhaps because the weight class of the HGV is not known. Again, these factors represent averages for the UK HGV fleet in 2005. These are derived directly from the average mpg values for all rigid and articulated HGVs in Table 1.9 of DfT (2008).

At a more aggregated level still are factors for all HGVs representing the average mpg for all rigid and articulated HGV classes in Table 1.9 of DfT (2008). This factor should be used if the user has no knowledge of or requirement for different classes of HGV and may be suitable for analysis of HGV CO_2 emissions in, for example, inter-modal freight transport comparisons.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Annex 7 - Freight Transport Conversion Tables

Last updated: Oct-10

Table 7e

Diesel HGV Road Freight Conversion Factors (UK Average Vehicle Loads): Tonne.km Basis							Scope 1 OR Scope 3				Scope 3	All Scopes	Scope 1 OR Scope 3				Scope 3	All Scopes
							CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
	Gross Vehicle Weight (tonnes)	% weight laden	UK av. payload (tonnes goods carried per vehicle)	Total tonne km travelled		x	kg CO_2 per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Rigid	>3.5-7.5t	41%	0.86			x	0.65946	0.00035	0.00685	0.66666	0.12790	0.79456						
Rigid	>7.5-17t	41%	1.82			x	0.41243	0.00022	0.00428	0.41693	0.07999	0.49692						
Rigid	>17t	53%	4.91			x	0.20027	0.00011	0.00208	0.20246	0.03884	0.24130						
All rigids	***UK average***	***52%***	***3.30***			***x***	***0.25115***	***0.00013***	***0.00261***	***0.25389***	***0.04871***	***0.30260***						
Articulated	>3.5-33t	45%	5.56			x	0.15262	0.00017	0.00159	0.15438	0.02962	0.18400						
Articulated	>33t	61%	11.31			x	0.08678	0.00010	0.00090	0.08778	0.01684	0.10462						
All articulateds	***UK average***	***60%***	***10.93***			***x***	***0.08869***	***0.00010***	***0.00092***	***0.08971***	***0.01721***	***0.10692***						
ALL HGVs	***UK average***	***58%***	***7.20***			***x***	***0.12427***	***0.00013***	***0.00191***	***0.12631***	***0.02423***	***0.15054***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources: Factors developed by AEA and agreed with Department for Transport (2010)

Notes: The user may want to use factors in kgCO_2/tonne.km for calculating the emissions due to transporting a given weight of freight a given distance for comparison with other modes of freight transport, e.g. for comparing road *vs* rail using tonne.km factors for other modes in Table 7f. A tonne.km is the distance travelled multiplied by the weight of freight carried by the HGV. So, for example, an HGV carrying 5 tonnes freight over 100 km has a tonne.km value of 500 tonne.km. As different users may require CO_2 factors for HGVs in different levels of detail of HGV type, factors are provided in kgCO_2 /tonne.km for: 3 different gross vehicle weight ranges of rigid-axled HGVs (most amount of detail possible) and 2 different gross vehicle weight ranges of articulated HGVs; fleet averaged factors for all types of rigids and articulated HGVs; factor averaged for all types of HGVs (least amount of detail).

The *'% weight laden'* refers to the extent to which the vehicle is loaded to its maximum carrying capacity (also known as the payload capacity). A 0% weight laden HGV 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.
The gCO_2/tonne.km factors in Table 7e have been calculated on the basis that a lorry will run empty for part of the time in the overall transporting of the freight. Thus the user does not need to double the distance of their freight tonne km for parts of a trip done empty loaded, as this has already been considered in the calculations. The distance should refer to the overall distance that the goods are moved.

The factors are derived from the 2005 fleet average kgCO_2 per vehicle km factors in Table 7d and the average tonne freight per vehicle lifted by each HGV weight class. The average tonne freight lifted figures are derived from the tonne.km and vehicle.km figures given for each class of HGV in Tables 1.12 and 1.13, respectively, in DfT (2008). Dividing the tonne.km by the vehicle.km figures gives the average tonnes freight lifted by each HGV class.

Tables 7d and 7e are provided as alternative methods for calculating CO_2 emissions from movement of freight by HGVs. The factors in g/vehicle.km (Table 7d) are sufficient (and with the ability to take into account different loading factors are preferential) for an operator who simply wants to calculate and compare CO_2 emissions for different ways of transporting goods around by optimising freight logistics. Factors in Table 7e may be better to use when comparing road freight with other modes for transporting a given weight of freight a given distance. To avoid double-counting, it is important that calculations **DO NOT USE BOTH** methods.

New emission factors for CH_4 and N_2O are based on UK Greenhouse Gas Inventory default values for 2008 (AEA, 2010)

Table 7f

Rail and Air Freight Mileage Conversion Factors: Tonne.km Basis							Scope 3				Scope 3	All Scopes	Scope 3				Scope 3	All Scopes
							CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Mode	Detail	Total tonne km travelled			x		kg CO_2 per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Rail	Diesel / Electric				x		0.02850	0.00003	0.00306	0.03159	0.00533	0.03692						
Mode	Detail	Total tonne km travelled	x	km uplift factor [1]	x		kg CO_2 per tonne.km	kg CO_2eq per tonne.km	kg CO_2eq per tonne.km	kg CO_2eq per tonne.km	kg CO_2eq per tonne.km	kg CO_2eq per tonne.km	Total kg CO_2	Total kg CO_2	Total kg CO_2	Total kg CO_2	Total kg CO_2	Total kg CO_2
Air	Domestic		x	109%	x		1.96073	0.00145	0.01930	1.98149	0.36444	2.34593						
	Short-haul international		x	109%	x		1.47389	0.00008	0.01451	1.48848	0.27395	1.76243						
	Long-haul international		x	109%	x		0.61324	0.00004	0.00604	0.61931	0.11398	0.73329						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources: Factors developed by AEA and agreed with Department for Transport (2010)
Office of Rail Regulation (ORR), 2009.
EMEP/CORINAIR Emissions Inventory Guidebook (EIG), EEA (2009)
Civil Aviation Authority (2010)

Notes:

Rail:

The CO_2 value for rail freight is based on currently available information on CO_2 emissions by diesel and electric freight trains in the UK in 2007 produced by ORR (Office of the Rail Regulator) and is available at:

http://www.rail-reg.gov.uk/upload/pdf/rolling-c9-environ.pdf

The rail freight CH_4 and N_2O factors are based on those used in the UK Greenhouse Gas Inventory for diesel rail for 2008 (AEA, 2010).

Air:

Freight is transported by two types of aircraft - dedicated cargo aircraft which carry freight only, and passenger aircraft which carry both passengers and their luggage, as well as freight. Statistics from the CAA for 2008 suggest a large proportion of long haul air freight is transported on passenger aircraft. While it is possible to estimate freight CO_2 factors per tonne.km for dedicated cargo aircraft in much the same way as the passenger.km factors for passengers, it is more difficult to generate freight CO_2 factors for aircraft that are also carrying passengers without double-counting.

Annex 7 - Freight Transport Conversion Tables

Last updated: Oct-10

The allocation of aircraft CO_2 emissions between passengers and freight on these aircraft is complex and for the purposes of these emission factors the allocation is carried out by treating freight carried on cargo or passenger services as equivalent. This is done by assuming the incorporation of the lost cargo capacity of passenger aircraft relative cargo-only equivalents into the passenger weighting. It is assumed this difference in freight cargo capacity is due to passenger-service specific equipment (such as seating, galley, toilets, food) and air frame modifications. The reference aircraft used in this calculation is the Boeing 747, as the freight configuration equivalent is used for over 90% of long-haul dedicated cargo transport from the UK.

[1] The 9% uplift factor comes from the IPCC Aviation and the global Atmosphere 8.2.2.3, which states that 9-10% should be added to take into account non-direct routes (i.e. not along the straight line great circle distances between destinations) and delays/circling. Airline industry representatives have indicated that the percentage uplift for short-haul flights will be higher and for long-haul flights will be lower, however specific data is not currently available to provide separate factors. This is under investigation for future versions of these guidelines.

Notes 10-12 from the passenger flights emission factors (Annex 6) also apply to the air freight emission factors.
New emission factors for CH_4 and N_2O are based on the UK Greenhouse Gas Inventory for 2008 (AEA, 2010)

Table 7g

						Scope 3				Scope 3	All Scopes	Scope 3				Scope 3	All Scopes
Maritime Shipping Freight Distance Conversion Factors: Tonne.km Basis						CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG	CO_2	CH_4	N_2O	Total Direct GHG	Total Indirect GHG	Grand Total GHG
Mode	Detail		Total tonne km travelled		x	kg CO_2 per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	kg CO_2e per tonne.km	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Ship Type	*Size**	*Av. Loading*															
Crude tanker (oil)	200,000+ dwt	48%			x	0.00290	0.00000	0.00002	0.00292	0.00049	0.00341						
Crude tanker (oil)	120,000–199,999 dwt	48%			x	0.00440	0.00000	0.00003	0.00443	0.00075	0.00518						
Crude tanker (oil)	80,000–119,999 dwt	48%			x	0.00590	0.00000	0.00005	0.00595	0.00101	0.00696						
Crude tanker (oil)	60,000–79,999 dwt	48%			x	0.00750	0.00000	0.00006	0.00756	0.00128	0.00884						
Crude tanker (oil)	10,000–59,999 dwt	48%			x	0.00910	0.00000	0.00007	0.00917	0.00155	0.01072						
Crude tanker (oil)	0–9999 dwt	48%			x	0.03330	0.00001	0.00026	0.03357	0.00568	0.03925						
Crude tanker (oil)	**Average**	**48%**			x	**0.00451**	**0.00000**	**0.00003**	**0.00454**	**0.00077**	**0.00531**						
Products tanker	60,000+ dwt	55%			x	0.00570	0.00000	0.00004	0.00574	0.00097	0.00671						
Products tanker	20,000–59,999 dwt	55%			x	0.01030	0.00000	0.00008	0.01038	0.00176	0.01214						
Products tanker	10,000–19,999 dwt	50%			x	0.01870	0.00001	0.00014	0.01885	0.00319	0.02204						
Products tanker	5000–9999 dwt	45%			x	0.02920	0.00001	0.00022	0.02943	0.00498	0.03441						
Products tanker	0–4999 dwt	45%			x	0.04500	0.00001	0.00035	0.04536	0.00768	0.05304						
Products tanker	**Average**	**54%**			x	**0.00891**	**0.00000**	**0.00007**	**0.00898**	**0.00152**	**0.01050**						
Chemical tanker	20,000+ dwt	64%			x	0.00840	0.00000	0.00006	0.00846	0.00143	0.00989						
Chemical tanker	10,000–19,999 dwt	64%			x	0.01080	0.00000	0.00008	0.01088	0.00184	0.01272						
Chemical tanker	5000–9999 dwt	64%			x	0.01510	0.00000	0.00012	0.01522	0.00258	0.01780						
Chemical tanker	0–4999 dwt	64%			x	0.02220	0.00001	0.00017	0.02238	0.00379	0.02617						
Chemical tanker	**Average**	**64%**			x	**0.01018**	**0.00000**	**0.00008**	**0.01026**	**0.00174**	**0.01200**						
LPG tanker	50,000+ m3	48%			x	0.00900	0.00000	0.00007	0.00907	0.00154	0.01061						
LPG tanker	0–49,999 m3	48%			x	0.04350	0.00001	0.00033	0.04384	0.00742	0.05126						
LNG tanker	200,000+ m3	48%			x	0.00930	0.00000	0.00007	0.00937	0.00159	0.01096						
LNG tanker	0–199,999 m3	48%			x	0.01450	0.00000	0.00011	0.01461	0.00247	0.01708						
LNG tanker	**Average**	**48%**			x	**0.01139**	**0.00000**	**0.00009**	**0.01148**	**0.00194**	**0.01342**						
Bulk carrier	200,000+ dwt	50%			x	0.00250	0.00000	0.00002	0.00252	0.00043	0.00295						
Bulk carrier	100,000–199,999 dwt	50%			x	0.00300	0.00000	0.00002	0.00302	0.00051	0.00353						
Bulk carrier	60,000–99,999 dwt	55%			x	0.00410	0.00000	0.00003	0.00413	0.00070	0.00483						
Bulk carrier	35,000–59,999 dwt	55%			x	0.00570	0.00000	0.00004	0.00574	0.00097	0.00671						
Bulk carrier	10,000–34,999 dwt	55%			x	0.00790	0.00000	0.00006	0.00796	0.00135	0.00931						
Bulk carrier	0–9999 dwt	60%			x	0.02920	0.00001	0.00022	0.02943	0.00498	0.03441						
Bulk carrier	**Average**	**51%**			x	**0.00349**	**0.00000**	**0.00003**	**0.00352**	**0.00060**	**0.00412**						
General cargo	10,000+ dwt	60%			x	0.01190	0.00000	0.00009	0.01199	0.00203	0.01402						
General cargo	5000–9999 dwt	60%			x	0.01580	0.00001	0.00012	0.01593	0.00270	0.01863						
General cargo	0–4999 dwt	60%			x	0.01390	0.00000	0.00011	0.01401	0.00237	0.01638						
General cargo	10,000+ dwt 100+ TEU	60%			x	0.01100	0.00000	0.00008	0.01108	0.00188	0.01296						
General cargo	5000–9999 dwt 100+ TEU	60%			x	0.01750	0.00001	0.00013	0.01764	0.00299	0.02063						
General cargo	0–4999 dwt 100+ TEU	60%			x	0.01980	0.00001	0.00015	0.01996	0.00338	0.02334						
General cargo	**Average**	**60%**			x	**0.01305**	**0.00000**	**0.00010**	**0.01315**	**0.00223**	**0.01538**						
Refrigerated cargo	**All dwt**	**50%**			x	**0.01290**	**0.00000**	**0.00010**	**0.01300**	**0.00220**	**0.01520**						
Container	8000+ TEU	70%			x	0.01250	0.00000	0.00010	0.01260	0.00213	0.01473						
Container	5000–7999 TEU	70%			x	0.01660	0.00001	0.00013	0.01674	0.00283	0.01957						
Container	3000–4999 TEU	70%			x	0.01660	0.00001	0.00013	0.01674	0.00283	0.01957						
Container	2000–2999 TEU	70%			x	0.02000	0.00001	0.00015	0.02016	0.00341	0.02357						
Container	1000–1999 TEU	70%			x	0.03210	0.00001	0.00025	0.03236	0.00548	0.03784						
Container	0–999 TEU	70%			x	0.03630	0.00001	0.00028	0.03659	0.00619	0.04278						
Container	**Average**	**70%**			x	**0.01592**	**0.00001**	**0.00012**	**0.01605**	**0.00272**	**0.01877**						
Vehicle transport	4000+ CEU	70%			x	0.03200	0.00001	0.00025	0.03226	0.00546	0.03772						
Vehicle transport	0–3999 CEU	70%			x	0.05760	0.00002	0.00044	0.05806	0.00983	0.06789						
Vehicle transport	**Average**	**70%**			x	**0.03805**	**0.00001**	**0.00029**	**0.03835**	**0.00649**	**0.04484**						
Ro–Ro ferry	2000+ LM	70%			x	0.04950	0.00002	0.00038	0.04990	0.00844	0.05834						
Ro–Ro ferry	0–1999 LM	70%			x	0.06030	0.00002	0.00046	0.06078	0.01029	0.07107						
Ro–Ro ferry	**Average**	**70%**			**x**	**0.05095**	**0.00002**	**0.00039**	**0.05136**	**0.00869**	**0.06005**						
Large RoPax ferry		-			**x**	**0.38434**	**0.00012**	**0.00295**	**0.38741**	**0.06556**	0.45297						
Total												**0**	**0**	**0**	**0**	**0**	**0**

Annex 7 - Freight Transport Conversion Tables

Last updated:	Oct-10

Sources

Factors developed by AEA and agreed with Department for Transport (2010). These factors are international averages and load factors may not be the same as for average for ships arriving at/leaving UK ports.

IMO (2009). "PREVENTION OF AIR POLLUTION FROM SHIPS, Second IMO GHG Study 2009. Update of the 2000 IMO GHG Study, Final report covering Phase 1". This report is available from the IMO's website at:
http://www.imo.org/includes/blastDataOnly.asp/data_id%3D26046/4-7.pdf

Notes

dwt = deadweight, tonnes
TEU = Twenty-Foot Equivalent Units (intermodal shipping container)
CEU = Car Equivalent Units
LM = Lane Meters
m3 = volume in cubic meters

The freight CO_2 emission factor for RoPax Ferries was derived from data provided by Best Foot Forward based on work for the Passenger Shipping Association (PSA) carried out in 2007/8. The calculated figure assumes an average HGV load factor of 13.6 tonnes, based on information in Table 2.6 of Road Transport Statistics 2005 (from the Department for Transport). RoPax Ferries are Roll-on Roll-off ferries that carry both road vehicles and their passengers as well as having additional passenger-only capacity.

Factors for the other representative ships are derived from information from Table 9.1 of the International Maritime Organisation's report on GHG emissions (IMO, 2009).

New emission factors for CH_4 and N_2O are based on the UK Greenhouse Gas Inventory for 2008 (AEA, 2010)

Only the weight of the cargo being transported should be used when calculating emissions from shipping. The weight of the ship (as incorporated into deadweight tonnage) should not be included in the emissions calculation

Annex 8 - Direct GHG Emissions from Use of Refrigeration and Air Conditioning Equipment

Last updated:	Jul-10

How to use this Annex

There are two methods presented here for the estimation of emissions from the use of refrigeration and air conditioning equipment. For smaller users the simple **A. Screening Method** will likely be the easiest way to calculate their emissions. For some larger users of refrigerant and they should have the information necessary to perform a more accurate estimation using a **B. Simplified Material Balance Method**.

A. Screening Method

This Screening Method will help organisations to estimate emissions from refrigeration and air conditioning based on the type of equipment used and emissions factors. This approach requires relatively little actual data collection however there is a high degree of uncertainty with these emission factors. Therefore if emissions from this equipment are determined to be significant when compared to your organisation's other emissions sources, then you should apply a better estimation method (e.g. a Material Balance Method). **Please note, there are extensive regulatory requirements governing the operation of stationary equipment using fluorinated greenhouse gases, including record keeping requirements for stationary refrigeration and air-conditioning equipment, heat pumps and fire protection equipment with a charge of 3kg or more. Guidance is available at:**
http://www.defra.gov.uk/environment/quality/air/fgas/index.htm

To complete these tables you will need to:

1) **Carry out an inventory of equipment to find out:**
(i) the number and types of each refrigeration unit;
(ii) the type of refrigerant used (e.g. HFC 134a, R404a, R407a, R407b, R407c, R410A, etc);
(iii) the total charge capacity of each piece of equipment (charge capacity is the mass of refrigerant used in a refrigerator or other cooling equipment);
(iv) the time in years used during the reporting period (e.g. 0.5 if used only during half of the reporting period then disposed)

Once you know the refrigerant type, please refer to **Annex 5** to identify its Global Warming Potential (GWP). Alternatively, defaults are currently filled out automatically from selected refrigerants in the Excel spreadsheet. For further guidance on typical charge capacity, please refer to **Table 8d**.

2) **Determine installation emissions**: Identify any new equipment that was installed during the reporting period and was charged (filled) on-site. Emissions from equipment that was charged at the manufacturer are not the responsibility of your organisation. For each new piece of equipment charged **on-site** use **Table 8a** to estimate emissions.

3) **Determine operating emissions**: This step estimates losses from equipment leaks and service losses over the life of the equipment. For all pieces of equipment, use **Table 8b** to estimate emissions. You will need to determine the length of time (in years) that each piece of equipment has be used.

4) **Determine disposal emissions**: Identify any pieces of equipment that were disposed of **on-site** during the reporting period. Emissions from equipment that was sent offsite for third party recycling, reclamation or disposal are not the responsibility of your organisation. For each piece disposed equipment, use **Table 8c** to estimate emissions.

5) **Calculate total emissions**: Add the emissions from each piece of equipment for each of emission - installation, operation and disposal - to get total emissions. Calculate separate totals for each type of refrigerant used.
Information on refrigerant type and kilograms (kg) of charge capacity can be sourced from:
(a) *Air conditioning chillers* and *modular units* : visual readings on the equipment, equipment manuals or maintenance records;
(b) *Refrigeration units* : visual readings on the equipment

Annex 8 Scopes & Boundaries:

Scope 1: Direct emissions from leakage of refrigerants. Data on indirect emissions from production of refrigeration not currently available.

Further information on scopes is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Annex 8 - Direct GHG Emissions from Use of Refrigeration and Air Conditioning Equipment

Last updated:	Jul-10

Table 8a

Scope 1

Emissions from Installation of Refrigeration and Air-conditioning Equipment

Type of Equipment	Number of Units	x	Equipment Charge Capacity (kg)	x	Installation Emission Factor	x			Refrigerant type (select from list from Annex 5)	Global Warming Potential (GWP)	x	Total kg CO_2 equivalent
Domestic Refrigeration		x		x	1.0%	x					x	
Stand-alone Commercial Applications		x		x	1.5%	x					x	
Medium & Large Commercial Applications		x		x	2.0%	x					x	
Transport Refrigeration		x		x	1.0%	x					x	
Industrial Refrigeration (inc. food processing and cold storage)		x		x	1.0%	x					x	
Chillers		x		x	1.0%	x					x	
Residential and Commercial A/C including Heat Pumps		x		x	1.0%	x					x	
Mobile Air Conditioning		x		x	1.0%	x					x	
Total												**0**

Table 8b

Scope 1

Emissions from operation of Refrigeration and Air-conditioning Equipment

Type of Equipment	Number of Units	x	Equipment Charge Capacity (kg)	x	Time used during reporting period (years)	x	Annual Leak Rate	x	Refrigerant type (select from list from Annex 5)	Global Warming Potential (GWP)	x	Total kg CO_2 equivalent
Domestic Refrigeration		x		x		x	0.3%	x			x	
Stand-alone Commercial Applications		x		x		x	2.0%	x			x	
Medium & Large Commercial Applications		x		x		x	11.0%	x			x	
Transport Refrigeration		x		x		x	8.0%	x			x	
Industrial Refrigeration (inc. food processing and cold storage)		x		x		x	8.0%	x			x	
Chillers		x		x		x	3.0%	x			x	
Residential and Commercial A/C including Heat Pumps		x		x		x	8.5%	x			x	
Mobile Air Conditioning		x		x		x	7.5%	x			x	
Total												**0**

Table 8c

Scope 1

Emissions from Disposal of Refrigeration and Air-conditioning Equipment

Refrigerant Type	Number of Units	x	Equipment Charge Capacity (kg)	x	Capacity remaining at disposal (%)	x	Refrigerant recovered (%)	x	Refrigerant type (select from list from Annex 5)	Global Warming Potential (GWP)	x	Total kg CO_2 equivalent
Domestic Refrigeration		x		x	80%	x	99.0%	x			x	
Stand-alone Commercial Applications		x		x	80%	x	94.5%	x			x	
Medium & Large Commercial Applications		x		x	100%	x	95.0%	x			x	
Transport Refrigeration		x		x	50%	x	94.0%	x			x	
Industrial Refrigeration (inc. food processing and cold storage)		x		x	100%	x	95.0%	x			x	
Chillers		x		x	100%	x	95.0%	x			x	
Residential and Commercial A/C including Heat Pumps		x		x	80%	x	95.0%	x			x	
Mobile Air Conditioning		x		x	50%	x	88.0%	x			x	
Total												**0**

Table 8d

Typical Charge Capacity for Equipment

Type of Equipment	Typical Range in Charge Capacity (kg)
Domestic Refrigeration	0.05 - 0.5
Stand-alone Commercial Applications	0.2 - 6
Medium & Large Commercial Applications	50 - 2,000
Transport Refrigeration	3 to 8
Industrial Refrigeration (inc. food processing and cold storage)	10 - 10,000
Chillers	10 - 2,000
Residential and Commercial A/C including Heat Pumps	0.5 - 100
Mobile Air Conditioning	0.5 - 1.5

Annex 8 - Direct GHG Emissions from Use of Refrigeration and Air Conditioning Equipment

Last updated:	Jul-10

Sources
UK Greenhouse Gas Inventory for 2007 (AEA)
2006 IPCC Guidelines for National Greenhouse Inventories (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_7_Ch7_ODS_Substitutes.pdf)
US EPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance - Direct HFC and PFC Emissions from use of Refrigeration and Air Conditioning Equipment (see: http://www.epa.gov/stateply/documents/resources/mfgrfg.pdf)

B. Simplified Material Balance Method

This is a simplified material balance method. This will enable more accurate estimation of refrigerant leakage than the Screening Method (Table 8a - d).
To complete Table 8e, you will need to:

1) Calculate installation emissions.
This step is only necessary if your organisation installed any new equipment during the reporting period that was not pre-charged by the equipment supplier. Emissions are calculated by taking the difference between the amount of refrigerant used to charge the equipment and the total capacity of the equipment. The difference is assumed to be released into the environment.

2) Determine equipment servicing emissions
Equipment servicing emissions result from the refrigerant that is used to service operating equipment. It is assumed that the servicing refrigerant is replacing the same amount that was lost to the environment.

3) Calculate disposal emissions
This step is only necessary if your organisation disposed of equipment during the reporting period. Emissions are calculated by taking the difference between the total capacity of the equipment disposed and the amount of refrigerant recovered. The difference is assumed to be released to the environment.

4) Calculate emissions
Emissions are calculated by summing the results of the first three steps.

This approach should be used for **each type of refrigerant and blend**.

This method requires the following information:

a) Refrigerant used to fill new equipment (set to 0 if the equipment has been pre-charged by the manufacturer);
b) Refrigerant used to fill equipment retrofitted to use this refrigerant (set to 0 if the equipment has been pre-charged by the manufacturer);
c) Total full capacity of new equipment using this refrigerant (set to 0 if the equipment has been pre-charged by the manufacturer);
d) Total full capacity of equipment that is retrofitted to use this refrigerant (set to 0 if the equipment has been pre-charged by the manufacturer);
e) Refrigerant used to service equipment;
f) Total full capacity of retiring equipment;
g) Total full capacity of equipment that is retrofitted away from this refrigerant to a different refrigerant;
h) Refrigerant recovered from retiring equipment;
i) Refrigerant recovered from equipment that is retrofitted away from this refrigerant to a different refrigerant.

Table 8e

																Scope 1
Estimating Refrigerant Emissions with Simplified Material Balance Method																
	Purchases of refrigerant used to charge new equipment (kg)	-	Total full capacity of the new equipment (kg)	+	Quantity of refrigerant used to service equipment (kg)	+	Total full capacity of retiring equipment (kg)	-	Refrigerant recovered from retiring equipment (kg)	x	Refrigerant type (select from list from Annex 5)	Global Warming Potential (GWP)	=	Total kg CO_2 equivalent
Refrigerant 1		-		+		+		-		x			=	
Refrigerant 2		-		+		+		-		x			=	
Refrigerant 3		-		+		+		-		x			=	
Refrigerant 4		-		+		+		-		x			=	
Refrigerant 5		-		+		+		-		x			=	
Refrigerant 6		-		+		+		-		x			=	
Refrigerant 7		-		+		+		-		x			=	
Refrigerant 8		-		+		+		-		x			=	
Refrigerant 9		-		+		+		-		x			=	
Refrigerant 10		-		+		+		-		x			=	
Total														0

Sources
2006 IPCC Guidelines for National Greenhouse Inventories (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_7_Ch7_ODS_Substitutes.pdf)
US EPA Climate Leaders Greenhouse Gas Inventory Protocol Core Module Guidance - Direct HFC and PFC Emissions from use of Refrigeration and Air Conditioning Equipment
(see: http://www.epa.gov/stateply/documents/resources/mfgrfg.pdf)

Annex 9 - Other UK Conversion Factor Tables

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The emission factors presented in this Annex incorporate emissions from the full life-cycle and include net CO_2, CH_4 and N_2O emissions. Care should be taken to use equivalent emission factors (EFs) for different activities - i.e. combine only direct EFs, OR indirect EFs OR total lifecycle EFs, or emissions factors for the same Scope (as defined by the GHG Protocol).

How to use this Annex

Tables 9a-c provide life-cycle conversion factors for water, biofuels and biomass:

1) Identify the amount of substance used

2) Identify the units. Are you measuring your fuel use in terms of mass, volume or energy?

3) Convert to the appropriate unit of volume or mass for the table:

(i) If you cannot find a factor for that unit, Annex 12 gives guidance on converting between different units of mass, volume, length and energy.

(ii) If you are measuring fuel use in terms of energy, is your unit of measurement net energy or gross energy (in the event that this is unclear you should contact your fuel supplier)? Annex 11 gives typical/average net/gross calorific values and the densities.

4) If you are using a biofuel blend **EITHER**:
(i) Use the total amount of pure biofuel used to calculate the emissions together with Table 9b, Part (i) and the total amount of pure conventional fuel together with Table 9b, Part (ii); ***OR***
(ii) Use the total amount of blended fuel in the calculation together with Table 9b, Part (iii). The combined emission factor (EF) is calculated by the excel spreadsheet automatically following your entry of the % biofuel blended with conventional fuel and entry of the the total amount of biofuel/conventional fuel blend. For an X% blend of biofuel with conventional fuel the combined emission factor is calculated as follows:
Total EF for X% biofuel/conventional fuel blend = X% x biofuel EF + (1-X%) x conventional fuel EF

5) Multiply the amount of fuel used by the conversion factor to get total emissions in kilograms of carbon dioxide equivalent (kg CO_2e). The excel spreadsheet does this automatically following your entry of the amount of fuel used into the appropriate box.

Please note that these emission factors **do not** enable you to calculate direct emissions of carbon dioxide for the combustion of biomass and biofuels. Further updates to these Guidelines will seek to address this issue. In the interim, please refer to the following weblink for direct CO_2 emissions from combustion:

http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

Table 9d provides life-cycle conversion factors for waste disposal:

To complete this table, you will need to:

1) **Check for existing data**. Data on waste arisings will be contained in waste transfer/consignment notes or receipts provided for individual waste transfers. All waste producers are legally required to retain these notes for a specified period. These may identify the quantity of waste arising and the company collecting the waste.

Has your organisation carried out a waste audit recently? This may provide further useful information, such as the composition of mixed waste sent for proposal.

2) **Speak to your waste contractor(s)**. Your waste contractor will be able to advise you to which location your wastes have subsequently been delivered (i.e. landfill site, recycling operation, compositing, or energy recovery facility).

Depending on the level of information that your waste contractor can provide, you will need to carry out step 3.

3) **Carry out a waste audit**

If you do not have detailed waste data from your waste contractors, you should carry out a waste inventory to determine:

(i) The total waste sent to landfill, recycled or composted. This can be done through sampling your waste in order to approximate total waste for each different waste treatment method

(ii) The waste composition (in tonnes) for each waste treatment method. This can be done through sampling, sorting, and weighing your waste to determine its percentage composition in tonnes. **If you choose to do this, please wear the appropriate protective clothing and do not attempt to sample any hazardous, toxic or radioactive waste.**

(iii) If known, the proportion of recycled material contained in each waste fraction (e.g. the disposed of paper might contain 10% recycled material)

Annex 9 - Other UK Conversion Factor Tables

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4) **Enter the data in the table**. Enter the weight (in tonnes) for each waste fraction (e.g. paper and card, textiles, etc) into the appropriate treatment method column along with the recycled material content of disposed waste (if known). The total net kgCO_2e emissions resulting from the waste will be automatically calculated as the sum of kgCO2e emissions from the total tonnes of waste produced and the kgCO2e emissions per tonne of waste for each waste treatment method.

For further assistance, please see Envirowise Guide GG414 Measuring to manage: the key to reducing waste costs, available free of charge from the Envirowise website.

Key information:

The **tonnes of waste prevented column** should be used if you want to determine the reduction in emissions associated with reduced procurement of materials.

Emission factors for waste treatment processes: The emission factors are based on a life cycle assessment and include not only the carbon costs of treating and transporting waste, but also the potential benefits where primary resource extraction or electricity generation are offset with energy recovery. The impact of waste prevention is calculated based on the embodied energy in primary material, and therefore inherently assumes the offsetting of virgin production.

Further additional information is also available below Table 9d.

Annex 9 Scopes & Boundaries:

Water
Scope 3: Emissions of greenhouse gases associated with the supply and treatment of water and the industry's buildings and transport.
Biofuels
Scope 1 : Direct emissions of CH_4 and N_2O from the combustion of fuel (CO_2 emissions are set to 0 for biofuels, and reported separately)
Scope 3: Indirect emissions associated with the production and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels. For further information see http://ies.jrc.ec.europa.eu/WTW
Outside of Scopes: Emissions data for direct CO_2 emissions from biologically sequestered carbon (e.g. CO_2 from burning biomass/biofuels) are reported separately from the scopes.
Waste
Scope 3:

Further information on scopes is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/business/reporting/index.htm
OR from the Greenhouse Gas Protocol's website at:
http://www.ghgprotocol.org/standards/corporate-standard

How were these factors calculated?

For further explanation on how these emission factors have been derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 9a

					Scope 1	Scope 3	All Scopes
Life-Cycle Conversion Factors for water					**Total Direct GHG**	**Total Indirect GHG**	**Grand Total GHG**
Fuel used	Year for emission factor	Total units used	Units	x	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit
Water supply	2007/08		million litres	x	-	276	276
	2008/09		million litres	x	-	300	300
	2007/08		cubic metres	x	-	0.2760	0.2760
	2008/09		cubic metres	x	-	0.3000	0.3000
Water treatment	2007/08		million litres	x	-	693	693
	2008/09		million litres	x	-	750	750
	2007/08		cubic metres	x	-	0.6930	0.6930
	2008/09		cubic metres	x	-	0.7500	0.7500
Total							

Scope 1	Scope 3	All Scopes
Total Direct GHG	**Total Indirect GHG**	**Grand Total GHG**
Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
0	**0**	**0**

Sources

Water UK Sustainability Indicators 2008/09, available at:
http://www.water.org.uk/home/policy/reports/sustainability/2008-09-sustainability-indicators

Annex 9 - Other UK Conversion Factor Tables

Last updated: Oct-10

Table 9b

NOTE: Please use EITHER Part (i) + Part (ii), OR Part (iii) to calculate emmissions to avoid double-counting. (More information is also provided on the use of these tables in the introduction to the Annex.)

Part (i):

Life-Cycle Conversion Factors for biofuels (pure)					Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG
Fuel used	% Blend biofuel with conventional fuels	Total units used	Units [1]	x	kg CO_2e per unit [2]	kg CO_2e per unit	kg CO_2e per unit [2]	kg CO_2e per unit [2]	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Biodiesel	100%		litres	x	0.0268	1.5586	1.5854	2.4930				
	100%		GJ	x	0.808	47.077	47.886	75.300				
Bioethanol	100%		litres	x	0.0125	0.6539	0.6664	1.5236				
	100%		GJ	x	0.586	30.729	31.315	71.600				
Biomethane	100%		kg	x	0.0050	1.3230	1.3280	2.7150				
	100%		GJ	x	0.106	27.000	27.106	55.408				
Total									**0**	**0**	**0**	**0**

+

Part (ii):

Life-Cycle Conversion Factors for conventional fuels (pure)					Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG
Fuel used	% Blend	Total units used	Units [1]	x	kg CO2e per unit	kg CO_2e per unit	kg CO2e per unit	kg CO_2e per unit	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Diesel	100%		litres	x	2.6720	0.5067	3.1787	0.0000				
	100%		GJ	x	74.767	14.179	88.946	0.000				
Petrol	100%		litres	x	2.3220	0.4109	2.7329	0.0000				
	100%		GJ	x	70.690	12.511	83.201	0.000				
CNG	100%		kg	x	2.8307	0.3977	3.2283	0.0000				
	100%		GJ	x	59.476	8.356	67.832	0.000				
Total									**0**	**0**	**0**	**0**

OR

Part (iii):

Life-Cycle Conversion Factors for biofuels (blends)					Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[3] Total Direct GHG
Fuel used	% Blend biofuel with conventional fuels	Total units used	Units [1]	x	kg CO_2e per unit [2]	kg CO_2e per unit	kg CO_2e per unit [2]	kg CO_2e per unit [2]	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Biodiesel / Diesel			litres	x								
Biodiesel / Diesel			GJ	x								
Bioethanol / Petrol			litres	x								
Bioethanol / Petrol			GJ	x								
Biomethane / CNG			kg	x								
Biomethane / CNG			GJ	x								
Total									**0**	**0**	**0**	**0**

Sources: Renewable Fuels Agency (2010)

Notes:

Emissions factors for biofuels are based on figures from the Renewable Fuels Agency (RFA). The average figures for biofuels for the period April-December 2009 are provided in the Quarterly report, April 2009 - January 2010 (published in April 2010), available on the RFA's website at:
http://www.renewablefuelsagency.gov.uk/carbon-and-sustainability/rtfo-reports
Detailed factors by source/supplier are provided and updated regularly in the RFA Quarterly Reports, available on the RFA's website (at link above).

[1] Emission factors for biofuels in kgCO_2e per GJ are provided on a Net CV (also known as lower heating value) basis.

[2] Direct emissions of CO_2 are set to 0 for biofuels, as the same amount of CO_2 is absorbed in the growth of the feedstock from which the biofuel is produced. However, RFA emission factors for biofuels do not include direct tailpipe emissions of methane (CH_4) and nitrous oxide (N_2O), which are not absorbed in the growth of the feedstock, therefore these have been added in based on conventional fuel equivalents.

[3] The Total GHG emissions outside of Scope 1, 2 and 3 is the actual amount of CO_2 emitted by the biofuel when combusted. This will be equivalent to the CO_2 absorbed in the growth of the feedstock used to produce the fuel. CO_2 emission factors are based on information from the BIOMASS Energy Centre (BEC). BEC is owned and managed by the UK Forestry Commission, via Forest Research, its research agency. Data on the direct emissions of biofuels is available at:
http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

Annex 9 - Other UK Conversion Factor Tables

Last updated:	Oct-10

Table 9c

Life-Cycle Conversion Factors for biomass and biogas				Scope 1 Total Direct GHG [5]	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[4] Total Direct GHG	Scope 1 Total Direct GHG 5	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Outside of Scopes[4] Total Direct GHG
Fuel used	Total units used	Units [3]	x	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	kg CO_2e per unit	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Wood Logs [1]		tonnes	x	-	77.38	77.38	1435.29				
		kWh of fuel	x	-	0.01895	0.02	0.35150				
Wood Chips [1]		tonnes	x	-	61.41	61.41	1372.00				
		kWh of fuel	x	-	0.01579	0.02	0.35400				
Wood Pellets [1]		tonnes	x	-	183.93	183.93	1649.00				
		kWh of fuel	x	-	0.03895	0.04	0.34900				
Grasses/Straw [2]		tonnes	x	-	41.08	41.08	1406.50				
		kWh of fuel	x	-	0.01020	0.01	0.34800				
Biogas [2]		tonnes	x	-	0.00	0.00	2040.00				
		kWh of fuel	x	-	0.00000	0.00	0.24600				
Total								**0**	**0**	**0**	**0**

Sources
BIOMASS Energy Centre (BEC), 2010
BRE, 2009

Notes
Biodiesel (HVO) = Biodiesel (Hydrotreated Vegetable Oil), biodiesel produced from vegetable oils using hydroprocessing.

[1] Wood pellets, chips, logs and grasses/straw may be used in biomass heating systems.

[2] The figure for grasses/straw and biogas (= 60% CH_4, 40% CO_2) is based on the figure from the BIOMASS Energy Centre (BEC). BEC is owned and managed by the UK Forestry Commission, via Forest Research, its research agency. Fuel property data on a range of other wood and other heating fuels is available at:
http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,20041&_dad=portal&_schema=PORTAL, and
http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

Biogas is a mixture of methane (CH_4) and carbon dioxide (CO_2) produced by anaerobic digestion, with small amounts of other gases. Biogas is effectively the same as landfill gas, which is produced by the anaerobic decomposition of organic material in landfill sites.

[3] Emission factors for biomass in kgCO_2e per kWh are provided on a Net CV (also known as lower heating value) basis.

[4] The Total GHG emissions outside of Scope 1, 2 and 3 is the actual amount of CO_2 emitted by the biomass when combusted. This will be equivalent to the CO_2 absorbed in the growth of the biomass. CO_2 emission factors are based on information from the BIOMASS Energy Centre (BEC). BEC is owned and managed by the UK Forestry Commission, via Forest Research, its research agency. Data on the direct emissions of biomass and biogas is available at:
http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

[5] Direct emissions of CO_2 are set to 0 for biomass and biogas, as the same amount of CO_2 is absorbed in the growth of the biomass from which they are produced /resulting. Direct emissions of methane (CH_4) and nitrous oxide (N_2O), which are not absorbed in the biomass growth phase are not currently available.

Annex 9 - Other UK Conversion Factor Tables

Last updated:	Oct-10

Table 9d

Life-Cycle Conversion Factors for Waste Disposal	Scope 3							
Waste fraction	kg CO_2e emitted per tonne virgin material [2]	Net kg CO_2e emitted per tonne of waste treated / disposed of by [1]:						
		Recycling		Energy from waste				
		Open Loop[7]	Closed Loop[7]	Power only moving grate	Anaerobic Digestion	Composting	Landfill	
Paper and Card	**950**	**-713**		**-500**	-121	57	**550**	
Kitchen/food waste	**4,000**			-89	**-100**	**30**	**365**	
Garden/plant waste	89			-121	**-100**	57	**210**	
Other organic	0	44		-271	-330	34	230	
Wood	256	**-6**		**-700**		**250**	**930**	
Textiles	19,294		**-3,800**	**600**			**300**	
Plastic (dense)	**3,100**		**-1,500**	**1,800**			**40**	
Plastic (film)	**2,500**		**-1,000**	**1,800**			**35**	
Ferrous metal	**3,100**		**-1,300**	-786			10	
Non-ferrous metal	**11,000**		**-9,000**	23			10	
Silt/soil	4	16		35			10	
Aggregate materials	**8**		**-4**	35			10	
Misc combustibles	102	58		242			305	
Glass	**840**	**2**	**-315**	**5**			10	
Tyres	**3,410**	**-20**	**-2,900**	**-1,500**				
Estimated impact of other materials (municipal and C&I)	2,860	-259		97	-13	7	81	

Waste fraction	Tonnes of waste PRODUCED	Tonnes of waste treated /disposed of by [4]:						**Total Net kg CO_2e emissions by waste fraction**
		Recycling		Energy from waste				
		Open Loop[3]	Closed Loop[3]	Power only moving grate	Anaerobic Digestion	Composting	Landfill	
Paper and Card								**0**
Kitchen/food waste								**0**
Garden/plant waste								**0**
Other organic								**0**
Wood								**0**
Textiles								**0**
Plastic (dense)								**0**
Plastic (film)								**0**
Ferrous metal								**0**
Non-ferrous metal								**0**
Silt/soil								**0**
Aggregate materials								**0**
Misc combustibles								**0**
Glass								**0**
Tyres								**0**
Estimated impact of other materials (municipal and C&I)								**0**
Total Net kgCO_2e emissions by category	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Grand Total Net kgCO_2e emissions								**0**

Sources Defra Waste Strategy, Table A.28: Emission factors for waste treatment processes (kg carbon dioxide equivalents/tonne of waste processed)
http://www.defra.gov.uk/ENVIRONMENT/waste/strategy/strategy07/documents/waste07-annex-a.pdf
Updated and new figures in **BOLD** provided by WRAP, **2009** and **2010**.

Notes The data summarised in the table covers the life cycle stages highlighted below. It excludes use of the product as this will be variable. For example, plastic may be used as automotive parts or as drinks packaging amongst other things. If it is used as drinks packaging it will require filling. As it is not known what the final use of the material is, this section of the life cycle is excluded for all materials. For some products forming is also excluded. Metals may be made into various products by different methods, excluded from these figures.

There are essentially zero Scope 1 emissions for waste.

[1] Impact of other treatments as in pRIA – http://www.defra.gov.uk/ENVIRONMENT/waste/strategy/review/documents/partialRIA.pdf – p.58.

[2] The waste production figure for textiles currently does not account for the split of material types on the UK market. Improvements will be made to this figure in future updates. Savings from embodied fossil energy resulting from avoiding waste are the negative of these figures.

[3] Open loop recycling is the process of recycling material into other products. Closed loop recycling is the process of recycling material back into the same product.

[4] On average in the UK 88% of non-recycled waste goes to landfill and 12% goes to energy from waste (power only moving grate).

More information on WRAP can be found at: http://www.wrap.org.uk/

Annex 9 - Other UK Conversion Factor Tables

Last updated:	Oct-10

Further additional information on Life Cycle Conversion Factors for Waste Disposal:

Table 9d provides emissions factors for reporting on emissions from waste disposal. These emissions would fall into the Scope 3 emissions of a reporting company. As with all Scope 3 emissions, these are life-cycle emissions factors and therefore cannot be directly compared to Scope1 or 2 /direct emissions factors in other annexes. These figures are estimates to be used in the absence of data specific to your goods and services. If you have more accurate information for your products, then please refer to the more accurate data for reporting your emissions.

The table is split into two halves. The top half contains all the emissions factors which are used to calculate the emissions which are calculated in the bottom half of the table. The (yellow) box in the bottom right corner gives the total net CO_2 emissions which can be reported in your GHG emissions report.

It is essential that, where possible, data is used to cover both the production of the materials used by an organisation, and the waste generated by an organisation. See diagram below for the life cycle stages covered.

The first column of figures include emissions related to the materials purchased by an organisation that are subsequently transferred to the waste stream for treatment or disposal. This includes the emissions from the following life cycle stages: extraction, primary processing, manufacturing and transportation. It excludes the use phase. The first column (yellow) will automatically total the tonnes of material sent through for waste treatment or disposal and is used to calculate the emissions associated with the production of the original materials. The rest of the blue columns deal with the emissions from different waste disposal routes. Enter the tonnes of waste sent to each waste disposal stream in the relevant blue boxes. The totals are calculated in the yellow boxes.

By quantifying both material use and emissions from waste management, the benefits of waste prevention and more effective management may be estimated. If only waste management emissions are calculated, the benefit of waste prevention will not be adequately covered.

Some of the figures in table 9d are negative numbers. This is because the recycling or energy recovery process avoids the production of primary materials and combustion of fossil fuels. The figures do not include avoided emissions from alternative waste management.

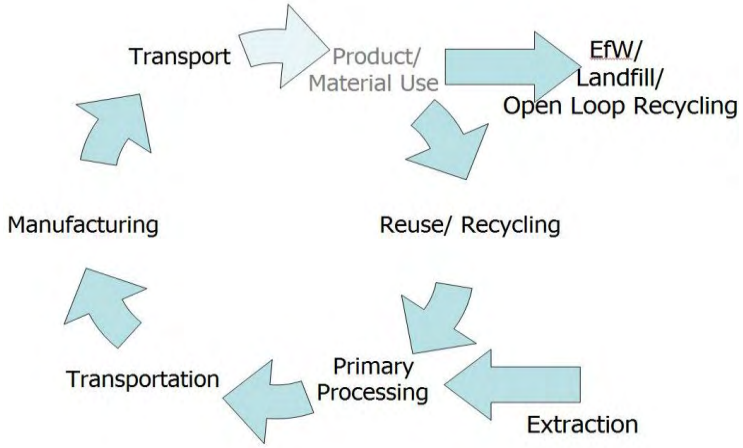
These figures should be used for site based reporting only. They should not be added together along a supply chain, as material use would be counted several times along a supply chain.

The data provided for recycling, energy recovery and landfill are based on absolute emissions for these options. Therefore, to identify the benefit of one option versus another (e.g. recycling versus landfill), the benefit is the difference between the two columns.

For further information on the factors in table 9d, please refer to the methodology paper for the 2010 update, which will be made available from:
http://www.defra.gov.uk/environment/business/reporting/conversion-factors.htm

A high level overview of the life cycle of materials and products is shown in figure 1 below.

Figure 1:



Annex 10 - International Electricity Emission Factors

Last updated: Aug-10

The factors presented in the three tables below are a timeseries of combined electricity and heat CO_2 emission factors per kWh **GENERATED** (Table 10a, i.e. before losses in transmission/distribution), electricity and heat CO_2 emission factors per kWh **LOSSES** in transmission/distribution (Table 10b) and per kWh **CONSUMED** (Table 10c, i.e. for the final consumer, including transmission/distribution losses).

How to use this Annex

To calculate emissions of carbon dioxide associated with *use of overseas grid electricity*:

1) Identify the amount electricity used, in units of kWh, for the relevant country.

2) Multiply this value by the conversion factor for the country or grid rolling average electricity use. You should use emission factors from **Table 10c** for electricity consumed from the national/local electricity grid for consistency with those provided for the UK in **Annex 3**.

3) Repeat the process for other countries and sum the totals.

Are the figures in this Annex comparable with those for the UK provided in Annex 3?

The two sets of data are not directly comparable as the figure in this annex include heat generated whereas the figures in Annex 3 do not.

The country I am looking for is not included, where can I find information?

We have provided emission factors for all EU member states and the major UK trading partners. Additional emission factors for other countries not included in this list can be found at the GHG Protocol website, though it should be noted the figures supplied there **do not** include losses from transmission and distribution of heat and electricity.

Data source

Emission factor data is from International Energy Agency (IEA) Data Services, 2006 and 2008 for "CO_2 Emissions per kWh Electricity and Heat Generated" and mainly sourced from the GHG Protocol website.

Data on losses in distribution of electricity and heat is calculated from 2006 country energy balances available at the IEA website.

Annex 10 Scopes & Boundaries:

Scope 2: Direct emissions of CO_2, CH_4 and N_2O from the combustion of fuel used in the generation of electricity and heat.

Scope 3: Indirect emissions associated with the extraction and transport of primary fuels as well as the refining, distribution, storage and retail of finished fuels used in the generation of electricity and heat.

Direct GHG emissions given in Table 10c are a combination of (Scope 2) Direct GHG emissions from Table 10a and (Scope 3) Direct GHG emissions from Table 10b.

How were these factors calculated?

For further explanation on how these emission factors have derived, please refer to the GHG conversion factor methodology paper available here:
http://www.defra.gov.uk/environment/business/reporting/methodology-papers.htm

Table 10a

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2e per kWh electricity and heat GENERATED [1]																		
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
European Union																		
Austria	0.24469	0.25193	0.20879	0.19367	0.20702	0.21400	0.22964	0.22780	0.20779	0.19495	0.18327	0.19399	0.19438	0.23599	0.22999	0.22487	0.21400
Belgium	0.34848	0.34225	0.33167	0.34604	0.36557	0.35816	0.33988	0.31096	0.31536	0.27838	0.28488	0.27194	0.26641	0.27356	0.26852	0.26796	0.26000
Bulgaria			0.47604	0.48248	0.45655	0.42959	0.41842	0.47489	0.48059	0.44558	0.43074	0.46342	0.43290	0.47026	0.47056	0.44800	0.44800
Cyprus			0.83152	0.83215	0.83592	0.82635	0.83682	0.84546	0.84748	0.86077	0.84190	0.78123	0.75972	0.83716	0.77642	0.79232	0.75800
Czech Republic	0.59926	0.59025	0.58666	0.58219	0.58573	0.58484	0.58138	0.56160	0.56931	0.55933	0.56747	0.55998	0.54608	0.50187	0.50354	0.51557	0.52700
Denmark	0.47621	0.50607	0.46966	0.45661	0.46987	0.43004	0.46686	0.42154	0.38973	0.36331	0.33928	0.33588	0.33197	0.35717	0.30820	0.28358	0.34100
Estonia			0.64874	0.61991	0.61883	0.68898	0.67908	0.67971	0.71961	0.70653	0.69716	0.68545	0.67219	0.72332	0.70093	0.66491	0.64000
Finland	0.23038	0.23502	0.20741	0.23238	0.26873	0.24976	0.28972	0.26777	0.21234	0.21163	0.21103	0.23952	0.25292	0.29295	0.25463	0.19355	0.24200
France	0.10995	0.12455	0.09949	0.06912	0.06984	0.07698	0.07804	0.07190	0.09737	0.08639	0.08275	0.07075	0.07628	0.08043	0.07812	0.09086	0.08500
Germany	0.57142	0.58368	0.55271	0.54990	0.54775	0.53246	0.52490	0.51749	0.50833	0.49459	0.49593	0.50623	0.51840	0.43795	0.43567	0.34923	0.40400
Greece	0.99119	0.94081	0.95854	0.93360	0.88408	0.87230	0.82824	0.86896	0.86022	0.82160	0.81356	0.83234	0.81518	0.77389	0.77722	0.77649	0.72500
Hungary	0.46926	0.46029	0.48531	0.45865	0.44188	0.44574	0.43312	0.43126	0.42725	0.41440	0.41183	0.39484	0.39161	0.42089	0.38953	0.33870	0.34400
Ireland	0.74996	0.75330	0.75950	0.73657	0.72921	0.72871	0.72790	0.71961	0.71520	0.69780	0.63923	0.67506	0.63709	0.59739	0.57154	0.58417	0.53500
Italy	0.57393	0.54898	0.53559	0.52517	0.51651	0.54673	0.52531	0.51510	0.51608	0.49802	0.50377	0.48518	0.50902	0.52480	0.41057	0.40539	0.40400
Latvia			0.27627	0.26876	0.25037	0.23812	0.26248	0.21815	0.19735	0.21684	0.20021	0.18967	0.18814	0.18285	0.16653	0.16203	0.16700
Lithuania			0.18583	0.18586	0.21514	0.17271	0.17314	0.16538	0.17224	0.17646	0.15775	0.14373	0.11981	0.11233	0.11021	0.12960	0.13900
Luxembourg	2.58835	2.47028	2.48372	2.46430	2.10744	1.34005	1.19289	0.81004	0.24886	0.25772	0.25507	0.23995	0.32877	0.33019	0.33381	0.32776	0.32600
Malta			1.02351	1.39164	1.16395	0.96173	0.97887	0.94159	0.93652	0.90859	0.86785	1.02822	0.81952	0.81377	0.90155	0.89189	0.83400
Netherlands	0.60221	0.58383	0.57094	0.57448	0.53817	0.52943	0.50072	0.49919	0.46938	0.46752	0.44678	0.46242	0.45856	0.46713	0.43991	0.38667	0.39400
Poland	0.65635	0.65066	0.65258	0.64027	0.64316	0.67525	0.66460	0.66689	0.66430	0.66515	0.67157	0.66038	0.66239	0.66228	0.66497	0.65890	0.65900
Portugal	0.51726	0.52237	0.62192	0.54591	0.49700	0.56964	0.42914	0.46668	0.46420	0.53935	0.48006	0.44252	0.51267	0.41390	0.45231	0.49822	0.41600
Romania			0.40957	0.38444	0.45613	0.44046	0.44433	0.38531	0.35133	0.35988	0.39544	0.41220	0.41240	0.45123	0.41829	0.39414	0.42900
Slovak Republic	0.37850	0.38870	0.36026	0.41249	0.36070	0.36983	0.36272	0.37889	0.35117	0.34875	0.26676	0.24878	0.22385	0.25551	0.24731	0.23206	0.22300
Slovenia			0.36616	0.37318	0.33451	0.33712	0.31751	0.38705	0.39374	0.36704	0.33134	0.34099	0.37192	0.36729	0.33665	0.32829	0.33200
Spain	0.42790	0.42373	0.48166	0.41924	0.41656	0.45661	0.35872	0.39189	0.38061	0.44476	0.42958	0.38326	0.43710	0.38101	0.38255	0.39430	0.35000
Sweden	0.04802	0.05813	0.05080	0.05202	0.05582	0.04999	0.07331	0.05029	0.05439	0.04808	0.04208	0.04324	0.05203	0.05955	0.05124	0.04454	0.04400
European Union - 27			**0.4431**	**0.4217**	**0.4205**	**0.4190**	**0.4092**	**0.3986**	**0.3932**	**0.3837**	**0.3808**	**0.3780**	**0.3838**	**0.3767**	**0.3623**	**0.3409**	**0.3540**
SUBTOTAL																	

2006 5-yr rolling average:	Scope 2 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG
Amount used per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh
	0.21985	0.02949	0.24934
	0.26729	0.03586	0.30315
	0.45394	0.06090	0.51484
	0.78472	0.10527	0.88999
	0.51881	0.06960	0.58841
	0.32438	0.04352	0.36790
	0.68027	0.09126	0.77153
	0.24721	0.03316	0.28037
	0.08214	0.01102	0.09316
	0.42905	0.05756	0.48661
	0.77356	0.10377	0.87733
	0.37695	0.05057	0.42752
	0.58504	0.07848	0.66352
	0.45076	0.06047	0.51123
	0.17331	0.02325	0.19656
	0.12219	0.01639	0.13858
	0.32931	0.04418	0.37349
	0.85215	0.11432	0.96647
	0.42925	0.05758	0.48683
	0.66151	0.08874	0.75025
	0.45862	0.06152	0.52014
	0.42101	0.05648	0.47749
	0.23635	0.03171	0.26806
	0.34723	0.04658	0.39381
	0.38899	0.05218	0.44117
	0.05027	0.00674	0.05701
	0.36351	**0.04877**	**0.41228**

Scope 2 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG
Total kg CO_2	Total kg CO_2e	Total kg CO_2e
0	**0**	**0**

% Total GWh		% Distribution Losses	
Electricity	Heat	Electricity	Heat
80.4%	19.6%	5.7%	8.0%
93.4%	6.6%	4.9%	7.8%
74.9%	25.1%	16.0%	13.0%
100.0%	0.0%	3.9%	0.0%
68.1%	31.9%	8.3%	16.8%
50.6%	49.4%	4.4%	20.1%
57.8%	42.2%	15.5%	13.3%
60.9%	39.1%	3.5%	6.7%
91.7%	8.3%	7.0%	0.0%
63.6%	36.4%	5.4%	7.8%
99.1%	0.9%	9.9%	0.0%
66.9%	33.1%	10.9%	0.0%
100.0%	0.0%	7.9%	0.0%
85.0%	15.0%	6.4%	0.0%
36.2%	63.8%	12.7%	16.7%
51.6%	48.4%	13.3%	16.4%
85.4%	14.6%	1.7%	0.0%
100.0%	0.0%	11.6%	0.0%
67.9%	32.1%	4.1%	17.0%
62.4%	37.6%	12.8%	0.0%
92.4%	7.6%	8.3%	0.0%
62.6%	37.4%	13.0%	22.0%
68.3%	31.7%	6.9%	12.9%
84.4%	15.6%	7.0%	16.9%
100.0%	0.0%	9.7%	0.0%
75.9%	24.1%	8.2%	3.5%
78.1%	**21.9%**	**7.4%**	**7.7%**

Annex 10 - International Electricity Emission Factors

Last updated:	Aug-10

Table 10a - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2 per kWh electricity and heat GENERATED [1]																		
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Other countries																		
Australia	0.81114	0.81428	0.82107	0.80583	0.78207	0.77585	0.82333	0.86546	0.87987	0.87203	0.86473	0.84491	0.89218	0.87169	0.84381	0.87331	0.92100
Brazil			0.06084	0.05531	0.05105	0.05516	0.05696	0.06202	0.06224	0.08248	0.08795	0.10387	0.08561	0.07917	0.08525	0.08422	0.08100
Canada	0.19498	0.18726	0.19610	0.17509	0.17176	0.17661	0.17061	0.18966	0.21602	0.20703	0.21665	0.22604	0.21335	0.22485	0.20661	0.19866	0.18400
China, People's Republic of			0.79426	0.79388	0.76786	0.80286	0.82061	0.80419	0.82316	0.79784	0.76491	0.73992	0.74854	0.77607	0.80563	0.78787	0.78800
Chinese Taipei			0.48987	0.50564	0.50348	0.51437	0.52105	0.55048	0.55964	0.57975	0.60381	0.61580	0.60567	0.63272	0.62770	0.63168	0.65900
Croatia			0.32515	0.32786	0.24992	0.27264	0.25359	0.29830	0.32332	0.30319	0.29929	0.30969	0.35384	0.37681	0.29775	0.31133	0.31800
Egypt			0.52963	0.50317	0.46645	0.44328	0.43274	0.44224	0.46745	0.45455	0.41181	0.38100	0.43668	0.43248	0.47314	0.47144	0.47000
Gibraltar			0.77740	0.77711	0.75511	0.76963	0.75564	0.77657	0.76963	0.76963	0.76347	0.75741	0.76367	0.75814	0.76963	0.74309	0.73000
Hong Kong (China)			0.81908	0.86040	0.87104	0.85239	0.82957	0.72387	0.74005	0.71496	0.71078	0.71890	0.72404	0.79368	0.82943	0.80978	0.85500
Iceland	0.00053	0.00050	0.00047	0.00081	0.00081	0.00164	0.00120	0.00110	0.00294	0.00377	0.00063	0.00061	0.00062	0.00062	0.00061	0.00062	0.00100
India			0.88896	0.91124	0.87567	0.92576	0.97061	0.94260	0.92136	0.91912	0.93849	0.93405	0.91902	0.90312	0.94195	0.94336	0.94400
Indonesia			0.63930	0.75615	0.64160	0.58193	0.63824	0.67546	0.65057	0.67653	0.64277	0.73930	0.71351	0.77524	0.75041	0.77074	0.67700
Israel			0.82042	0.82244	0.82091	0.82134	0.82714	0.82183	0.76572	0.76726	0.76090	0.77282	0.82278	0.81757	0.80746	0.76748	0.77400
Japan	0.43054	0.42103	0.42688	0.40857	0.42609	0.40822	0.40560	0.39122	0.37914	0.39491	0.39855	0.39972	0.41966	0.44154	0.42480	0.42854	0.41800
Korea, Republic of	0.51227	0.55043	0.57791	0.55932	0.54307	0.53149	0.52809	0.54967	0.49437	0.47919	0.50111	0.50186	0.42514	0.44532	0.44399	0.41819	0.53300
Malaysia			0.62327	0.60436	0.55630	0.55639	0.55913	0.46610	0.53937	0.52772	0.51668	0.54070	0.59111	0.52545	0.53121	0.55701	0.65500
Mexico	0.53547	0.53476	0.50954	0.50989	0.56112	0.50683	0.50616	0.52187	0.57158	0.56116	0.56619	0.56849	0.55814	0.55990	0.52234	0.51547	0.54100
New Zealand	0.12801	0.13034	0.17406	0.13874	0.11552	0.11166	0.13925	0.21296	0.21404	0.23758	0.23032	0.27575	0.24675	0.28996	0.24068	0.27542	0.30900
Norway	0.00343	0.00455	0.00389	0.00418	0.00518	0.00450	0.00631	0.00549	0.00551	0.00603	0.00407	0.00585	0.00530	0.00834	0.00701	0.00550	0.00700
Pakistan			0.39318	0.38422	0.39114	0.40487	0.44259	0.45370	0.41139	0.46779	0.47943	0.46281	0.44254	0.37003	0.39672	0.37957	0.41300
Philippines			0.48341	0.47905	0.51878	0.50864	0.51395	0.56993	0.59138	0.50095	0.49810	0.52989	0.48219	0.46017	0.45697	0.49515	0.43500
Russian Federation			0.30843	0.29134	0.29622	0.29192	0.34205	0.32843	0.32652	0.32713	0.32089	0.32159	0.32676	0.32939	0.32494	0.33796	0.32900
Saudi Arabia			0.83294	0.83768	0.81569	0.81506	0.80198	0.80867	0.81486	0.81158	0.80984	0.77824	0.75127	0.73951	0.75952	0.74761	0.75500
Singapore			0.84116	1.00403	0.97650	0.93841	0.87978	0.76920	0.77416	0.65604	0.66367	0.63457	0.59497	0.57374	0.55622	0.54393	0.53600
South Africa			0.85529	0.88050	0.86359	0.87811	0.86066	0.86947	0.92746	0.88972	0.89301	0.82893	0.81943	0.84522	0.86554	0.84836	0.86900
Switzerland	0.02177	0.02442	0.02779	0.02070	0.01978	0.02187	0.02555	0.02267	0.02774	0.02197	0.02205	0.02138	0.02178	0.02259	0.02368	0.02623	0.02600
Thailand			0.64630	0.63010	0.62341	0.60608	0.62543	0.63371	0.60817	0.59608	0.56408	0.56238	0.53846	0.52788	0.53794	0.53134	0.51100
Turkey	0.58397	0.59327	0.59385	0.52419	0.57271	0.53246	0.53848	0.55055	0.55838	0.57718	0.52586	0.55054	0.47848	0.44834	0.42703	0.43284	0.43800
Ukraine			0.36674	0.38358	0.35477	0.36430	0.33096	0.32098	0.32944	0.33654	0.34431	0.32729	0.32267	0.37860	0.31273	0.31432	0.34400
United States			0.58821	0.59026	0.58721	0.57095	0.58005	0.60391	0.60454	0.59611	0.58610	0.60227	0.57485	0.57475	0.57545	0.57293	0.55900
Africa			**0.67861**	**0.68994**	**0.68222**	**0.68711**	**0.67110**	**0.67875**	**0.70997**	**0.67985**	**0.66700**	**0.62209**	**0.62281**	**0.63664**	**0.65082**	**0.64274**	**0.64500**
Latin America			**0.19213**	**0.18320**	**0.17804**	**0.18197**	**0.18683**	**0.19286**	**0.20077**	**0.20386**	**0.19580**	**0.20569**	**0.19745**	**0.19323**	**0.20295**	**0.19697**	**0.19400**
Middle-East			**0.71633**	**0.72223**	**0.72563**	**0.72785**	**0.72046**	**0.71890**	**0.70506**	**0.70894**	**0.70558**	**0.70556**	**0.69179**	**0.68727**	**0.69660**	**0.69011**	**0.67000**
Non-OECD Europe			**0.47920**	**0.46804**	**0.47977**	**0.48344**	**0.47047**	**0.48048**	**0.47697**	**0.44937**	**0.47373**	**0.48714**	**0.48527**	**0.51260**	**0.48935**	**0.47859**	**0.49900**
SUBTOTAL																	
GRAND TOTAL																	

2006 5-yr rolling average:	Scope 2 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG
Amount used per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh
	0.88040	0.11811	0.99851
	0.08305	0.01114	0.09419
	0.20549	0.02757	0.23306
	0.78122	0.10480	0.88602
	0.63135	0.08470	0.71605
	0.33155	0.04448	0.37603
	0.45675	0.06127	0.51802
	0.75291	0.10100	0.85391
	0.80239	0.10764	0.91003
	0.00069	0.00009	0.00078
	0.93029	0.12480	1.05509
	0.73738	0.09892	0.83630
	0.79786	0.10703	0.90489
	0.42651	0.05722	0.48373
	0.45313	0.06079	0.51392
	0.57196	0.07673	0.64869
	0.53937	0.07236	0.61173
	0.27236	0.03654	0.30890
	0.00663	0.00089	0.00752
	0.40037	0.05371	0.45408
	0.46590	0.06250	0.52840
	0.32961	0.04422	0.37383
	0.75058	0.10069	0.85127
	0.56097	0.07525	0.63622
	0.84951	0.11396	0.96347
	0.02406	0.00323	0.02729
	0.52932	0.07101	0.60033
	0.44494	0.05969	0.50463
	0.33446	0.04487	0.37933
	0.57140	0.07665	0.64805
	0.63960	**0.08580**	**0.72540**
	0.19692	**0.02642**	**0.22334**
	0.68715	**0.09218**	**0.77933**
	0.49296	**0.06613**	**0.55909**

Scope 2 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG
Total kg CO_2	Total kg CO_2e	Total kg CO_2e
0	**0**	**0**
0	**0**	**0**

% Total GWh		% Distribution Losses	
Electricity	Heat	Electricity	Heat
100.0%	0.0%	7.6%	0.0%
99.7%	0.3%	15.6%	0.0%
98.5%	1.5%	8.2%	0.0%
79.7%	20.3%	7.8%	1.4%
100.0%	0.0%	3.7%	0.0%
77.1%	22.9%	12.9%	13.5%
100.0%	0.0%	16.4%	0.0%
100.0%	0.0%	0.0%	0.0%
100.0%	0.0%	10.9%	0.0%
77.1%	22.9%	4.7%	10.4%
100.0%	0.0%	26.8%	0.0%
100.0%	0.0%	12.3%	0.0%
100.0%	0.0%	2.9%	0.0%
99.3%	0.7%	4.9%	0.0%
87.9%	12.1%	3.7%	1.9%
100.0%	0.0%	4.3%	0.0%
100.0%	0.0%	17.6%	0.0%
99.7%	0.3%	7.6%	0.0%
97.5%	2.5%	8.1%	16.1%
100.0%	0.0%	25.2%	0.0%
100.0%	0.0%	13.1%	0.0%
36.9%	63.1%	14.8%	2.6%
100.0%	0.0%	7.8%	0.0%
100.0%	0.0%	5.5%	0.0%
100.0%	0.0%	7.2%	0.0%
92.5%	7.5%	6.8%	7.5%
100.0%	0.0%	8.0%	0.0%
94.2%	5.8%	15.7%	0.0%
52.5%	47.5%	15.6%	25.2%
98.4%	1.6%	6.6%	18.0%
99.9%	**0.1%**	**12.0%**	**0.0%**
99.9%	**0.1%**	**16.7%**	**0.0%**
100.0%	**0.0%**	**14.0%**	**0.0%**
74.7%	**25.3%**	**15.7%**	**15.4%**

Source

Emission factor data is from International Energy Agency Data Services, 2006 and 2008 for "CO_2 Emissions per kWh Electricity and Heat Generated" and mainly sourced from the GHG Protocol website http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat (for 2006) is sourced from the IEA website at: http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Electricity/Heat
Data on losses in distribution of electricity and heat is calculated from 2006 country energy balances available at the IEA website at:
http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Balances

Notes

Indirect (Scope 3) emission factors for different countries were estimated as being roughtly a similar ratio CO_2 emission factors as for the UK (which is 13.4%), in the absence of other information.

[1] Emissions factors for electricity and heat GENERATED (and supplied to the grid where relevant) - **EXCLUDES** losses from the transmission and distribution grid.
If you cannot find an emission factor for a particular country, please refer to the larger list available on the GHG Protocol website at the link above.

Annex 10 - International Electricity Emission Factors

Last updated: Aug-10

Table 10b

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2 per kWh electricity and heat LOSSES in transmission and distribution [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
European Union																	
Austria	0.01607	0.01654	0.01371	0.01271	0.01359	0.01404	0.01508	0.01495	0.01364	0.01280	0.01203	0.01273	0.01277	0.01549	0.01510	0.01476	0.01400
Belgium	0.01868	0.01835	0.01778	0.01855	0.01959	0.01920	0.01822	0.01667	0.01691	0.01492	0.01527	0.01458	0.01428	0.01466	0.01440	0.01436	0.01400
Bulgaria			0.08445	0.08560	0.08100	0.07621	0.07423	0.08425	0.08527	0.07905	0.07642	0.08222	0.07681	0.08343	0.08348	0.07949	0.08036
Cyprus			0.03414	0.03416	0.03432	0.03393	0.03436	0.03471	0.03479	0.03533	0.03456	0.03207	0.03119	0.03437	0.03187	0.03253	0.03112
Czech Republic	0.07588	0.07474	0.07428	0.07372	0.07417	0.07405	0.07361	0.07111	0.07208	0.07082	0.07185	0.07090	0.06915	0.06355	0.06376	0.06529	0.06539
Denmark	0.06218	0.06608	0.06132	0.05962	0.06135	0.05616	0.06096	0.05504	0.05088	0.04744	0.04430	0.04386	0.04335	0.04664	0.04024	0.03703	0.04719
Estonia			0.10891	0.10407	0.10389	0.11567	0.11400	0.11410	0.12081	0.11861	0.11704	0.11507	0.11285	0.12143	0.11767	0.11162	0.10921
Finland	0.01118	0.01140	0.01006	0.01128	0.01304	0.01212	0.01406	0.01300	0.01030	0.01027	0.01024	0.01163	0.01228	0.01421	0.01236	0.00939	0.01217
France	0.00731	0.00828	0.00661	0.00459	0.00465	0.00512	0.00519	0.00478	0.00648	0.00574	0.00550	0.00470	0.00507	0.00535	0.00519	0.00604	0.00583
Germany	0.03846	0.03929	0.03720	0.03701	0.03687	0.03584	0.03533	0.03483	0.03422	0.03329	0.03338	0.03408	0.03490	0.02948	0.02932	0.02351	0.02693
Greece	0.10757	0.10210	0.10402	0.10131	0.09594	0.09466	0.08988	0.09430	0.09335	0.08916	0.08829	0.09032	0.08846	0.08398	0.08435	0.08427	0.07882
Hungary	0.03744	0.03672	0.03872	0.03659	0.03525	0.03557	0.03456	0.03441	0.03409	0.03306	0.03286	0.03150	0.03124	0.03358	0.03107	0.02703	0.02698
Ireland	0.06446	0.06475	0.06529	0.06332	0.06268	0.06264	0.06257	0.06186	0.06148	0.05998	0.05494	0.05803	0.05476	0.05136	0.04913	0.05022	0.04599
Italy	0.03305	0.03161	0.03085	0.03025	0.02975	0.03148	0.03025	0.02967	0.02972	0.02868	0.02901	0.02794	0.02931	0.03022	0.02365	0.02335	0.02330
Latvia			0.04849	0.04718	0.04395	0.04180	0.04608	0.03830	0.03464	0.03807	0.03515	0.03329	0.03303	0.03210	0.02923	0.02845	0.03015
Lithuania			0.03298	0.03299	0.03819	0.03065	0.03073	0.02935	0.03057	0.03132	0.02800	0.02551	0.02127	0.01993	0.01956	0.02300	0.02415
Luxembourg	0.03936	0.03757	0.03777	0.03747	0.03205	0.02038	0.01814	0.01231	0.00378	0.00391	0.00388	0.00365	0.00500	0.00502	0.00508	0.00498	0.00472
Malta			0.13403	0.18224	0.15243	0.12594	0.12818	0.12330	0.12264	0.11899	0.11365	0.13465	0.10732	0.10656	0.11806	0.11680	0.10921
Netherlands	0.04762	0.04617	0.04515	0.04543	0.04255	0.04186	0.03960	0.03948	0.03712	0.03697	0.03533	0.03657	0.03626	0.03694	0.03478	0.03057	0.03549
Poland	0.04941	0.04899	0.04913	0.04820	0.04843	0.05084	0.05004	0.05021	0.05001	0.05008	0.05057	0.04973	0.04987	0.04987	0.05006	0.04961	0.05714
Portugal	0.04314	0.04356	0.05186	0.04552	0.04144	0.04750	0.03578	0.03891	0.03871	0.04497	0.04003	0.03690	0.04275	0.03451	0.03771	0.04155	0.03470
Romania			0.08088	0.07592	0.09008	0.08698	0.08775	0.07609	0.06938	0.07107	0.07809	0.08140	0.08144	0.08911	0.08261	0.07783	0.08391
Slovak Republic	0.03672	0.03771	0.03494	0.04002	0.03499	0.03587	0.03518	0.03675	0.03406	0.03383	0.02587	0.02414	0.02171	0.02478	0.02399	0.02251	0.02148
Slovenia			0.03390	0.03455	0.03098	0.03121	0.02940	0.03583	0.03646	0.03398	0.03068	0.03158	0.03444	0.03401	0.03117	0.03040	0.03093
Spain	0.04587	0.04543	0.05163	0.04494	0.04465	0.04895	0.03845	0.04201	0.04080	0.04768	0.04605	0.04108	0.04686	0.04084	0.04101	0.04227	0.03752
Sweden	0.00358	0.00434	0.00379	0.00388	0.00416	0.00372	0.00547	0.00375	0.00406	0.00359	0.00314	0.00322	0.00388	0.00444	0.00382	0.00332	0.00335
European Union - 27			**0.03588**	**0.03416**	**0.03406**	**0.03393**	**0.03314**	**0.03229**	**0.03184**	**0.03108**	**0.03085**	**0.03061**	**0.03108**	**0.03051**	**0.02934**	**0.02761**	**0.02865**
SUBTOTAL																	

2006 5-yr rolling average: Amount used per year, kWh	Scope 2 Total Direct GHG: kg CO_2 per kWh	Scope 3 Total Indirect GHG: kg CO_2e per kWh	All Scopes Grand Total GHG: kg CO_2e per kWh
	0.01442	0.00194	0.01636
	0.01434	0.00192	0.01626
	0.08072	0.01083	0.09155
	0.03222	0.00432	0.03654
	0.06543	0.00878	0.07421
	0.04289	0.00575	0.04864
	0.11456	0.01537	0.12993
	0.01208	0.00162	0.01370
	0.00549	0.00074	0.00623
	0.02883	0.00387	0.03270
	0.08397	0.01127	0.09524
	0.02998	0.00402	0.03400
	0.05029	0.00675	0.05704
	0.02596	0.00348	0.02944
	0.03059	0.00410	0.03469
	0.02158	0.00290	0.02448
	0.00496	0.00066	0.00562
	0.11159	0.01497	0.12656
	0.03481	0.00467	0.03948
	0.05131	0.00689	0.05820
	0.03824	0.00513	0.04337
	0.08298	0.01113	0.09411
	0.02289	0.00307	0.02596
	0.03219	0.00432	0.03651
	0.04170	0.00560	0.04730
	0.00376	0.00051	0.00427
	0.02944	**0.00394**	**0.03338**

Scope 2 Total Direct GHG: Total kg CO_2	Scope 3 Total Indirect GHG: Total kg CO_2e	All Scopes Grand Total GHG: Total kg CO_2e
0	**0**	**0**

% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
79.5%	20.5%	5.7%	8.0%
94.2%	5.8%	4.9%	7.8%
70.2%	29.8%	16.0%	13.0%
100.0%	0.0%	3.9%	0.0%
65.7%	34.3%	8.3%	16.8%
54.5%	45.5%	4.4%	20.1%
48.6%	51.4%	15.5%	13.3%
65.9%	34.1%	3.5%	6.7%
89.0%	11.0%	7.0%	0.0%
61.3%	38.7%	5.4%	7.8%
98.9%	1.1%	9.9%	0.0%
68.0%	32.0%	10.9%	0.0%
100.0%	0.0%	7.9%	0.0%
84.9%	15.1%	6.4%	0.0%
45.2%	54.8%	12.7%	16.7%
43.1%	56.9%	13.3%	16.4%
89.7%	10.3%	1.7%	0.0%
100.0%	0.0%	11.6%	0.0%
75.1%	24.9%	4.1%	17.0%
54.7%	45.3%	12.8%	0.0%
92.4%	7.6%	8.3%	0.0%
61.2%	38.8%	13.0%	22.0%
67.4%	32.6%	6.9%	12.9%
84.8%	15.2%	7.0%	16.9%
100.0%	0.0%	9.7%	0.0%
72.9%	27.1%	8.2%	3.5%
77.0%	**23.0%**	**7.4%**	**7.7%**

Table 10b - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2 per kWh electricity and heat LOSSES in transmission and distribution [2]

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Other countries																	
Australia	0.06645	0.06671	0.06727	0.06602	0.06408	0.06356	0.06745	0.07091	0.07209	0.07145	0.07085	0.06922	0.07309	0.07141	0.06913	0.07155	0.07546
Brazil			0.01125	0.01023	0.00944	0.01020	0.01054	0.01147	0.01151	0.01526	0.01626	0.01921	0.01584	0.01464	0.01577	0.01557	0.01493
Canada	0.01714	0.01646	0.01725	0.01540	0.01511	0.01553	0.01501	0.01668	0.01900	0.01821	0.01905	0.01987	0.01876	0.01977	0.01817	0.01747	0.01624
China, People's Republic of			0.05533	0.05530	0.05348	0.05593	0.05717	0.05602	0.05734	0.05558	0.05329	0.05154	0.05214	0.05406	0.05612	0.05488	0.05484
Chinese Taipei			0.01877	0.01938	0.01930	0.01971	0.01997	0.02109	0.02144	0.02221	0.02314	0.02359	0.02321	0.02424	0.02405	0.02420	0.02525
Croatia			0.04853	0.04893	0.03731	0.04069	0.03785	0.04453	0.04826	0.04525	0.04467	0.04622	0.05282	0.05624	0.04445	0.04646	0.04760
Egypt			0.10403	0.09883	0.09162	0.08707	0.08500	0.08686	0.09181	0.08928	0.08089	0.07483	0.08577	0.08494	0.09293	0.09260	0.09231
Gibraltar			0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hong Kong (China)			0.10036	0.10542	0.10673	0.10445	0.10165	0.08869	0.09068	0.08760	0.08709	0.08808	0.08872	0.09725	0.10163	0.09922	0.10476
Iceland	0.00004	0.00003	0.00003	0.00005	0.00005	0.00010	0.00007	0.00007	0.00018	0.00024	0.00004	0.00004	0.00003	0.00004	0.00004	0.00004	0.00006
India			0.32513	0.33327	0.32027	0.33859	0.35499	0.34475	0.33698	0.33616	0.34325	0.34162	0.33612	0.33030	0.34451	0.34503	0.34526
Indonesia			0.08973	0.10613	0.09005	0.08168	0.08958	0.09481	0.09132	0.09495	0.09022	0.10376	0.10015	0.10882	0.10533	0.10818	0.09502
Israel			0.02468	0.02473	0.02468	0.02470	0.02487	0.02472	0.02302	0.02307	0.02289	0.02324	0.02474	0.02459	0.02428	0.02308	0.02328
Japan	0.02189	0.02141	0.02171	0.02077	0.02167	0.02076	0.02062	0.01990	0.01928	0.02009	0.02027	0.02032	0.02135	0.02246	0.02161	0.02179	0.02127
Korea, Republic of	0.01845	0.01982	0.02082	0.02014	0.01956	0.01914	0.01902	0.01979	0.01780	0.01725	0.01805	0.01807	0.01531	0.01604	0.01598	0.01506	0.01927
Malaysia			0.02812	0.02725	0.02509	0.02509	0.02521	0.02102	0.02433	0.02380	0.02330	0.02438	0.02666	0.02370	0.02396	0.02512	0.02954
Mexico	0.11466	0.11451	0.10911	0.10918	0.12015	0.10853	0.10838	0.11175	0.12239	0.12016	0.12124	0.12172	0.11951	0.11989	0.11185	0.11038	0.11584
New Zealand	0.01048	0.01068	0.01425	0.01136	0.00946	0.00915	0.01140	0.01744	0.01753	0.01946	0.01887	0.02259	0.02021	0.02374	0.01971	0.02256	0.02522
Norway	0.00031	0.00041	0.00035	0.00037	0.00047	0.00041	0.00057	0.00049	0.00049	0.00055	0.00036	0.00052	0.00047	0.00075	0.00063	0.00050	0.00063
Pakistan			0.13242	0.12940	0.13173	0.13635	0.14905	0.15280	0.13854	0.15754	0.16145	0.15587	0.14904	0.12462	0.13361	0.12783	0.13909
Philippines			0.07280	0.07214	0.07813	0.07660	0.07741	0.08583	0.08906	0.07544	0.07502	0.07981	0.07262	0.06930	0.06882	0.07457	0.06551
Russian Federation			0.02138	0.02021	0.02054	0.02025	0.02372	0.02278	0.02264	0.02268	0.02225	0.02230	0.02266	0.02284	0.02253	0.02344	0.02519
Saudi Arabia			0.07054	0.07094	0.06908	0.06903	0.06792	0.06848	0.06901	0.06873	0.06858	0.06591	0.06363	0.06263	0.06432	0.06332	0.06394
Singapore			0.04857	0.05798	0.05639	0.05419	0.05080	0.04442	0.04470	0.03788	0.03832	0.03664	0.03436	0.03313	0.03211	0.03141	0.03095
South Africa			0.06590	0.06785	0.06654	0.06766	0.06631	0.06700	0.07146	0.06855	0.06881	0.06387	0.06314	0.06513	0.06668	0.06536	0.06696
Switzerland	0.00160	0.00180	0.00205	0.00152	0.00146	0.00161	0.00188	0.00167	0.00204	0.00162	0.00163	0.00158	0.00161	0.00166	0.00175	0.00194	0.00192
Thailand			0.05650	0.05508	0.05450	0.05299	0.05468	0.05540	0.05317	0.05211	0.04932	0.04917	0.04707	0.04615	0.04703	0.04645	0.04468
Turkey	0.10003	0.10163	0.10172	0.08980	0.09810	0.09121	0.09224	0.09431	0.09565	0.09887	0.09009	0.09430	0.08196	0.07680	0.07316	0.07415	0.07634
Ukraine			0.09382	0.09813	0.09076	0.09320	0.08466	0.08212	0.08428	0.08609	0.08809	0.08373	0.08254	0.09686	0.08000	0.08040	0.08666
United States			0.04259	0.04274	0.04252	0.04134	0.04200	0.04372	0.04378	0.04316	0.04243	0.04361	0.04162	0.04162	0.04166	0.04149	0.04090
Africa			**0.09295**	**0.09450**	**0.09343**	**0.09411**	**0.09192**	**0.09297**	**0.09724**	**0.09312**	**0.09135**	**0.08520**	**0.08530**	**0.08720**	**0.08913**	**0.08803**	**0.08826**
Latin America			**0.03844**	**0.03665**	**0.03562**	**0.03640**	**0.03737**	**0.03858**	**0.04016**	**0.04078**	**0.03917**	**0.04115**	**0.03950**	**0.03865**	**0.04059**	**0.03940**	**0.03875**
Middle-East			**0.11689**	**0.11784**	**0.11840**	**0.11877**	**0.11755**	**0.11730**	**0.11505**	**0.11568**	**0.11513**	**0.11513**	**0.11288**	**0.11214**	**0.11366**	**0.11261**	**0.10932**
Non-OECD Europe			**0.08861**	**0.08655**	**0.08872**	**0.08939**	**0.08699**	**0.08884**	**0.08819**	**0.08309**	**0.08760**	**0.09008**	**0.08973**	**0.09479**	**0.09049**	**0.08850**	**0.09230**
SUBTOTAL																	
GRAND TOTAL																	

2006 5-yr rolling average: Amount used per year, kWh	Scope 3 Total Direct GHG: kg CO_2 per kWh	Scope 3 Total Indirect GHG: kg CO_2e per kWh	All Scopes Grand Total GHG: kg CO_2e per kWh
	0.07213	0.00967	0.08180
	0.01535	0.00206	0.01741
	0.01809	0.00242	0.02051
	0.05441	0.00730	0.06171
	0.02419	0.00324	0.02743
	0.04951	0.00664	0.05615
	0.08971	0.01204	0.10175
	0.00000	0.00000	0.00000
	0.09831	0.01319	0.11150
	0.00005	0.00001	0.00006
	0.34024	0.04564	0.38588
	0.10350	0.01389	0.11739
	0.02399	0.00322	0.02721
	0.02169	0.00291	0.02460
	0.01633	0.00219	0.01852
	0.02579	0.00346	0.02925
	0.11549	0.01549	0.13098
	0.02229	0.00299	0.02528
	0.00060	0.00008	0.00068
	0.13484	0.01809	0.15293
	0.07016	0.00941	0.07957
	0.02333	0.00313	0.02646
	0.06357	0.00853	0.07210
	0.03239	0.00435	0.03674
	0.06545	0.00878	0.07423
	0.00177	0.00024	0.00201
	0.04628	0.00621	0.05249
	0.07648	0.01026	0.08674
	0.08530	0.01144	0.09674
	0.04145	0.00556	0.04701
	0.08759	**0.01175**	**0.09934**
	0.03938	**0.00528**	**0.04466**
	0.11213	**0.01504**	**0.12717**
	0.09116	**0.01223**	**0.10339**

Scope 3 Total Direct GHG: Total kg CO_2	Scope 3 Total Indirect GHG: Total kg CO_2e	All Scopes Grand Total GHG: Total kg CO_2e
0	**0**	**0**
0	**0**	**0**

% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
100.0%	0.0%	7.6%	0.0%
100.0%	0.0%	15.6%	0.0%
98.2%	1.8%	8.2%	0.0%
79.8%	20.2%	7.8%	1.4%
100.0%	0.0%	3.7%	0.0%
82.8%	17.2%	12.9%	13.5%
100.0%	0.0%	16.4%	0.0%
100.0%	0.0%	0.0%	0.0%
100.0%	0.0%	10.9%	0.0%
77.2%	22.8%	4.7%	10.4%
100.0%	0.0%	26.8%	0.0%
100.0%	0.0%	12.3%	0.0%
100.0%	0.0%	2.9%	0.0%
99.3%	0.7%	4.9%	0.0%
87.2%	12.8%	3.7%	1.9%
100.0%	0.0%	4.3%	0.0%
100.0%	0.0%	17.6%	0.0%
100.0%	0.0%	7.6%	0.0%
97.9%	2.1%	8.1%	16.1%
100.0%	0.0%	25.2%	0.0%
100.0%	0.0%	13.1%	0.0%
31.7%	68.3%	14.8%	2.6%
100.0%	0.0%	7.8%	0.0%
100.0%	0.0%	5.5%	0.0%
100.0%	0.0%	7.2%	0.0%
92.8%	7.2%	6.8%	7.5%
100.0%	0.0%	8.0%	0.0%
92.9%	7.1%	15.7%	0.0%
49.9%	50.1%	15.6%	25.2%
99.0%	1.0%	6.6%	18.0%
100.0%	**0.0%**	**12.0%**	**0.0%**
100.0%	**0.0%**	**16.7%**	**0.0%**
100.0%	**0.0%**	**14.0%**	**0.0%**
73.5%	**26.5%**	**15.7%**	**15.4%**

Source

Emission factor data is from International Energy Agency Data Services, 2006 and 2008 for "CO_2 Emissions per kWh Electricity and Heat Generated" and mainly sourced from the GHG Protocol website http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat (for 2006) is sourced from the IEA website at: http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Electricity/Heat

Data on losses in distribution of electricity and heat is calculated from 2006 country energy balances available at the IEA website at: http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Balances

Annex 10 - International Electricity Emission Factors

Last updated: Aug-10

Notes

Indirect (Scope 3) emission factors for different countries were estimated as being roughtly a similar ratio CO_2 emission factors as for the UK (which is 13.4%), in the absence of other information.

[2] Emissions factors for electricity and heat LOSSES from the transmission and distribution grid.
If you cannot find an emission factor for a particular country, please refer to the larger list available on the GHG Protocol website at the link above.
Emission factors per kWh energy LOSSES in trasmission and distribution are calculated using % distribution losses for 2006.

Table 10c

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2 per kWh electricity and heat CONSUMED [3]																		
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
European Union																		
Austria	0.26076	0.26847	0.22250	0.20638	0.22061	0.22804	0.24472	0.24275	0.22143	0.20775	0.19530	0.20672	0.20715	0.25148	0.24509	0.23963	0.22800	
Belgium	0.36716	0.36060	0.34945	0.36459	0.38516	0.37736	0.35810	0.32763	0.33227	0.29330	0.30015	0.28652	0.28069	0.28822	0.28292	0.28232	0.27400	
Bulgaria			0.56049	0.56808	0.53755	0.50580	0.49265	0.55914	0.56586	0.52463	0.50716	0.54564	0.50971	0.55369	0.55404	0.52749	0.52836	
Cyprus			0.86566	0.86631	0.87024	0.86028	0.87118	0.88017	0.88227	0.89610	0.87646	0.81330	0.79091	0.87153	0.80829	0.82485	0.78912	
Czech Republic	0.67514	0.66499	0.66094	0.65591	0.65990	0.65889	0.65499	0.63271	0.64139	0.63015	0.63932	0.63088	0.61523	0.56542	0.56730	0.58086	0.59239	
Denmark	0.53839	0.57215	0.53098	0.51623	0.53122	0.48620	0.52782	0.47658	0.44061	0.41075	0.38358	0.37974	0.37532	0.40381	0.34844	0.32061	0.38819	
Estonia			0.75765	0.72398	0.72272	0.80465	0.79308	0.79381	0.84042	0.82514	0.81420	0.80052	0.78504	0.84475	0.81860	0.77653	0.74921	
Finland	0.24156	0.24642	0.21747	0.24366	0.28177	0.26188	0.30378	0.28077	0.22264	0.22190	0.22127	0.25115	0.26520	0.30716	0.26699	0.20294	0.25417	
France	0.11726	0.13283	0.10610	0.07371	0.07449	0.08210	0.08323	0.07668	0.10385	0.09213	0.08825	0.07545	0.08135	0.08578	0.08331	0.09690	0.09083	
Germany	0.60988	0.62297	0.58991	0.58691	0.58462	0.56830	0.56023	0.55232	0.54255	0.52788	0.52931	0.54031	0.55330	0.46743	0.46499	0.37274	0.43093	
Greece	1.09876	1.04291	1.06256	1.03491	0.98002	0.96696	0.91812	0.96326	0.95357	0.91076	0.90185	0.92266	0.90364	0.85787	0.86157	0.86076	0.80382	
Hungary	0.50670	0.49701	0.52403	0.49524	0.47713	0.48131	0.46768	0.46567	0.46134	0.44746	0.44469	0.42634	0.42285	0.45447	0.42060	0.36573	0.37098	
Ireland	0.81442	0.81805	0.82479	0.79989	0.79189	0.79135	0.79047	0.78147	0.77668	0.75778	0.69417	0.73309	0.69185	0.64875	0.62067	0.63439	0.58099	
Italy	0.60698	0.58059	0.56644	0.55542	0.54626	0.57821	0.55556	0.54477	0.54580	0.52670	0.53278	0.51312	0.53833	0.55502	0.43422	0.42874	0.42730	
Latvia			0.32476	0.31594	0.29432	0.27992	0.30856	0.25645	0.23199	0.25491	0.23536	0.22296	0.22117	0.21495	0.19576	0.19048	0.19715	
Lithuania			0.21881	0.21885	0.25333	0.20336	0.20387	0.19473	0.20281	0.20778	0.18575	0.16924	0.14108	0.13226	0.12977	0.15260	0.16315	
Luxembourg	2.62771	2.50785	2.52149	2.50177	2.13949	1.36043	1.21103	0.82235	0.25264	0.26163	0.25895	0.24360	0.33377	0.33521	0.33889	0.33274	0.33072	
Malta			1.15754	1.57388	1.31638	1.08767	1.10705	1.06489	1.05916	1.02758	0.98150	1.16287	0.92684	0.92033	1.01961	1.00869	0.94321	
Netherlands	0.64983	0.63000	0.61609	0.61991	0.58072	0.57129	0.54032	0.53867	0.50650	0.50449	0.48211	0.49899	0.49482	0.50407	0.47469	0.41724	0.42949	
Poland	0.70576	0.69965	0.70171	0.68847	0.69159	0.72609	0.71464	0.71710	0.71431	0.71523	0.72214	0.71011	0.71226	0.71215	0.71503	0.70851	0.71614	
Portugal	0.56040	0.56593	0.67378	0.59143	0.53844	0.61714	0.46492	0.50559	0.50291	0.58432	0.52009	0.47942	0.55542	0.44841	0.49002	0.53977	0.45070	
Romania			0.49045	0.46036	0.54621	0.52744	0.53208	0.46140	0.42071	0.43095	0.47353	0.49360	0.49384	0.54034	0.50090	0.47197	0.51291	
Slovak Republic	0.41522	0.42641	0.39520	0.45251	0.39569	0.40570	0.39790	0.41564	0.38523	0.38258	0.29263	0.27292	0.24556	0.28029	0.27130	0.25457	0.24448	
Slovenia			0.40006	0.40773	0.36549	0.36833	0.34691	0.42288	0.43020	0.40102	0.36202	0.37257	0.40636	0.40130	0.36782	0.35869	0.36293	
Spain	0.47377	0.46916	0.53329	0.46418	0.46121	0.50556	0.39717	0.43390	0.42141	0.49244	0.47563	0.42434	0.48396	0.42185	0.42356	0.43657	0.38752	
Sweden	0.05160	0.06247	0.05459	0.05590	0.05998	0.05371	0.07878	0.05404	0.05845	0.05167	0.04522	0.04646	0.05591	0.06399	0.05506	0.04786	0.04735	
European Union - 27			**0.47899**	**0.45590**	**0.45458**	**0.45297**	**0.44236**	**0.43092**	**0.42501**	**0.41480**	**0.41169**	**0.40861**	**0.41484**	**0.40717**	**0.39160**	**0.36847**	**0.38265**	
SUBTOTAL																		

2006 5-yr rolling average:	Scope 2, 3 [4] Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Scope 2, 3 [4] Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	% Total GWh		% Distribution Losses	
Amount used per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Electricity	Heat	Electricity	Heat
	0.23427	0.03143	0.26570				79.5%	20.5%	5.7%	8.0%
	0.28163	0.03778	0.31941				94.2%	5.8%	4.9%	7.8%
	0.53466	0.07173	0.60639				70.2%	29.8%	16.0%	13.0%
	0.81694	0.10959	0.92653				100.0%	0.0%	3.9%	0.0%
	0.58424	0.07838	0.66262				65.7%	34.3%	8.3%	16.8%
	0.36727	0.04927	0.41654				54.5%	45.5%	4.4%	20.1%
	0.79483	0.10663	0.90146				48.6%	51.4%	15.5%	13.3%
	0.25929	0.03478	0.29407				65.9%	34.1%	3.5%	6.7%
	0.08763	0.01176	0.09939				89.0%	11.0%	7.0%	0.0%
	0.45788	0.06143	0.51931				61.3%	38.7%	5.4%	7.8%
	0.85753	0.11504	0.97257				98.9%	1.1%	9.9%	0.0%
	0.40693	0.05459	0.46152				68.0%	32.0%	10.9%	0.0%
	0.63533	0.08523	0.72056				100.0%	0.0%	7.9%	0.0%
	0.47672	0.06395	0.54067				84.9%	15.1%	6.4%	0.0%
	0.20390	0.02735	0.23125				45.2%	54.8%	12.7%	16.7%
	0.14377	0.01929	0.16306				43.1%	56.9%	13.3%	16.4%
	0.33427	0.04484	0.37911				89.7%	10.3%	1.7%	0.0%
	0.96374	0.12929	1.09303				100.0%	0.0%	11.6%	0.0%
	0.46406	0.06225	0.52631				75.1%	24.9%	4.1%	17.0%
	0.71282	0.09563	0.80845				54.7%	45.3%	12.8%	0.0%
	0.49686	0.06665	0.56351				92.4%	7.6%	8.3%	0.0%
	0.50399	0.06761	0.57160				61.2%	38.8%	13.0%	22.0%
	0.25924	0.03478	0.29402				67.4%	32.6%	6.9%	12.9%
	0.37942	0.05090	0.43032				84.8%	15.2%	7.0%	16.9%
	0.43069	0.05778	0.48847				100.0%	0.0%	9.7%	0.0%
	0.05403	0.00725	0.06128				72.9%	27.1%	8.2%	3.5%
	0.39295	**0.05271**	**0.44566**				**77.0%**	**23.0%**	**7.4%**	**7.7%**
				0	**0**	**0**				

Table 10c - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2006: kgCO_2 per kWh electricity and heat CONSUMED [3]																		
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	
Other countries																		
Australia	0.87759	0.88099	0.88834	0.87185	0.84615	0.83941	0.89078	0.93637	0.95196	0.94348	0.93558	0.91413	0.96527	0.94310	0.91294	0.94486	0.99646	
Brazil			0.07209	0.06554	0.06049	0.06536	0.06750	0.07349	0.07375	0.09774	0.10421	0.12308	0.10145	0.09381	0.10102	0.09979	0.09593	
Canada	0.21212	0.20372	0.21335	0.19049	0.18687	0.19214	0.18562	0.20634	0.23502	0.22524	0.23570	0.24591	0.23211	0.24462	0.22478	0.21613	0.20024	
China, People's Republic of			0.84959	0.84918	0.82134	0.85879	0.87778	0.86021	0.88050	0.85342	0.81820	0.79146	0.80068	0.83013	0.86175	0.84275	0.84284	
Chinese Taipei			0.50864	0.52502	0.52278	0.53408	0.54102	0.57157	0.58108	0.60196	0.62695	0.63939	0.62888	0.65696	0.65175	0.65588	0.68425	
Croatia			0.37368	0.37679	0.28723	0.31333	0.29144	0.34283	0.37158	0.34844	0.34396	0.35591	0.40666	0.43305	0.34220	0.35779	0.36560	
Egypt			0.63366	0.60200	0.55807	0.53035	0.51774	0.52910	0.55926	0.54383	0.49270	0.45583	0.52245	0.51742	0.56607	0.56404	0.56231	
Gibraltar			0.77140	0.77711	0.75511	0.76963	0.75564	0.77657	0.76963	0.76963	0.76347	0.75741	0.76367	0.75814	0.76963	0.74309	0.73000	
Hong Kong (China)			0.91944	0.96582	0.97777	0.95684	0.93122	0.81256	0.83073	0.80256	0.79787	0.80698	0.81276	0.89093	0.93106	0.90900	0.95976	
Iceland	0.00057	0.00053	0.00050	0.00086	0.00086	0.00174	0.00127	0.00117	0.00312	0.00401	0.00067	0.00065	0.00065	0.00066	0.00065	0.00066	0.00106	
India			1.21409	1.24451	1.19594	1.26435	1.32560	1.28735	1.25834	1.25528	1.28174	1.27567	1.25514	1.23342	1.28646	1.28839	1.28926	
Indonesia			0.72903	0.86228	0.73165	0.66361	0.72782	0.77027	0.74189	0.77148	0.73299	0.84306	0.81366	0.88406	0.85574	0.87892	0.77202	
Israel			0.84510	0.84717	0.84559	0.84604	0.85201	0.84655	0.78874	0.79033	0.78379	0.79606	0.84752	0.84216	0.83174	0.79056	0.79728	
Japan	0.45243	0.44244	0.44859	0.42934	0.44776	0.42898	0.42622	0.41112	0.39842	0.41500	0.41882	0.42004	0.44101	0.46400	0.44641	0.45033	0.43927	
Korea, Republic of	0.53072	0.57025	0.59873	0.57946	0.56263	0.55063	0.54711	0.56946	0.51217	0.49644	0.51916	0.51993	0.44045	0.46136	0.45997	0.43325	0.55227	
Malaysia			0.65139	0.63161	0.58139	0.58148	0.58434	0.48712	0.56370	0.55152	0.53998	0.56508	0.61777	0.54915	0.55517	0.58213	0.68454	
Mexico	0.65013	0.64927	0.61865	0.61907	0.68127	0.61536	0.61454	0.63362	0.69397	0.68132	0.68743	0.69021	0.67765	0.67979	0.63419	0.62585	0.65684	
New Zealand	0.13849	0.14102	0.18831	0.15010	0.12498	0.12081	0.15065	0.23040	0.23157	0.25704	0.24919	0.29834	0.26696	0.31370	0.26039	0.29798	0.33422	
Norway	0.00374	0.00496	0.00424	0.00455	0.00565	0.00491	0.00688	0.00598	0.00600	0.00658	0.00443	0.00637	0.00577	0.00909	0.00764	0.00600	0.00763	
Pakistan			0.52560	0.51362	0.52287	0.54122	0.59164	0.60650	0.54993	0.62533	0.64088	0.61868	0.59158	0.49465	0.53033	0.50740	0.55209	
Philippines			0.55621	0.55119	0.59691	0.58524	0.59136	0.65576	0.68044	0.57639	0.57312	0.60970	0.55481	0.52947	0.52579	0.56972	0.50051	
Russian Federation			0.32981	0.31155	0.31676	0.31217	0.36577	0.35121	0.34916	0.34981	0.34314	0.34389	0.34942	0.35223	0.34747	0.36140	0.35419	
Saudi Arabia			0.90348	0.90862	0.88477	0.88409	0.86990	0.87715	0.88387	0.88031	0.87842	0.84415	0.81490	0.80214	0.82384	0.81093	0.81894	
Singapore			0.88973	1.06201	1.03289	0.99260	0.93058	0.81362	0.81886	0.69392	0.70199	0.67121	0.62933	0.60687	0.58833	0.57534	0.56695	
South Africa			0.92119	0.94835	0.93013	0.94577	0.92697	0.93647	0.99892	0.95827	0.96182	0.89280	0.88257	0.91035	0.93222	0.91372	0.93596	
Switzerland	0.02337	0.02622	0.02984	0.02222	0.02124	0.02348	0.02743	0.02434	0.02978	0.02359	0.02368	0.02296	0.02339	0.02425	0.02543	0.02817	0.02792	
Thailand			0.70280	0.68518	0.67791	0.65907	0.68011	0.68911	0.66134	0.64819	0.61340	0.61155	0.58553	0.57403	0.58497	0.57779	0.55568	
Turkey	0.68400	0.69490	0.69557	0.61399	0.67081	0.62367	0.63072	0.64486	0.65403	0.67605	0.61595	0.64484	0.56044	0.52514	0.50019	0.50699	0.51434	
Ukraine			0.46056	0.48171	0.44553	0.45750	0.41562	0.40310	0.41372	0.42263	0.43240	0.41102	0.40521	0.47546	0.39273	0.39472	0.43066	
United States			0.63080	0.63300	0.62973	0.61229	0.62205	0.64763	0.64832	0.63927	0.62853	0.64588	0.61647	0.61637	0.61711	0.61442	0.59990	
Africa			**0.77156**	**0.78444**	**0.77565**	**0.78122**	**0.76302**	**0.77172**	**0.80721**	**0.77297**	**0.75835**	**0.70729**	**0.70811**	**0.72384**	**0.73995**	**0.73077**	**0.73326**	
Latin America			**0.23057**	**0.21985**	**0.21366**	**0.21837**	**0.22420**	**0.23144**	**0.24093**	**0.24464**	**0.23497**	**0.24684**	**0.23695**	**0.23188**	**0.24354**	**0.23637**	**0.23275**	
Middle-East			**0.83322**	**0.84007**	**0.84403**	**0.84662**	**0.83801**	**0.83620**	**0.82011**	**0.82462**	**0.82071**	**0.82069**	**0.80467**	**0.79941**	**0.81026**	**0.80272**	**0.77932**	
Non-OECD Europe			**0.56781**	**0.55459**	**0.56849**	**0.57283**	**0.55746**	**0.56932**	**0.56516**	**0.53246**	**0.56133**	**0.57722**	**0.57500**	**0.60739**	**0.57984**	**0.56709**	**0.59130**	
SUBTOTAL																		
GRAND TOTAL																		

2006 5-yr rolling average:	Scope 2, 3 [4] Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Scope 2, 3 [4] Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	% Total GWh		% Distribution Losses	
Amount used per year, kWh	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Electricity	Heat	Electricity	Heat
	0.95253	0.12778	1.08031				100.0%	0.0%	7.6%	0.0%
	0.09840	0.01320	0.11160				100.0%	0.0%	15.6%	0.0%
	0.22358	0.02999	0.25357				98.2%	1.8%	8.2%	0.0%
	0.83563	0.11210	0.94773				79.8%	20.2%	7.8%	1.4%
	0.65554	0.08794	0.74348				100.0%	0.0%	3.7%	0.0%
	0.38106	0.05112	0.43218				82.8%	17.2%	12.9%	13.5%
	0.54646	0.07331	0.61977				100.0%	0.0%	16.4%	0.0%
	0.75291	0.10100	0.85391				100.0%	0.0%	0.0%	0.0%
	0.90070	0.12083	1.02153				100.0%	0.0%	10.9%	0.0%
	0.00074	0.00010	0.00084				77.2%	22.8%	4.7%	10.4%
	1.27053	0.17044	1.44097				100.0%	0.0%	26.8%	0.0%
	0.84088	0.11281	0.95369				100.0%	0.0%	12.3%	0.0%
	0.82185	0.11025	0.93210				100.0%	0.0%	2.9%	0.0%
	0.44820	0.06013	0.50833				99.3%	0.7%	4.9%	0.0%
	0.46946	0.06298	0.53244				87.2%	12.8%	3.7%	1.9%
	0.59775	0.08019	0.67794				100.0%	0.0%	4.3%	0.0%
	0.65486	0.08785	0.74271				100.0%	0.0%	17.6%	0.0%
	0.29465	0.03953	0.33418				100.0%	0.0%	7.6%	0.0%
	0.00723	0.00097	0.00820				97.9%	2.1%	8.1%	16.1%
	0.53521	0.07180	0.60701				100.0%	0.0%	25.2%	0.0%
	0.53606	0.07191	0.60797				100.0%	0.0%	13.1%	0.0%
	0.35294	0.04735	0.40029				31.7%	68.3%	14.8%	2.6%
	0.81415	0.10922	0.92337				100.0%	0.0%	7.8%	0.0%
	0.59336	0.07960	0.67296				100.0%	0.0%	5.5%	0.0%
	0.91496	0.12274	1.03770				100.0%	0.0%	7.2%	0.0%
	0.02583	0.00347	0.02930				92.8%	7.2%	6.8%	7.5%
	0.57560	0.07722	0.65282				100.0%	0.0%	8.0%	0.0%
	0.52142	0.06995	0.59137				92.9%	7.1%	15.7%	0.0%
	0.41976	0.05631	0.47607				49.9%	50.1%	15.6%	25.2%
	0.61285	0.08221	0.69506				99.0%	1.0%	6.6%	18.0%
	0.72719	**0.09755**	**0.82474**				**100.0%**	**0.0%**	**12.0%**	**0.0%**
	0.23630	**0.03170**	**0.26800**				**100.0%**	**0.0%**	**16.7%**	**0.0%**
	0.79928	**0.10722**	**0.90650**				**100.0%**	**0.0%**	**14.0%**	**0.0%**
	0.58412	**0.07836**	**0.66248**				**73.5%**	**26.5%**	**15.7%**	**15.4%**
				0	**0**	**0**				
				0	**0**	**0**				

Annex 10 - International Electricity Emission Factors

Last updated:	Aug-10

Source

Emission factor data is from International Energy Agency Data Services, 2006 and 2008 for "CO_2 Emissions per kWh Electricity and Heat Generated" and mainly sourced from the GHG Protocol website http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat (for 2006) is sourced from the IEA website at: http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Electricity/Heat
Data on losses in distribution of electricity and heat is calculated from 2006 country energy balances available at the IEA website at:
http://www.iea.org/Textbase/stats/prodresult.asp?PRODUCT=Balances

Notes

Indirect (Scope 3) emission factors for different countries were estimated as being roughtly a similar ratio CO_2 emission factors as for the UK (which is 13.4%), in the absence of other information.

[3] Emissions factors for electricity and heat generated (and supplied to the grid where relevant) - **INCLUDES** losses from the transmission and distribution grid, i.e.
Emission Factor (Electricity/Heat CONSUMED) = Emission Factor (Electricity/Heat GENERATED) + Emission Factor (Electricity/Heat LOSSES)
If you cannot find an emission factor for a particular country, please refer to the larger list available on the GHG Protocol website at the link above.
Emission factors per kWh energy consumed are calculated using % distribution losses for 2006.

Annex 11 - Fuel Properties

Last updated:	May-10

How to use this Annex

This annex can be used to help you convert between common units of energy, together with the unit conversions provided in **Annex 12**. In this Annex the typical/average UK calorific values and densities of the most common fuels has been provided.

Table 11

Fuel properties	Net CV	Gross CV	Density	Density	Net CV	Gross CV
	GJ/tonne	GJ/tonne	kg/m^3	litres/tonne	kWh/kg	kWh/kg
Commonly Used Fossil Fuels						
Aviation Spirit	45.02	47.39	707.2	1414	12.50	13.16
Aviation Turbine Fuel	43.87	46.18	800.6	1249	12.19	12.83
Burning Oil [1]	43.85	46.16	803.2	1245	12.18	12.82
Coal (domestic) [2]	28.98	30.50	850.0	1176	8.05	8.47
Coal (electricity generation) [3]	24.13	25.40			6.70	7.06
Coal (industrial) [4]	24.80	26.10			6.89	7.25
Coking Coal	30.97	32.60			8.60	9.06
Diesel	42.81	45.55	834.7	1198	11.89	12.65
Fuel Oil	40.97	43.59	977.5	1023	11.38	12.11
Gas Oil	42.81	45.55	867.3	1153	11.89	12.65
LPG	45.91	49.29	508.1	1968	12.75	13.69
Naphtha	45.27	47.66	689.7	1450	12.58	13.24
Natural Gas	47.59	52.82	0.7459	1340651	13.22	14.67
Petrol	44.74	47.09	734.2	1362	12.43	13.08
Other Fuels						
Biodiesel (ME) [5]	37.20	41.04	890.0	1124	10.33	11.40
Biodiesel (BtL or HVO) [6]	44.00	46.32	780.0	1282	12.22	12.87
Bioethanol [7]	26.80	29.25	794.0	1259	7.44	8.13
BioETBE [8]	36.30	39.62	750.0	1333	10.08	11.01
Biogas [9]	30.00	33.30	0.9626	1038840	8.33	9.25
Biomethane [10]	49.00	54.39	0.7263	1376907	13.61	15.11
CNG [11]	24.80	26.10	175.0	5714	6.89	7.25
Grasses/Straw [12]	14.50	15.26	160.0	6250	4.03	4.24
LNG [13]	47.59	52.82	452.5	2210	13.22	14.67
Wood Pellets [12]	16.62	17.50	1538.5	650	4.62	4.86
Wood Chips [12]	14.00	14.74	250.0	4000	3.89	4.09
Methane (CH_4)	50.00	55.50	0.7170	1394700	13.89	15.42
Carbon Dioxide (CO_2)	0.00	0.00	1.9800	505051	0.00	0.00

Sources

Data for Commonly Used Fossil Fuels was sourced from the Digest of UK Energy Statistics 2008 (DECC), available at: http://www.decc.gov.uk/media/viewfile.ashx?filepath=statistics/publications/dukes/dukes08.pdf&filetype=4
Figures for CNG and biofuels are predominantly based on data from JRC/EUCAR/CONCAWE EU Well-to-Wheels study, 2007 update. Available at: http://ies.jrc.ec.europa.eu/WTW.html

Notes

[1] Burning oil is also known as kerosene or paraffin used for heating systems. Aviation Turbine fuel is a similar kerosene fuel specifically refined to a higher quality for aviation.

[2] Factors should only be used for coal supplied for domestic purposes. Coal supplied to power stations or for industrial purposes have different emission factors.

[3] Factors should only be used for coal supplied for electricity generation (power stations). Coal supplied for domestic or industrial purposes have different emission factors.

[4] 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 UK ETS.

[5] Biodiesel ME (Methyl Ester) is the conventionally produced biodiesel type (also known as 1st generation biodiesel).

[6] Biodiesel, BtL (Biomass-to-Liquid) is an advanced biodiesel fuel not yet in significant commercial production (also known as 2nd generation biodiesel). Biodiesel HVO (Hydrotreated Vegetable Oil) is a new type of biodiesel, similar in properties to BtL biodiesel fuel, only recently becoming available.

[7] Bioethanol is a biofuel commonly used in petrol engined vehicles, usually in a low % blend with conventional petrol.

[8] BioETBE is a biofuel that can be used in petrol engined vehicles in a low % blend with conventional petrol, usually as a replacement for conventional octane enhancers.

[9] Figures are indicative for uncompressed biogas assuming an assumed content of 60% methane and 40% of mainly carbon dioxide (with small quantities of nitrogen, oxygen, hydrogen and hydrogen disulphide). Note: the relative proportions can vary significantly depending on the source of the biogas, e.g. landfill gas, sewage gas, anaerobic digestion of biomass, etc. This will affect all physical properties.

[10] Figures are for uncompressed biomethane (of suitable purity for transport applications) comprising an average of 98% methane and 2% carbon dioxide. Biomethane can be produced by upgrading biogas through removal of the majority of the carbon dioxide and other impurities.

[11] CNG (Compressed Natural Gas) is an alternative transport fuel, typically at 200 bar pressure.

[12] Based on average information on wood pellets, wood chips, grasses/straw (bales) sourced from the BIOMASS Energy Centre (BEC), which is owned and managed by the UK Forestry Commission, via Forest Research, its research agency. Fuel property data on a range of other wood and other heating fuels is available at: http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,20041&_dad=portal&_schema=PORTAL, and http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,163182&_dad=portal&_schema=PORTAL

[13] LNG (Liquefied Natural Gas) is an alternative transport fuel. Some of the natural gas used in the UK network is also imported as LNG by ship in tankers.

Annex 12 - Unit Conversions

Last updated:	Jun-09

How to use this Annex

This Annex can be used to help you convert between common units of energy, volume, mass or distance.

Table 12a provides conversions from common units of **Energy**

Table 12b provides conversions from common units of **Volume**

Table 12c provides conversions from common units of **Weight/Mass**

Table 12d provides conversions from common units of **Length/Distance**

If this annex does not have the conversion factor you are looking for, a more complete list of conversions is available here: http://www.onlineconversion.com/

Common unit abbreviations:
kilo (k) = 1,000 or 10^3
mega (M) = 1,000,000 or 10^6
giga (G) = 1,000,000,000 or 10^9
tera (T) = 1,000,000,000,000 or 10^{12}
peta (P) = 1,000,000,000,000,000 or 10^{15}

Table 12a **Energy**

From/To - multiply by	GJ	kWh	therm	toe	kcal
Gigajoule, GJ	1	277.78	9.47817	0.02388	238,903
Kilowatthour, kWh	0.0036	1	0.03412	0.00009	860.05
Therm	0.10551	29.307	1	0.00252	25,206
Tonne oil equivalent, toe	41.868	11,630	396.83	1	10,002,389
Kilocalorie, kcal	0.000004186	0.0011627	0.000039674	0.000000100	1

Table 12b **Volume**

From/To - multiply by	L	m^3	cu ft	Imp. gallon	US gallon	Bbl (US,P)
Litres, L	1	0.001	0.03531	0.21997	0.26417	0.0062898
Cubic metres, m^3	1000	1	35.315	219.97	264.17	6.2898
Cubic feet, cu ft	28.317	0.02832	1	6.2288	7.48052	0.17811
Imperial gallon	4.5461	0.00455	0.16054	1	1.20095	0.028594
US gallon	3.7854	0.0037854	0.13368	0.83267	1	0.023810
Barrel (US, petroleum), bbl	158.99	0.15899	5.6146	34.972	42	1

Table 12c **Weight/Mass**

From/To - multiply by	kg	tonne	ton (UK)	ton (US)	lb
Kilogram, kg	1	0.001	0.00098	0.00110	2.20462
tonne, t (metric ton)	1000	1	0.98421	1.10231	2204.62368
ton (UK, long ton)	1016.04642	1.01605	1	1.12000	2240
ton (US, short ton)	907.18	0.90718	0.89286	1	2000
Pound, lb	0.45359	0.00045359	0.00044643	0.00050	1

Table 12d **Length/Distance**

From/To - multiply by	m	ft	mi	km	nmi
Metre, m	1	3.2808	0.00062137	0.001	0.00053996
Feet, ft	0.30480	1	0.000	0.0003048	0.00016458
Miles, mi	1609.34	5280	1	1.60934	0.86898
Kilometres, km	1000	3280.8	0.62137	1	0.53996
Nautical miles, nmi or NM	1852	6076.1	1.15078	1.852	1

From/To - multiply by	m	ft	in	cm	yd
Metre, m	1	3.28084	39.37008	100	1.09361
Feet, ft	0.30480	1	12	30.48000	0.33333
Inch, in	0.02540	0.08333	1	2.54000	0.02778
Centimetres, cm	0.01	0.03281	0.39370	1	0.01094
Yard, yd	0.91440	3	36	91.44000	1

Annex 13 - Indirect emissions from the supply chain

Last updated:	Sep-09

Unlike most of the emission factors provided in the annexes, the emission factors presented in *this* Annex only cover indirect emissions from the supply chain and include CO_2, CH_4, N_2O and F-gas emissions. Indirect emissions are those which are generated by other organisations as part of the process of providing goods and services to your company.

The data in this annex has not been updated since the 2009 release, since more recent information was not available.

How to use this Annex

This annex is intended to be used primarily as a high level diagnostic tool/for initial scoping/estimating. **If you have more specific information about the supply chain emissions of any particular product then that source should be used instead.** Such adjustments should be clearly documented.

This annex also includes a number of activities that are also covered in other annexes, such as coal, fuels refined from crude oil, mains electricity, gas, water and for various modes of transport. **If you have more specific/detailed information for such activities that will enable you to make calculations of emissions using the emission factors in the other annexes these should be used in perference to the factors in this annex as they will be much more accurate.** However, the information in this annex may still be useful for a rough initial calculation of the relative importance of these activities in the first instance.

The table below provides emission factors for spending on different groups of products:

1) Identify the amount spent on different product groups, excluding VAT, in £s

2) Multiply the amount of spending by the conversion factor to get total emissions in kilograms of carbon dioxide equivalent (kg CO_2eq). The excel spreadsheet does this automatically following your entry of the amount of spending into the appropriate box.

For example, if £1000 is spent on 'ceramic goods', then the table calculates that 1,309 kilograms of CO2eq were released during all stages of the production of these goods, including raw material extraction, processing, manufacturing, transportation, packaging etc. As a result, these emissions factors are different from the emission factors shown in the other annexes. They are similar to life-cycle emissions, but do not account for direct emissions which are included in life-cycle estimates (e.g. from the actual combustion of the fuel).

Please use this annex in conjunction with Annex F in the Defra Guidance on measuring emissions from your supply chain which is available at http://www.defra.gov.uk/environment/business/reporting/index.htm

Key information:

This Annex can be used to produce indicative estimates of the Greenhouse Gas emissions relating to the production of goods and services purchased by your company. The estimates can only be indicative as they represent the average emissions relating to each product group, and the emission factors relating to specific products within the group may be quite different. If you have specific information about the supply chain emissions of any particular product then this source should be used instead.

The information derived from this table can be combined with data on direct emissions, i.e. those relating to actual fuel use (e.g. litres of fuel used, or derived from mileage estimates). The footnotes to the table give more information about what the factors shown in the table mean in terms of purchases of energy products and transport services.

Are these factors directly comparable to those in the other annexes?

No. The emission factors provided in this annex are for the supply chain emissions of GHG resulting from the production and transportation of broad categories of goods and services. They express Scope 2 and 3 emissions as defined by the GHG Protocol. Because they encompass all the supply chain impacts (i.e. indirect emissions), these emission factors are **not directly comparable** with those from other annexes, which generally **only** include emissions from the point of use (generation for electricity; life cycle in the case of Annex 9).

Which products are included in which categories?

Some guidance is available in the comment boxes in the Table. The categories are based upon the Standard Industrial Classification (SIC 2003): further information on the SIC 2003 is available here:
http://www.statistics.gov.uk/statbase/Product.asp?vlnk=14012

What are the factors for each of the individual Greenhouse Gases?

The factors for each of the six gases included in the overall calculation are included for information in Table 13.

Do the factors take into account emissions relating to imported goods, and those relating to the formation of capital assets used in making the products?

The factors are derived from a multi-region model and hence take some account of the emissions relating to the production of imports. However, the estimates do not incorporate any allowance for emissions relating to the formation of capital assets, whether in the UK or overseas.

Annex 13 Scopes & Boundaries:
Scope 3. For boundaries, see **How were these factors calculated?**

How were these factors calculated?

The factors are based on a model of the economy, known as the input-output model, which describes in monetary terms how the goods and services produced by different sectors of the economy are used by other sectors to produce their own output. These monetary accounts are linked to information about the greenhouse gas emissions of different sectors of the economy. By using the input-output model, these emissions are then attributed to the monetary transactions taking place in the economy. The result is an estimate of the total upstream emissions associated with the supply of a particular product group.

The input-output tables used for this exercise are in 2004 basic prices (i.e. net of taxes on products and distributors' margins). It may be advisable to take subsequent price changes into account when using the factors shown below. It should also be noted that emissions in more recent years may have changed because of subsequent changes in the structure and emissions intensity of the supply chain since 2004.

For more detail on the methodology used, contact the Centre for Sustainability Accounting: info@censa.org.uk
http://www.censa.org.uk

Table 13

								Scope 3			
Supply chain emission factors for spending on products: kgCO_2eq per £								Total GHG			
SIC code (SIC 2003)	Product category	Carbon Dioxide (CO_2)	Methane (CH_4)	Nitrous Oxide (N_2O)	HFCs	PFCs	SF_6	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e
01	Agriculture products[1]	0.82	1.20	1.71	0.01	0.00	0.00		x	3.76	
02	Forestry products	0.63	0.07	0.03	0.04	0.00	0.00		x	0.77	
05	Fish products[1]	1.35	0.17	0.05	0.02	0.00	0.00		x	1.59	
10	Coal, lignite, peat[2]	0.99	5.99	0.02	0.03	0.00	0.00		x	7.04	
11	Crude petroleum, natural gas[2]	1.18	0.14	0.02	0.00	0.00	0.00		x	1.35	
13	Metal ores	17.35	0.40	0.31	13.33	0.00	0.00		x	31.40	
14	Stone, sand and clay, other minerals	1.55	0.28	0.04	0.01	0.00	0.00		x	1.89	
15	Food and drink products[1]	0.71	0.42	0.45	0.01	0.00	0.00		x	1.59	
16	Tobacco products	0.38	0.25	0.28	0.01	0.00	0.00		x	0.93	
17	Textiles	0.80	0.08	0.04	0.02	0.00	0.00		x	0.95	
18	Wearing apparel	0.57	0.08	0.04	0.01	0.00	0.00		x	0.71	
19	Leather products, footwear	0.41	0.02	0.01	0.02	0.00	0.00		x	0.46	
20	Wood and wood products	0.90	0.06	0.02	0.01	0.00	0.00		x	1.00	
21	Pulp and paper, paper products	1.15	0.10	0.03	0.01	0.00	0.00		x	1.30	
22	Printing matter and related services	0.45	0.05	0.02	0.01	0.00	0.00		x	0.53	
23	Refined petroleum, coke and other fuels[3]	2.22	0.59	0.03	0.01	0.00	0.00		x	2.85	
24.11,24.12	Industrial gases and dyes	1.88	0.19	0.04	0.03	0.01	0.01		x	2.16	
24.13	Inorganic chemicals	2.11	0.18	0.05	0.04	0.01	0.01		x	2.41	

24.14	Organic chemicals	1.52	0.15	0.23	0.12	0.03	0.01		x	2.06	
24.15	Fertilisers	2.89	0.23	2.98	0.04	0.01	0.01		x	6.15	
24.16,24.17	Plastics & synthetic resins etc	1.25	0.14	0.08	0.05	0.01	0.01		x	1.54	
24.2	Pesticides	1.04	0.14	0.05	0.04	0.01	0.01		x	1.28	
24.3	Paints, varnishes, printing ink etc	0.71	0.11	0.05	0.03	0.01	0.01		x	0.91	
24.4	Pharmaceuticals	0.62	0.09	0.05	0.03	0.01	0.01		x	0.81	
24.5	Soap and toilet preparations	0.64	0.08	0.04	0.03	0.01	0.01		x	0.80	
24.6	Other chemical products	0.81	0.11	0.05	0.04	0.01	0.01		x	1.02	
24.7	Man-made fibres	1.69	0.12	0.06	0.05	0.01	0.01		x	1.93	
25.1	Rubber products	0.92	0.13	0.10	0.03	0.01	0.01		x	1.19	
25.2	Plastic products	0.90	0.10	0.05	0.06	0.01	0.01		x	1.13	
26.1	Glass and glass products	1.39	0.18	0.02	0.02	0.00	0.00		x	1.62	
26.2,26.3	Ceramic goods	0.99	0.27	0.03	0.02	0.00	0.00		x	1.31	
26.4	Structural clay products	1.74	0.24	0.02	0.02	0.00	0.00		x	2.04	
26.5	Cement, lime and plaster	12.09	0.32	0.08	0.02	0.00	0.00		x	12.51	
26.6-26.8	Articles of concrete, stone etc	1.30	0.25	0.02	0.01	0.00	0.00		x	1.59	
27.1-27.3	Iron and steel	3.86	0.19	0.04	0.02	0.00	0.01		x	4.11	
27.4	Non-ferrous metals	2.29	0.44	0.03	0.02	0.04	0.08		x	2.91	
27.5	Metal castings	1.26	0.16	0.02	0.02	0.00	0.04		x	1.51	
28	Metal products	1.04	0.10	0.02	0.01	0.00	0.00		x	1.18	
29	Machinery and equipment	0.66	0.07	0.02	0.02	0.00	0.01		x	0.78	
30	Office machinery and computers	0.47	0.05	0.02	0.03	0.01	0.01		x	0.58	
31	Electrical machinery	0.64	0.07	0.02	0.02	0.00	0.01		x	0.77	
32	Radio, television and communications	0.45	0.05	0.02	0.03	0.01	0.01		x	0.56	
33	Medical and precision instruments	0.45	0.05	0.02	0.02	0.01	0.01		x	0.57	
34	Motor vehicles	0.74	0.09	0.03	0.02	0.01	0.01		x	0.89	
35	Other transport equipment	0.66	0.07	0.02	0.01	0.00	0.00		x	0.76	
36, 37	Furniture, other manufactured goods, recycling services	0.80	0.07	0.03	0.02	0.00	0.00		x	0.92	
40.1	Mains electricity[3]	9.26	0.44	0.06	0.01	0.00	0.02		x	9.79	
40.2,40.3	Mains gas[3]	2.49	0.85	0.02	0.01	0.00	0.00		x	3.38	
41	Mains water	0.53	0.04	0.01	0.01	0.00	0.00		x	0.59	
45	Construction[4]	0.43	0.08	0.02	0.01	0.00	0.00		x	0.54	
50	Motor vehicle distribution and repair, automotive fuel retail	0.39	0.05	0.02	0.01	0.00	0.00		x	0.47	
51	Wholesale distribution	0.42	0.07	0.03	0.01	0.00	0.00		x	0.53	
52	Retail distribution	0.26	0.04	0.03	0.04	0.00	0.00		x	0.37	
55	Hotels, catering, pubs etc	0.39	0.11	0.09	0.01	0.00	0.00		x	0.60	
60.1	Railway transport[5]	0.70	0.04	0.04	0.00	0.00	0.00		x	0.79	
60.2	Road transport[5]	1.01	0.08	0.02	0.01	0.00	0.00		x	1.12	
61	Water transport[5]	3.85	0.13	0.06	0.01	0.00	0.00		x	4.05	
62	Air transport[5]	3.38	0.16	0.05	0.01	0.00	0.00		x	3.59	
63	Ancillary transport services	0.31	0.04	0.01	0.00	0.00	0.00		x	0.36	
64	Post and telecommunications	0.30	0.04	0.01	0.01	0.00	0.00		x	0.37	
65	Banking and finance	0.16	0.02	0.01	0.00	0.00	0.00		x	0.19	
66	Insurance and pension funds	0.31	0.04	0.01	0.00	0.00	0.00		x	0.36	
67	Auxiliary financial services	0.25	0.03	0.01	0.00	0.00	0.00		x	0.30	
70	Real estate activities	0.08	0.01	0.00	0.00	0.00	0.00		x	0.10	
71	Renting of machinery etc	0.33	0.05	0.01	0.01	0.00	0.00		x	0.41	
72	Computer services	0.21	0.03	0.01	0.00	0.00	0.00		x	0.25	
73	Research and development	0.34	0.06	0.02	0.01	0.00	0.00		x	0.44	
74	Legal, consultancy, other business activities	0.16	0.02	0.01	0.00	0.00	0.00		x	0.20	
75	Public admininstration and defence	0.38	0.05	0.01	0.01	0.00	0.00		x	0.45	
80	Education	0.21	0.03	0.01	0.00	0.00	0.00		x	0.27	
85	Health and social work	0.30	0.05	0.03	0.01	0.00	0.00		x	0.39	
90	Sewage and refuse services	0.52	1.73	0.11	0.01	0.00	0.02		x	2.39	
91	Services from membership organisations	0.16	0.03	0.01	0.00	0.00	0.00		x	0.20	
92	Recreational services	0.25	0.05	0.03	0.01	0.00	0.00		x	0.35	
93	Other service activities	0.31	0.07	0.02	0.01	0.00	0.00		x	0.41	
	TOTAL										**0**

Source Calculated by Centre for Sustainability Accounting (CenSA), York, based on previous calculations by Stockholm Environment Institute (SEI), University of York
The Centre for Sustainability Accounting (info@censa.org.uk) is able to supply more detailed and up-to-date factors to complement those presented here, see also:
http://www.censa.org.uk

Notes

[1] Agricultural and fish products are those bought direct from farmers or the fisheries industry. Where products have been prepared for consumption they should be treated as products from the food and drink manufacturing industry (SIC code 15 in the above table).

[2] These emissions relate to the activities of the industries engaged in the extraction of energy carriers. Where fuels are processed before use then the factors identified by footnote 3 should be used.

[3] These emission factors relate to the supply and distribution of energy products for general consumption, and take into account emissions relating to the extraction and processing of the energy carriers (e.g. oil refineries). Except in the case of electricity, they do not include emissions relating to your company's use of the energy (for which see primarily Annex 1). In the case of electricity, these factors include the emissions relating to the production of the fuels used to generate the electricity, whereas those shown in Annex 3 of the 2009 Defra / DECC GHG Conversion Factors are limited just to emissions from the use of those fuels by the electricity producers.

[4] These factors relate to spending on construction projects, not to emissions relating to construction projects in the supply chain.

[5] These factors relate to transport services for hire or reward (including public transport services), not to emissions from vehicles owned by your company (for which estimates of actual fuel use should be used). They differ from those shown in Annexes 6 and 7, insofar as the upstream emissions relating to transport services are not included in the other annexes.