2012 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 or 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:	May-12

General Introduction

What are Greenhouse Gas Conversion Factors?

Greenhouse Gases (GHGs) can be measured by recording emissions at source by continuous emissions monitoring **or** by estimating the amount emitted by multiplying activity data (such as the amount of fuel used) by relevant emissions conversion factors.

These conversion factors allow activity data (e.g. litres of fuel used, number of miles driven, tonnes of waste sent to landfill) to be converted into kilograms of carbon dioxide equivalent (CO_2e). CO_2e is a universal unit of measurement that allows the global warming potential of different GHGs to be compared.

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).

What are the major changes and updates from the 2012 version?

Major changes and updates from the 2012 version are as follows:

i. The indirect GHG emission factors (emissions from production and distribution of fuels to their point of use/combustion) have been updated reflecting the most recent analysis by JEC (2011, see http://iet.jrc.ec.europa.eu/about-jec/). This has resulted in an increase in these emission factors for most fuels and this is reflected in the indirect GHG emission factors across the Annexes.

ii. New emission factors have been provided in Annex 1 for Recycled Fuel Oil. This fuel is produced from waste oil and is classified by the Environment Agency as waste and so is subject to the Waste Incineration Directive (WID). Therefore only those companies who are compliant with WID are able to use it as a fuel.

iii. In Annex 3 the emission factors for electricity for 1990 to 1995 have been recalculated based on changes to the NAEI timeseries and data from DUKES (2011). In addition, GHG emissions from electricity produced in Crown Dependencies has been included across the time-series for better consistency with the data in DUKES (2011) on GWh electricity generation.

iv. New time-series emission factors for the supply of purchased of heat/steam have been provided in Annex 3. These emission factors are based on average information from the UK CHPQA scheme since there are no suitable data sources covering supply of heat/steam across all source types.

v. The methodology used to define the emission factors for road vehicles (except motorcycles and buses) in Annex 6 and Annex 7 has been updated to utilise the factors used in the 2010 NAEI to account for the age/activity of the vehicle fleet in the UK, derived from DVLA licensing data and DfT's ANPR (Automatic Number Plate Recognition) data.

vi. The source categories for emissions resulting from different refrigeration and air conditioning equipment have been updated in Annex 8 to reflect the updated characterisation in the UK National Atmospheric Emissions Inventory.

vii. The emissions factors for waste in Annex 9 have been moved to Annex 14 and split out into Material Consumption and Material Waste Disposal components. The range of materials covered in the new Annex 14 tables has also been expanded (as well as updated /amended) to include a wider range of materials and also products, based on information on new analysis provided by WRAP.

In this new Annex 14 the information for material consumption has been separated out from the emissions associated with waste disposal in order to allow separate reporting of these emission sources, in compliance with the GHG Protocol Scope 3 Standard. This change is to bring them into alignment with the principle that a corporate GHG account is an inventory of actual emissions and removals, and should not include values for avoided emissions (e.g. savings from reduced demand for primary materials and combustion of fossil fuels).

Defra will separately provide information on the full lifecycle of materials and the GHG emissions impact of these (e.g. consistent with PAS2050 requirements) on their website later in 2012.

Consequently Annex 9 has been renamed since the previous update (2011), to avoid potential confusion and for better alignment with its reduced contents.

viii. Annex 13 has been updated to provide a time-series from 2004 to 2009 for supply chain emission factors for spending on products (emission factors were previously presented for a single year only). There have also been some revisions to the source categorisation.

ix. All other updates are essentially revisions of the previous year's data based on new/improved data using existing calculation methodologies (i.e. similar methodological approach as for the 2011 update).

x. The supporting methodological paper to explain how all of the emission factors have been derived is being produced/updated. This methodological paper is expected to be available by end June 2012 and will be made available here: http://www.defra.gov.uk/environment/economy/business-efficiency/reporting

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, average factors for transport are based on the composition of the UK fleet and UK-specific occupancy/loading factors where relevant. If your organisation would like to report overseas electricity emissions, you should consult Annex 10.

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/economy/business-efficiency/reporting/

2. Your personal carbon footprint - Individuals who wish to calculate the carbon footprint from their day-to-day activity may be interested in the Government's Act on CO2 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 EU ETS, CCAs or CRC - see links below for details relevant to these

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/126698.aspx

Do I need to update all my earlier 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 2012 update:

Electricity consumption year:	EF to use reporting in 2012:	EF used in 2011 reporting:
2012	new 2010*	N/A
2011	new 2010*	2009*
2010	new 2010*	2009*
2009	new 2009	2009
2008	new 2008	2008
2007	new 2007	2007
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 2010 data for the current 2012 update). A company **should not** generally recalculate their emissions for all previous years using the newer factors. The 2012 factors should only be applied for calculating emissions for 2010, 2011 and 2012. For earlier years you should use the factors that use that year's data but please note that there is usually a 2 year gap between update year and the factors. For example, if you are reporting emissions which occurred in 2008, you should use the 2010 factors (as these are based on 2008 data) but only for those not recorded on a time series. For emissions recorded in time series you should use the 2012 factors.

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 2011-12, you should also recalculate the 2010-11 emissions using the 2011 update data, as these are for the most part based on 2010 datasets. Figures reported for 2009 should use emission factors from the 2011 update, which are mostly based on 2009 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 supplied Electricity, Heat or Steam, 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 GHG emissions from the use of Water, Biomass and Biofuels, 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
- To calculate GHG emissions from the Materials Consumption and from Waste Disposal, see Annex 14

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.

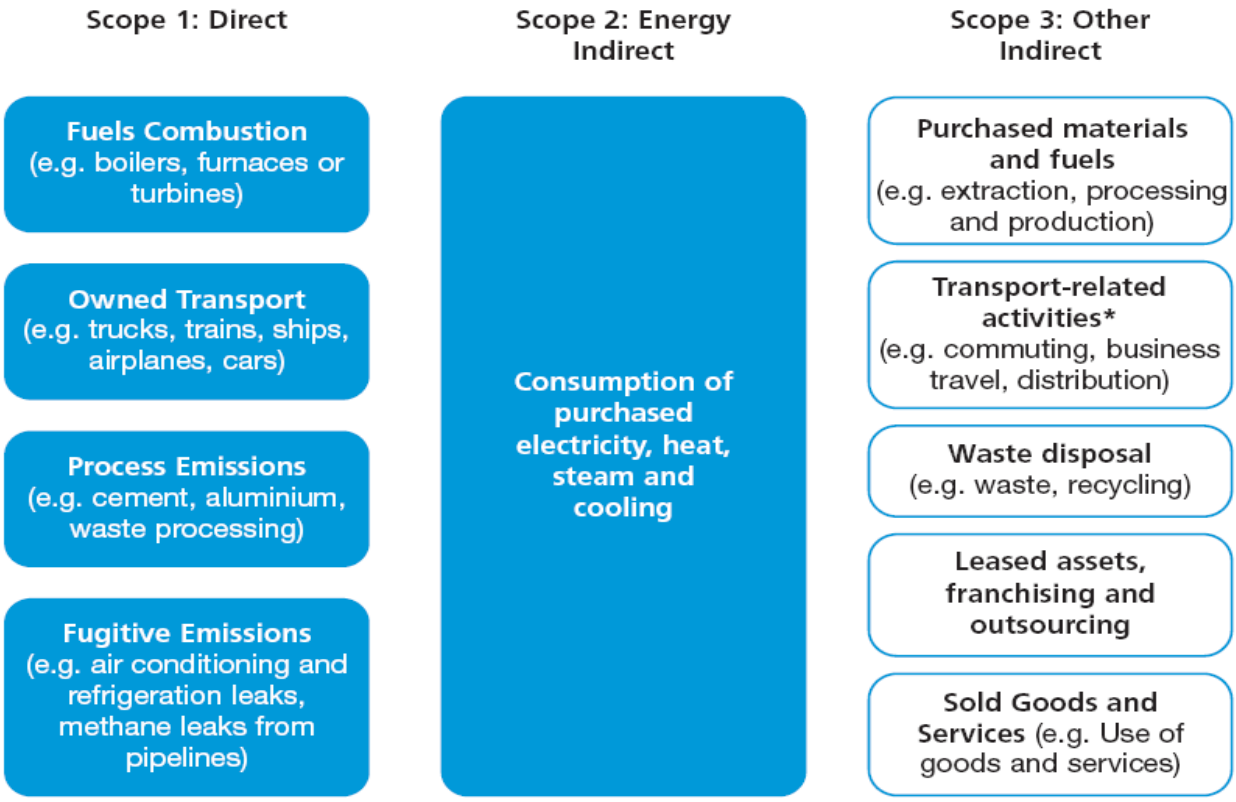
How do I use this document?

This document provides GHG emissions conversion factors for a variety of activities. You can directly input your activity data into the spreadsheet which will then calculate your emissions. Alternatively you can use the emissions factors provided for use in your own spreadsheet or programme.

If you are using this document in order to calculate your organisation's GHG footprint, you must first read the Defra/DECC 'Guidance on how to measure and report on your greenhouse gas emissions' which is available at http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

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.

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



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/economy/business-efficiency/reporting

The Department for Transport provides guidance to help companies report their work-related travel: http://webarchive.nationalarchives.gov.uk/20110503201342/http://www.dft.gov.uk/pgr/sustainable/greenhousegasemissions/

The Carbon Trust also provides information about carbon footprinting for companies available at http://www.carbontrust.com/client-services/footprinting/measurement

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/How-we-can-help-you/Professional-Stan

The Government's Act on CO2 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

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

Last updated: Apr-12

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 paragraph 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.

Note: *In the UK biofuels are added to virtually all of the transport fuel sold by filling stations (and by most fuel wholesalers) and this has the effect of slightly reducing the greenhouse gas emissions of the fuel. This is reflected in the emission factors below. For fuel purchased at filling stations or obtained from private commercial refuelling you should use the factor labelled "average biofuel blend" unless you know the biofuel content is higher or lower than average. In this latter case, if you are purchasing pure petrol or diesel which you know has* ***not*** *been blended with biofuels then you should use the factor labelled "100% mineral fuel", or alternatively use the bespoke biofuel blend calculations provided in Annex 9, Table 9b.*

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 the following links:
http://iet.jrc.ec.europa.eu/about-jec/
http://iet.jrc.ec.europa.eu/about-jec/downloads

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/economy/business-efficiency/reporting/

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

Last updated: Apr-12

Table 1a

Converting fuel types by unit mass				Scope 1 CO_2	Scope 1 CH_4	Scope 1 N_2O	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Scope 1 CO_2	Scope 1 CH_4	Scope 1 N_2O	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes 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	3133.1	28.5	31.0	3192.6	635.2	3827.8						
Aviation Turbine Fuel [1]		tonnes	x	3149.7	1.6	31.0	3182.3	656.0	3838.3						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil[1]		tonnes	x	3149.7	6.8	8.6	3165.1	655.7	3820.8						
CNG [2]		tonnes	x	2718.8	4.0	1.6	2724.4	422.4	3146.8						
Coal (industrial)[3]		tonnes	x	2139.1	1.6	43.1	2183.8	400.5	2584.3						
Coal (electricity generation)[4]		tonnes	x	2238.2	0.4	19.5	2258.2	369.3	2627.5						
Coal (domestic)[5]		tonnes	x	2448.7	329.7	37.7	2816.2	442.0	3258.2						
Coking Coal		tonnes	x	3125.3	27.8	70.6	3223.7	452.4	3676.1						
Diesel (average biofuel blend)[11,12]		tonnes	x	3046.8	1.1	22.6	3070.5	693.7	3764.2						
Diesel (100% mineral diesel)[14]		tonnes	x	3164.3	1.1	22.7	3188.2	672.2	3860.4						
Fuel Oil [6]		tonnes	x	3216.4	2.8	8.9	3228.1	608.8	3836.9						
Gas Oil [7]		tonnes	x	3190.0	3.5	299.1	3492.6	672.3	4164.9						
LNG [8]		tonnes	x	2718.8	4.0	1.6	2724.4	954.5	3678.9						
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	444.9	3587.0						
Other Petroleum Gas		tonnes	x	2662.0	1.3	1.6	2664.8	324.2	2989.0						
Petrol (average biofuel blend)[11,13]		tonnes	x	3029.7	4.4	8.0	3042.1	644.4	3686.5						
Petrol (100% mineral petrol)[14]		tonnes	x	3135.0	4.5	8.1	3147.6	630.8	3778.4						
Petroleum Coke		tonnes	x	3227.8	2.3	78.5	3308.5	393.2	3701.7						
Recycled Fuel Oil [15]		tonnes	x	3171.1	1.9	8.5	3181.5	386.2	3567.7						
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 1b

Converting fuel types by unit volume				Scope 1 CO_2	Scope 1 CH_4	Scope 1 N_2O	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Scope 1 CO_2	Scope 1 CH_4	Scope 1 N_2O	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes 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	2.2205	0.0202	0.0220	2.2626	0.4502	2.7128						
Aviation Turbine Fuel [1]		litres	x	2.5258	0.0013	0.0249	2.5519	0.5261	3.0780						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil[1]		litres	x	2.5319	0.0055	0.0069	2.5443	0.5271	3.0714						
CNG [2]		litres	x	0.4758	0.0007	0.0003	0.4768	0.0739	0.5507						
Diesel (average biofuel blend)[11,12]		litres	x	2.5636	0.0009	0.0190	2.5835	0.5837	3.1672						
Diesel (100% mineral diesel)[14]		litres	x	2.6569	0.0009	0.0191	2.6769	0.5644	3.2413						
Gas Oil [7]		litres	x	2.7595	0.0030	0.2587	3.0213	0.5815	3.6028						
LNG [8]		litres	x	1.2302	0.0018	0.0007	1.2328	0.4319	1.6647						
LPG		litres	x	1.5301	0.0007	0.0018	1.5326	0.1918	1.7244						
Natural Gas		cubic metre	x	2.0280	0.0030	0.0012	2.0322	0.2100	2.2422						
Petrol (average biofuel blend)[11,13]		litres	x	2.2332	0.0033	0.0058	2.2423	0.4750	2.7173						
Petrol (100% mineral petrol)[14]		litres	x	2.3051	0.0033	0.0059	2.3144	0.4638	2.7782						
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: Apr-12

Table 1c

Converting fuel types on an energy, Gross CV basis [9]				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	0.23785	0.00217	0.00235	0.24237	0.04822	0.29059
Aviation Turbine Fuel [1]		kWh	x	0.24548	0.00012	0.00242	0.24802	0.05113	0.29915
Biofuels	See Annex 9							See Annex 9	See Annex 9
Burning Oil[1]		kWh	x	0.24562	0.00053	0.00067	0.24682	0.05113	0.29795
CNG [2]		kWh	x	0.18483	0.00027	0.00011	0.18521	0.02871	0.21392
Coal (industrial)[3]		kWh	x	0.28521	0.00021	0.00575	0.29117	0.05340	0.34457
Coal (electricity generation)[4]		kWh	x	0.32360	0.00006	0.00282	0.32648	0.05340	0.37988
Coal (domestic)[5]		kWh	x	0.29582	0.03983	0.00456	0.34021	0.05340	0.39361
Coking Coal		kWh	x	0.36889	0.00328	0.00833	0.38051	0.05340	0.43391
Diesel (average biofuel blend)[11,12]		kWh	x	0.24350	0.00010	0.00180	0.24540	0.05530	0.30070
Diesel (100% mineral diesel)[14]		kWh	x	0.25167	0.00009	0.00181	0.25357	0.05347	0.30704
Electricity	See Annex 3							See Annex 3	See Annex 3
Fuel Oil [6]		kWh	x	0.26729	0.00023	0.00074	0.26826	0.05059	0.31885
Gas Oil [7]		kWh	x	0.25372	0.00028	0.02379	0.27778	0.05347	0.33125
LNG [8]		kWh	x	0.18483	0.00027	0.00011	0.18521	0.06489	0.25010
LPG		kWh	x	0.21419	0.00010	0.00025	0.21455	0.02685	0.24140
		therms	x	6.27730	0.00300	0.00740	6.28780	0.78692	7.07472
Lubricants		kWh	x	0.26353	0.00016	0.00070	0.26439	0.03210	0.29649
Naphtha		kWh	x	0.23588	0.00020	0.00060	0.23669	0.03352	0.27021
Natural Gas		kWh	x	0.18483	0.00027	0.00011	0.18521	0.01914	0.20435
		therms	x	5.41680	0.00790	0.00330	5.42800	0.56101	5.98901
Other Petroleum Gas		kWh	x	0.18919	0.00009	0.00011	0.18939	0.02304	0.21243
Petrol (average biofuel blend)[11,13]		kWh	x	0.23480	0.00030	0.00060	0.23570	0.04980	0.28550
Petrol (100% mineral petrol)[14]		kWh	x	0.23967	0.00034	0.00062	0.24063	0.04822	0.28885
Petroleum Coke		kWh	x	0.32495	0.00023	0.00790	0.33307	0.03958	0.37265
Recycled Fuel Oil [15]		kWh	x	0.26353	0.04193	0.00480	0.31020	0.03210	0.34230
Refinery Miscellaneous		kWh	x	0.24501	0.00023	0.00067	0.24591	0.02984	0.27575
		therms	x	7.18060	0.00660	0.01960	7.20690	0.87462	8.08152
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**

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

Last updated: Apr-12

Table 1d

Converting fuel types on an energy, Net CV basis [10]				Scope 1				Scope 3	All Scopes	Scope 1				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 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	0.25037	0.00228	0.00248	0.25513	0.05076	0.30589						
Aviation Turbine Fuel [1]		kWh	x	0.25840	0.00013	0.00254	0.26108	0.05382	0.31490						
Biofuels	See Annex 9							See Annex 9	See Annex 9	See Annex 9				See Annex 9	See Annex 9
Burning Oil[1]		kWh	x	0.25854	0.00056	0.00071	0.25981	0.05382	0.31363						
CNG [2]		kWh	x	0.20508	0.00030	0.00012	0.20550	0.03186	0.23736						
Coal (industrial)[3]		kWh	x	0.30023	0.00022	0.00605	0.30650	0.05621	0.36271						
Coal (electricity generation)[4]		kWh	x	0.34063	0.00006	0.00297	0.34367	0.05621	0.39988						
Coal (domestic)[5]		kWh	x	0.31139	0.04193	0.00480	0.35811	0.05621	0.41432						
Coking Coal		kWh	x	0.38831	0.00345	0.00877	0.40053	0.05621	0.45674						
Diesel (average biofuel blend)[11,12]		kWh	x	0.25910	0.00010	0.00190	0.26110	0.05900	0.32010						
Diesel (100% mineral diesel)[14]		kWh	x	0.26774	0.00010	0.00192	0.26975	0.05688	0.32663						
Electricity	See Annex 3							See Annex 3	See Annex 3	See Annex 3				See Annex 3	See Annex 3
Fuel Oil [6]		kWh	x	0.28435	0.00025	0.00079	0.28539	0.05382	0.33921						
Gas Oil [7]		kWh	x	0.26991	0.00030	0.02530	0.29551	0.05688	0.35239						
LNG [8]		kWh	x	0.20508	0.00030	0.00012	0.20550	0.07200	0.27750						
LPG		kWh	x	0.22974	0.00011	0.00027	0.23012	0.02880	0.25892						
		therms	x	6.73310	0.00330	0.00800	6.74430	0.84406	7.58836						
Lubricants		kWh	x	0.28035	0.00017	0.00075	0.28126	0.03415	0.31541						
Naphtha		kWh	x	0.24830	0.00022	0.00064	0.24915	0.03528	0.28443						
Natural Gas		kWh	x	0.20508	0.00030	0.00012	0.20550	0.02124	0.22674						
		therms	x	6.01020	0.00880	0.00360	6.02270	0.62247	6.64517						
Other Petroleum Gas		kWh	x	0.20564	0.00010	0.00012	0.20586	0.02505	0.23091						
Petrol (average biofuel blend)[11,13]		kWh	x	0.24710	0.00040	0.00060	0.24810	0.05260	0.30070						
Petrol (100% mineral petrol)[14]		kWh	x	0.25228	0.00036	0.00065	0.25329	0.05076	0.30405						
Petroleum Coke		kWh	x	0.34205	0.00024	0.00831	0.35060	0.04166	0.39226						
Recycled Fuel Oil [15]		kWh	x	0.28035	0.00017	0.00075	0.28130	0.03415	0.31545						
Refinery Miscellaneous		kWh	x	0.25819	0.00024	0.00071	0.25914	0.03145	0.29059						
		therms	x	7.56690	0.00700	0.02070	7.59450	0.92167	8.51617						
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

Sources

UK Greenhouse Gas Inventory for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/
Digest of UK Energy Statistics 2011 (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, by off-road and agricultural vehicles (for which use it is known as 'red diesel') 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 1 - Converting from fuel use to carbon dioxide equivalent emissions

Last updated: Apr-12

[11] In the UK biofuels are added to virtually all of the transport fuel sold by filling stations (and by most fuel wholesalers) and this has the effect of slightly reducing the greenhouse gas emissions of the fuel. For fuel purchased at filling stations or obtained from private commercial refuelling, you should use the factor labelled "average biofuel blend" unless you know the biofuel content is higher or lower than average. In this latter case, if you are purchasing pure diesel which you know has not been blended with biofuels then you should use the factor labelled "100% mineral fuel", or alternatively use the bespoke biofuel blend calculations provided in Annex 9, Table 9b.

[12] The "average biofuel blend" emission factors calculated here for diesel supplied at public retail and private commercial refuelling stations factor in the biodiesel supplied in the UK as a proportion of the total supply of diesel+biodiesel (3.6% by unit volume, 3.3% by unit energy). These estimates have been made based on the most recently available reports on the Renewable Transport Fuel Obligation (RTFO), and renewable energy statistics. For more information see:
http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ and
http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

[13] The "average biofuel blend" emission factors calculated here for petrol supplied at public retail and private commercial refuelling stations, factoring in the bioethanol supplied in the UK as a proportion of the total supply of petrol+bioethanol (= 2.9% by unit volume, 1.9% by unit energy). These estimates have been made based on the most recently available reports on the Renewable Transport Fuel Obligation (RTFO), and renewable energy statistics. For more information see:
http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ and
http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

[14] The emission factors for 100% mineral fuel petrol or diesel should only be used if you are sure the fuel used does not contain biofuel.

[15] Recycled fuel oils (processed fuel oils) are typically made up of a combination used engine oil, paintshop residues and other oils and are used to replace conventional fuel oils in some factories (e.g. asphalt manufacturers) and power stations. Recycled Fuel Oil is produced from waste oil and is classified by the Environment Agency as waste and so is subject to the Waste Incineration Directive (WID). Therefore only those companies who are compliant with WID are able to use it as a fuel. The WID can be found at:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:332:0091:0111:EN:PDF

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:

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

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

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/economy/business-efficiency/reporting

Annex 3 - Converting from purchased electricity, heat and steam use to carbon dioxide equivalent emissions

Last updated: Apr-12

How to use this Annex

Electricity

The factors presented in the three tables below (3a, 3b and 3c) are a timeseries of electricity CO_2e 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 losses from the national transmission and local distribution grids).

In the majority of cases, the **'Grid Rolling Average'** factor from **Table 3c** should be used. Tables 3a and 3b are included to assist companies reporting in a manner consistent with the Greenhouse Gas Protocol format, which requires separate reporting of GHG emissions due to transmission and distribution losses.

To calculate emissions of carbon dioxide equivalents 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.

Heat and Steam

The factors presented in the Table 3d below are a timeseries of CO_2e emission factors per kWh supplied heat or steam based on information from the UK CHPQA scheme, and are new for this 2012 update to the conversion factor Annexes. In most cases this energy will be provided directly, however in cases where district heating is utilised an additional correction factor of 5% is applied to reflect average energy losses in the supplied heat distribution.

To calculate emissions of carbon dioxide equivalents associated with use of purchased heat/steam:

1) Identify the amount heat or steam used, in units of kWh;

2) Multiply this value by the conversion factor for heat or steam.

3) If the heat used is provided via a district heating scheme, add an additional 5% to the calculated CO_2e emissions to reflect distribution losses.

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) and Heat/Steam (Table 3d Direct GHG).

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.

How are the factors calculated?

Electricity

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), factoring in net imports of electricity via the interconnectors with Ireland and France*. 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 (plus those from the proportion of imported electricity), 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, and the proportion of net imported electricity also changes*. Because these annual changes can be large (the factor depends very heavily on the relative prices of coal and natural gas as well as fluctuations in peak demand and renewables), 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.

From 2011, imported electricity has been accounted for in the calculations of the emission factors. The UK is a net importer of electricity from the interconnector with France, and a net exporter of electricity to Ireland according to DUKES (2011). More details on the methodology, its impacts and the rationale can be found in the methodology paper for the 2011 update, on Defra's website at:
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

Heat and Steam

The heat and steam conversion factors given represent the average emission from the heat and steam supplied by the CHPQA scheme operators for a given year. This factor changes from year to year, as the fuel mix consumed changes. This factor is updated annually. No statistics are available that would allow the calculation of UK national average emission factors for the supply of heat and steam from non-CHP operations.

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/economy/business-efficiency/reporting/

Annex 3 - Converting from purchased electricity, heat and steam use to carbon dioxide equivalent emissions

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

Green Tariffs are electricity tariffs marketed as having environmental credentials (e.g. from predominantly renewable sources). 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/economy/business-efficiency/reporting/

How should I report the carbon emissions from my use of CHP-backed electricity 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/economy/business-efficiency/reporting/

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

ELECTRICITY

Table 3a

Electricity emission factors from 1990 to 2010 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	0.70393	0.00019	0.00577	0.70989
1991	0.67804	0.00018	0.00558	0.68379
1992	0.64035	0.00017	0.00527	0.64579
1993	0.57379	0.00017	0.00439	0.57835
1994	0.55081	0.00018	0.00412	0.55511
1995	0.52410	0.00018	0.00384	0.52812
1996	0.50106	0.00017	0.00341	0.50464
1997	0.46436	0.00017	0.00294	0.46747
1998	0.47177	0.00018	0.00298	0.47493
1999	0.44127	0.00018	0.00255	0.44401
2000	0.46686	0.00019	0.00281	0.46986
2001	0.48416	0.00020	0.00301	0.48737
2002	0.47163	0.00020	0.00284	0.47466
2003	0.49269	0.00020	0.00308	0.49597
2004	0.48777	0.00020	0.00295	0.49092
2005	0.48016	0.00022	0.00303	0.48341
2006	0.50760	0.00022	0.00335	0.51117
2007	0.49994	0.00023	0.00312	0.50330
2008	0.48657	0.00024	0.00291	0.48972
2009	0.44718	0.00025	0.00262	0.45006
2010	0.45453	0.00026	0.00268	0.45747
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 [3]	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
	0.70393	0.00019	0.00577	0.70989	0.10334	0.81323
	0.69098	0.00018	0.00568	0.69684	0.10144	0.79828
	0.67410	0.00018	0.00554	0.67982	0.09896	0.77878
	0.64903	0.00018	0.00525	0.65446	0.09528	0.74974
	0.62938	0.00018	0.00503	0.63459	0.09239	0.72698
	0.59342	0.00018	0.00464	0.59823	0.08711	0.68534
	0.55802	0.00017	0.00421	0.56240	0.08192	0.64432
	0.52282	0.00017	0.00374	0.52674	0.07616	0.60290
	0.50242	0.00018	0.00346	0.50605	0.07246	0.57851
	0.48051	0.00018	0.00314	0.48383	0.06818	0.55201
	0.46906	0.00018	0.00294	0.47218	0.06548	0.53766
	0.46568	0.00018	0.00286	0.46873	0.06411	0.53284
	0.46714	0.00019	0.00284	0.47016	0.06390	0.53406
	0.47132	0.00019	0.00286	0.47437	0.06429	0.53866
	0.48062	0.00020	0.00294	0.48376	0.06567	0.54943
	0.48328	0.00020	0.00298	0.48647	0.06615	0.55262
	0.48797	0.00021	0.00305	0.49123	0.06697	0.55820
	0.49363	0.00022	0.00311	0.49695	0.06776	0.56471
	0.49241	0.00022	0.00307	0.49570	0.06729	0.56299
	0.48429	0.00023	0.00301	0.48753	0.06585	0.55338
	0.47916	0.00024	0.00294	0.48234	0.06468	0.54702
	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	% Net Imports of Electricity
Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e		
						8.1%	3.8%
						8.3%	5.2%
						7.5%	5.3%
						7.2%	5.2%
						9.6%	5.2%
						9.1%	5.0%
						8.4%	4.8%
						7.8%	4.8%
						8.4%	3.5%
						8.3%	3.9%
						8.4%	3.8%
						8.6%	2.8%
						8.3%	2.2%
						8.5%	0.6%
						8.7%	2.0%
						7.2%	2.2%
						7.2%	2.0%
						7.1%	1.4%
						7.3%	2.9%
						7.6%	0.8%
						7.4%	0.7%
0	0	0	0	0	0		

Annex 3 - Converting from purchased electricity, heat and steam use to carbon dioxide equivalent emissions

Table 3b

Electricity emission factors from 1990 to 2010 per kWh (electricity LOSSES):	CO_2	CH_4	N_2O	Total GHG	Grid Rolling Average [1]:	Scope 3 CO_2	Scope 3 CH_4	Scope 3 N_2O	Scope 3 Total Direct GHG	Scope 3 Total Indirect GHG [3]	All Scopes Grand Total GHG	Scope 3 CO_2	Scope 3 CH_4	Scope 3 N_2O	Scope 3 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	% Transmission and Distribution Losses	% Net Imports of Electricity
UK Grid Electricity Year	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	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	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e		
1990	0.06185	0.00002	0.00051	0.06237		0.06185	0.00002	0.00051	0.06237	0.00835	0.07072							8.1%	3.8%
1991	0.06113	0.00002	0.00050	0.06165		0.06149	0.00002	0.00051	0.06201	0.00839	0.07040							8.3%	5.2%
1992	0.05227	0.00001	0.00043	0.05271		0.05842	0.00002	0.00048	0.05891	0.00747	0.06638							7.5%	5.3%
1993	0.04431	0.00001	0.00034	0.04466		0.05489	0.00001	0.00044	0.05535	0.00683	0.06217							7.2%	5.2%
1994	0.05831	0.00002	0.00044	0.05877		0.05557	0.00002	0.00044	0.05603	0.00884	0.06487							9.6%	5.2%
1995	0.05229	0.00002	0.00038	0.05269		0.05366	0.00002	0.00042	0.05410	0.00790	0.06200							9.1%	5.0%
1996	0.04597	0.00002	0.00031	0.04630		0.05063	0.00002	0.00038	0.05103	0.00688	0.05791							8.4%	4.8%
1997	0.03925	0.00001	0.00025	0.03951		0.04803	0.00002	0.00034	0.04838	0.00594	0.05432							7.8%	4.8%
1998	0.04324	0.00002	0.00027	0.04353		0.04781	0.00002	0.00033	0.04816	0.00608	0.05424							8.4%	3.5%
1999	0.03968	0.00002	0.00023	0.03993		0.04408	0.00002	0.00029	0.04439	0.00563	0.05002							8.3%	3.9%
2000	0.04273	0.00002	0.00026	0.04300		0.04217	0.00002	0.00026	0.04245	0.00549	0.04794							8.4%	3.8%
2001	0.04533	0.00002	0.00028	0.04563		0.04205	0.00002	0.00026	0.04232	0.00549	0.04781							8.6%	2.8%
2002	0.04244	0.00002	0.00026	0.04271		0.04268	0.00002	0.00026	0.04296	0.00527	0.04824							8.3%	2.2%
2003	0.04559	0.00002	0.00028	0.04589		0.04315	0.00002	0.00026	0.04343	0.00544	0.04888							8.5%	0.6%
2004	0.04654	0.00002	0.00028	0.04684		0.04452	0.00002	0.00027	0.04481	0.00572	0.05053							8.7%	2.0%
2005	0.03751	0.00002	0.00024	0.03776		0.04348	0.00002	0.00027	0.04377	0.00479	0.04855							7.2%	2.2%
2006	0.03947	0.00002	0.00026	0.03975		0.04231	0.00002	0.00026	0.04259	0.00483	0.04742							7.2%	2.0%
2007	0.03799	0.00002	0.00024	0.03825		0.04142	0.00002	0.00026	0.04170	0.00479	0.04649							7.1%	1.4%
2008	0.03837	0.00002	0.00023	0.03861		0.03997	0.00002	0.00025	0.04024	0.00492	0.04516							7.3%	2.9%
2009	0.03684	0.00002	0.00022	0.03708		0.03804	0.00002	0.00024	0.03829	0.00501	0.04330							7.6%	0.8%
2010	0.03619	0.00002	0.00021	0.03643		0.03777	0.00002	0.00023	0.03802	0.00477	0.04280							7.4%	0.7%
Other electricity factor																			
Renewables [2]	0	0	0	0		0	0	0	0	0	0								
Total												0	0	0	0	0	0		

Table 3c

Electricity emission factors from 1990 to 2010 per kWh (electricity CONSUMED):	CO_2	CH_4	N_2O	Total GHG	Grid Rolling Average [1]:	Scope 2, 3 [4] CO_2	Scope 2, 3 [4] CH_4	Scope 2, 3 [4] N_2O	Scope 2, 3 [4] Total Direct GHG	Scope 3 Total Indirect GHG [3]	All Scopes Grand Total GHG	Scope 2, 3 [3] CO_2	Scope 2, 3 [3] CH_4	Scope 2, 3 [3] N_2O	Scope 2, 3 [3] Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	% Transmission and Distribution Losses	% Net Imports of Electricity
UK Grid Electricity Year	kg CO_2 per kWh	kg CO_2e per kWh	kg CO_2e per kWh	kg CO_2e per kWh	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	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e		
1990	0.76578	0.00021	0.00628	0.77226		0.76578	0.00021	0.00628	0.77226	0.11169	0.88395							8.1%	3.8%
1991	0.73916	0.00019	0.00609	0.74544		0.75247	0.00020	0.00618	0.75885	0.10983	0.86868							8.3%	5.2%
1992	0.69262	0.00018	0.00570	0.69850		0.73252	0.00019	0.00602	0.73873	0.10643	0.84516							7.5%	5.3%
1993	0.61810	0.00018	0.00473	0.62302		0.70391	0.00019	0.00570	0.70980	0.10211	0.81191							7.2%	5.2%
1994	0.60912	0.00020	0.00456	0.61387		0.68496	0.00019	0.00547	0.69062	0.10123	0.79185							9.6%	5.2%
1995	0.57639	0.00020	0.00422	0.58080		0.64708	0.00019	0.00506	0.65233	0.09501	0.74734							9.1%	5.0%
1996	0.54702	0.00019	0.00372	0.55094		0.60865	0.00019	0.00459	0.61343	0.08880	0.70223							8.4%	4.8%
1997	0.50361	0.00018	0.00319	0.50698		0.57085	0.00019	0.00408	0.57512	0.08210	0.65722							7.8%	4.8%
1998	0.51501	0.00020	0.00326	0.51846		0.55023	0.00019	0.00379	0.55421	0.07854	0.63275							8.4%	3.5%
1999	0.48096	0.00020	0.00278	0.48394		0.52460	0.00019	0.00343	0.52822	0.07381	0.60203							8.3%	3.9%
2000	0.50958	0.00021	0.00307	0.51286		0.51124	0.00020	0.00320	0.51463	0.07097	0.58560							8.4%	3.8%
2001	0.52949	0.00022	0.00329	0.53300		0.50773	0.00020	0.00312	0.51105	0.06960	0.58065							8.6%	2.8%
2002	0.51406	0.00022	0.00309	0.51737		0.50982	0.00021	0.00310	0.51313	0.06917	0.58230							8.3%	2.2%
2003	0.53828	0.00022	0.00336	0.54186		0.51448	0.00021	0.00312	0.51781	0.06973	0.58754							8.5%	0.6%
2004	0.53430	0.00022	0.00323	0.53776		0.52514	0.00022	0.00321	0.52857	0.07139	0.59996							8.7%	2.0%
2005	0.51766	0.00023	0.00327	0.52117		0.52676	0.00022	0.00325	0.53023	0.07094	0.60117							7.2%	2.2%
2006	0.54707	0.00024	0.00361	0.55092		0.53028	0.00023	0.00331	0.53382	0.07180	0.60562							7.2%	2.0%
2007	0.53794	0.00025	0.00336	0.54154		0.53505	0.00023	0.00337	0.53865	0.07255	0.61120							7.1%	1.4%
2008	0.52493	0.00026	0.00314	0.52833		0.53238	0.00024	0.00332	0.53594	0.07221	0.60815							7.3%	2.9%
2009	0.48403	0.00028	0.00284	0.48714		0.52233	0.00025	0.00324	0.52582	0.07086	0.59668							7.6%	0.8%
2010	0.49072	0.00028	0.00289	0.49390		0.51694	0.00026	0.00317	0.52037	0.06945	0.58982							7.4%	0.7%
Other electricity factor																			
Renewables [2]	0	0	0	0		0	0	0	0	0	0								
Total												0	0	0	0	0	0		

Sources

Based on UK Greenhouse Gas Inventory for 2010 (AEA, 2012) (available at http://naei.defra.gov.uk) 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 2011, 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 (plus net imports) 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 (similarly for imported electricity from other countries) 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 (as well as the % of net electricity imports via interconnectors). Because these annual changes can be large (the factor depends very heavily on the relative prices of coal and natural gas as well as fluctuations in peak demand and renewables), 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/economy/business-efficiency/reporting/

[3] These indirect GHG emissions are due to upstream emissions from production and delivery of fuel to power stations.

[4] 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 reported in Scope 3.

Annex 3 - Converting from purchased electricity, heat and steam use to carbon dioxide equivalent emissions

HEAT & STEAM

Table 3d

Heat / Steam emission factor timeseries in kgGHG per kWh (energy SUPPLIED):	Use of District Heating (DH) [5]		Total Heat or Steam [6]:	Scope 2				Scope 3	All Scopes	Scope 2				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
Year	% Loss Factor	% Total Heat/Steam provided by DH	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	Total kg CO_2	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
2001	5.0%			0.23770	0.00034	0.00088	0.23892	0.05045	0.28937						
2002	5.0%			0.22970	0.00035	0.00080	0.23085	0.05187	0.28272						
2003	5.0%			0.23393	0.00035	0.00073	0.23501	0.05136	0.28637						
2004	5.0%			0.22750	0.00035	0.00090	0.22875	0.05073	0.27948						
2005	5.0%			0.22105	0.00036	0.00074	0.22215	0.05027	0.27242						
2006	5.0%			0.23072	0.00039	0.00071	0.23183	0.05014	0.28197						
2007	5.0%			0.23118	0.00040	0.00066	0.23224	0.05065	0.28289						
2008	5.0%			0.22441	0.00050	0.00067	0.22558	0.05015	0.27573						
2009	5.0%			0.22196	0.00058	0.00071	0.22325	0.04998	0.27323						
2010	5.0%			0.21859	0.00064	0.00082	0.22005	0.04988	0.26993						
Total										**0**	**0**	**0**	**0**	**0**	**0**

Sources

Heat and steam emission factors based on fuel input data provided by CHP scheme operators to the UK CHP Quality Assurance (CHPQA) programme (which is held in confidence by AEA, 2012).

Notes

[5] For district heating systems, where the location of use of the heat is some distance from the point of production, there are distribution energy losses. These losses are typically around 5%, which need to be factored into the calculation of overall GHG emissions. The user needs to provide an indication of the proportion of heat/steam provided by district heating systems for their operations, as opposed to more localised sources.
NOTE: Emissions due to losses in distribution are classed as Scope 3 under the GHG Protocol, so therefore only need to be accounted for where companies are also measuring their Scope 3 emissions.

[6] The heat and steam conversion factors given represent the average emission from the heat and steam supplied by the CHPQA scheme operators for a given year. This factor changes from year to year, as the fuel mix consumed changes. This factor is updated annually. No statistics are available that would allow the calculation of UK national average emission factors for the supply of heat and steam from non-CHP operations.

The emission factors have been calculated according to the 1/3:2/3 Method (DUKES). Under the UK's Climate Change Agreements (CCAs), this method used to apportion fuel use to heat and power assumes that twice as many units of fuel are required to generate each unit of electricity than are required to generate each unit of heat. This follows from the observation that the efficiency of the generation of electricity (at electricity only generating plant) varies from as little as 25% to 50%, while the efficiency of the generation of heat in fired boilers ranges from 50% to about 90%. This method is also outlined/applied in Annex 2.

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/emitted 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/emitted.

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:	Apr-12

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

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. 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/economy/business-efficiency/reporting/

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) [1]	x	Unit conversion tonnes to kg	Total kg CO_2e
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 [2]							
R404A	52:44:4 blend of HFC-143a, -125 and -134a		x	3,260	x	1,000	
R407A	20:40:40 blend of HFC-32, -125 and -134a [3]		x	1,770	x	1,000	
R407C	23:25:52 blend of HFC-32, -125 and -134a		x	1,526	x	1,000	
R407F	30:30:40 blend of HFC-32, -125 and -134a [3]		x	1,555	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: Apr-12

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_2e
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-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	
R1234yf [4]	CH_2CFCF_3		x	4	x	1,000	
R1234ze [4]	$CHFCHCF_3$		x	6	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 5a 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

[2] Information on blends is based largely on information from the UK Institute of Refrigeration website: http://www.ior.org.uk/index.php

[3] Additional information on blends R407A and R407F were sourced from: http://www.fluorocarbons.org/applications/commercial-refrigeration

[4] The GWP of R1234yf and R1234ze are tentative and still awaiting official confirmation. The figures presented here are based on data from producers and will be revisited in a future update.

Annex 6 - Passenger Transport Conversion Tables

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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.

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://iet.jrc.ec.europa.eu/about-jec/

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). For further details on the control approach please refer to the Defra/DECC guidance at: http://www.defra.gov.uk/environment/economy/business-efficiency/reporting

For further information on reporting transport emissions please refer to the Department for Transport's work-related travel guidance, which is available at:
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting

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/economy/business-efficiency/reporting

Annex 6 - Passenger Transport Conversion Tables

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Table 6a

Standard Road Transport Fuel Conversion Factors

Fuel used*	Total units used	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	kg CH_4 per unit	kg N_2O 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	Total kg CO_2	Total kg CH_4	Total kg N_2O	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 (average biofuel blend)*		litres		2.2332	0.0033	0.0058	2.2423	0.4750	2.7173						
Petrol (100% mineral petrol)		litres		2.3051	0.0033	0.0059	2.3144	0.4638	2.7782						
Diesel (average biofuel blend)*		litres		2.5636	0.0009	0.0190	2.5835	0.5837	3.1672						
Diesel (100% mineral diesel)		litres		2.6569	0.0009	0.0191	2.6769	0.5644	3.2413						
Compressed Natural Gas (CNG)		kg		2.7188	0.0040	0.0016	2.7244	0.4224	3.1468						
Liquid Petroleum Gas (LPG)		litres		1.5301	0.0007	0.0018	1.5326	0.1918	1.7244						
Total										**0**	**0**	**0**	**0**	**0**	**0**

Sources

UK Greenhouse Gas Inventory for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/
Digest of UK Energy Statistics 2011 (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

Emission factors for petrol and diesel from public & commercial refuelling stations have been estimated based on information from the most recent reporting on the Renewable Transport Fuels Obligation (RTFO). See Annex 1 for more detailed information.

* **Note:** *In the UK biofuels are added to virtually all of the transport fuel sold by filling stations (and by most fuel wholesalers) and this has the effect of slightly reducing the greenhouse gas emissions of the fuel. This is reflected in the emission factors above. For fuel purchased at filling stations or obtained from private commercial refuelling you should use the factor labelled "average biofuel blend" unless you know the biofuel content is higher or lower than average. In this latter case, if you are purchasing pure petrol or diesel which you know has* ***not*** *been blended with biofuels then you should use the factor labelled "100% mineral fuel", or alternatively use the bespoke biofuel blend calculations provided in Annex 9, Table 9b.*

The "average biofuel blend" emission factors calculated here are for diesel and petrol supplied at public retail and private commercial refuelling stations, factoring in the biodiesel supplied in the UK as a proportion of the total supply of diesel+biodiesel (=3.6% by unit volume, 3.3% by unit energy), and the bioethanol supplied in the UK as a proportion of the total supply of petrol+bioethanol (=2.9% by unit volume, 1.9% by unit energy). These estimates have been made based on the most recently available reports on:

(i) the Renewable Transport Fuel Obligation (RTFO): http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ *and*
(ii) Renewable energy statistics: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

Table 6b

Passenger Road Transport Conversion Factors: Petrol Cars

Size of car	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	kg CH_4 per unit	kg N_2O 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	Total kg CO_2	Total kg CH_4	Total kg N_2O	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
Small petrol car, up to 1.4 litre engine		miles	x	0.26461	0.00024	0.00105	0.26590	0.05324	0.31913						
		km	x	0.16442	0.00015	0.00065	0.16522	0.03308	0.19830						
Medium petrol car, from 1.4 - 2.0 litres		miles	x	0.33289	0.00024	0.00105	0.33418	0.06698	0.40116						
		km	x	0.20685	0.00015	0.00065	0.20765	0.04162	0.24927						
Large petrol cars, above 2.0 litres		miles	x	0.47820	0.00024	0.00105	0.47949	0.09622	0.57571						
		km	x	0.29714	0.00015	0.00065	0.29794	0.05979	0.35773						
Average petrol car		miles	x	0.32361	0.00024	0.00105	0.32489	0.06511	0.39001						
		km	x	0.20108	0.00015	0.00065	0.20188	0.04046	0.24234						
Total for petrol cars										**0**	**0**	**0**	**0**	**0**	**0**

Table 6c

Passenger Road Transport Conversion Factors: Diesel Cars

Size of car	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	kg CH_4 per unit	kg N_2O 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	Total kg CO_2	Total kg CH_4	Total kg N_2O	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
Small diesel car, up to 1.7 litre or under		miles	x	0.22716	0.00008	0.00285	0.23009	0.04571	0.27579						
		km	x	0.14115	0.00005	0.00177	0.14297	0.02840	0.17137						
Medium diesel car, from 1.7 to 2.0 litre		miles	x	0.28281	0.00008	0.00285	0.28574	0.05691	0.34265						
		km	x	0.17573	0.00005	0.00177	0.17755	0.03536	0.21291						
Large diesel car, over 2.0 litre		miles	x	0.37628	0.00008	0.00285	0.37921	0.07570	0.45491						
		km	x	0.23381	0.00005	0.00177	0.23563	0.04704	0.28267						
Average diesel car		miles	x	0.29805	0.00008	0.00285	0.30098	0.05996	0.36094						
		km	x	0.18520	0.00005	0.00177	0.18702	0.03726	0.22428						
Total for diesel cars										**0**	**0**	**0**	**0**	**0**	**0**

Annex 6 - Passenger Transport Conversion Tables

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Table 6d

Passenger Road Transport Conversion Factors: Alternative Fuel Cars

Type of alternative fuel car	Total units travelled	Units	x	Scope 1 OR Scope 3: CO_2 kg CO_2 per unit	Scope 1 OR Scope 3: CH_4 kg CO_2e per unit	Scope 1 OR Scope 3: N_2O kg CO_2e per unit	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: 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
Medium petrol hybrid car		miles	x	0.18638	0.00014	0.00105	0.18755	0.03750	0.22505						
		km	x	0.11581	0.00008	0.00065	0.11654	0.02330	0.13984						
Large petrol hybrid car		miles	x	0.33140	0.00017	0.00105	0.33260	0.06668	0.39928						
		km	x	0.20592	0.00010	0.00065	0.20667	0.04143	0.24810						
Average petrol hybrid car		miles	x	0.21564	0.00016	0.00105	0.21684	0.04339	0.26023						
		km	x	0.13399	0.00010	0.00065	0.13474	0.02696	0.16170						
Medium LPG car		miles	x	0.30315	0.00066	0.00216	0.30597	0.03800	0.34397						
		km	x	0.18837	0.00041	0.00134	0.19012	0.02361	0.21373						
Large LPG car		miles	x	0.43547	0.00066	0.00216	0.43829	0.05459	0.49288						
		km	x	0.27059	0.00041	0.00134	0.27234	0.03392	0.30626						
Average LPG car		miles	x	0.34274	0.00066	0.00216	0.34556	0.04297	0.38853						
		km	x	0.21297	0.00041	0.00134	0.21472	0.02670	0.24142						
Medium CNG car		miles	x	0.27061	0.00121	0.00216	0.27397	0.04204	0.31601						
		km	x	0.16815	0.00075	0.00134	0.17024	0.02612	0.19636						
Large CNG car		miles	x	0.38874	0.00121	0.00216	0.39210	0.06038	0.45248						
		km	x	0.24155	0.00075	0.00134	0.24364	0.03752	0.28116						
Average CNG car		miles	x	0.30595	0.00121	0.00216	0.30932	0.04752	0.35684						
		km	x	0.19011	0.00075	0.00134	0.19220	0.02953	0.22173						
Total for alternative fuel cars										0	0	0	0	0	0

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	Scope 1 OR Scope 3: CH_4 kg CO_2e per unit	Scope 1 OR Scope 3: N_2O kg CO_2e per unit	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: 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
Average small car (unknown fuel)		miles	x	0.25510	0.00021	0.00151	0.25682	0.05129	0.30811						
		km	x	0.15851	0.00013	0.00094	0.15958	0.03187	0.19145						
Average medium car (unknown fuel)		miles	x	0.31099	0.00018	0.00174	0.31290	0.06313	0.37604						
		km	x	0.19324	0.00011	0.00108	0.19443	0.03923	0.23366						
Average large car (unknown fuel)		miles	x	0.41173	0.00014	0.00211	0.41399	0.08417	0.49816						
		km	x	0.25584	0.00009	0.00131	0.25724	0.05230	0.30954						
Average car (unknown fuel)		miles	x	0.31141	0.00018	0.00174	0.31332	0.06317	0.37649						
		km	x	0.19350	0.00011	0.00108	0.19469	0.03925	0.23394						
Total for average cars										0	0	0	0	0	0

Sources
Notes

Factors developed by AEA and agreed with Department for Transport (2012)

These factors are estimated average values for the UK car fleet in 2011, travelling on average trips in the UK, as assumed in the 2010 NAEI. They are calculated based on data from SMMT on new car CO_2 emissions from 1997 to 2011 combined with factors derived from DVLA licensing data and DfT's ANPR (Automatic Number Plate Recognition) data, used in the 2010 NAEI to account for the age/activity of the UK car fleet. An uplift of 15% is included in these emission factors - this uplift has been agreed with DfT to take into account further real-world driving effects on emissions relative to test-cycle based data (Tables 6b - 6h). Further work is ongoing to understand this uplift in more detail and revise it if necessary in the future.

The emission factors per vehicle-km provided in the table may be converted to factors per passenger-km for comparison with statistics from other modes of transport using the vehicle occupancy (number of passengers) - e.g. kgCO_2 per vehicle-km / occupancy factor = kgCO_2 per passenger-km. According to DfT statistics from the National Travel Survey, the average car/van occupancy in 2010 across all journey types was 1.564 passengers per car/van. Average occupancy can vary significantly for different trip purposes, for example the equivalent average car/van occupancy for business related travel/commuting was only ~1.174 in 2010. This latter figure is the most relevant for company reporting of business related travel in the absence of company-specific information.

For more details, see Table NTS0906, http://www.dft.gov.uk/statistics/releases/national-travel-survey-2010/

According to the Energy Saving 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 conditioning, 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.

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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. If manufacturer data on average fuel consumption is used then the calculated CO2 emissions should be uplifted by 15%, consistent with the methodology described above.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Table 6f

Passenger Road Transport Conversion Factors: Petrol Cars by Market Segment				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
Market segment 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
A. Mini		miles	x	0.23799	0.00024	0.00105	0.23928	0.04788	0.28716						
		km	x	0.14788	0.00015	0.00065	0.14868	0.02975	0.17843						
B. Supermini		miles	x	0.26611	0.00024	0.00105	0.26739	0.05354	0.32094						
		km	x	0.16535	0.00015	0.00065	0.16615	0.03327	0.19942						
C. Lower Medium		miles	x	0.31638	0.00024	0.00105	0.31767	0.06367	0.38133						
		km	x	0.19659	0.00015	0.00065	0.19739	0.03956	0.23695						
D. Upper Medium		miles	x	0.36307	0.00024	0.00105	0.36436	0.07305	0.43740						
		km	x	0.22560	0.00015	0.00065	0.22640	0.04539	0.27179						
E. Executive		miles	x	0.42490	0.00024	0.00105	0.42619	0.08549	0.51167						
		km	x	0.26402	0.00015	0.00065	0.26482	0.05312	0.31794						
F. Luxury		miles	x	0.56269	0.00024	0.00105	0.56398	0.11322	0.67720						
		km	x	0.34964	0.00015	0.00065	0.35044	0.07035	0.42079						
G. Sports		miles	x	0.40716	0.00024	0.00105	0.40845	0.08193	0.49038						
		km	x	0.25300	0.00015	0.00065	0.25380	0.05091	0.30471						
H. Dual Purpose 4x4		miles	x	0.45272	0.00024	0.00105	0.45401	0.09109	0.54510						
		km	x	0.28131	0.00015	0.00065	0.28211	0.05660	0.33871						
I. MPV		miles	x	0.35549	0.00024	0.00105	0.35678	0.07152	0.42829						
		km	x	0.22089	0.00015	0.00065	0.22169	0.04444	0.26613						
Total for petrol cars										0	0	0	0	0	0

Table 6g

Passenger Road Transport Conversion Factors: Diesel Cars by Market Segment				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
Market segment 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
A. Mini		miles	x	0.16702	0.00008	0.00285	0.16995	0.03360	0.20355						
		km	x	0.10378	0.00005	0.00177	0.10560	0.02088	0.12648						
B. Supermini		miles	x	0.22349	0.00008	0.00285	0.22642	0.04497	0.27138						
		km	x	0.13887	0.00005	0.00177	0.14069	0.02794	0.16863						
C. Lower Medium		miles	x	0.25397	0.00008	0.00285	0.25690	0.05110	0.30800						
		km	x	0.15781	0.00005	0.00177	0.15963	0.03175	0.19138						
D. Upper Medium		miles	x	0.28048	0.00008	0.00285	0.28341	0.05644	0.33985						
		km	x	0.17428	0.00005	0.00177	0.17610	0.03507	0.21117						
E. Executive		miles	x	0.32319	0.00008	0.00285	0.32612	0.06503	0.39115						
		km	x	0.20082	0.00005	0.00177	0.20264	0.04041	0.24305						
F. Luxury		miles	x	0.38528	0.00008	0.00285	0.38821	0.07752	0.46573						
		km	x	0.23940	0.00005	0.00177	0.24122	0.04817	0.28939						
G. Sports		miles	x	0.26760	0.00008	0.00285	0.27053	0.05385	0.32438						
		km	x	0.16628	0.00005	0.00177	0.16810	0.03346	0.20156						
H. Dual Purpose 4x4		miles	x	0.40197	0.00008	0.00285	0.40489	0.08089	0.48578						
		km	x	0.24977	0.00005	0.00177	0.25159	0.05026	0.30185						
I. MPV		miles	x	0.31374	0.00008	0.00285	0.31667	0.06313	0.37981						
		km	x	0.19495	0.00005	0.00177	0.19677	0.03923	0.23600						
Total for diesel cars										0	0	0	0	0	0

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Table 6h

Passenger Road Transport Conversion Factors: Cars (unknown fuel) by Market Segment				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
Market segment 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
A. Mini		miles	x	0.23633	0.00023	0.00124	0.23780	0.04661	0.28440						
		km	x	0.14685	0.00014	0.00077	0.14776	0.02896	0.17672						
B. Supermini		miles	x	0.25968	0.00021	0.00151	0.26141	0.05197	0.31337						
		km	x	0.16136	0.00013	0.00094	0.16243	0.03229	0.19472						
C. Lower Medium		miles	x	0.29237	0.00019	0.00163	0.29419	0.06054	0.35473						
		km	x	0.18167	0.00012	0.00101	0.18280	0.03762	0.22042						
D. Upper Medium		miles	x	0.31805	0.00018	0.00174	0.31997	0.06791	0.38788						
		km	x	0.19763	0.00011	0.00108	0.19882	0.04220	0.24102						
E. Executive		miles	x	0.36836	0.00014	0.00211	0.37062	0.07559	0.44621						
		km	x	0.22889	0.00009	0.00131	0.23029	0.04697	0.27726						
F. Luxury		miles	x	0.50189	0.00014	0.00211	0.50414	0.09477	0.59892						
		km	x	0.31186	0.00009	0.00131	0.31326	0.05889	0.37215						
G. Sports		miles	x	0.39765	0.00014	0.00211	0.39991	0.06719	0.46710						
		km	x	0.24709	0.00009	0.00131	0.24849	0.04175	0.29024						
H. Dual Purpose 4x4		miles	x	0.41742	0.00014	0.00211	0.41967	0.08774	0.50741						
		km	x	0.25937	0.00009	0.00131	0.26077	0.05452	0.31529						
I. MPV		miles	x	0.33143	0.00016	0.00193	0.33352	0.06915	0.40267						
		km	x	0.20594	0.00010	0.00120	0.20724	0.04297	0.25021						
Total for cars (unknown fuel)										0	0	0	0	0	0

Sources
Notes

Factors developed by AEA and agreed with Department for Transport (2012)

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 2010 travelling on average trips in the UK. They are calculated based on data from SMMT on new car CO_2 emissions from 1997 to 2011 by SMMT, combined with factors derived from DVLA licensing data and DfT's ANPR (Automatic Number Plate Recognition) data, used in the 2010 NAEI to account for the age/activity of the UK car fleet. An uplift of 15% is included in these emission factors - this uplift has been agreed with DfT to take into account further real-world driving effects on emissions relative to test-cycle based data (Tables 6b - 6h). Further work is ongoing to understand this uplift 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 considers 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.

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 actual 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. If manufacturer data on average fuel consumption is used then the calculated CO_2 emissions should be uplifted by 15%, consistent with the methodology described above.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 6 - Passenger Transport Conversion Tables

Last updated: Apr-12

Table 6i

Passenger Road Transport Conversion Factors: Vans (Light Commercial Vehicles)

Type of van	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	kg CH_4 per unit	kg N_2O 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	Total kg CO_2	Total kg CH_4	Total kg N_2O	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 van (Class I), up to 1.305 tonne		miles	x	0.31881	0.00043	0.00182	0.32106	0.06460	0.38565						
		km	x	0.19810	0.00026	0.00113	0.19949	0.04014	0.23963						
Petrol van (Class II), 1.305 to 1.74 tonne		miles	x	0.33967	0.00043	0.00182	0.34192	0.06880	0.41072						
		km	x	0.21106	0.00026	0.00113	0.21246	0.04275	0.25521						
Petrol van (Class III), 1.74 to 3.5 tonne		miles	x	0.41172	0.00047	0.00419	0.41639	0.08378	0.50017						
		km	x	0.25583	0.00029	0.00261	0.25873	0.05206	0.31079						
Petrol van up to 3.5 tonne		miles	x	0.34104	0.00043	0.00213	0.34359	0.06914	0.41273						
		km	x	0.21191	0.00027	0.00132	0.21350	0.04296	0.25646						
Diesel van (Class I), up to 1.305 tonne		miles	x	0.24478	0.00008	0.00176	0.24662	0.05238	0.29900						
		km	x	0.15210	0.00005	0.00109	0.15324	0.03255	0.18579						
Diesel van (Class II), 1.305 to 1.74 tonne		miles	x	0.36106	0.00008	0.00260	0.36373	0.07726	0.44099						
		km	x	0.22435	0.00005	0.00161	0.22601	0.04801	0.27402						
Diesel van (Class III), 1.74 to 3.5 tonne		miles	x	0.42563	0.00008	0.00306	0.42877	0.09109	0.51985						
		km	x	0.26447	0.00005	0.00190	0.26642	0.05660	0.32302						
Diesel van up to 3.5 tonne		miles	x	0.39784	0.00008	0.00286	0.40078	0.08513	0.48591						
		km	x	0.24721	0.00005	0.00178	0.24903	0.05290	0.30193						
LPG van up to 3.5 tonne		miles	x	0.41773	0.00118	0.00438	0.42329	0.05306	0.47635						
		km	x	0.25957	0.00073	0.00272	0.26302	0.03297	0.29599						
CNG van up to 3.5 tonne		miles	x	0.37795	0.00216	0.00438	0.38449	0.05972	0.44421						
		km	x	0.23485	0.00134	0.00272	0.23891	0.03711	0.27602						
Average van up to 3.5 tonne		miles	x	0.39487	0.00010	0.00282	0.39779	0.08451	0.48229						
		km	x	0.24536	0.00006	0.00176	0.24717	0.05251	0.29968						
Total for vans										0	0	0	0	0	0

Sources
Notes

Factors developed by AEA and agreed with Department for Transport (2012)

Emission factors for petrol and diesel light good vehicles (vans up to 3.5 tonnes) were calculated based on the vehicle emission factors used in the National Atmospheric Emissions Inventory (NAEI) and Greenhouse Gas Inventory for 2010 (AEA, 2012). 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 2010.

The emission factors per vehicle-km provided in the table may be converted to factors per passenger-km for comparison with statistics from other modes of transport using the vehicle occupancy (number of passengers) - e.g. kgCO_2 per vehicle-km / occupancy factor = kgCO_2 per passenger-km. According to DfT statistics from the National Travel Survey, the average car/van occupancy in 2010 was 1.564 passengers per car/van. Average occupancy can vary significantly for different trip purposes, for example the equivalent average car/van occupancy for business related travel/commuting was only ~1.174 in 2010.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Table 6j

Passenger Road Transport Conversion Factors: Motorcycles

Size of motorcycle	Total units travelled	Units	x	Scope 1 OR Scope 3: kg CO_2 per unit	kg CH_4 per unit	kg N_2O 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	Total kg CO_2	Total kg CH_4	Total kg N_2O	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
Small petrol motorbike (mopeds/scooters up to 125cc)		miles	x	0.13678	0.00381	0.00058	0.14117	0.02752	0.16869						
		km	x	0.08499	0.00237	0.00036	0.08772	0.01710	0.10482						
Medium petrol motorbike (125-500cc)		miles	x	0.16602	0.00423	0.00100	0.17125	0.03341	0.20466						
		km	x	0.10316	0.00263	0.00062	0.10641	0.02076	0.12717						
Large petrol motorbike (over 500cc)		miles	x	0.22087	0.00314	0.00100	0.22500	0.04443	0.26944						
		km	x	0.13724	0.00195	0.00062	0.13981	0.02761	0.16742						
Average petrol motorbike (unknown engine size)		miles	x	0.18678	0.00381	0.00097	0.19156	0.03758	0.22914						
		km	x	0.11606	0.00237	0.00060	0.11903	0.02335	0.14238						
Total for motorcycles										0	0	0	0	0	0

Sources
Notes

Factors developed by AEA and agreed with Department for Transport (2012)

These factors are based on calculations of average emissions data by size category, based data provided by Clear (2010) (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.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 6 - Passenger Transport Conversion Tables

Last updated: Apr-12

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	0.20477	0.00005	0.00177	0.20659	0.02668	0.23327						
	Black cab		x	0.23381	0.00005	0.00177	0.23563	0.04704	0.28267						
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	0.14626	0.00004	0.00126	0.14756	0.02943	0.17699						
	Black cab		x	0.15587	0.00003	0.00118	0.15709	0.03136	0.18845						
Bus	Local bus (not London) [3]		x	0.12269	0.00013	0.00098	0.12380	0.02606	0.14986						
	Local London bus [4]		x	0.08201	0.00007	0.00055	0.08263	0.01742	0.10005						
	Average local bus		x	**0.11097**	**0.00012**	**0.00086**	**0.11195**	**0.02357**	**0.13552**						
	Coach [5]		x	0.02810	0.00007	0.00057	0.02874	0.00597	0.03471						
Rail	National rail [6]		x	0.05501	0.00005	0.00312	0.05818	0.00897	0.06715						
	International rail (Eurostar) [7]		x	0.01502	0.00001	0.00009	0.01512	0.00203	0.01715						
	Light rail and tram [8]		x	0.06709	0.00003	0.00041	0.06753	0.00906	0.07659						
	London Underground [9]		x	0.07142	0.00004	0.00044	0.07190	0.00964	0.08154						
Ferry (Large RoPax) [10]	Foot passengers		x	0.01912	0.00001	0.00015	0.01928	0.00362	0.02290						
	Car passengers		x	0.13216	0.00004	0.00101	0.13321	0.02502	0.15823						
	Average (all passengers)		x	**0.11516**	**0.00004**	**0.00088**	**0.11608**	**0.02180**	**0.13788**						
Total										**0**	**0**	**0**	**0**	**0**	**0**

Sources: Department for Transport, Transport for London and AEA (2012)

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).
Taxi emissions factors do not factor in cruising (i.e. non-revenue) emissions, so are likely to be under-estimates. However, information on the significance of this activity is not currently available. This aspect will be reconsidered for future updates to the emission factors.

[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 buses using DfT's BSOG dataset and statistics.

[5] The emission factor for coach transport is the figure from the National Express Group, available at: http://www.nationalexpressgroup.com/ourway/climatechange.aspx. National Express are responsible for the majority of long-distance coach services in the UK

[6] The national rail factor refers to an average emission per passenger kilometre for diesel and electric trains in 2009/10. The CO2 value for passenger rail is based on currently available information on CO2 emissions by diesel and electric passenger trains in the UK in 2009/10 produced by ORR (Office of the Rail Regulator) and is available in Chapter 9 of National Rail Trends at http://www.rail-reg.gov.uk/server/show/nav.2026
Emission factors for freight rail (from the same source) are provided in Annex 7, Table 7f.

[7] The emission factor for international rail is based on electricity grid average emission factors. Eurostar's published figures differ from the figure quoted in the table above as they are 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 CO2 emission factor for grid rolling average electricity from Table 3c. DLR and Croydon Tramlink figures were recalculated using the updated 2010 grid rolling average from those available in the Transport for London 2011 Health, Safety and Environment Report: http://www.tfl.gov.uk/assets/downloads/corporate/tfl-health-safety-and-environment-report-2011.pdf

[9] The London Underground rail factor is recalculated using the updated 2010 grid rolling average from figures in the Transport for London 2011 Health, Safety and Environment Report: http://www.tfl.gov.uk/assets/downloads/corporate/tfl-health-safety-and-environment-report-2011.pdf

[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 factors per passenger km.

All: Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 6 - Passenger Transport Conversion Tables

Last updated:	Apr-12

Table 6l

Air Passenger Transport Conversion Factors[11]						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		Passenger kms travelled (pkm)	x	km uplift factor[13]	x	kg CO_2 per pkm [14]	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 [15]	*Cabin class* [12]																
Domestic[15]	**Average**		x	109%	x	**0.16513**	**0.00010**	**0.00163**	**0.16685**	**0.03439**	**0.20124**						
Short-haul international[15]	**Average**		x	109%	x	**0.09429**	**0.00001**	**0.00093**	**0.09522**	**0.01964**	**0.11486**						
	Economy class		x	109%	x	0.08985	0.00001	0.00088	0.09074	0.01872	0.10946						
	Business class		x	109%	x	0.13478	0.00001	0.00133	0.13612	0.02807	0.16419						
Long-haul international[15]	**Average**		x	109%	x	**0.10789**	**0.00001**	**0.00106**	**0.10896**	**0.02247**	**0.13143**						
	Economy class		x	109%	x	0.07876	0.00000	0.00078	0.07954	0.01640	0.09594						
	Premium economy class		x	109%	x	0.12601	0.00001	0.00124	0.12726	0.02625	0.15351						
	Business class		x	109%	x	0.22840	0.00001	0.00225	0.23066	0.04757	0.27823						
	First class		x	109%	x	0.31504	0.00002	0.00310	0.31816	0.06562	0.38378						
Total												**0**	**0**	**0**	**0**	**0**	**0**

Source: Developed by AEA (2012) using the methodology developed in discussion with the Department for Transport and the airline industry, 2009.
EMEP/EEA air pollutant emission inventory guidebook 2009 (EEA, 2009)
Civil Aviation Authority (2011)

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.

[11] 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. This factor is derived from Table 1 of Aviation radiative forcing in 2000: and update on IPCC (1999), Sausen R. et al (2005): http://elib.dlr.de/19906/1/s13.pdf
Note that the factor of 1.9 has not been applied here. If used, the factor would be applied to the emissions factor for CO_2 set out here.

[12] 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.

[13] The 109% 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:
http://www.ipcc.ch/ipccreports/sres/aviation/121.htm#8223
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.
Note that this factor is unrelated to the radiative forcing factor outlined in note 11.

[14] The emissions factors are based on typical aircraft fuel burn over illustrative trip distances listed in the EMEP/EEA air pollutant emission inventory guidebook 2009 (EEA, 2009) – available at the EEA website at: http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009. 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 in the EEA publication 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.

[15] The long haul estimate is based on a flight length from the EMEP/EEA 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

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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.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 7 - Freight Transport Conversion Tables

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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 vehicle reference weight, 1 tonne for vans between 1.305-1.740 tonnes vehicle reference weight and 2 tonnes for vans up to 3.5 tonnes vehicle reference weight. Reference weight is equivalent to the vehicle kerb weight plus 60kg.

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.
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.

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 CO2, CH4 and N2O 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://iet.jrc.ec.europa.eu/about-jec/

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 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 and other sector specific guidance (for freight transport) is available from Defra's website in the guidance on reporting at:
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/
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/economy/business-efficiency/reporting

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 (average biofuel blend)*		litres		x	2.2332	0.00330	0.00580	2.24230	0.47500	2.7173						
Petrol (100% mineral petrol)		litres		x	2.3051	0.00330	0.00590	2.31440	0.46380	2.7782						
Diesel (average biofuel blend)*		litres		x	2.5636	0.00090	0.01900	2.58350	0.58370	3.1672						
Diesel (100% mineral diesel)		litres		x	2.6569	0.00090	0.01910	2.67690	0.56440	3.2413						
Compressed Natural Gas (CNG)		kg		x	2.7188	0.00397	0.00162	2.72442	0.42240	3.1468						
Liquid Petroleum Gas (LPG)		litres		x	1.5301	0.00070	0.00180	1.53260	0.19180	1.7244						
Total											0	0	0	0	0	0

Annex 7 - Freight Transport Conversion Tables

Last updated:	Apr-12

Sources
UK Greenhouse Gas Inventory for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/
Digest of UK Energy Statistics 2011 (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
Emission factors for petrol and diesel from public & commercial refuelling stations have been estimated based on information from the most recent reporting on the Renewable Transport Fuels Obligation (RTFO). See Annex 1 for more detailed information.
* **Note:** *In the UK biofuels are added to virtually all of the transport fuel sold by filling stations (and by most fuel wholesalers) and this has the effect of slightly reducing the greenhouse gas emissions of the fuel. This is reflected in the emission factors above. For fuel purchased at filling stations or obtained from private commercial refuelling you should use the factor labelled "average biofuel blend" unless you know the biofuel content is higher or lower than average. In this latter case, if you are purchasing pure petrol or diesel which you know has* ***not*** *been blended with biofuels then you should use the factor labelled "100% mineral fuel", or alternatively use the bespoke biofuel blend calculations provided in Annex 9, Table 9b.*
The "average biofuel blend" emission factors calculated here are for diesel and petrol supplied at public retail and private commercial refuelling stations, factoring in the biodiesel supplied in the UK as a proportion of the total supply of diesel+biodiesel (3.6% by unit volume, 3.3% by unit energy), and the bioethanol supplied in the UK as a proportion of the total supply of petrol+bioethanol (= 2.9% by unit volume, 1.9% by unit energy). These estimates have been made based on the most recently available reports on:
(i) the Renewable Transport Fuel Obligation (RTFO): http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ *and*
(ii) Renewable energy statistics: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/source/renewables/renewables.aspx

Table 7b

Van/Light Commercial Vehicle 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
Type of van	Vehicle Reference Weight (tonnes)	% weight laden	UK av. payload (tonnes goods carried per vehicle)	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
Petrol (Class I)	up to 1.305t	37%	0.24			x	0.19810	0.00026	0.00113	0.19949	0.04014	0.23963						
Petrol (Class II)	1.305t to 1.74t	37%	0.26			x	0.21106	0.00026	0.00113	0.21246	0.04275	0.25521						
Petrol (Class III)	1.74t to 3.5t	41%	0.53			x	0.25583	0.00029	0.00261	0.25873	0.05206	0.31079						
Petrol (average)	***up to 3.5t***	***40%***	***0.31***			***x***	***0.21191***	***0.00027***	***0.00132***	***0.21350***	***0.04296***	***0.25646***						
Diesel (Class I)	up to 1.305t	37%	0.24			x	0.15210	0.00005	0.00109	0.15324	0.03255	0.18579						
Diesel (Class II)	1.305t to 1.74t	37%	0.36			x	0.22435	0.00005	0.00161	0.22601	0.04801	0.27402						
Diesel (Class III)	1.74t to 3.5t	41%	0.53			x	0.26447	0.00005	0.00190	0.26642	0.05660	0.32302						
Diesel (average)	***up to 3.5t***	***40%***	***0.47***			***x***	***0.24721***	***0.00005***	***0.00178***	***0.24903***	***0.05290***	***0.30193***						
LPG	up to 3.5t	40%	0.47			x	0.25957	0.00073	0.00272	0.26302	0.03297	0.29599						
CNG	up to 3.5t	40%	0.47			x	0.23485	0.00134	0.00272	0.23891	0.03711	0.27602						
Average (all vehicles)	***up to 3.5t***	***40%***	***0.46***			***x***	***0.24536***	***0.00006***	***0.00176***	***0.24717***	***0.05251***	***0.29968***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Table 7c

Van/Light Commercial Vehicle 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
	Vehicle Reference 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
Petrol (Class I)	up to 1.305t	37%	0.24			x	0.84163	0.00112	0.00480	0.84755	0.17053	1.01808						
Petrol (Class II)	1.305t to 1.74t	37%	0.26			x	0.80104	0.00100	0.00428	0.80633	0.16224	0.96857						
Petrol (Class III)	1.74t to 3.5t	41%	0.53			x	0.47999	0.00055	0.00489	0.48543	0.09767	0.58310						
Petrol (average)	***up to 3.5t***	***40%***	***0.31***			***x***	***0.69014***	***0.00087***	***0.00430***	***0.69531***	***0.13990***	***0.83521***						
Diesel (Class I)	up to 1.305t	37%	0.24			x	0.64444	0.00020	0.00464	0.64928	0.13793	0.78721						
Diesel (Class II)	1.305t to 1.74t	37%	0.36			x	0.62238	0.00013	0.00448	0.62699	0.13319	0.76018						
Diesel (Class III)	1.74t to 3.5t	41%	0.53			x	0.49658	0.00009	0.00357	0.50024	0.10627	0.60651						
Diesel (average)	***up to 3.5t***	***40%***	***0.47***			***x***	***0.52407***	***0.00010***	***0.00377***	***0.52794***	***0.11215***	***0.64009***						
LPG	up to 3.5t	40%	0.47			x	0.55027	0.00156	0.00577	0.55760	0.06990	0.62750						
CNG	up to 3.5t	40%	0.47			x	0.49787	0.00285	0.00577	0.50648	0.07867	0.58515						
Average (all vehicles)	***up to 3.5t***	***40%***	***0.46***			***x***	***0.53168***	***0.00013***	***0.00380***	***0.53561***	***0.11378***	***0.64939***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources
Factors developed by AEA and agreed with Department for Transport (2012)

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 vehicle reference weight. Reference weight is equivalent to the vehicle kerb weight plus 60kg.
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.
Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 7 - Freight Transport Conversion Tables

Last updated: Apr-12

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	0.54291	0.00022	0.00606	0.54919	0.11666	0.66585						
		50%				x	0.59012	0.00022	0.00606	0.59640	0.12669	0.72309						
		100%				x	0.63733	0.00022	0.00606	0.64361	0.13672	0.78033						
		46%	*(UK average load)*			*x*	*0.58635*	*0.00022*	*0.00606*	*0.59263*	*0.12589*	*0.71852*						
Rigid	>7.5-17t	0%				x	0.64930	0.00027	0.00746	0.65703	0.13957	0.79660						
		50%				x	0.74206	0.00027	0.00746	0.74979	0.15928	0.90907						
		100%				x	0.83482	0.00027	0.00746	0.84255	0.17898	1.02153						
		39%	*(UK average load)*			*x*	*0.72166*	*0.00027*	*0.00746*	*0.72939*	*0.15494*	*0.88433*						
Rigid	>17t	0%				x	0.78075	0.00036	0.00998	0.79109	0.16805	0.95914						
		50%				x	0.95214	0.00036	0.00998	0.96248	0.20446	1.16694						
		100%				x	1.12353	0.00036	0.00998	1.13387	0.24087	1.37474						
		54%	*(UK average load)*			*x*	*0.96632*	*0.00036*	*0.00998*	*0.97666*	*0.20747*	*1.18413*						
All rigids	***UK average***	***53%***				***x***	***0.82475***	***0.00031***	***0.00852***	***0.83358***	***0.17708***	***1.01066***						
Articulated	>3.5-33t	0%				x	0.72374	0.00049	0.00912	0.73335	0.15578	0.88913						
		50%				x	0.90468	0.00049	0.00912	0.91429	0.19422	1.10851						
		100%				x	1.08562	0.00049	0.00912	1.09523	0.23266	1.32789						
		44%	*(UK average load)*			*x*	*0.88297*	*0.00049*	*0.00912*	*0.89258*	*0.18961*	*1.08219*						
Articulated	>33t	0%				x	0.69872	0.00055	0.01020	0.70947	0.15071	0.86018						
		50%				x	0.93163	0.00055	0.01020	0.94238	0.20019	1.14257						
		100%				x	1.16454	0.00055	0.01020	1.17529	0.24967	1.42496						
		62%	*(UK average load)*			*x*	*0.98753*	*0.00055*	*0.01020*	*0.99828*	*0.21206*	*1.21034*						
All artics	***UK average***	***61%***				***x***	***0.98753***	***0.00055***	***0.01020***	***0.99828***	***0.21206***	***1.21034***						
ALL HGVs	***UK average***	***57%***				***x***	***0.90015***	***0.00043***	***0.00930***	***0.90988***	***0.19328***	***1.10316***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources

Factors developed by AEA and agreed with Department for Transport (2012)
UK Greenhouse Gas Inventory for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/
Transport Statistics Bulletin: Road Freight Statistics 2010, (DfT, 2011)
http://www.dft.gov.uk/statistics/series/road-freight/

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, 2011), from a survey on the average miles per gallon and average loading factor for different sizes of rigid and artic HGVs in the 2010 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 RFS0141 of DfT (2011) 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 2010 given in Table RFS0117 of DfT (2011).

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 2010. 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 RFS0117 and RFS0141 in DfT (2010).

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 2010. These are derived directly from the average mpg values for all rigid and articulated HGVs in Table RFS0117 of DfT (2011).

At a more aggregated level still are factors for all HGVs representing the average mpg for all rigid and articulated HGV classes in Table RFS0117 of DfT (2011). 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.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Annex 7 - Freight Transport Conversion Tables

Last updated: Apr-12

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	46%	1.01			x	0.57921	0.00022	0.00599	0.58542	0.12436	0.70978						
Rigid	>7.5-17t	39%	2.06			x	0.35035	0.00013	0.00362	0.35410	0.07522	0.42932						
Rigid	>17t	54%	5.08			x	0.19030	0.00007	0.00197	0.19234	0.04086	0.23320						
All rigids	***UK average***	***53%***	***3.35***			***x***	***0.24595***	***0.00009***	***0.00254***	***0.24858***	***0.05281***	***0.30139***						
Articulated	>3.5-33t	44%	5.51			x	0.16023	0.00009	0.00166	0.16198	0.03441	0.19639						
Articulated	>33t	62%	11.78			x	0.08381	0.00005	0.00087	0.08473	0.01800	0.10273						
All artics	***UK average***	***61%***	***11.31***			***x***	***0.08730***	***0.00005***	***0.00090***	***0.08825***	***0.01875***	***0.10700***						
ALL HGVs	***UK average***	***57%***	***7.40***			***x***	***0.12168***	***0.00008***	***0.00190***	***0.12366***	***0.02627***	***0.14993***						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources: Factors developed by AEA and agreed with Department for Transport (2012)

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 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 2010 fleet average kgCO_2 per vehicle km factors in Table 7d and the average tonne of 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 RFS0117 and RFS0109, respectively, DfT (2011). 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.

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

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		0.02760	0.00004	0.00299	0.03063	0.00571	0.03634						
Mode	Detail	Total tonne km travelled	x	km uplift factor [1]	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_2	Total kg CO_2	Total kg CO_2	Total kg CO_2	Total kg CO_2
Air	Domestic		x	109%	x		2.04350	0.00126	0.02012	2.06487	0.42564	2.49051						
	Short-haul international		x	109%	x		1.22924	0.00007	0.01210	1.24141	0.25604	1.49745						
	Long-haul international		x	109%	x		0.63470	0.00004	0.00625	0.64099	0.13220	0.77319						
Total													**0**	**0**	**0**	**0**	**0**	**0**

Sources: Factors developed by AEA and agreed with Department for Transport (2012)
Office of Rail Regulation (ORR), 2011.
EMEP/EEA air pollutant emission inventory guidebook 2009 (EEA, 2009)
Civil Aviation Authority (2011)

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 2009/10 produced by ORR (Office of the Rail Regulator) and is available at:

http://www.rail-reg.gov.uk/server/show/nav.2026

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

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 2010 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: Apr-12

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.
Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

Table 7g

Maritime Shipping Freight Distance 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
Ship Type	*Size**	*Av. Loading*															
Crude tanker (oil)	200,000+ dwt	48%			x	0.00290	0.00000	0.00002	0.00292	0.00055	0.00347						
Crude tanker (oil)	120,000–199,999 dwt	48%			x	0.00440	0.00000	0.00003	0.00443	0.00083	0.00526						
Crude tanker (oil)	80,000–119,999 dwt	48%			x	0.00590	0.00000	0.00005	0.00595	0.00112	0.00707						
Crude tanker (oil)	60,000–79,999 dwt	48%			x	0.00750	0.00000	0.00006	0.00756	0.00142	0.00898						
Crude tanker (oil)	10,000–59,999 dwt	48%			x	0.00910	0.00000	0.00007	0.00917	0.00172	0.01089						
Crude tanker (oil)	0–9999 dwt	48%			x	0.03330	0.00001	0.00026	0.03357	0.00630	0.03987						
Crude tanker (oil)	**Average**	**48%**			x	**0.00451**	**0.00000**	**0.00003**	**0.00454**	**0.00085**	**0.00539**						
Products tanker	60,000+ dwt	55%			x	0.00570	0.00000	0.00004	0.00574	0.00108	0.00682						
Products tanker	20,000–59,999 dwt	55%			x	0.01030	0.00000	0.00008	0.01038	0.00195	0.01233						
Products tanker	10,000–19,999 dwt	50%			x	0.01870	0.00001	0.00014	0.01885	0.00354	0.02239						
Products tanker	5000–9999 dwt	45%			x	0.02920	0.00001	0.00022	0.02943	0.00553	0.03496						
Products tanker	0–4999 dwt	45%			x	0.04500	0.00001	0.00034	0.04535	0.00852	0.05387						
Products tanker	**Average**	**54%**			x	**0.00891**	**0.00000**	**0.00007**	**0.00898**	**0.00169**	**0.01067**						
Chemical tanker	20,000+ dwt	64%			x	0.00840	0.00000	0.00006	0.00846	0.00159	0.01005						
Chemical tanker	10,000–19,999 dwt	64%			x	0.01080	0.00000	0.00008	0.01088	0.00204	0.01292						
Chemical tanker	5000–9999 dwt	64%			x	0.01510	0.00000	0.00012	0.01522	0.00286	0.01808						
Chemical tanker	0–4999 dwt	64%			x	0.02220	0.00001	0.00017	0.02238	0.00420	0.02658						
Chemical tanker	**Average**	**64%**			x	**0.01018**	**0.00000**	**0.00008**	**0.01026**	**0.00193**	**0.01219**						
LPG tanker	50,000+ m3	48%			x	0.00900	0.00000	0.00007	0.00907	0.00170	0.01077						
LPG tanker	0–49,999 m3	48%			x	0.04350	0.00001	0.00033	0.04384	0.00823	0.05207						
LNG tanker	200,000+ m3	48%			x	0.00930	0.00000	0.00007	0.00937	0.00176	0.01113						
LNG tanker	0–199,999 m3	48%			x	0.01450	0.00000	0.00011	0.01461	0.00274	0.01735						
LNG tanker	**Average**	**48%**			x	**0.01139**	**0.00000**	**0.00009**	**0.01148**	**0.00216**	**0.01364**						
Bulk carrier	200,000+ dwt	50%			x	0.00250	0.00000	0.00002	0.00252	0.00047	0.00299						
Bulk carrier	100,000–199,999 dwt	50%			x	0.00300	0.00000	0.00002	0.00302	0.00057	0.00359						
Bulk carrier	60,000–99,999 dwt	55%			x	0.00410	0.00000	0.00003	0.00413	0.00078	0.00491						
Bulk carrier	35,000–59,999 dwt	55%			x	0.00570	0.00000	0.00004	0.00574	0.00108	0.00682						
Bulk carrier	10,000–34,999 dwt	55%			x	0.00790	0.00000	0.00006	0.00796	0.00150	0.00946						
Bulk carrier	0–9999 dwt	60%			x	0.02920	0.00001	0.00022	0.02943	0.00553	0.03496						
Bulk carrier	**Average**	**51%**			x	**0.00349**	**0.00000**	**0.00003**	**0.00352**	**0.00066**	**0.00418**						
General cargo	10,000+ dwt	60%			x	0.01190	0.00000	0.00009	0.01199	0.00225	0.01424						
General cargo	5000–9999 dwt	60%			x	0.01580	0.00001	0.00012	0.01593	0.00299	0.01892						
General cargo	0–4999 dwt	60%			x	0.01390	0.00000	0.00011	0.01401	0.00263	0.01664						
General cargo	10,000+ dwt 100+ TEU	60%			x	0.01100	0.00000	0.00008	0.01108	0.00208	0.01316						
General cargo	5000–9999 dwt 100+ TEU	60%			x	0.01750	0.00001	0.00013	0.01764	0.00331	0.02095						
General cargo	0–4999 dwt 100+ TEU	60%			x	0.01980	0.00001	0.00015	0.01996	0.00375	0.02371						
General cargo	**Average**	**60%**			x	**0.01305**	**0.00000**	**0.00010**	**0.01315**	**0.00247**	**0.01562**						
Refrigerated cargo	**All dwt**	**50%**			x	**0.01290**	**0.00000**	**0.00010**	**0.01300**	**0.00244**	**0.01544**						
Container	8000+ TEU	70%			x	0.01250	0.00000	0.00010	0.01260	0.00237	0.01497						
Container	5000–7999 TEU	70%			x	0.01660	0.00001	0.00013	0.01674	0.00314	0.01988						
Container	3000–4999 TEU	70%			x	0.01660	0.00001	0.00013	0.01674	0.00314	0.01988						
Container	2000–2999 TEU	70%			x	0.02000	0.00001	0.00015	0.02016	0.00379	0.02395						
Container	1000–1999 TEU	70%			x	0.03210	0.00001	0.00025	0.03236	0.00608	0.03844						
Container	0–999 TEU	70%			x	0.03630	0.00001	0.00028	0.03659	0.00687	0.04346						
Container	**Average**	**70%**			x	**0.01592**	**0.00001**	**0.00012**	**0.01605**	**0.00301**	**0.01906**						
Vehicle transport	4000+ CEU	70%			x	0.03200	0.00001	0.00025	0.03226	0.00606	0.03832						
Vehicle transport	0–3999 CEU	70%			x	0.05760	0.00002	0.00044	0.05806	0.01090	0.06896						
Vehicle transport	**Average**	**70%**			x	**0.03805**	**0.00001**	**0.00029**	**0.03835**	**0.00720**	**0.04555**						
Ro–Ro ferry	2000+ LM	70%			x	0.04950	0.00002	0.00038	0.04990	0.00937	0.05927						
Ro–Ro ferry	0–1999 LM	70%			x	0.06030	0.00002	0.00046	0.06078	0.01141	0.07219						
Ro–Ro ferry	**Average**	**70%**			**x**	**0.05095**	**0.00002**	**0.00039**	**0.05136**	**0.00964**	**0.06100**						
Large RoPax ferry		-			**x**	**0.38434**	**0.00012**	**0.00295**	**0.38741**	**0.07275**	0.46016						
Total												**0**	**0**	**0**	**0**	**0**	**0**

Annex 7 - Freight Transport Conversion Tables

Last updated:	Apr-12

Sources

Factors developed by AEA and agreed with Department for Transport (2012). 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 at: http://www.imo.org/blast/blastDataHelper.asp?data_id=27795&filename=GHGStudyFINAL.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).

Emission factors for CH4 and N2O are based on UK Greenhouse Gas Inventory values for 2010 (AEA, 2012), available at: http://naei.defra.gov.uk/

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, Air Conditioning Equipment and Heat Pumps

Last updated:	Apr-12

How to use this Annex

There are two methods presented here for the estimation of emissions from the use of refrigeration, air conditioning equipment and heat pumps. For smaller users the simple **A. Screening Method** will likely be the easiest way to calculate their emissions. Some larger users of refrigerant 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, air conditioning and heat pumps 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/air conditioning/heat pump 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 the 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, equipment manuals or maintenance records.
(c) *Heat pumps* : visual readings on the equipment, equipment manuals or maintenance records.

Annex 8 Scopes & Boundaries:

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

Scope 1 covers activities that are owned or controlled by an organisation that release emissions straight into the atmosphere, this includes fugitive emissions, for example air conditioning and refrigeration leaks. Therefore, only the company or organisation that owns or controls the building should report air conditioning and refrigeration emission under their Scope 1.

Note: Emissions covered by this annex could also be counted/reported under the Scope 3 inventory of organisations that DO NOT own or control the building that uses the air conditioning and/or refrigeration equipment.

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

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

Last updated:	Apr-12

Table 8a

Scope 1

Emissions from Installation of Refrigeration and Air-conditioning Equipment (only applies to equipment filled on site)

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 [1]		x		x		x					x	
Small Hermetic Stand-Alone Refrigeration Units [1]		x		x		x					x	
Condensing Units		x		x	2.0%	x					x	
Centralised Supermarket Refrigeration Systems		x		x	2.0%	x					x	
Industrial Systems		x		x	1.0%	x					x	
Small Stationary Air Conditioning [2]		x		x	2.0%	x					x	
Medium Stationary Air Conditioning		x		x	1.0%	x					x	
Large Stationary Air Conditioning (Chillers) [2]		x		x	0.5%	x					x	
Heat Pumps [2]		x		x	2.0%	x					x	
Land Transport Refrigeration [1]		x		x		x					x	
Marine Transport Refrigeration		x		x	0.5%	x					x	
Light-Duty Mobile Air Conditioning [1]		x		x		x					x	
Other Mobile Air Conditioning [2]		x		x	0.5%	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	
Small Hermetic Stand-Alone Refrigeration Units		x		x		x	1.5%	x			x	
Condensing Units		x		x		x	10.0%	x			x	
Centralised Supermarket Refrigeration Systems		x		x		x	18.0%	x			x	
Industrial Systems		x		x		x	8.0%	x			x	
Small Stationary Air Conditioning		x		x		x	3.0%	x			x	
Medium Stationary Air Conditioning		x		x		x	6.0%	x			x	
Large Stationary Air Conditioning (Chillers)		x		x		x	3.0%	x			x	
Heat Pumps		x		x		x	6.0%	x			x	
Land Transport Refrigeration		x		x		x	15.0%	x			x	
Marine Transport Refrigeration		x		x		x	40.0%	x			x	
Light-Duty Mobile Air Conditioning		x		x		x	10.0%	x			x	
Other Mobile Air Conditioning		x		x		x	10.0%	x			x	
Total												**0**

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

Last updated:	Apr-12

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	65%	x			x	
Small Hermetic Stand-Alone Refrigeration Units		x		x	80%	x	60%	x			x	
Condensing Units		x		x	80%	x	85%	x			x	
Centralised Supermarket Refrigeration Systems		x		x	100%	x	92%	x			x	
Industrial Systems		x		x	100%	x	85%	x			x	
Small Stationary Air Conditioning		x		x	80%	x	70%	x			x	
Medium Stationary Air Conditioning		x		x	80%	x	70%	x			x	
Large Stationary Air Conditioning (Chillers)		x		x	80%	x	80%	x			x	
Heat Pumps		x		x	80%	x	65%	x			x	
Land Transport Refrigeration		x		x	50%	x	80%	x			x	
Marine Transport Refrigeration		x		x	50%	x	70%	x			x	
Light-Duty Mobile Air Conditioning		x		x	50%	x	70%	x			x	
Other Mobile Air Conditioning		x		x	50%	x	70%	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
Small Hermetic Stand-Alone Refrigeration Units	0.2-6.0
Condensing Units	50-2,000
Centralised Supermarket Refrigeration Systems	50-2,000
Industrial Systems	10-10,000
Small Stationary Air Conditioning	0.5-100
Medium Stationary Air Conditioning	0.5-100
Large Stationary Air Conditioning (Chillers)	10-2,000
Heat Pumps	0.5-100
Land Transport Refrigeration	3 - 8
Marine Transport Refrigeration	3 - 8
Light-Duty Mobile Air Conditioning	0.5-1.5
Other Mobile Air Conditioning	0.5-1.5

Sources

UK Greenhouse Gas Inventory for 2010 (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)
Development of the GHG refrigeration and air conditioning model, Final report, December 2011. Prepared for the Department of Energy and Climate Change by ICF International. Available at: http://www.decc.gov.uk/assets/decc/11/cutting-emissions/3844-greenhouse-gas-inventory-improvement-project-deve.pdf

Notes

[1] These categories are almost exclusively pre-filled, so there are no installation emissions in the majority of cases.

[2] For some categories the units may be either pre-filled (smaller units) or filled on site (generally larger units). The default conservative assumption is that the units are filled on site, however if you have more specific/different information for your particular installation that suggests it comes prefilled it may be more appropriate to exclude these units from your calculations of installation emissions.

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

Last updated:	Apr-12

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 - Bioenergy & Water Conversion Factor Tables

Last updated:	Apr-12

The emission factors presented in this Annex have been prepared for use within company reporting in line with GHG Protocol Scope 3 Guidance (predominantly) and include total CO_2, CH_4 and N_2O emissions in units of CO_2e (CO_2 equivalent). 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).

NOTE: Information on waste disposal previously provided in Table 9d of Annex 9 has now been moved to a separate new Annex 14. This Annex 9 has therefore been renamed since the previous update (2011), to avoid potential confusion and for better alignment with its contents.

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 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.

The additionally presented 'Outside of Scopes' emission factors also enable you to calculate direct emissions of carbon dioxide for the combustion of biomass and biofuels.

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 CH4 and N2O from the combustion of fuel (CO2 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://iet.jrc.ec.europa.eu/about-jec/
Outside of Scopes: Emissions data for direct CO2 emissions from biologically sequestered carbon (e.g. CO2 from burning biomass/biofuels) are reported separately from the scopes.

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

Annex 9 - Bioenergy & Water Conversion Factor Tables

Last updated:	Apr-12

Table 9a

Life-Cycle Conversion Factors for water					Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes Grand Total GHG	Scope 1 Total Direct GHG	Scope 3 Total Indirect GHG	All Scopes 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	Total kg CO_2e	Total kg CO_2e	Total kg CO_2e
Water supply	2007/08		million litres	x	-	276	276			
	2008/09		million litres	x	-	300	300			
	2009/10		million litres	x	-	340	340			
	2010/11		million litres	x	-	344	344			
	2007/08		cubic metres	x	-	0.2760	0.2760			
	2008/09		cubic metres	x	-	0.3000	0.3000			
	2009/10		cubic metres	x	-	0.3400	0.3400			
	2010/11		cubic metres	x	-	0.3441	0.3441			
Water treatment	2007/08		million litres	x	-	693	693			
	2008/09		million litres	x	-	750	750			
	2009/10		million litres	x	-	700	700			
	2010/11		million litres	x	-	709	709			
	2007/08		cubic metres	x	-	0.6930	0.6930			
	2008/09		cubic metres	x	-	0.7500	0.7500			
	2009/10		cubic metres	x	-	0.7000	0.7000			
	2010/11		cubic metres	x	-	0.7085	0.7085			
Total								**0**	**0**	**0**

Sources

Water UK Sustainability Indicators 2009/10, available at:
http://www.water.org.uk/home/news/press-releases/sustainability-indicators-09-10

Annex 9 - Bioenergy & Water Conversion Factor Tables

Last updated:	Apr-12

Table 9b

NOTE: Please use EITHER Part (i) + Part (ii), OR Part (iii) to calculate emissions 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	0.0175	1.1138	1.1313	2.4921				
	100%		GJ	x	0.528	33.654	34.182	75.300				
Bioethanol	100%		litres	x	0.0057	0.8224	0.8281	1.5241				
	100%		GJ	x	0.267	38.636	38.903	71.600				
Biomethane	100%		kg	x	0.0052	1.3230	1.3282	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	2.6769	0.5644	3.2413	0.0000				
	100%		GJ	x	74.308	15.667	89.975	0.000				
Petrol	100%		litres	x	2.3144	0.4638	2.7782	0.0000				
	100%		GJ	x	70.360	14.100	84.460	0.000				
CNG	100%		kg	x	2.7244	0.4224	3.1468	0.0000				
	100%		GJ	x	57.083	8.850	65.934	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: Department for Transport (2011), DECC (2011)

Notes: Emissions factors for biofuels are based on figures from the Department for Transport (DfT). The average figures for biofuels for the period April 2010-April 2011 are provided in the RTFO Quarterly report, April 2010 - April 2011 (published in April 2011), available on the DfT's website at: http://www.dft.gov.uk/topics/sustainable/biofuels/rtfo/ and http://www.dft.gov.uk/statistics?post_type=release&series=biofuels-series
Detailed factors by source/supplier are provided and updated in the DfT Quarterly Reports, available on the DfT'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 CO2 emitted by the biofuel when combusted. This will be equivalent to the CO2 absorbed in the growth of the feedstock used to produce the fuel. CO2 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 - Bioenergy & Water Conversion Factor Tables

Last updated:	Apr-12

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	0.01895	0.35150				
Wood Chips [1]		tonnes	x	-	61.41	61.41	1372.00				
		kWh of fuel	x	-	0.01579	0.01579	0.35400				
Wood Pellets [1]		tonnes	x	-	183.93	183.93	1649.00				
		kWh of fuel	x	-	0.03895	0.03895	0.34900				
Grasses/Straw [2]		tonnes	x	-	41.08	41.08	1406.50				
		kWh of fuel	x	-	0.01020	0.01020	0.34800				
Biogas [2]		tonnes	x	-	0.00	0.00	2040.00				
		kWh of fuel	x	-	0.00000	0.00000	0.24600				
Total								**0**	**0**	**0**	**0**

Sources

BIOMASS Energy Centre (BEC), 2010
BRE, 2009

Notes

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

[2] The figure for grasses/straw and biogas (= 60% CH4, 40% CO2) 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 CO2 emitted by the biomass when combusted. This will be equivalent to the CO2 absorbed in the growth of the biomass. CO2 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 10 - International Electricity Emission Factors

Last updated: May-12

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 the International Energy Agency (IEA) Data Services, 2011 for "CO2 Emissions per kWh from electricity and heat generation" and mainly sourced from the GHG Protocol website, http://www.ghgprotocol.org/calculation-tools

Data on losses in distribution of electricity and heat is calculated from 2005 - 2009 country energy balances available at the IEA website (2011).

Annex 10 Scopes & Boundaries:
Scope 2: Direct emissions of CO_2 from the combustion of fuel used in the generation of electricity and heat (data not available for other greenhouse gases).
Scope 3: Indirect emissions of CO_2, CH_4 and N_2O 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/economy/business-efficiency/reporting/

Table 10a

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: kgCO_2 per kWh electricity and heat GENERATED [1]																					2009 5-yr rolling average:	Scope 2 Total Direct GHG		Scope 3 Total Indirect GHG		All Scopes Grand Total GHG		% Total GWh		% Distribution Losses	
Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Amount used per year, kWh	kg CO_2 per kWh	Total kg CO_2	kg CO_2e per kWh	Total kg CO_2e	kg CO_2e per kWh	Total kg CO_2e	Electricity	Heat	Electricity	Heat
European Union																															
Austria	0.24455	0.25184	0.20865	0.19352	0.20685	0.21391	0.22921	0.22744	0.20758	0.19313	0.18010	0.20089	0.19698	0.23291	0.22420	0.21861	0.21348	0.20019	0.18479	0.16323		0.19606		0.02666		0.22272		78.7%	21.3%	5.5%	8.0%
Belgium	0.34442	0.34106	0.33005	0.34373	0.36385	0.35664	0.33816	0.31007	0.31497	0.27808	0.28434	0.27150	0.26626	0.27419	0.28053	0.27095	0.25978	0.24965	0.24898	0.21789		0.24945		0.03392		0.28337		91.4%	8.6%	4.9%	4.2%
Bulgaria			0.47331	0.48028	0.45508	0.42776	0.41754	0.46931	0.47793	0.44464	0.43068	0.46457	0.43280	0.47025	0.47348	0.44937	0.44405	0.51896	0.49320	0.46345		0.47381		0.06443		0.53824		74.2%	25.8%	14.9%	12.8%
Cyprus			0.82735	0.82810	0.83187	0.82226	0.83271	0.84131	0.84325	0.85637	0.83763	0.77743	0.75605	0.83330	0.77243	0.78837	0.75812	0.76064	0.75866	0.74427		0.76201		0.10361		0.86562		100.0%	0.0%	4.1%	0.0%
Czech Republic	0.59599	0.58776	0.57380	0.58652	0.59436	0.60021	0.58317	0.58408	0.58818	0.57878	0.59521	0.58245	0.55983	0.52324	0.52421	0.52449	0.52562	0.54997	0.53716	0.51425		0.53030		0.07211		0.60241		70.4%	29.6%	7.8%	17.0%
Denmark	0.47714	0.50695	0.47267	0.46031	0.47083	0.43462	0.47212	0.42825	0.39662	0.37105	0.34788	0.34437	0.34055	0.36553	0.31749	0.29262	0.35261	0.32448	0.30509	0.30275		0.31551		0.04290		0.35841		52.4%	47.6%	5.4%	20.1%
Estonia	0.56083	0.54819	0.61954	0.59639	0.59712	0.67945	0.67524	0.66382	0.71410	0.70067	0.69167	0.67865	0.66173	0.71663	0.70140	0.70951	0.65181	0.74781	0.75186	0.70385		0.71297		0.09694		0.80991		58.7%	41.3%	14.4%	14.4%
Finland	0.22710	0.23214	0.20508	0.22948	0.26503	0.24740	0.28065	0.26029	0.21192	0.21203	0.21143	0.24102	0.25236	0.29162	0.25304	0.19289	0.24065	0.22969	0.18712	0.20541		0.21115		0.02871		0.23986		59.8%	40.2%	3.6%	6.0%
France	0.10916	0.12290	0.09810	0.06797	0.06859	0.07564	0.07918	0.07286	0.09982	0.08649	0.08395	0.07183	0.07739	0.08090	0.07912	0.09321	0.08658	0.08998	0.08675	0.08985		0.08927		0.01214		0.10141		92.5%	7.5%	7.0%	0.0%
Germany	0.55265	0.56102	0.54587	0.53898	0.53855	0.52222	0.52436	0.51309	0.50585	0.48882	0.49381	0.50550	0.50768	0.43439	0.43613	0.40594	0.40425	0.46815	0.44118	0.43050		0.43000		0.05847		0.48847		77.0%	23.0%	5.2%	7.8%
Greece	0.99009	0.94120	0.97127	0.94889	0.92586	0.94565	0.84186	0.81945	0.79692	0.77862	0.81733	0.83121	0.81417	0.77752	0.77643	0.77568	0.72728	0.74938	0.74486	0.72240		0.74392		0.10115		0.84507		99.1%	0.9%	8.1%	0.0%
Hungary	0.41968	0.41700	0.43228	0.43262	0.43325	0.43246	0.42405	0.42802	0.42765	0.41185	0.40073	0.39368	0.39137	0.42465	0.39243	0.34065	0.34392	0.34577	0.33084	0.30206		0.33265		0.04523		0.37788		69.8%	30.2%	10.4%	1.5%
Ireland	0.73998	0.74282	0.74807	0.73297	0.72967	0.72662	0.70762	0.70577	0.70252	0.69656	0.64210	0.66821	0.63488	0.60317	0.57422	0.58179	0.54545	0.50373	0.47798	0.46524		0.51484		0.07000		0.58484		100.0%	0.0%	7.9%	0.0%
Italy	0.57455	0.54819	0.53510	0.52412	0.51509	0.54532	0.52398	0.51360	0.51280	0.49439	0.49768	0.48151	0.50304	0.51086	0.45886	0.44850	0.46793	0.43992	0.42129	0.38641		0.43281		0.05885		0.49166		84.9%	15.1%	6.3%	0.0%
Latvia			0.27995	0.27247	0.25078	0.23886	0.26166	0.21764	0.19775	0.21797	0.19963	0.18938	0.18789	0.18250	0.16623	0.16178	0.16731	0.16405	0.16223	0.15307		0.16169		0.02199		0.18368		39.1%	60.9%	11.4%	15.4%
Lithuania			0.18529	0.18524	0.21443	0.17396	0.17263	0.16828	0.17554	0.17762	0.15956	0.14698	0.12329	0.11359	0.11368	0.13601	0.13793	0.12099	0.11470	0.11115		0.12416		0.01688		0.14104		50.9%	49.1%	11.2%	14.8%
Luxembourg	2.55159	2.43482	2.44648	2.42911	2.22450	1.73831	1.56562	1.05885	0.46475	0.52869	0.51692	0.45406	0.40096	0.40305	0.39410	0.38940	0.38735	0.37952	0.38163	0.38429		0.38444		0.05227		0.43671		87.9%	12.1%	1.9%	0.0%
Malta			1.02049	1.38784	1.16015	0.95725	0.97330	0.93658	0.93164	0.90346	0.81902	1.00723	0.93443	0.94644	0.91332	1.03378	0.95415	1.01189	0.84871	0.85042		0.93979		0.12779		1.06758		100.0%	0.0%	14.2%	0.0%
Netherlands	0.58835	0.57181	0.55952	0.57410	0.53614	0.46440	0.44310	0.42814	0.41702	0.41548	0.40002	0.41404	0.40148	0.40563	0.39551	0.38706	0.39432	0.39972	0.39208	0.37449		0.38953		0.05297		0.44250		72.1%	27.9%	4.1%	17.7%
Poland	0.64058	0.63337	0.63719	0.63627	0.64082	0.67051	0.66206	0.66505	0.66291	0.66417	0.67076	0.65670	0.65554	0.65525	0.65594	0.65044	0.65729	0.65913	0.65550	0.64020		0.65251		0.08872		0.74123		63.5%	36.5%	11.0%	0.0%
Portugal	0.51620	0.52043	0.62047	0.54407	0.51950	0.57240	0.43184	0.46107	0.47095	0.53864	0.47952	0.44193	0.51196	0.41325	0.45150	0.50087	0.41782	0.38462	0.38353	0.36824		0.41102		0.05589		0.46691		92.4%	7.6%	7.4%	0.0%
Romania			0.40929	0.38409	0.45570	0.44006	0.44392	0.38486	0.35097	0.36582	0.39580	0.40364	0.41232	0.45072	0.41780	0.40265	0.43901	0.45349	0.43980	0.41435		0.42986		0.05845		0.48831		66.5%	33.5%	14.3%	21.8%
Slovak Republic	0.37559	0.38589	0.35771	0.40975	0.35609	0.37466	0.36103	0.37698	0.35094	0.33976	0.26669	0.24116	0.21487	0.25478	0.24002	0.22900	0.22341	0.22929	0.21754	0.22172		0.22419		0.03048		0.25467		70.2%	29.8%	5.0%	14.7%
Slovenia	0.35989	0.29920	0.34568	0.35878	0.32407	0.32797	0.31179	0.36540	0.37059	0.34040	0.33831	0.35348	0.37149	0.36707	0.34073	0.34459	0.35496	0.36665	0.32884	0.31603		0.34221		0.04653		0.38874		85.7%	14.3%	6.5%	15.5%
Spain	0.42715	0.42161	0.47435	0.41584	0.41079	0.45343	0.35774	0.39197	0.38092	0.44439	0.42994	0.38172	0.43402	0.37838	0.38176	0.39684	0.36875	0.38709	0.32658	0.29878		0.35561		0.04835		0.40396		100.0%	0.0%	5.9%	0.0%
Sweden	0.04827	0.05870	0.05098	0.05204	0.05628	0.05001	0.07390	0.05079	0.05319	0.04894	0.04152	0.04205	0.05170	0.05939	0.05098	0.04404	0.04796	0.04004	0.04007	0.04314		0.04305		0.00585		0.04890		74.5%	25.5%	7.7%	3.9%
European Union - 27			**0.43878**	**0.41941**	**0.41931**	**0.41375**	**0.40612**	**0.39487**	**0.39044**	**0.38159**	**0.38102**	**0.37639**	**0.38003**	**0.37355**	**0.36575**	**0.35830**	**0.36246**	**0.37303**	**0.35485**	**0.33891**		**0.35751**		**0.04861**		**0.40612**		**81.6%**	**18.4%**	**6.8%**	**7.7%**
SUBTOTAL																							**0**		**0**		**0**					

Annex 10 - International Electricity Emission Factors

Last updated: May-12

Table 10a - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: 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	2007	2008	2009
Other countries																				
Australia	0.81518	0.81924	0.82552	0.81015	0.80408	0.80987	0.82342	0.82589	0.86353	0.86464	0.85303	0.85962	0.92875	0.91783	0.89880	0.90971	0.92562	0.87631	0.85560	0.85293
Brazil			0.06099	0.05541	0.05117	0.05530	0.05711	0.06222	0.06222	0.08221	0.08761	0.10335	0.08525	0.07886	0.08503	0.08395	0.08100	0.07277	0.08885	0.06413
Canada	0.20345	0.19565	0.20469	0.18298	0.17955	0.18436	0.17827	0.19764	0.22119	0.21215	0.22195	0.23110	0.21608	0.22851	0.21387	0.20018	0.20129	0.19731	0.18772	0.16723
People's Rep. of China			0.79424	0.79386	0.76781	0.80280	0.82056	0.80406	0.82292	0.79757	0.76459	0.73962	0.74821	0.77567	0.80522	0.78720	0.78746	0.75823	0.74424	0.74257
Chinese Taipei			0.50213	0.52515	0.52356	0.53346	0.53960	0.57041	0.57744	0.59576	0.62638	0.64095	0.63133	0.65053	0.64631	0.65129	0.65917	0.65530	0.65024	0.63478
Croatia			0.32418	0.32746	0.24922	0.27159	0.25273	0.29745	0.32230	0.30585	0.30327	0.31286	0.35666	0.37967	0.30001	0.31391	0.32018	0.38487	0.34149	0.28339
Egypt			0.52968	0.50320	0.46648	0.44331	0.43277	0.44226	0.46748	0.45457	0.41183	0.38101	0.43669	0.43248	0.47316	0.47403	0.47343	0.45041	0.45976	0.46553
Gibraltar			0.77368	0.77337	0.75148	0.76592	0.75199	0.77284	0.76592	0.76594	0.75981	0.75378	0.75998	0.75451	0.76593	0.76066	0.77101	0.77087	0.75670	0.73952
Hong Kong, China			0.82063	0.86204	0.86434	0.85526	0.82323	0.72359	0.73968	0.71594	0.71182	0.71996	0.72516	0.79505	0.74912	0.75544	0.75391	0.77473	0.75742	0.76297
Iceland	0.00052	0.00049	0.00046	0.00080	0.00080	0.00162	0.00119	0.00109	0.00292	0.00375	0.00062	0.00060	0.00061	0.00062	0.00061	0.00061	0.00054	0.00137	0.00075	0.00042
India			0.85618	0.88191	0.85089	0.90138	0.94329	0.91449	0.89732	0.90141	0.92042	0.92114	0.90726	0.89223	0.93093	0.92283	0.92079	0.94335	0.95426	0.95141
Indonesia			0.60357	0.69108	0.61301	0.59149	0.60878	0.65846	0.63403	0.65412	0.65345	0.68138	0.67764	0.71907	0.70139	0.71644	0.73807	0.77490	0.75190	0.74569
Israel	0.80818	0.80460	0.79071	0.80623	0.80202	0.80501	0.80996	0.80363	0.74794	0.75011	0.74893	0.75195	0.81180	0.80461	0.78521	0.77798	0.75825	0.75536	0.71229	0.69488
Japan	0.43450	0.42494	0.43089	0.41198	0.42981	0.41097	0.40801	0.39353	0.38125	0.39678	0.40059	0.40149	0.42208	0.44443	0.42716	0.42912	0.41845	0.45218	0.43761	0.41471
DPR of Korea			0.54278	0.50499	0.50767	0.48121	0.52056	0.55805	0.49966	0.55241	0.58359	0.58260	0.56801	0.54177	0.52846	0.52180	0.53320	0.46857	0.48136	0.49886
Malaysia			0.59831	0.57504	0.52580	0.52353	0.52519	0.46637	0.50533	0.48742	0.47591	0.50017	0.54655	0.49171	0.53793	0.60496	0.60700	0.61065	0.65592	0.64865
Mexico	0.54929	0.56641	0.54057	0.54536	0.59322	0.53852	0.53357	0.55609	0.57415	0.55119	0.55938	0.56132	0.55840	0.57095	0.49545	0.50931	0.48224	0.47915	0.43032	0.45498
New Zealand	0.10745	0.11640	0.14990	0.11989	0.09701	0.08695	0.11034	0.15795	0.14033	0.17032	0.15976	0.20196	0.17285	0.20987	0.19293	0.23357	0.22815	0.19415	0.21283	0.16650
Norway	0.00342	0.00453	0.00387	0.00418	0.00516	0.00449	0.00629	0.00548	0.00550	0.00600	0.00406	0.00583	0.00530	0.00833	0.00712	0.00556	0.00695	0.00745	0.00641	0.01729
Pakistan			0.39319	0.38423	0.39115	0.40492	0.44263	0.45374	0.41143	0.46783	0.47945	0.46297	0.44283	0.37076	0.39726	0.38000	0.41318	0.43265	0.45112	0.45772
Philippines			0.42143	0.41381	0.43150	0.45707	0.47178	0.49519	0.50385	0.45130	0.49425	0.47972	0.44946	0.45262	0.45225	0.49548	0.43303	0.44776	0.48677	0.47816
Russian Federation			0.31939	0.29111	0.29602	0.29176	0.34188	0.32832	0.32636	0.32696	0.32076	0.32148	0.32666	0.32930	0.32457	0.32497	0.32857	0.32250	0.32551	0.31740
Saudi Arabia			0.81349	0.81957	0.81428	0.81344	0.80052	0.80723	0.81351	0.81022	0.80538	0.77753	0.75087	0.73716	0.75414	0.73916	0.74909	0.72611	0.73561	0.75723
Singapore			0.84129	1.00411	0.95658	0.91620	0.87312	0.76485	0.73182	0.75584	0.76198	0.72472	0.66428	0.59734	0.56626	0.54348	0.53026	0.52807	0.52144	0.51886
South Africa			0.85531	0.88052	0.86361	0.87813	0.86067	0.86949	0.92747	0.88973	0.89303	0.82892	0.81941	0.84908	0.87118	0.85141	0.83151	0.82719	0.94774	0.92590
Switzerland	0.03495	0.03896	0.04035	0.03183	0.03102	0.03373	0.03769	0.03536	0.04177	0.03507	0.03597	0.03569	0.03902	0.03904	0.04027	0.04613	0.04549	0.04099	0.04042	0.03993
Thailand			0.64630	0.63008	0.62341	0.60306	0.60952	0.63384	0.60814	0.59624	0.56701	0.56632	0.54766	0.53573	0.54281	0.53541	0.51092	0.54640	0.52886	0.51338
Turkey	0.56842	0.56675	0.55701	0.50511	0.55039	0.51248	0.52095	0.52474	0.53042	0.54890	0.51886	0.54389	0.47199	0.44407	0.41938	0.42638	0.43822	0.47821	0.49528	0.47993
Ukraine			0.39057	0.40700	0.38143	0.38344	0.33347	0.32350	0.33200	0.33911	0.34682	0.32954	0.32475	0.38099	0.31648	0.33115	0.34551	0.36025	0.38611	0.37396
United States			0.58714	0.58222	0.58117	0.57923	0.58409	0.61645	0.60365	0.59049	0.58589	0.61681	0.56733	0.57082	0.57113	0.56964	0.54230	0.54921	0.53519	0.50817
Africa			**0.67255**	**0.68359**	**0.67656**	**0.68530**	**0.66909**	**0.67559**	**0.70264**	**0.67135**	**0.65765**	**0.61569**	**0.61823**	**0.63284**	**0.64358**	**0.63071**	**0.62525**	**0.61472**	**0.66554**	**0.64326**
Latin America			**0.18378**	**0.17292**	**0.16444**	**0.16725**	**0.16409**	**0.16585**	**0.17208**	**0.17112**	**0.17317**	**0.18222**	**0.17921**	**0.17972**	**0.17760**	**0.17761**	**0.17820**	**0.17612**	**0.18409**	**0.17480**
Middle East			**0.69777**	**0.70472**	**0.71670**	**0.71420**	**0.70387**	**0.70234**	**0.69832**	**0.70886**	**0.70740**	**0.71431**	**0.69958**	**0.67683**	**0.69302**	**0.68845**	**0.69235**	**0.67927**	**0.69092**	**0.69026**
Non-OECD Europe and Eurasia			**0.35120**	**0.33026**	**0.33244**	**0.32603**	**0.35561**	**0.34429**	**0.34417**	**0.34290**	**0.34382**	**0.34067**	**0.34490**	**0.35439**	**0.34244**	**0.34253**	**0.35344**	**0.34906**	**0.35297**	**0.34412**
SUBTOTAL																				
GRAND TOTAL																				

2009 5-yr rolling average: Amount used per year, kWh	Scope 2 Total Direct GHG: kg CO_2 per kWh	Scope 2 Total Direct GHG: Total kg CO_2	Scope 3 Total Indirect GHG: kg CO_2e per kWh	Scope 3 Total Indirect GHG: Total kg CO_2e	All Scopes Grand Total GHG: kg CO_2e per kWh	All Scopes Grand Total GHG: Total kg CO_2e	% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
	0.88403		0.12020		1.00423		100.0%	0.0%	7.6%	0.0%
	0.07814		0.01062		0.08876		99.7%	0.3%	15.8%	0.0%
	0.19075		0.02594		0.21669		98.5%	1.5%	9.1%	0.0%
	0.76394		0.10387		0.86781		81.7%	18.3%	6.8%	1.4%
	0.65016		0.08840		0.73856		100.0%	0.0%	4.1%	0.0%
	0.32877		0.04470		0.37347		78.8%	21.2%	11.4%	13.8%
	0.46463		0.06318		0.52781		100.0%	0.0%	12.2%	0.0%
	0.75975		0.10330		0.86305		100.0%	0.0%	0.0%	0.0%
	0.76089		0.10346		0.86435		100.0%	0.0%	10.7%	0.0%
	0.00074		0.00010		0.00084		81.3%	18.7%	4.0%	11.8%
	0.93853		0.12761		1.06614		100.0%	0.0%	25.1%	0.0%
	0.74540		0.10135		0.84675		100.0%	0.0%	11.2%	0.0%
	0.73975		0.10059		0.84034		100.0%	0.0%	3.0%	0.0%
	0.43041		0.05852		0.48893		99.4%	0.6%	4.9%	0.0%
	0.50076		0.06809		0.56885		88.7%	11.3%	3.8%	2.2%
	0.62544		0.08504		0.71048		100.0%	0.0%	2.9%	0.0%
	0.47120		0.06407		0.53527		100.0%	0.0%	17.5%	0.0%
	0.20704		0.02815		0.23519		99.2%	0.8%	7.6%	0.0%
	0.00873		0.00119		0.00992		97.1%	2.9%	8.4%	12.7%
	0.42693		0.05805		0.48498		100.0%	0.0%	22.1%	0.0%
	0.46824		0.06367		0.53191		100.0%	0.0%	13.2%	0.0%
	0.32379		0.04403		0.36782		37.5%	62.5%	13.6%	7.0%
	0.74144		0.10082		0.84226		100.0%	0.0%	9.4%	0.0%
	0.52842		0.07185		0.60027		100.0%	0.0%	5.6%	0.0%
	0.87675		0.11921		0.99596		100.0%	0.0%	9.6%	0.0%
	0.04259		0.00579		0.04838		93.1%	6.9%	6.8%	8.9%
	0.52699		0.07166		0.59865		100.0%	0.0%	7.0%	0.0%
	0.46360		0.06304		0.52664		94.2%	5.8%	15.2%	0.0%
	0.35940		0.04887		0.40827		54.2%	45.8%	15.1%	25.2%
	0.54090		0.07355		0.61445		97.0%	3.0%	6.5%	15.7%
	0.63590		**0.08646**		**0.72236**		**100.0%**	**0.0%**	**12.2%**	**0.0%**
	0.17816		**0.02422**		**0.20238**		**99.9%**	**0.1%**	**16.6%**	**0.0%**
	0.68825		**0.09358**		**0.78183**		**100.0%**	**0.0%**	**13.9%**	**0.0%**
	0.34842		**0.04738**		**0.39580**		**43.1%**	**56.9%**	**13.9%**	**10.1%**
		0		**0**		**0**				
		0		**0**		**0**				

Source

Emission factor data is from the International Energy Agency (IEA) Data Services, 2011 for "CO_2 Emissions per kWh from electricity and heat generation" and mainly sourced from the GHG Protocol website, http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat 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 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 roughly a similar ratio CO_2 emission factors as for the UK (which is 13.6%), 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.

Table 10b

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: 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	2007	2008	2009
European Union																				
Austria	0.01625	0.01673	0.01386	0.01286	0.01375	0.01421	0.01523	0.01512	0.01380	0.01284	0.01196	0.01335	0.01309	0.01548	0.01490	0.01435	0.01361	0.01289	0.01188	0.01032
Belgium	0.01790	0.01773	0.01715	0.01787	0.01891	0.01854	0.01757	0.01612	0.01637	0.01445	0.01478	0.01411	0.01384	0.01425	0.01458	0.01453	0.01299	0.01218	0.01264	0.01072
Bulgaria			0.09240	0.09377	0.08885	0.08352	0.08152	0.09162	0.09331	0.08681	0.08408	0.09070	0.08449	0.09180	0.09244	0.07973	0.07231	0.08921	0.07966	0.07426
Cyprus			0.04700	0.04705	0.04726	0.04671	0.04731	0.04780	0.04791	0.04865	0.04759	0.04417	0.04295	0.04734	0.04388	0.03237	0.04019	0.03729	0.02505	0.02961
Czech Republic	0.07364	0.07262	0.07090	0.07247	0.07344	0.07416	0.07206	0.07217	0.07267	0.07151	0.07354	0.07196	0.06918	0.06465	0.06477	0.06641	0.06215	0.06558	0.06260	0.05966
Denmark	0.06568	0.06978	0.06507	0.06336	0.06481	0.05982	0.06498	0.05895	0.05459	0.05107	0.04789	0.04740	0.04688	0.05032	0.04370	0.03821	0.04593	0.04240	0.04418	0.04508
Estonia	0.11442	0.11184	0.12639	0.12167	0.12182	0.13862	0.13776	0.13543	0.14569	0.14294	0.14111	0.13846	0.13500	0.14621	0.14310	0.11911	0.11130	0.14156	0.12140	0.10673
Finland	0.01053	0.01077	0.00951	0.01064	0.01229	0.01148	0.01302	0.01208	0.00984	0.00983	0.00980	0.01118	0.01171	0.01353	0.01174	0.00936	0.01103	0.00999	0.00898	0.00985
France	0.00737	0.00829	0.00661	0.00458	0.00462	0.00511	0.00534	0.00492	0.00674	0.00583	0.00566	0.00484	0.00522	0.00546	0.00534	0.00620	0.00579	0.00599	0.00594	0.00628
Germany	0.03435	0.03488	0.03394	0.03351	0.03348	0.03246	0.03260	0.03190	0.03145	0.03038	0.03070	0.03143	0.03156	0.02701	0.02711	0.02732	0.02548	0.02849	0.02762	0.02454
Greece	0.10234	0.09729	0.10039	0.09808	0.09571	0.09775	0.08702	0.08470	0.08237	0.08048	0.08448	0.08592	0.08415	0.08037	0.08026	0.08417	0.06967	0.06536	0.06580	0.04209
Hungary	0.03493	0.03471	0.03598	0.03601	0.03606	0.03600	0.03530	0.03563	0.03560	0.03428	0.03336	0.03277	0.03257	0.03534	0.03266	0.02718	0.02760	0.02783	0.02609	0.03041
Ireland	0.06534	0.06559	0.06605	0.06473	0.06443	0.06416	0.06249	0.06232	0.06204	0.06151	0.05670	0.05901	0.05606	0.05326	0.05071	0.05001	0.04593	0.04415	0.04028	0.03915
Italy	0.03598	0.03433	0.03351	0.03282	0.03226	0.03415	0.03282	0.03217	0.03211	0.03096	0.03116	0.03015	0.03151	0.03199	0.02874	0.02583	0.02683	0.02656	0.02470	0.02394
Latvia			0.05390	0.05245	0.04828	0.04599	0.05038	0.04190	0.03807	0.04196	0.03844	0.03646	0.03617	0.03513	0.03200	0.02840	0.02735	0.02514	0.02302	0.02203
Lithuania			0.03581	0.03581	0.04144	0.03363	0.03337	0.03252	0.03394	0.03433	0.03084	0.02841	0.02383	0.02195	0.02197	0.02414	0.02168	0.01818	0.01610	0.01530
Luxembourg	0.01748	0.01668	0.01676	0.01664	0.01523	0.01190	0.01073	0.00725	0.00318	0.00362	0.00354	0.00311	0.00274	0.00276	0.00270	0.00592	0.00704	0.00678	0.00719	0.00720
Malta			0.16590	0.22562	0.18861	0.15561	0.15823	0.15226	0.15145	0.14687	0.13315	0.16374	0.15192	0.15386	0.14847	0.13538	0.14212	0.17166	0.15206	0.16888
Netherlands	0.04655	0.04525	0.04427	0.04543	0.04242	0.03675	0.03506	0.03388	0.03300	0.03287	0.03166	0.03276	0.03177	0.03209	0.03130	0.03061	0.02910	0.02895	0.02843	0.02817
Poland	0.04633	0.04581	0.04609	0.04603	0.04635	0.04850	0.04789	0.04811	0.04795	0.04805	0.04851	0.04751	0.04742	0.04740	0.04744	0.04897	0.04493	0.04625	0.04155	0.04112
Portugal	0.04368	0.04404	0.05251	0.04605	0.04396	0.04844	0.03654	0.03902	0.03986	0.04558	0.04058	0.03740	0.04333	0.03497	0.03821	0.04177	0.02967	0.02299	0.03065	0.02696
Romania			0.08396	0.07880	0.09348	0.09028	0.09106	0.07895	0.07200	0.07504	0.08119	0.08280	0.08458	0.09246	0.08570	0.07951	0.08944	0.09125	0.08978	0.08871
Slovak Republic	0.03245	0.03334	0.03091	0.03540	0.03076	0.03237	0.03119	0.03256	0.03032	0.02935	0.02304	0.02084	0.01856	0.02202	0.02074	0.02222	0.02060	0.02020	0.01610	0.01484
Slovenia	0.02896	0.02408	0.02782	0.02888	0.02608	0.02639	0.02509	0.02941	0.02983	0.02739	0.02723	0.02845	0.02989	0.02954	0.02743	0.03191	0.02865	0.02976	0.02539	0.02889
Spain	0.04457	0.04400	0.04950	0.04340	0.04286	0.04731	0.03733	0.04090	0.03975	0.04638	0.04487	0.03984	0.04529	0.03948	0.03983	0.04254	0.02012	0.02214	0.01846	0.01170
Sweden	0.00342	0.00416	0.00362	0.00369	0.00399	0.00354	0.00524	0.00360	0.00377	0.00347	0.00294	0.00298	0.00366	0.00421	0.00361	0.00328	0.00336	0.00276	0.00296	0.00307
European Union - 27			**0.03567**	**0.03409**	**0.03408**	**0.03362**	**0.03301**	**0.03210**	**0.03173**	**0.03101**	**0.03097**	**0.03059**	**0.03089**	**0.03036**	**0.02972**	**0.02902**	**0.02671**	**0.02733**	**0.02626**	**0.02436**
SUBTOTAL																				

2009 5-yr rolling average: Amount used per year, kWh	Scope 3 Total Direct GHG: kg CO_2 per kWh	Scope 3 Total Direct GHG: Total kg CO_2	Scope 3 Total Indirect GHG: kg CO_2e per kWh	Scope 3 Total Indirect GHG: Total kg CO_2e	All Scopes Grand Total GHG: kg CO_2e per kWh	All Scopes Grand Total GHG: Total kg CO_2e	% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
	0.01261		0.00171		0.01432		78.7%	21.3%	5.5%	8.0%
	0.01261		0.00171		0.01432		91.4%	8.6%	4.9%	4.2%
	0.07903		0.01075		0.08978		74.2%	25.8%	14.9%	12.8%
	0.03290		0.00447		0.03737		100.0%	0.0%	4.1%	0.0%
	0.06328		0.00860		0.07188		70.4%	29.6%	7.8%	17.0%
	0.04316		0.00587		0.04903		52.4%	47.6%	5.4%	20.1%
	0.12002		0.01632		0.13634		58.7%	41.3%	14.4%	14.4%
	0.00984		0.00134		0.01118		59.8%	40.2%	3.6%	6.0%
	0.00604		0.00082		0.00686		92.5%	7.5%	7.0%	0.0%
	0.02669		0.00363		0.03032		77.0%	23.0%	5.2%	7.8%
	0.06542		0.00890		0.07432		99.1%	0.9%	8.1%	0.0%
	0.02782		0.00378		0.03160		69.8%	30.2%	10.4%	1.5%
	0.04390		0.00597		0.04987		100.0%	0.0%	7.9%	0.0%
	0.02557		0.00348		0.02905		84.9%	15.1%	6.3%	0.0%
	0.02519		0.00343		0.02862		39.1%	60.9%	11.4%	15.4%
	0.01908		0.00259		0.02167		50.9%	49.1%	11.2%	14.8%
	0.00683		0.00093		0.00776		87.9%	12.1%	1.9%	0.0%
	0.15402		0.02094		0.17496		100.0%	0.0%	14.2%	0.0%
	0.02905		0.00395		0.03300		72.1%	27.9%	4.1%	17.7%
	0.04456		0.00606		0.05062		63.5%	36.5%	11.0%	0.0%
	0.03041		0.00413		0.03454		92.4%	7.6%	7.4%	0.0%
	0.08774		0.01193		0.09967		66.5%	33.5%	14.3%	21.8%
	0.01879		0.00255		0.02134		70.2%	29.8%	5.0%	14.7%
	0.02892		0.00393		0.03285		85.7%	14.3%	6.5%	15.5%
	0.02299		0.00313		0.02612		100.0%	0.0%	5.9%	0.0%
	0.00309		0.00042		0.00351		74.5%	25.5%	7.7%	3.9%
	0.02674		**0.00364**		**0.03038**		**81.6%**	**18.4%**	**6.8%**	**7.7%**
		0		**0**		**0**				

[2] Emissions factors for electricity and heat LOSSES in 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: May-12

Table 10b - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: 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	2007	2008	2009
Other countries																				
Australia	0.07548	0.07586	0.07644	0.07502	0.07445	0.07499	0.07625	0.07647	0.07996	0.08006	0.07899	0.07960	0.08599	0.08498	0.08323	0.07453	0.08498	0.06833	0.06795	0.06787
Brazil			0.01148	0.01043	0.00963	0.01041	0.01075	0.01171	0.01171	0.01548	0.01650	0.01945	0.01605	0.01485	0.01601	0.01552	0.01522	0.01323	0.01671	0.01261
Canada	0.01480	0.01423	0.01489	0.01331	0.01306	0.01341	0.01297	0.01437	0.01608	0.01543	0.01614	0.01681	0.01571	0.01662	0.01555	0.01761	0.02016	0.02169	0.01794	0.01646
People's Rep. of China			0.05331	0.05328	0.05153	0.05388	0.05507	0.05397	0.05523	0.05353	0.05131	0.04964	0.05022	0.05206	0.05404	0.05484	0.05148	0.04712	0.04295	0.03792
Chinese Taipei			0.02350	0.02457	0.02450	0.02497	0.02526	0.02669	0.02703	0.02788	0.02932	0.03000	0.02955	0.03044	0.03025	0.02960	0.02525	0.02955	0.02657	0.02963
Croatia			0.05203	0.05256	0.04000	0.04359	0.04056	0.04774	0.05174	0.04909	0.04867	0.05021	0.05725	0.06094	0.04815	0.04685	0.04195	0.05380	0.03896	0.03696
Egypt			0.07666	0.07283	0.06752	0.06416	0.06263	0.06401	0.06766	0.06579	0.05960	0.05514	0.06320	0.06260	0.06848	0.09310	0.06051	0.05811	0.05736	0.05723
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	0.00000	0.00000	0.00000
Hong Kong, China			0.09743	0.10234	0.10261	0.10154	0.09774	0.08590	0.08781	0.08499	0.08451	0.08548	0.08609	0.09439	0.08893	0.09257	0.08687	0.09518	0.08893	0.09372
Iceland	0.00004	0.00003	0.00003	0.00006	0.00006	0.00012	0.00008	0.00008	0.00020	0.00026	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00003	0.00010	0.00003	0.00002
India			0.33770	0.34786	0.33562	0.35553	0.37206	0.36071	0.35392	0.35555	0.36305	0.36332	0.35785	0.35192	0.36718	0.33751	0.32294	0.30330	0.30731	0.29791
Indonesia			0.08585	0.09831	0.08720	0.08414	0.08660	0.09366	0.09019	0.09305	0.09296	0.09693	0.09639	0.10229	0.09978	0.10056	0.09804	0.09630	0.08764	0.08510
Israel	0.02731	0.02719	0.02672	0.02724	0.02710	0.02721	0.02737	0.02716	0.02528	0.02535	0.02531	0.02541	0.02743	0.02719	0.02654	0.02543	0.02280	0.02325	0.01782	0.02693
Japan	0.02189	0.02141	0.02171	0.02076	0.02165	0.02070	0.02056	0.01982	0.01921	0.02000	0.02019	0.02022	0.02127	0.02239	0.02152	0.02182	0.02120	0.02264	0.02311	0.02226
DPR of Korea			0.01921	0.01788	0.01797	0.01703	0.01842	0.01975	0.01768	0.01955	0.02065	0.02062	0.02010	0.01918	0.01870	0.01879	0.01971	0.01790	0.01774	0.01977
Malaysia			0.02447	0.02351	0.02151	0.02141	0.02148	0.01907	0.02067	0.01994	0.01946	0.02045	0.02235	0.02011	0.02199	0.02729	0.00854	0.01158	0.01864	0.02687
Mexico	0.11471	0.11829	0.11289	0.11389	0.12388	0.11246	0.11143	0.11613	0.11991	0.11511	0.11682	0.11722	0.11662	0.11923	0.10347	0.10906	0.10134	0.10232	0.09248	0.09605
New Zealand	0.00890	0.00965	0.01242	0.00993	0.00804	0.00721	0.00914	0.01309	0.01163	0.01412	0.01324	0.01674	0.01432	0.01739	0.01599	0.01913	0.01872	0.01569	0.01803	0.01379
Norway	0.00035	0.00047	0.00040	0.00043	0.00054	0.00046	0.00064	0.00057	0.00056	0.00062	0.00042	0.00060	0.00054	0.00086	0.00074	0.00050	0.00066	0.00069	0.00059	0.00169
Pakistan			0.13508	0.13200	0.13438	0.13911	0.15207	0.15588	0.14135	0.16072	0.16471	0.15905	0.15214	0.12737	0.13649	0.12797	0.12510	0.10966	0.12300	0.11571
Philippines			0.06909	0.06785	0.07075	0.07494	0.07735	0.08120	0.08261	0.07399	0.08104	0.07866	0.07370	0.07421	0.07415	0.07462	0.06527	0.07098	0.07598	0.07045
Russian Federation			0.02809	0.02560	0.02603	0.02565	0.03007	0.02887	0.02870	0.02875	0.02821	0.02827	0.02872	0.02896	0.02854	0.02253	0.03534	0.03452	0.03576	0.03609
Saudi Arabia			0.07334	0.07389	0.07341	0.07334	0.07217	0.07278	0.07334	0.07304	0.07261	0.07010	0.06769	0.06646	0.06799	0.10188	0.06344	0.07165	0.07558	0.07415
Singapore			0.05869	0.07005	0.06673	0.06391	0.06090	0.05335	0.05106	0.05273	0.05316	0.05056	0.04634	0.04167	0.03950	0.03233	0.03062	0.03122	0.03097	0.03102
South Africa			0.10960	0.11283	0.11066	0.11253	0.11030	0.11142	0.11886	0.11402	0.11444	0.10623	0.10501	0.10880	0.11164	0.06560	0.09134	0.08766	0.10560	0.11637
Switzerland	0.00268	0.00299	0.00310	0.00244	0.00238	0.00259	0.00289	0.00272	0.00321	0.00270	0.00276	0.00274	0.00300	0.00300	0.00309	0.00341	0.00334	0.00311	0.00305	0.00301
Thailand			0.05607	0.05466	0.05409	0.05232	0.05288	0.05499	0.05276	0.05172	0.04919	0.04913	0.04752	0.04648	0.04710	0.04732	0.04467	0.03803	0.03496	0.03332
Turkey	0.10497	0.10466	0.10286	0.09328	0.10163	0.09464	0.09620	0.09690	0.09796	0.10136	0.09581	0.10044	0.08716	0.08201	0.07745	0.07304	0.07037	0.07636	0.07855	0.08214
Ukraine			0.11122	0.11590	0.10862	0.10919	0.09496	0.09212	0.09453	0.09656	0.09876	0.09384	0.09247	0.10849	0.09012	0.08976	0.08839	0.08723	0.09152	0.08752
United States			0.04386	0.04349	0.04342	0.04327	0.04363	0.04605	0.04509	0.04411	0.04377	0.04608	0.04239	0.04264	0.04267	0.04124	0.04032	0.03988	0.03605	0.03637
Africa			**0.11363**	**0.11549**	**0.11430**	**0.11579**	**0.11305**	**0.11414**	**0.11871**	**0.11343**	**0.11112**	**0.10402**	**0.10445**	**0.10692**	**0.10873**	**0.08638**	**0.08810**	**0.08020**	**0.09117**	**0.09425**
Latin America			**0.03626**	**0.03412**	**0.03245**	**0.03300**	**0.03238**	**0.03273**	**0.03396**	**0.03376**	**0.03417**	**0.03595**	**0.03536**	**0.03546**	**0.03504**	**0.03553**	**0.03558**	**0.03480**	**0.03578**	**0.03553**
Middle East			**0.10097**	**0.10197**	**0.10370**	**0.10335**	**0.10185**	**0.10163**	**0.10105**	**0.10258**	**0.10237**	**0.10336**	**0.10124**	**0.09794**	**0.10028**	**0.11234**	**0.10272**	**0.10214**	**0.10767**	**0.12952**
Non-OECD Europe and Eurasia			**0.04169**	**0.03920**	**0.03947**	**0.03870**	**0.04221**	**0.04087**	**0.04086**	**0.04071**	**0.04082**	**0.04045**	**0.04094**	**0.04207**	**0.04065**	**0.04873**	**0.04573**	**0.04458**	**0.04565**	**0.04479**
SUBTOTAL																				
GRAND TOTAL																				

2009 5-yr rolling average: Amount used per year, kWh	Scope 3 Total Direct GHG: kg CO_2 per kWh	Total kg CO_2	Scope 3 Total Indirect GHG: kg CO_2e per kWh	Total kg CO_2e	All Scopes Grand Total GHG: kg CO_2e per kWh	Total kg CO_2e	% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
	0.07273		0.00989		0.08262		100.0%	0.0%	7.6%	0.0%
	0.01466		0.00199		0.01665		99.7%	0.3%	15.8%	0.0%
	0.01877		0.00255		0.02132		98.5%	1.5%	9.1%	0.0%
	0.04686		0.00637		0.05323		81.7%	18.3%	6.8%	1.4%
	0.02812		0.00382		0.03194		100.0%	0.0%	4.1%	0.0%
	0.04370		0.00594		0.04964		78.8%	21.2%	11.4%	13.8%
	0.06526		0.00887		0.07413		100.0%	0.0%	12.2%	0.0%
	0.00000		0.00000		0.00000		100.0%	0.0%	0.0%	0.0%
	0.09145		0.01243		0.10388		100.0%	0.0%	10.7%	0.0%
	0.00004		0.00001		0.00005		81.3%	18.7%	4.0%	11.8%
	0.31379		0.04267		0.35646		100.0%	0.0%	25.1%	0.0%
	0.09953		0.01272		0.10625		100.0%	0.0%	11.2%	0.0%
	0.02325		0.00316		0.02641		100.0%	0.0%	3.0%	0.0%
	0.02221		0.00302		0.02523		99.4%	0.6%	4.9%	0.0%
	0.01878		0.00255		0.02133		88.7%	11.3%	3.8%	2.2%
	0.01858		0.00253		0.02111		100.0%	0.0%	2.9%	0.0%
	0.10025		0.01363		0.11388		100.0%	0.0%	17.5%	0.0%
	0.01707		0.00232		0.01939		99.2%	0.8%	7.6%	0.0%
	0.00083		0.00011		0.00094		97.1%	2.9%	8.4%	12.7%
	0.12029		0.01636		0.13665		100.0%	0.0%	22.1%	0.0%
	0.07146		0.00972		0.08118		100.0%	0.0%	13.2%	0.0%
	0.03285		0.00447		0.03732		37.5%	62.5%	13.6%	7.0%
	0.07734		0.01052		0.08786		100.0%	0.0%	9.4%	0.0%
	0.03123		0.00425		0.03548		100.0%	0.0%	5.6%	0.0%
	0.09331		0.01269		0.10600		100.0%	0.0%	9.6%	0.0%
	0.00318		0.00043		0.00361		93.1%	6.9%	6.8%	8.9%
	0.03966		0.00539		0.04505		100.0%	0.0%	7.0%	0.0%
	0.07609		0.01035		0.08644		94.2%	5.8%	15.2%	0.0%
	0.08888		0.01209		0.10097		54.2%	45.8%	15.1%	25.2%
	0.03877		0.00527		0.04404		97.0%	3.0%	6.5%	15.7%
	0.08802		**0.01197**		**0.09999**		**100.0%**	**0.0%**	**12.2%**	**0.0%**
	0.03544		**0.00482**		**0.04026**		**99.9%**	**0.1%**	**16.6%**	**0.0%**
	0.11088		**0.01508**		**0.12596**		**100.0%**	**0.0%**	**13.9%**	**0.0%**
	0.04590		**0.00624**		**0.05214**		**43.1%**	**56.9%**	**13.9%**	**10.1%**
		0		**0**		**0**				
		0		**0**		**0**				

Source

Emission factor data is from the International Energy Agency (IEA) Data Services, 2011 for "CO_2 Emissions per kWh from electricity and heat generation" and mainly sourced from the GHG Protocol website, http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat 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 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 roughly a similar ratio CO_2 emission factors as for the UK (which is 13.6%), 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 consumed are calculated using % distribution losses for the 5-year average, 2005-2009.

Table 10c

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: 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	2007	2008	2009
European Union																				
Austria	0.26080	0.26857	0.22251	0.20638	0.22060	0.22812	0.24444	0.24256	0.22138	0.20597	0.19206	0.21424	0.21007	0.24839	0.23910	0.23296	0.22709	0.21308	0.19667	0.17355
Belgium	0.36232	0.35879	0.34720	0.36160	0.38276	0.37518	0.35573	0.32619	0.33134	0.29253	0.29912	0.28561	0.28010	0.28844	0.29511	0.28548	0.27277	0.26183	0.26162	0.22861
Bulgaria			0.56571	0.57405	0.54393	0.51128	0.49906	0.56093	0.57124	0.53145	0.51476	0.55527	0.51729	0.56205	0.56592	0.52910	0.51636	0.60817	0.57286	0.53771
Cyprus			0.87435	0.87515	0.87913	0.86897	0.88002	0.88911	0.89116	0.90502	0.88522	0.82160	0.79900	0.88064	0.81631	0.82074	0.79831	0.79793	0.78371	0.77388
Czech Republic	0.66963	0.66038	0.64470	0.65899	0.66780	0.67437	0.65523	0.65625	0.66085	0.65029	0.66875	0.65441	0.62901	0.58789	0.58898	0.59090	0.58777	0.61555	0.59976	0.57391
Denmark	0.54282	0.57673	0.53774	0.52367	0.53564	0.49444	0.53710	0.48720	0.45121	0.42212	0.39577	0.39177	0.38743	0.41585	0.36119	0.33083	0.39854	0.36688	0.34927	0.34783
Estonia	0.67525	0.66003	0.74593	0.71806	0.71894	0.81807	0.81300	0.79925	0.85979	0.84361	0.83278	0.81711	0.79673	0.86284	0.84450	0.82862	0.76311	0.88937	0.87326	0.81058
Finland	0.23763	0.24291	0.21459	0.24012	0.27732	0.25888	0.29367	0.27237	0.22176	0.22186	0.22123	0.25220	0.26407	0.30515	0.26478	0.20225	0.25168	0.23968	0.19610	0.21526
France	0.11653	0.13119	0.10471	0.07255	0.07321	0.08075	0.08452	0.07778	0.10656	0.09232	0.08961	0.07667	0.08261	0.08636	0.08446	0.09941	0.09237	0.09597	0.09269	0.09613
Germany	0.58700	0.59590	0.57981	0.57249	0.57203	0.55468	0.55696	0.54499	0.53730	0.51920	0.52451	0.53693	0.53924	0.46140	0.46324	0.43326	0.42973	0.49664	0.46880	0.45504
Greece	1.09243	1.03849	1.07166	1.04697	1.02157	1.04340	0.92888	0.90415	0.87929	0.85910	0.90181	0.91713	0.89832	0.85789	0.85669	0.85985	0.79695	0.81474	0.81066	0.76449
Hungary	0.45461	0.45171	0.46826	0.46863	0.46931	0.46846	0.45935	0.46365	0.46325	0.44613	0.43409	0.42645	0.42394	0.45999	0.42509	0.36783	0.37152	0.37360	0.35693	0.33247
Ireland	0.80532	0.80841	0.81412	0.79770	0.79410	0.79078	0.77011	0.76809	0.76456	0.75807	0.69880	0.72722	0.69094	0.65643	0.62493	0.63180	0.59138	0.54788	0.51826	0.50439
Italy	0.61053	0.58252	0.56861	0.55694	0.54735	0.57947	0.55867	0.54577	0.54491	0.52535	0.52884	0.51166	0.53455	0.54285	0.48760	0.47433	0.49476	0.46648	0.44599	0.41035
Latvia			0.33385	0.32492	0.29906	0.28485	0.31204	0.25954	0.23582	0.25993	0.23807	0.22584	0.22406	0.21763	0.19823	0.19018	0.19466	0.18919	0.18525	0.17510
Lithuania			0.22110	0.22105	0.25587	0.20759	0.20600	0.20080	0.20948	0.21195	0.19040	0.17539	0.14712	0.13554	0.13565	0.16015	0.15961	0.13917	0.13080	0.12645
Luxembourg	2.56907	2.45150	2.46324	2.44575	2.23973	1.75021	1.57635	1.06610	0.46793	0.53231	0.52046	0.45717	0.40370	0.40581	0.39680	0.39532	0.39439	0.38630	0.38882	0.39149
Malta			1.18639	1.61346	1.34876	1.11286	1.13153	1.08884	1.08309	1.05033	0.95217	1.17097	1.08635	1.10030	1.06179	1.16916	1.09627	1.18355	1.00077	1.01930
Netherlands	0.63490	0.61706	0.60379	0.61953	0.57856	0.50115	0.47816	0.46202	0.45002	0.44835	0.43168	0.44680	0.43325	0.43772	0.42681	0.41767	0.42342	0.42867	0.42051	0.40266
Poland	0.68691	0.67918	0.68328	0.68230	0.68717	0.71901	0.70995	0.71316	0.71086	0.71222	0.71927	0.70421	0.70296	0.70265	0.70338	0.69941	0.70222	0.70538	0.69705	0.68132
Portugal	0.55988	0.56447	0.67298	0.59012	0.56346	0.62084	0.46838	0.50009	0.51081	0.58422	0.52010	0.47933	0.55529	0.44822	0.48971	0.54264	0.44749	0.40761	0.41418	0.39520
Romania			0.49325	0.46289	0.54918	0.53034	0.53498	0.46381	0.42297	0.44086	0.47699	0.48644	0.49690	0.54318	0.50350	0.48216	0.52845	0.54474	0.52958	0.50306
Slovak Republic	0.40804	0.41923	0.38862	0.44515	0.38685	0.40703	0.39222	0.40954	0.38126	0.36911	0.28973	0.26200	0.23343	0.27680	0.26076	0.25122	0.24401	0.24949	0.23364	0.23656
Slovenia	0.38885	0.32328	0.37350	0.38766	0.35015	0.35436	0.33688	0.39481	0.40042	0.36779	0.36554	0.38193	0.40138	0.39661	0.36816	0.37650	0.38361	0.39641	0.35423	0.34492
Spain	0.47172	0.46561	0.52385	0.45924	0.45365	0.50074	0.39507	0.43287	0.42067	0.49077	0.47481	0.42156	0.47931	0.41786	0.42159	0.43938	0.38887	0.40923	0.34504	0.31048
Sweden	0.05169	0.06286	0.05460	0.05573	0.06027	0.05355	0.07914	0.05439	0.05696	0.05241	0.04446	0.04503	0.05536	0.06360	0.05459	0.04732	0.05132	0.04280	0.04303	0.04621
European Union - 27			**0.47445**	**0.45350**	**0.45339**	**0.44737**	**0.43913**	**0.42697**	**0.42217**	**0.41260**	**0.41199**	**0.40698**	**0.41092**	**0.40391**	**0.39547**	**0.38732**	**0.38917**	**0.40036**	**0.38111**	**0.36327**
SUBTOTAL																				

2009 5-yr rolling average: Amount used per year, kWh	Scope 2, 3[1] Total Direct GHG: kg CO_2 per kWh	Total kg CO_2	Scope 3 Total Indirect GHG: kg CO_2e per kWh	Total kg CO_2e	All Scopes Grand Total GHG: kg CO_2e per kWh	Total kg CO_2e	% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
	0.20867		0.02837		0.23704		78.7%	21.3%	5.5%	8.0%
	0.26206		0.03563		0.29769		91.4%	8.6%	4.9%	4.2%
	0.55284		0.07517		0.62801		74.2%	25.8%	14.9%	12.8%
	0.79491		0.10809		0.90300		100.0%	0.0%	4.1%	0.0%
	0.59358		0.08071		0.67429		70.4%	29.6%	7.8%	17.0%
	0.35867		0.04877		0.40744		52.4%	47.6%	5.4%	20.1%
	0.83299		0.11326		0.94625		58.7%	41.3%	14.4%	14.4%
	0.22099		0.03005		0.25104		59.8%	40.2%	3.6%	6.0%
	0.09531		0.01296		0.10827		92.5%	7.5%	7.0%	0.0%
	0.45669		0.06210		0.51879		77.0%	23.0%	5.2%	7.8%
	0.80934		0.11005		0.91939		99.1%	0.9%	8.1%	0.0%
	0.36047		0.04901		0.40948		69.8%	30.2%	10.4%	1.5%
	0.55874		0.07597		0.63471		100.0%	0.0%	7.9%	0.0%
	0.45938		0.06233		0.52071		84.9%	15.1%	6.3%	0.0%
	0.18688		0.02541		0.21229		39.1%	60.9%	11.4%	15.4%
	0.14324		0.01948		0.16272		50.9%	49.1%	11.2%	14.8%
	0.39126		0.05320		0.44446		87.9%	12.1%	1.9%	0.0%
	0.09381		0.14873		1.24254		100.0%	0.0%	14.2%	0.0%
	0.41859		0.05692		0.47551		72.1%	27.9%	4.1%	17.7%
	0.69708		0.09478		0.79186		63.5%	36.5%	11.0%	0.0%
	0.44142		0.06002		0.50144		92.4%	7.6%	7.4%	0.0%
	0.51760		0.07038		0.58798		66.5%	33.5%	14.3%	21.8%
	0.24298		0.03304		0.27602		70.2%	29.8%	5.0%	14.7%
	0.37113		0.05046		0.42159		85.7%	14.3%	6.5%	15.5%
	0.37860		0.05148		0.43008		100.0%	0.0%	5.9%	0.0%
	0.04614		0.00627		0.05241		74.5%	25.5%	7.7%	3.9%
	0.38425		**0.05225**		**0.43650**		**81.6%**	**18.4%**	**6.8%**	**7.7%**
		0		**0**		**0**				

Annex 10 - International Electricity Emission Factors

Last updated: May-12

Table 10c - continued

Overseas Electricity/Heat Conversion Factors from 1990 to 2009: 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	2007	2008	2009
Other countries																				
Australia	0.89066	0.89510	0.90196	0.88517	0.87853	0.88486	0.89967	0.90236	0.94349	0.94470	0.93202	0.93922	1.01474	1.00281	0.98203	0.98424	1.01060	0.94464	0.92355	0.92080
Brazil			0.07247	0.06584	0.06080	0.06571	0.06786	0.07393	0.07393	0.09769	0.10411	0.12280	0.10130	0.09371	0.10104	0.09947	0.09622	0.08600	0.10556	0.07674
Canada	0.21825	0.20988	0.21958	0.19629	0.19261	0.19777	0.19124	0.21201	0.23727	0.22758	0.23809	0.24791	0.23179	0.24513	0.22942	0.21779	0.22145	0.21900	0.20566	0.18369
People's Rep. of China			0.84755	0.84714	0.81934	0.85668	0.87563	0.85803	0.87815	0.85110	0.81590	0.78926	0.79843	0.82773	0.85926	0.84204	0.83894	0.80535	0.78719	0.78049
Chinese Taipei			0.52563	0.54972	0.54806	0.55843	0.56486	0.59710	0.60447	0.62364	0.65570	0.67095	0.66088	0.68097	0.67656	0.68089	0.68442	0.68485	0.67681	0.66441
Croatia			0.37621	0.38002	0.28922	0.31518	0.29329	0.34519	0.37404	0.35494	0.35194	0.36307	0.41391	0.44061	0.34816	0.36076	0.36213	0.43867	0.38045	0.32035
Egypt			0.60634	0.57603	0.53400	0.50747	0.49540	0.50627	0.53514	0.52036	0.47143	0.43615	0.49989	0.49508	0.54164	0.56713	0.53394	0.50852	0.51712	0.52276
Gibraltar			0.77368	0.77337	0.75148	0.76592	0.75199	0.77284	0.76592	0.76594	0.75981	0.75378	0.75998	0.75451	0.76593	0.76066	0.77101	0.77087	0.75670	0.73952
Hong Kong, China			0.91806	0.96438	0.96695	0.95680	0.92097	0.80949	0.82749	0.80093	0.79633	0.80544	0.81125	0.88944	0.83805	0.84801	0.84078	0.86991	0.84635	0.85669
Iceland	0.00056	0.00052	0.00049	0.00086	0.00086	0.00174	0.00127	0.00117	0.00312	0.00401	0.00067	0.00065	0.00065	0.00066	0.00065	0.00065	0.00057	0.00147	0.00078	0.00044
India			1.19388	1.22977	1.18651	1.25691	1.31535	1.27520	1.25124	1.25696	1.28347	1.28446	1.26511	1.24415	1.29811	1.26034	1.24373	1.24665	1.26157	1.24932
Indonesia			0.68942	0.78939	0.70021	0.67563	0.69538	0.75212	0.72422	0.74717	0.74641	0.77831	0.77403	0.82136	0.80117	0.81700	0.83611	0.87120	0.83954	0.83079
Israel	0.83549	0.83179	0.81743	0.83347	0.82912	0.83222	0.83733	0.83079	0.77322	0.77546	0.77424	0.77736	0.83923	0.83180	0.81175	0.80341	0.78105	0.77861	0.73011	0.72181
Japan	0.45639	0.44635	0.45260	0.43274	0.45146	0.43167	0.42857	0.41335	0.40046	0.41678	0.42078	0.42171	0.44335	0.46682	0.44868	0.45094	0.43965	0.47482	0.46072	0.43697
DPR of Korea			0.56199	0.52287	0.52564	0.49824	0.53898	0.57780	0.51734	0.57196	0.60424	0.60322	0.58811	0.56095	0.54716	0.54059	0.55291	0.48647	0.49910	0.51863
Malaysia			0.62278	0.59855	0.54731	0.54494	0.54667	0.48544	0.52600	0.50736	0.49537	0.52062	0.56890	0.51182	0.55992	0.63225	0.61554	0.62223	0.67456	0.67552
Mexico	0.66400	0.68470	0.65346	0.65925	0.71710	0.65098	0.64500	0.67222	0.69406	0.66630	0.67620	0.67854	0.67502	0.69018	0.59892	0.61837	0.58558	0.58147	0.52280	0.55103
New Zealand	0.11635	0.12605	0.16232	0.12982	0.10505	0.09416	0.11948	0.17104	0.15196	0.18444	0.17300	0.21870	0.18717	0.22726	0.20892	0.25270	0.24687	0.20984	0.23086	0.18029
Norway	0.00377	0.00500	0.00427	0.00461	0.00570	0.00495	0.00693	0.00605	0.00606	0.00662	0.00448	0.00643	0.00584	0.00919	0.00786	0.00606	0.00761	0.00814	0.00700	0.01898
Pakistan			0.52827	0.51623	0.52553	0.54403	0.59470	0.60962	0.55278	0.62855	0.64416	0.62202	0.59497	0.49813	0.53375	0.50797	0.53828	0.54231	0.57412	0.57343
Philippines			0.49052	0.48166	0.50225	0.53201	0.54913	0.57639	0.58646	0.52529	0.57529	0.55838	0.52316	0.52683	0.52640	0.57010	0.49830	0.51874	0.56275	0.54861
Russian Federation			0.34748	0.31671	0.32205	0.31741	0.37195	0.35719	0.35506	0.35571	0.34897	0.34975	0.35538	0.35826	0.35311	0.34750	0.36391	0.35702	0.36127	0.35349
Saudi Arabia			0.88683	0.89346	0.88769	0.88678	0.87269	0.88001	0.88685	0.88326	0.87799	0.84763	0.81856	0.80362	0.82213	0.84104	0.81253	0.79776	0.81119	0.83138
Singapore			0.89998	1.07416	1.02331	0.98011	0.93402	0.81820	0.78288	0.80857	0.81514	0.77528	0.71062	0.63901	0.60576	0.57581	0.56088	0.55929	0.55241	0.54988
South Africa			0.96491	0.99335	0.97427	0.99066	0.97097	0.98091	1.04633	1.00375	1.00747	0.93515	0.92442	0.95788	0.98282	0.91701	0.92285	0.91485	1.05334	1.04227
Switzerland	0.03763	0.04195	0.04345	0.03427	0.03340	0.03632	0.04058	0.03808	0.04498	0.03777	0.03873	0.03843	0.04202	0.04204	0.04336	0.04954	0.04883	0.04410	0.04347	0.04294
Thailand			0.70237	0.68474	0.67750	0.65538	0.66240	0.68883	0.66090	0.64796	0.61620	0.61545	0.59518	0.58221	0.58991	0.58273	0.55559	0.58443	0.56382	0.54670
Turkey	0.67339	0.67141	0.65987	0.59839	0.65202	0.60712	0.61715	0.62164	0.62838	0.65026	0.61467	0.64433	0.55915	0.52608	0.49683	0.49942	0.50859	0.55457	0.57383	0.56207
Ukraine			0.50179	0.52290	0.49005	0.49263	0.42843	0.41562	0.42653	0.43567	0.44558	0.42338	0.41722	0.48948	0.40660	0.42091	0.43390	0.44748	0.47763	0.46148
United States			0.63100	0.62571	0.62459	0.62250	0.62772	0.66250	0.64874	0.63460	0.62966	0.66289	0.60972	0.61346	0.61380	0.61088	0.58262	0.58909	0.57124	0.54454
Africa			**0.78618**	**0.79908**	**0.79086**	**0.80109**	**0.78214**	**0.78973**	**0.82135**	**0.78478**	**0.76877**	**0.71971**	**0.72268**	**0.73976**	**0.75231**	**0.71709**	**0.71335**	**0.69492**	**0.75671**	**0.73751**
Latin America			**0.22004**	**0.20704**	**0.19689**	**0.20025**	**0.19647**	**0.19858**	**0.20604**	**0.20488**	**0.20734**	**0.21817**	**0.21457**	**0.21518**	**0.21264**	**0.21314**	**0.21378**	**0.21092**	**0.21987**	**0.21033**
Middle East			**0.79874**	**0.80669**	**0.82040**	**0.81755**	**0.80572**	**0.80397**	**0.79937**	**0.81144**	**0.80977**	**0.81767**	**0.80082**	**0.77477**	**0.79330**	**0.80079**	**0.79507**	**0.78141**	**0.79859**	**0.81978**
Non-OECD Europe and Eurasia			**0.39289**	**0.36946**	**0.37191**	**0.36473**	**0.39782**	**0.38516**	**0.38503**	**0.38361**	**0.38464**	**0.38112**	**0.38584**	**0.39646**	**0.38309**	**0.39126**	**0.39917**	**0.39364**	**0.39862**	**0.38891**
SUBTOTAL																				
GRAND TOTAL																				

2009 5-yr rolling average: Amount used per year, kWh	Scope 2, 3 [4] Total Direct GHG: kgCO_2 per kWh	Total kgCO_2	Scope 3 Total Indirect GHG: kgCO_2e per kWh	Total kgCO_2e	All Scopes Grand Total GHG: kgCO_2e per kWh	Total kgCO_2e	% Total GWh: Electricity	% Total GWh: Heat	% Distribution Losses: Electricity	% Distribution Losses: Heat
	0.95677		0.13009		1.08686		100.0%	0.0%	7.6%	0.0%
	0.09280		0.01262		0.10542		99.7%	0.3%	15.8%	0.0%
	0.20952		0.02849		0.23801		98.5%	1.5%	9.1%	0.0%
	0.81080		0.11025		0.92105		81.7%	18.3%	6.8%	1.4%
	0.67828		0.09223		0.77051		100.0%	0.0%	4.1%	0.0%
	0.37247		0.05065		0.42312		78.8%	21.2%	11.4%	13.8%
	0.52989		0.07205		0.60194		100.0%	0.0%	12.2%	0.0%
	0.75975		0.10330		0.86305		100.0%	0.0%	0.0%	0.0%
	0.85235		0.11590		0.96825		100.0%	0.0%	10.7%	0.0%
	0.00078		0.00011		0.00089		81.3%	18.7%	4.0%	11.8%
	1.25232		0.17028		1.42260		100.0%	0.0%	25.1%	0.0%
	0.83893		0.11407		0.95300		100.0%	0.0%	11.2%	0.0%
	0.76300		0.10375		0.86675		100.0%	0.0%	3.0%	0.0%
	0.45262		0.06154		0.51416		99.4%	0.6%	4.9%	0.0%
	0.51954		0.07064		0.59018		88.7%	11.3%	3.8%	2.2%
	0.64402		0.08757		0.73159		100.0%	0.0%	2.9%	0.0%
	0.57145		0.07770		0.64915		100.0%	0.0%	17.5%	0.0%
	0.22411		0.03047		0.25458		99.2%	0.8%	7.6%	0.0%
	0.00956		0.00130		0.01086		97.1%	2.9%	8.4%	12.7%
	0.54722		0.07441		0.62163		100.0%	0.0%	22.1%	0.0%
	0.53970		0.07338		0.61308		100.0%	0.0%	13.2%	0.0%
	0.35664		0.04849		0.40513		37.5%	62.5%	13.6%	7.0%
	0.81878		0.11133		0.93011		100.0%	0.0%	9.4%	0.0%
	0.55965		0.07610		0.63575		100.0%	0.0%	5.6%	0.0%
	0.97006		0.13190		1.10196		100.0%	0.0%	9.6%	0.0%
	0.04578		0.00622		0.05200		93.1%	6.9%	6.8%	8.9%
	0.56665		0.07705		0.64370		100.0%	0.0%	7.0%	0.0%
	0.53970		0.07338		0.61308		94.2%	5.8%	15.2%	0.0%
	0.44828		0.06095		0.50923		54.2%	45.8%	15.1%	25.2%
	0.57967		0.07882		0.65849		97.0%	3.0%	6.5%	15.7%
	0.72392		**0.09843**		**0.82235**		**100.0%**	**0.0%**	**12.2%**	**0.0%**
	0.21361		**0.02905**		**0.24266**		**99.9%**	**0.1%**	**16.6%**	**0.0%**
	0.79913		**0.10866**		**0.90779**		**100.0%**	**0.0%**	**13.9%**	**0.0%**
	0.39432		**0.05362**		**0.44794**		**43.1%**	**56.9%**	**13.9%**	**10.1%**
		0		**0**		**0**				
		0		**0**		**0**				

Source: Emission factor data is from the International Energy Agency (IEA) Data Services, 2011 for "CO_2 Emissions per kWh from electricity and heat generation" and mainly sourced from the GHG Protocol website, http://www.ghgprotocol.org/calculation-tools

Data on the proportion of electricity and heat 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 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 roughly a similar ratio CO_2 emission factors as for the UK (which is 13.6%), 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 the 5-year average, 2005-2009.

[4] 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 11 - Fuel Properties

Last updated:	Mar-12

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	45.05	47.42	708.7	1411	12.51	13.17
Aviation Turbine Fuel	43.88	46.19	801.9	1247	12.19	12.83
Burning Oil [1]	43.86	46.16	803.9	1244	12.18	12.82
Coal (domestic) [2]	28.31	29.80	850.0	1176	7.86	8.28
Coal (electricity generation) [3]	23.66	24.90			6.57	6.92
Coal (industrial) [4]	25.65	27.00			7.13	7.50
Coking Coal	28.98	30.50			8.05	8.47
Diesel	42.91	45.64	839.6	1191	11.92	12.68
Fuel Oil	40.72	43.32	985.2	1015	11.31	12.03
Gas Oil	42.55	45.26	865.1	1156	11.82	12.57
LPG	45.90	49.23	522.4	1914	12.75	13.68
Naphtha	45.40	47.79	678.4	1474	12.61	13.28
Natural Gas	47.73	52.96	0.7	1340651	13.26	14.71
Petrol	44.74	47.09	735.3	1360	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]	47.73	52.96	175.0	5714	13.26	14.71
Grasses/Straw [12]	14.50	15.26	160.0	6250	4.03	4.24
LNG [13]	47.73	52.96	452.5	2210	13.26	14.71
Wood Chips [12]	14.00	14.74	250.0	4000	3.89	4.09
Wood Logs [12]	14.70	15.48	425.0	2353	4.08	4.30
Wood Pellets [12]	17.00	17.90	650.0	1538	4.72	4.97
Methane (CH_4)	50.00	55.50	0.7170	1394700	13.89	15.42
Carbon Dioxide (CO_2)	0.00	0.00	2.0	505051	0.00	0.00

Sources

Data for Commonly Used Fossil Fuels was sourced from the Digest of UK Energy Statistics 2011 (DECC), available at: http://www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx
Figures for CNG and biofuels are predominantly based on data from JEC - Joint Research Centre-EUCAR-CONCAWE collaboration, "Well-to-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context" Version 3c, 2011 (Report EUR 24952 EN - 2011). Available at: http://iet.jrc.ec.europa.eu/about-jec/

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
Kilowatt-hour, 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: Mar-12

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.

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 preference to the factors in this annex as they will be more specific.** 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 (in actual prices in £s, including VAT).

2) Multiply the amount of spending 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 spending into the appropriate box.

For example, if £1000 is spent on 'ceramic goods' (in purchasers' prices) in 2009, then the table calculates that 585 kilograms of CO_2e 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 take into account direct emissions by your company, which may be included in life-cycle estimates (e.g. from the actual combustion of fuel by your company).

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/economy/business-efficiency/reporting/

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): further information on the SIC 2003 is available here:

http://www.ons.gov.uk/ons/guide-method/classifications/archived-standard-classifications/uk-standard-industrial-classification-1992--sic92-/index.html

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

The factors for each of the six Kyoto gases included in the overall calculation are available on request from Defra. Email
Enviro.Statistics@defra.gsi.gov.uk

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 for products supplied for consumption in the UK but do take account of the emissions relating to the production of products imported for intermediate consumption (i.e. those products that are used by UK industries in the process of supplying products for consumption in the UK. 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. For the factors in this Annex an input-output model of the world economy was used with two distinct regions - the UK and the Rest of World.

By using the input-output model, the industrial emissions are then attributed to final products bought by consumers. The result is an estimate of the total upstream emissions associated with the supply of a particular product group.

The supply chain emission factors are expressed on a purchasers' price basis (i.e. the actual sales price including taxes on products and distribution 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 2009.

Table 13

Supply chain emission factors for spending on products: kgCO_2e per £			2004		Scope 3		2005		Scope 3		2006		Scope 3		2007		Scope 3		2008		Scope 3		2009		Scope 3	
					Total GHG				Total GHG				Total GHG				Total GHG				Total GHG				Total GHG	
SIC code (SIC 2003)	Code	Product category	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e
01	UK-1	Agriculture products[2]		x	3.53			x	3.53			x	3.29			x	2.95			x	2.55			x	2.68	
02	UK-2	Forestry products		x	0.61			x	0.59			x	0.56			x	0.54			x	0.47			x	0.40	
05	UK-3	Fish products[2]		x	1.29			x	1.22			x	1.27			x	1.15			x	1.01			x	0.72	
10	UK-4	Coal, lignite, peat[3]		x	6.21			x	5.83			x	8.74			x	7.17			x	7.14			x	6.13	
11	UK-5	Crude petroleum, natural gas[3]		x	1.33			x	1.11			x	0.93			x	0.92			x	0.81			x	0.72	
13	UK-6	Metal ores		x	1.00			x	1.18			x	1.27			x	1.23			x	1.23			x	n/a	
14	UK-7	Stone, sand and clay, other minerals		x	1.57			x	1.42			x	1.36			x	1.32			x	1.32			x	1.08	
15	UK-8	Food and drink products[1]		x	1.30			x	1.28			x	1.23			x	1.14			x	1.08			x	0.97	
16	UK-9	Tobacco products		x	0.17			x	0.17			x	0.16			x	0.16			x	0.14			x	0.13	
17	UK-10	Textiles		x	0.43			x	0.43			x	0.38			x	0.35			x	0.35			x	0.32	
18	UK-11	Wearing apparel		x	0.38			x	0.35			x	0.32			x	0.30			x	0.28			x	0.29	
19	UK-12	Leather products		x	0.40			x	0.38			x	0.38			x	0.38			x	0.34			x	0.30	
20	UK-13	Wood and wood products		x	1.12			x	1.00			x	0.97			x	0.95			x	0.90			x	0.80	
21	UK-14	Pulp and paper products		x	0.85			x	0.80			x	0.77			x	0.73			x	0.72			x	0.78	
22	UK-15	Printing and publishing		x	0.45			x	0.44			x	0.40			x	0.39			x	0.38			x	0.36	
23	UK-16	Refined petroleum and other fuels[3]		x	1.23			x	1.24			x	1.17			x	1.20			x	1.19			x	1.06	
24.11,24.12	UK-17	Industrial gases and dyes		x	1.59			x	1.63			x	1.53			x	1.42			x	1.36			x	1.06	
24.13	UK-18	Inorganic chemicals		x	1.32			x	1.31			x	1.22			x	1.15			x	1.13			x	1.36	
24.14	UK-19	Organic chemicals		x	1.85			x	1.53			x	1.38			x	1.34			x	1.27			x	1.06	
24.15	UK-20	Fertilisers		x	4.48			x	3.97			x	3.74			x	4.06			x	3.67			x	2.25	
24.16,24.17	UK-21	Plastics & synthetic resins etc		x	1.62			x	1.65			x	1.51			x	1.44			x	1.38			x	1.08	
24.2	UK-22	Pesticides		x	1.27			x	1.21			x	1.12			x	1.08			x	1.01			x	0.97	
24.3	UK-23	Paints, varnishes, printing ink etc		x	0.67			x	0.65			x	0.63			x	0.60			x	0.58			x	0.50	
24.4	UK-24	Pharmaceuticals		x	0.71			x	0.66			x	0.59			x	0.59			x	0.52			x	0.43	
24.5	UK-25	Soap and toilet preparations		x	0.45			x	0.45			x	0.40			x	0.39			x	0.39			x	0.33	
24.6	UK-26	Other chemical products		x	1.05			x	1.04			x	0.96			x	0.92			x	0.92			x	0.76	
24.7	UK-27	Man-made fibres		x	2.08			x	1.80			x	2.07			x	2.13			x	2.13			x	1.54	
25.1	UK-28	Rubber products		x	1.03			x	1.05			x	0.92			x	0.96			x	0.86			x	0.67	
25.2	UK-29	Plastic products		x	1.23			x	1.22			x	1.16			x	1.13			x	1.09			x	0.85	
26.1	UK-30	Glass and glass products		x	1.53			x	1.42			x	1.28			x	1.26			x	1.23			x	1.25	
26.2,26.3	UK-31	Ceramic goods		x	0.86			x	0.80			x	0.71			x	0.74			x	0.70			x	0.58	
26.4	UK-32	Structural clay products		x	1.23			x	1.31			x	1.23			x	1.17			x	1.21			x	1.68	
26.5	UK-33	Cement, lime and plaster		x	6.89			x	6.69			x	7.06			x	7.07			x	7.07			x	6.78	
26.6-26.8	UK-34	Articles of concrete, stone etc		x	1.62			x	1.53			x	1.57			x	1.46			x	1.40			x	1.21	
27.1-27.3	UK-35	Iron and steel		x	3.86			x	3.49			x	3.44			x	3.44			x	3.31			x	2.97	
27.4	UK-36	Non-ferrous metals		x	2.39			x	2.21			x	2.49			x	2.45			x	2.36			x	1.92	
27.5	UK-37	Metal castings		x	1.63			x	1.55			x	1.55			x	1.50			x	1.40			x	1.12	
28	UK-38	Metal products		x	1.30			x	1.29			x	1.32			x	1.36			x	1.27			x	1.07	
29	UK-39	Machinery and equipment		x	0.84			x	0.82			x	0.81			x	0.82			x	0.79			x	0.70	
30	UK-40	Office machinery and computers		x	0.81			x	0.76			x	0.76			x	0.65			x	0.61			x	0.53	
31	UK-41	Electrical machinery		x	0.91			x	0.87			x	0.87			x	0.83			x	0.80			x	0.62	
32	UK-42	Radio, television and communications		x	0.48			x	0.47			x	0.46			x	0.37			x	0.38			x	0.48	
33	UK-43	Medical and precision instruments		x	0.57			x	0.55			x	0.54			x	0.44			x	0.43			x	0.30	
34	UK-44	Motor vehicles manufacturing		x	0.97			x	0.91			x	0.90			x	0.90			x	0.85			x	0.70	
35	UK-45	Other transport equipment		x	0.73			x	0.73			x	0.67			x	0.66			x	0.60			x	0.59	
36, 37	UK-46	Furniture, other manufactured goods, recycling services		x	0.62			x	0.61			x	0.58			x	0.56			x	0.56			x	0.48	
40.1	UK-47	Electricity production and distribution[3]		x	7.51			x	6.97			x	6.50			x	6.15			x	5.18			x	4.80	
40.2,40.3	UK-48	Gas distribution[3]		x	3.94			x	3.48			x	3.26			x	3.25			x	3.12			x	2.03	
41	UK-49	Water Supply		x	0.82			x	0.74			x	0.71			x	0.65			x	0.56			x	0.44	
45	UK-50	Construction[4]		x	0.62			x	0.59			x	0.56			x	0.53			x	0.53			x	0.49	
50	UK-51	Motor vehicle distribution and repair, automotive fuel retail		x	1.03			x	0.95			x	0.90			x	0.92			x	0.85			x	0.77	
51	UK-52	Wholesale distribution		x	0.70			x	0.69			x	0.66			x	0.62			x	0.61			x	0.51	
52	UK-53	Retail distribution		x	0.49			x	0.45			x	0.44			x	0.41			x	0.39			x	0.38	
55	UK-54	Hotels, catering, pubs etc		x	0.66			x	0.64			x	0.60			x	0.57			x	0.54			x	0.49	
60.1	UK-55	Railway transport[5]		x	1.20			x	1.15			x	1.11			x	0.96			x	0.84			x	0.93	
60.2	UK-56	Road transport[5]		x	1.25			x	1.23			x	1.19			x	1.15			x	1.14			x	0.95	
61	UK-57	Water transport[5]		x	3.96			x	3.58			x	2.63			x	2.31			x	1.99			x	1.96	
62	UK-58	Air transport[5]		x	3.44			x	3.50			x	3.37			x	3.16			x	2.91			x	2.86	
63	UK-59	Ancillary transport services		x	0.43			x	0.41			x	0.38			x	0.36			x	0.34			x	0.32	
64	UK-60	Post and telecommunications		x	0.47			x	0.45			x	0.72			x	0.46			x	0.44			x	0.41	
65	UK-61	Banking and finance		x	0.25			x	0.23			x	0.21			x	0.19			x	0.16			x	0.15	
66	UK-62	Insurance and pension funds		x	0.38			x	0.37			x	0.36			x	0.33			x	0.31			x	0.28	
67	UK-63	Auxiliary financial services		x	0.33			x	0.30			x	0.29			x	0.25			x	0.24			x	0.23	
70	UK-64	Real estate activities		x	0.14			x	0.13			x	0.12			x	0.11			x	0.11			x	0.12	
71	UK-65	Renting of machinery etc		x	0.53			x	0.52			x	0.50			x	0.47			x	0.44			x	0.32	
72	UK-66	Computer services		x	0.29			x	0.28			x	0.28			x	0.26			x	0.24			x	0.20	
73	UK-67	Research and development		x	0.66			x	0.63			x	0.58			x	0.55			x	0.52			x	0.30	
74	UK-68	Legal, consultancy and other business activities		x	0.24			x	0.22			x	0.21			x	0.19			x	0.17			x	0.17	
75	UK-69	Public administration and defence		x	0.53			x	0.48			x	0.46			x	0.43			x	0.41			x	0.39	
80	UK-70	Education		x	0.33			x	0.31			x	0.29			x	0.26			x	0.24			x	0.23	
85	UK-71	Health and social work		x	0.51			x	0.48			x	0.42			x	0.40			x	0.38			x	0.34	
90	UK-72	Sewage and refuse services		x	2.37			x	2.13			x	2.01			x	1.91			x	1.77			x	1.42	

Table 13

Supply chain emission factors for spending on products: kgCO_2e per £			2004		Scope 3		2005		Scope 3		2006		Scope 3		2007		Scope 3		2008		Scope 3		2009		Scope 3	
			Total GHG				Total GHG				Total GHG				Total GHG				Total GHG				Total GHG			
SIC code (SIC 2003)	Code	Product category	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e	Amount spent by product category (£)	x	Total kg CO_2e per £	Total kg CO_2e
91	UK-73	Membership organisations		x	0.25			x	0.23			x	0.20			x	0.19			x	0.17			x	0.15	
92	UK-74	Recreational services		x	0.39			x	0.36			x	0.33			x	0.31			x	0.29			x	0.28	
93	UK-75	Other service activities		x	0.43			x	0.40			x	0.38			x	0.35			x	0.32			x	0.31	
						0				**0**				**0**				**0**				**0**				**0**

Source

Calculated by Centre for Sustainability Accounting (CenSA), Leeds, UK.
http://www.censa.org.uk
Defra (Enviro.Statistics@defra.gsi.gov.uk) is able to supply more detailed factors by the 6 Kyoto GHGs to complement those presented here.

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 (UK-8 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, which is consistent with the basis of the Grand Total GHG emission factors shown in Annex 3.

[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.

Annex 14 - Indirect emissions resulting from Material Consumption and Waste Disposal

Last updated:	Apr-12

The emission factors presented in this Annex have been prepared for use within company reporting in line with GHG Protocol Scope 3 Guidance (predominantly) and include total CO_2, CH_4 and N_2O emissions in units of CO_2e (CO_2 equivalent).

How to use this Annex

This Annex contains information provided previously in Annex 9 Table 9d in the previous (2011) update. In this new Annex 14 the information for material consumption has been separated out from the emissions associated with waste disposal in order to allow separate reporting of these emission sources, in compliance with the GHG Protocol Scope 3 Standard. This change is to bring them into alignment with the principle that a corporate GHG account is an inventory of actual emissions and removals, and should not include values for avoided emissions (e.g. savings from reduced demand for primary materials and combustion of fossil fuels).

Table 14a provides company reporting factors for material consumption by source/type. Please note these are not full life cycle and do not include all emissions.

To complete this table, you will need to:

1) Check for existing data on your material / product procurement, covering quantity, weight, and recycled content. This may be held alongside purchasing records, or may require an estimate of the weight of goods purchased.

2) **Enter the data in the table**. Enter the weight (in tonnes) for each material fraction (e.g. paper and card, textiles, etc) into the appropriate column. Where recycled content is not known it should be assumed that all material is primary. The total net $kgCO_2e$ emissions are automatically calculated by summing the total emissions for each type of material consumed (and the total emissions for each type of material consumed is calculated by multiplying the total mass of each material type by the relevant emission factor).

Table 14b provides company reporting factors for waste disposal. Please note these are not full life cycle factors and do not include all emissions from waste management as, in alignment with the GHG Protocol Scope 3 Standard, the emissions associated with recycling are attributed to the user of the recycled materials, and emissions from energy generation are attributed to organisation consuming the energy. Only transportation and minimal preparation emissions are attributed to the entity disposing of the waste. The factors are not suitable for comparing waste management options as they do not show the total change in emissions resulting from each disposal option.

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 disposal.

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.**

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. The total net $kgCO_2e$ emissions resulting from the waste will be automatically calculated as the sum of kgCO2e emissions for each type of material disposed of (and the $kgCO_2e$ emissions for each type of material disposed of is automatically calculated by applying the appropriate emission factor for each disposal method to the mass of material disposed of in that way).

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

Key information:

Table 14a (Emission factors for material consumption): These emission factors should be used if you want to determine the emissions associated with the consumption of procured materials. This information can then be used to monitor reductions in emissions associated with reduced procurement/consumption of materials, or changes in recycled content, over time.

Table 14b (Emission factors for waste treatment processes): The emission factors are based on company reporting guidelines and only include the GHG emissions which are attributable to the reporting company which disposes of the waste material. They do not include the potential benefits where primary resource extraction is replaced by recycled material, or fossil-based electricity generation is replaced by energy from waste. 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 information:

Table 14a provides emissions factors for reporting on emissions from material consumption. Table 14b provides emissions factors for reporting on emissions from waste disposal. These emissions fall into the Scope 3 emissions of a reporting company for companies that are not directly involved in/controlling the waste disposal process. The material emission factors provided are averages and may differ from the emissions associated with the specific materials consumed (or disposed of) by the reporting company. Supplier-specific emission factors would be more accurate, where such primary data is available. The figures will also contain some double counting for companies involved in producing the given materials. All figures should therefore be seen as approximate.

The tables are split into two halves. The left half contains all the emissions factors which are used to calculate the emissions which are calculated in the right 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.

When considering the relative environmental merits of waste management options, it is essential that, where possible, consideration is given to the total change in GHG emissions resulting from the use of different waste management options, including consideration of emissions which are avoided when recycling replaces primary material production, and energy from waste replaces primary fossil-based energy generation. DEFRA will provide separate information for this purpose. Values for avoided emissions, e.g. through recycling replacing primary material production, should not be reported within a corporate inventory of actual physical emissions and removals, but can be reported separately.

Annex 14 - Indirect emissions resulting from Material Consumption and Waste Disposal

Last updated: Apr-12

Table 14a includes emissions related to the materials purchased by an organisation that are subsequently transferred to the waste stream for treatment or disposal, or are used in products that they supply. This includes the emissions from the following life cycle stages: extraction, primary processing, manufacturing and transportation. It excludes the use phase. The blue columns deal with the emissions for different types of sourced material. Enter the tonnes of material in the relevant blue boxes and the totals are calculated in the yellow boxes.

The figures provided are not appropriate for comparing the relative merits of alternate waste management options.

All the figures in table 14a and 14b are positive numbers. This is because the recycling or energy recovery figures exclude any savings from reduced demand for primary materials and combustion of fossil fuels. The figures do not include avoided emissions from alternative waste management, in compliance with the principle that a corporate GHG account is an inventory of actual physical emissions and removals.

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.

For further information on the factors in table 14a and 14b, please refer to the methodology paper for the 2012 update, which will be made available from:
http://www.defra.gov.uk/environment/economy/business-efficiency/reporting

Annex 14 Scopes & Boundaries:

Material Consumption:
Scope 3

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/economy/business-efficiency/reporting/
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/economy/business-efficiency/reporting/

Table 14a

Emission Factors for Material Consumption (Please note these are not full life-cycle)	**Scope 3** [2]							Tonnes of material used by source/type:							**Total Net kg CO_2e emissions by material**
	GHG Protocol Scope 3 Category 1, 2, 4					***Cat. 1, 2***									
Material	Gross kg CO_2e emitted per tonne of material used by source/type [1]:														
	Primary Material Production (cradle to gate)	(Prepared for) Re-use	Recycled Material: Open Loop [3, 6]	Recycled Material: Closed Loop [3]		Compost		Primary Material	(Prepared for) Re-use	Recycled Material: Open Loop [3]	Recycled Material: Closed Loop [3]		Compost		
Aggregates (Rubble)	11	2	3	3											0
Batteries (Post Consumer Non Automotive)	12,108		No data												0
Construction, Demolition and Excavation: Average	No data	No data	No data	No data											0
Construction, Demolition and Excavation: Asbestos	27														0
Construction, Demolition and Excavation: Asphalt	39	2	0	28											0
Construction, Demolition and Excavation: Bricks	245		3												0
Construction, Demolition and Excavation: Concrete	135		3	3											0
Construction, Demolition and Excavation: Insulation	1,865			1,854											0
Construction, Demolition and Excavation: Metals	4,769			865											0
Construction, Demolition and Excavation: Soils				1											0
Books	955		No Data	777		36									0
Glass	895	No Data	0	508											0
Metal: Aluminium cans and foil (excl forming)	10,488			1,222											0
Metal: Mixed Cans	4,964			1,054											0
Metal: Scrap Metal	3,126			963											0
Metal: Steel Cans	2,708			986											0
Mineral Oil	1,401			655											0
Food and Drink	3,590					15									0
Garden Material						15									0
Mixed Food and Garden Material						15									0
Paper and board: Board (Av. board: 78% corrugate, 22% cartonboard)	1,038		No Data	680		36									0
Paper and board: Mixed (assumed 25% paper, 75% board)	1,017		No Data	680		36									0
Paper and board: Paper	955		No Data	680		36									0
Plasterboard	120			32											0
Plastics: Average plastics	3,179		693	1,977											0
Plastics: Average plastic film (incl bags)	2,591		599	1,528											0
Plastics: Average plastic rigid (incl bottles)	3,281		599	2,138											0
Plastics: HDPE (incl forming)	2,789		599	1,641											0
Plastics: LDPE and LLDPE (incl forming)	2,612		599	1,528											0
Plastics: PET (incl forming)	4,368		599	2,677											0
Plastics: PP (incl forming)	3,254		599	2,319											0
Plastics: PS (incl forming)	4,548		1,936	3,321											0
Plastics: PVC (incl forming)	3,136		599	2,262											0
Clothing [5]	22,310	131		131											0
Tyres	3,410	489	2	0											0
Fridges and Freezers	3,814	No Data	0												0
Large Electrical Items	537	No Data	0												0
Mixed Electrical Items	1,149	No Data	0												0
Small Electrical Items	1,761	No Data	0												0
Wood	666	46	264	122		285									0
								0	**0**	**0**	**0**		**0**		**0**

Annex 14 - Indirect emissions resulting from Material Consumption and Waste Disposal

Last updated: Apr-12

Table 14b

Emission Factors for Waste Disposal (Please note these are not full life-cycle)	Scope 3 [2]								Total Tonnes of waste PRODUCED	Tonnes of waste treated /disposed of by method [4]:							Total Net kg CO_2e emissions by waste fraction	Supplementary Information (not part of Scope 3) [8]	
	GHG Protocol Scope 3 Category 5, 12																		
Waste fraction	Gross kg CO_2e emitted per tonne of waste treated / disposed of (excluding avoided impacts) by method [1]:																		
		(Preparation for) Re-use	Recycling		Energy Recovery [7]		Composting	Landfill		(Preparation for) Re-use	Recycling		Energy Recovery [7]		Composting	Landfill		Net Benefit of Recycling Versus Landfill	Net Benefit of Recycling Versus Landfill, Alternative
			Open Loop [3, 6]	Closed Loop [3]	Combustion	Anaerobic Digestion (AD)					Open Loop [3]	Closed Loop [3]	Combustion	Anaerobic Digestion					
Aggregates (Rubble)		1	1	1				2									0	-4	
Batteries (Post Consumer Non Automotive)			65		No Data			75									0	-487	
Construction, Demolition and Excavation: Average		1	1	1				2									0		
Construction, Demolition and Excavation: Asbestos								2									0		
Construction, Demolition and Excavation: Asphalt		1	1	1				2									0		
Construction, Demolition and Excavation: Bricks			1					2									0		
Construction, Demolition and Excavation: Concrete			1	1				2									0		
Construction, Demolition and Excavation: Insulation				1				2									0		
Construction, Demolition and Excavation: Metals				1				2									0		
Construction, Demolition and Excavation: Soils				1				2									0		
Books			No Data	21	21		21	553									0	-736	
Glass		No Data	21	21	21			26									0	-392 (Col'r Sep'd)	-216 (Mix'd Col's)
Metal: Aluminium cans and foil (excl forming)				21	21			21									0	-9,267	
Metal: Mixed Cans				21	21			21									0	-3,911	
Metal: Scrap Metal				21	29			20									0	-2,171	
Metal: Steel Cans				21	31			21									0	-1,723	
Mineral Oil				21	21			0									0	-725	
Commercial and industrial waste, average				21	21	21		199									0	-1,281	
Municipal waste, average			21	21	21	21		290									0	-1,969	
Organic Waste: Food and Drink Waste					21	21	6	570									0	-489 (Compost)	-612 (AD)
Organic Waste: Garden Waste					21	21	6	213									0	-272 (Compost)	-265 (AD)
Organic Waste: Mixed Food and Garden Waste					21	21	6	254									0	-296 (Compost)	-380 (AD)
Paper and board: Board (Av. board: 78% corrugate, 22% cartonboard)			No Data	21	21		21	553									0	-820	
Paper and board: Mixed (assumed 25% paper, 75% board)			No Data	21	21		21	553									0	-799	
Paper and board: Paper			No Data	21	21		21	553									0	-736	
Plasterboard				21				72									0	-139	
Plastics: Average plastics			21	21	21			34									0	-1,215	
Plastics: Average plastic film (incl bags)			21	21	21			34									0	-1,076	
Plastics: Average plastic rigid (incl bottles)			21	21	21			34									0	-1,156	
Plastics: HDPE (incl forming)			21	21	21			34									0	-1,161	
Plastics: LDPE and LLDPE (incl forming)			21	21	21			34									0	-1,098	
Plastics: PET (incl forming)			21	21	21			34									0	-1,705	
Plastics: PP (incl forming)			21	21	21			34									0	-948	
Plastics: PS (incl forming)			21	21	21			34									0	-1,240	
Plastics: PVC (incl forming)			21	21	21			34									0	-888	
Clothing [5]		21		21	21			552									0	-14,069	
Tyres		21	21	21													0		
WEEE - Fridges and Freezers		No Data	21					17									0	-656	
WEEE - Large		No Data	21		21			17									0	-1,266	
WEEE - Mixed		No Data	21		21			17									0	-1,374	
WEEE - Small		No Data	21		21			17									0	-1,482	
Wood		21	21	21	21		21	851									0	-1,224	
										0	0	0	0	0	0	0	0		

Sources

The GHG Protocol Scope 3 conversion factors for material consumption and for waste disposal were collated and developed by WRAP (2012)
More information on WRAP can be found at: http://www.wrap.org.uk/

Notes

The data summarised in the table have been revised to be in line with company reporting requirements in the WRI/WBCSD GHG Protocol Scope 3 Standard. Under this protocol, in order to avoid double-counting, the emissions associated with recycling are attributed to the user of the recycled materials, and the same attribution approach has also been applied to the emissions from energy generation from waste . Only transportation and minimal preparation emissions are attributed to the entity disposing of the waste. DEFRA will separately provide information on the full GHG impact of different waste disposal options.
There have been significant changes to the methodologies and assumptions used in deriving the emission factors between the previous (2011) and the current (2012) update. As a result, some of the factors have changed significantly. Further more detailed information will be provided in the methodology paper for the 2012 update to be made available from Defra's website at: http://www.defra.gov.uk/environment/economy/business-efficiency/reporting

Emissions are Scope 3 for companies that are not directly involved in/controlling the waste disposal process. There are Scope 1 emissions for waste, for those companies that are responsible for the relevant elements e.g. the methane from landfill is a Scope 1 emission for the company that owns or operates the landfill site, and the emissions from incinerating waste are Scope 1 emissions for the company which owns or operates the incinerator.

[1] Impact of other treatments can be found in: http://www.defra.gov.uk/publications/files/pb13548-economic-principles-wr110613.pdf

[2] In accordance with the WRI/WBCSD GHG Protocol, values for avoided emissions should not be included within a corporate GHG inventory. A corporate GHG inventory is an inventory of actual physical emissions to and removals from (e.g. sequestration) the atmosphere, and should not include values for avoided emissions.

[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 recovery (combustion).

[5] When calculating the impact of reuse of clothing, a critical issue is the propensity of reused items to displace new items. For more information on this topic refer to: http://www.wrap.org.uk/content/environmental-and-economic-benefits-re-use

[6] For Open and Closed Loop Recycling, any calculation of impact should include the avoided raw material (e.g. if glass is used in aggregate, the impact is the open loop recycling emissions, minus the production of aggregates and any avoided waste management emissions). The figures presented in the main table exclude estimates resulting from avoided raw material based on the typical/average expected situation for different waste fractions.

[7] To be consistent with the way in which the GHG Protocol Scope 3 Standard treats the emissions from recycled material, the emissions associated with EfW are not attributed to the entity with disposes of the waste. The emissions from combustion are therefore excluded in this column. DEFRA will provide separate Annexes later in 2012 which will include information suitable for lifecycle based assessments and for PAS 2050 compliant reporting.

[8] Please **do not use** the figures in the "Supplementary Information" table for calculating waste emissions in a corporate GHG inventory. A corporate GHG inventory should not include values for avoided emissions.