



Notes and Definitions: Energy and environment



Petroleum consumption by transport mode and fuel type: ENV0101 (TSGB0301)

The Department for Energy and Climate Change (DECC) produces petroleum consumption figures which are published in table 3.2 of the *Digest of United Kingdom Energy Statistics* (DUKES) and can be found at:

www.decc.gov.uk/en/content/cms/statistics/source/oil/oil.aspx.

These notes include:

- Information on data sources
- Definitions
- General information about the data including links to further background information

This information relates to the energy and environment data tables ENV0101 to ENV0401 which can be accessed through the [Energy and environment statistics webpage](#).

Road transport – Estimates of total consumption of road fuels are produced by DECC – based on inland deliveries of petrol (motor spirit), road diesel (DERV) and liquefied petroleum gas (propane and butane). However it is not possible to trace what this fuel is used for. The DECC figures include the road fuel consumed by off-road machinery and equipment.

The National Atmospheric Emissions Inventory (NAEI) produces estimated breakdowns by vehicle type of petrol and DERV consumption as a part of its work in producing the UK greenhouse gas emissions estimates.

To produce the breakdowns of road fuel consumption by vehicle type the NAEI produces “bottom up” estimates of petrol and DERV consumption by vehicle type derived using a number of different data sources including:

- road traffic volume estimates by vehicle type and road type
- information on the what kinds of vehicles are on the road (engine sizes, fuel types, how old vehicles are etc) and
- estimated grams of fuel used per km for different types of vehicles under different conditions.

The “bottom up” estimates are then adjusted to add up to the “top down” totals for petrol and DERV produced by DECC (after removal of estimated fuel consumed by off-road machinery and equipment).

The road fuel consumption by vehicle type estimates are revised periodically due to methodological improvements and due to revisions in the data sources used. These revisions are usually small.

More information on the methodology used by the NAEI to construct the breakdown of road

transport fuel consumption by vehicle type can be found in the Annex to the UK Greenhouse Gas Emissions Inventory report which can be found at:

http://naei.defra.gov.uk/report_link.php?report_id=693 (see pages 433 – 492 of the annex).

Rail – DECC are unable to produce estimates of gas oil deliveries to railways in the same way as fuel deliveries to other transport sectors. This is because the gas oil used by rail is indistinguishable from other uses of gas oil, and refiners sell the gas oil for rail use on to resellers rather than direct to rail companies. Previously rail gas oil consumption has been estimated by the NAEI as a part of their work in producing the UK rail emissions estimates, based on:

- train km and freight tonne km data
- assumed mix of locomotives
- fuel consumption factors for different locomotives.

However 2009 UK rail emissions estimates made use of fuel consumption figures for Great Britain from ATOC (Association of Train Operating Companies)/ORR (Office of Rail Regulation) which are available broken down by passenger rail/freight rail for years 2005/06 onwards. Adjustment factors were applied to the back series for rail freight and passenger rail gas oil consumption separately, to produce consistent time series.

Shipping – Fuel oil and gas/diesel oil delivered, for inland, coastal & international shipping for use in ports and harbours. This includes gas/diesel oil used by fishing vessels and for UK oil and gas exploration and production.

Aviation – Total inland deliveries of aviation turbine fuel and aviation spirit. This covers deliveries of aviation fuels in the United Kingdom to UK and foreign airlines, UK and foreign governments (including armed services) and for private flying.

More information on petroleum consumption (including the 2010 average mass to volume conversion factors on page 229 of the 2011 Edition) can be found in DUKES at:

www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

The conversion factors from mass to volume for petrol and road diesel for 2010 (which hold approximately for previous years) were:

Petrol:	One tonne = 299 gallons or 1,360 litres
Road diesel:	One tonne = 262 gallons or 1,191 litres

Energy consumption by transport mode and energy source: ENV0102 (TSGB0302)

This is the energy content of fuels delivered to consumers, excluding non-energy use of fuels. The data measures the energy content of the fuels, both primary and secondary, supplied to final users. Thus it is net of fuel industry's own use and conversion, transmission and distribution losses.

These figures are calculated using net calorific values, which mean that they exclude the amount of energy necessary to evaporate the water present in the fuel or formed during the combustion process.

The figures are given in million tonnes of oil equivalent. This unit should be regarded as a measure of energy content rather than a physical quantity. There is no intention to represent an actual physical tonne of oil. One tonne of oil is not equal to one tonne of oil equivalent.

1 tonne of oil equivalent (toe):
= 10^7 kilocalories
= 396.83 therms
= 41.868 Gigajoules (GJ)
= 11,630 Kilowatt hours (kWh).

Data for individual fuels are converted from original units to tonnes of oil equivalent using net calorific values and conversion factors appropriate to each category of fuel and then aggregated.

Estimated average net calorific values in 2010 for road petroleum fuels are:

44.7 GJ per tonne of motor spirit (petrol)
42.9 GJ per tonne of DERV (diesel)
46.0 GJ per tonne of LPG

The full set of estimated average net calorific values are published in tables A3 of the UK Digest Energy Statistics (DUKES) and can be found at:

www.decc.gov.uk/en/content/cms/statistics/source/cv/cv.aspx

More information on UK energy consumption can be found in the Digest of UK Energy Statistics (DUKES) at: www.decc.gov.uk/en/content/cms/statistics/publications/dukes/dukes.aspx

Average new car fuel consumption: ENV0103 (TSGB0303)

These figures are based on all newly registered petrol and diesel passenger cars for each year in question. They are calculated from average CO₂ emissions figures (g CO₂ per km) for registrations of new petrol and diesel cars, weighted by the numbers of new car for each model. These average CO₂ figures are converted into fuel consumption figures (litres per 100km) using information on the typical carbon content of petrol and diesel published in Defra and DECC emission reporting guidelines. This approach accounts for the relative sales of different models of car. From 2001 onwards new car CO₂ figures have been recorded on the DVLA's registration database and earlier figures are based on the Society of Motor Manufacturers & Traders (SMMT) car registration database. The conversion to miles per gallon is indicative only as the conversion is carried out on the overall litres per 100km average rather than individually for every model. The latter would give a slightly different result, but cannot be carried out for all years in the series.

The CO₂ figures for individual vehicle models used in both databases are obtained under carefully controlled laboratory conditions in order to ensure repeatability and a fair comparison between models. The standard test used consists of drive cycles simulating urban and extra-urban driving, effectively with a single occupant, on a level road and without heaters or lights on. The actual fuel consumption achieved on the road will reflect many extraneous factors such as cold starts, different driving conditions, weather conditions, different loads carried, gradients, etc. More information on the standard test used can be found at: <http://carfueldata.direct.gov.uk/downloads/default.aspx>

Average heavy goods vehicle fuel consumption: ENV0104 (TSGB0304)

The miles per gallon figures in ENV0104 are for Great Britain-registered HGVs carrying freight within the United Kingdom (or travelling empty as part of their normal business). The figures exclude non-freight carrying HGVs such as recovery vehicles or fire engines. The figures are produced from data collected by the DfT's Continuing Survey of Road Goods Transport (CSRGT), based on returns on the amount of fuel purchased by road hauliers or taken from their own supplies for a surveyed vehicle, and the mileage covered by that vehicle, during a given survey week.

During a given survey week, for some hauliers the amount of fuel purchased for a vehicle may be less than the amount actually used during the survey week (for example, if they had filled up the tank just prior to the survey week and then topped up during the week with a smaller amount), while for others the amount of fuel purchased may be much more than the fuel actually used during the week. It is believed that over the whole survey these two scenarios balance out giving unbiased estimates of the average miles per gallon.

Petrol and diesel prices and duties: ENV0105 (TSGB0305)

The price estimates are based on information provided by oil marketing companies and super/hypermarket chains and are representative of prices paid (inclusive of taxes) on or about the 15th of the month. Changes in fuel duty historically occurred during the month in which a Budget was held, although in some years the rates have increased twice during the year. VAT is rebated to business users.

Greenhouse gas emissions by transport mode: ENV0201, (TSGB0306) ENV0202 (TSGB0307) and ENV0401

Table ENV0201 shows greenhouse gas (GHG) emissions from transport based on the internationally agreed basket of greenhouse gases carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (CO₂, CH₄, N₂O, HFCs, PFCs and SF₆). Table ENV0202 shows transport emissions of carbon dioxide alone.

Greenhouse gases

Some gases have a higher global warming potential than others, so the greenhouse gas emissions are expressed in terms of the equivalent million tonnes of carbon dioxide (MtCO₂e). On this basis carbon dioxide makes up over 98% of greenhouse gases for transport. More information on greenhouse gases can be found at:

www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/intro/intro.aspx

Carbon dioxide is reported in terms of 'net emissions', which means total emissions minus total removals of CO₂ from the atmosphere by carbon sinks. Carbon sinks are incorporated within the Land Use, Land Use Change and Forestry (LULUCF) sector, which covers afforestation, reforestation, deforestation and forest management.

The figures on greenhouse gas emissions from transport in sections (a) and (b) of ENV0201 and ENV0202 are in principle based on fuel purchased in the UK, in line with international guidelines. This is to avoid double counting of emissions between individual nation states.

The 'by source' emissions – section (a) of ENV0201 and ENV0202

These figures are produced by the National Atmospheric Emissions Inventory (NAEI) on behalf of the Department for Energy and Climate Change (DECC). The 'by source' emissions figures allocate emissions to the sector producing them. The 'by source' figures in these tables, are those published by DECC and they include crown dependencies (Jersey, Guernsey, and the Isle of Man) and exclude overseas territories.

Road transport is by far the main source of transport greenhouse gas (GHG) emissions. Carbon dioxide makes up over 98% of GHG emissions from road transport. Carbon dioxide emissions from road transport by mode are calculated directly from the estimated amounts of fuel consumed using information on the carbon content of the fuels. An outline of how road transport fuel consumption by mode is estimated can be found in the "Road transport" section on pages 1-2.

The road transport emissions of the other greenhouse gases are derived along the same lines as

road transport emissions of air pollutants (see the background note for table ENV0301 on page 8).

Rail carbon dioxide emissions are calculated directly from estimated rail gas oil consumption. In the past rail oil consumption was modelled using other data sources but the latest rail emissions estimates make use of real data on rail fuel consumption for Great Britain. More information on this can be found in the “Rail” section on pages 2.

Shipping – Shipping emissions are based on the DECC marine fuel deliveries figures. Naval fuel consumption from UK supplies is subtracted from these figures. Naval emissions are allocated to ‘Military aircraft and shipping’, which is included in the “Other” category of tables ENV0201 and ENV0202. There were some changes in total shipping emissions in the latest version of GHG emissions estimates. This was mainly due to a reassessment of data on fuel consumption on inland waterways. This resulted in a reallocation of diesel and petrol and the associated emissions from road transport to inland waterways.

In the past the domestic/international split for the consumption of marine fuels has been based on refiner’s best estimates. In 2011 the (1990-2009) version of the emissions inventory made use of estimates ‘bottom up’ estimates of marine fuel consumption from a detailed study using information on marine vessel movements, carried out by Entec on behalf of DEFRA. The Entec/DEFRA study estimated 2007 fuel consumption from domestic and international shipping, by vessel type. These estimates for 2007 were forward- and back-cast to for the full time series using DfT maritime statistics as proxies for changes in marine vessel activity for each vessel type over time.

Domestic shipping fuel consumption was taken directly from the Entec/DEFRA study and the remaining marine fuel (after subtraction of naval consumption) is allocated to international shipping, ensuring that the resulting figures add up to DECC totals for marine fuels.

Aviation – Aviation carbon dioxide emissions estimates are based on the DECC figures on the deliveries of aviation spirit and aviation turbine fuel in the UK. The fuel used for military aviation is subtracted from these figures. Emissions for military aircraft are allocated to ‘Military aircraft and shipping’, which is included in the ‘Other’ category in tables ENV0201 and ENV0202.

The aviation fuels (after subtraction of fuel used for military aviation) are split between domestic aviation and international aviation on the basis of data on domestic and international flights, taking into account the types of aircraft used for each flight. Only international flights departing the UK are included for compatibility with consumption of fuels from UK supplies.

More details of how greenhouse gas emissions are estimated are given in the Annex to the UK Greenhouse Gas Inventory report, which can be found at:

http://naei.defra.gov.uk/report_link.php?report_id=693 (see pages 433-440 of the annex for the details of the methodology for transport emissions)

More data on UK greenhouse gas emissions can be found on the DECC website at:

http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/uk_emissions/uk_emissions.aspx

Emissions from international transport and table ENV0401

Emissions from international aviation and international shipping are reported separately in table ENV0201 and ENV0202. These emissions are not included in the UK total submitted to the UNFCCC but are instead reported as memo items, since there is no internationally agreed way of allocating these emissions to individual nation states.

However the DfT is committed to reducing greenhouse gas emissions from both domestic and international transport. As a business plan indicator, the DfT therefore uses total transport greenhouse gas emissions which includes international transport emissions (based on fuel consumption from UK fuel bunkers). The data for this indicator are shown in table ENV0401.

The 'by end-user' emissions – section (b) of ENV0201 and ENV0202

These figures are based on the 'by source' emissions data, but re-allocate emissions from power stations and fuel processing facilities within the UK to the final users of the fuel on an approximate basis, according to their use of the fuel.

The environmental accounts – section (c) of ENV0201 and ENV0202

The ONS Environmental Accounts report greenhouse gas emissions (GHG) produced by UK residents and UK-registered companies, broken down by the industry emitting the gases. These emissions figures are on the same basis as the National Accounts and so can be used to look at emissions per unit of economic output.

Environmental Accounts GHG figures are based on the 'by source' NAEI data (including emissions from international aviation and international shipping), but apply cross-boundary adjustments to remove purchases by overseas residents of UK fuel, and add purchases by UK residents of foreign fuel.

Emissions are allocated to economic sector regardless of the activity that produced them. For example HGV emissions are allocated to a range of industries including the road haulage industry (referred to as road freight and removal services) and parts of the retail & wholesale, manufacturing and construction sectors.

In the 2012 ONS Environmental Accounts greenhouse gas emissions from biofuels were included in the end-user emissions. The justification is that although total emissions from biofuels are zero, with the carbon dioxide emitted having been captured by the biofuels, the economic sectors that these take place in are different.

The 2011 version of the environmental accounts switched to using the Standard Industrial Classification of Economic Activities 2007 (SIC 2007). The details of SIC 2007 can be found at: www.ons.gov.uk/ons/guide-method/classifications/current-standard-classifications/standard-industrial-classification/index.html

Air quality pollutant emissions by transport mode: ENV0301 (TSGB0308)

Table ENV0301 shows the estimated emissions of key pollutants from transport, that affects air quality, human health and ecosystems. These figures are produced by the NAEI on behalf of DEFRA and are based on United Nations Economic Commission for Europe (UNECE) definitions.

Emissions from aviation (cruise, both domestic and international) and international shipping are not included in the national total that is reported to the UNECE but are reported separately as memo items. Emissions from aircraft cruising at altitude or from international shipping in sea territories distant from the UK make a relatively small contribution to ground-level air quality in the UK compared with emissions occurring during take-off and landing and from domestic shipping around UK coastal waters, but they do contribute to global air pollution.

Road transport is by far the main source of air quality pollutant emissions from transport. Estimates of sulphur dioxide emissions and lead emissions from transport by mode are calculated directly from the estimated amounts of fuel consumed, using information on the sulphur/lead content of road fuels. An outline of how road transport fuel consumption by mode is estimated can be found in the “Road transport” section on pages 1-2.

The emissions of other air pollutants from road transport (and the basket greenhouse gases other than carbon dioxide) are not directly related to road fuel consumption in the same way, as they are also affected by vehicle technologies such as particle traps and catalytic converters. Instead they are derived from a range different information/data sources including:

- road traffic volume estimates by vehicle type and road type;
- information on the what kinds of vehicles are on the road (engine sizes, fuel types,...);
- estimated grams of pollutant emitted per km for different types of vehicles under different conditions (from the DfT/TRL speed-related emission factor equations, see page 9);
- catalyst failure rates;
- information on the retrofitting of older vehicles with modern pollution abatement devices;
- models for cold start emissions (excess emissions when a vehicle is started with its engine below normal operating temperature);
- models for emissions from the evaporation of petrol from the tank, fuel delivery system in vehicles, and while the vehicle is in motion.

Shipping – In the latest version of the emissions estimates, there was some reallocation from road transport to domestic shipping to across the time series. The reasons for this are explained in the section on ‘Shipping’, page 6.

Rail – In the latest version of the emissions estimates, rail lead sulphur dioxide emissions estimates (which are derived directly from estimated fuel consumption) were revised down slightly across the time series.

More details of the methodology used by the NAEI can be found in the UK Informative Inventory Report which can be found at:

http://naei.defra.gov.uk/report_link.php?report_id=689 (see pages 87-151)

More data and information about air pollutant emissions can be found on the DEFRA website at: www.defra.gov.uk/statistics/environment/air-quality/

Average emissions from road vehicles in urban conditions: ENV0302 (TSGB0309)

ENV0302 part (a)

These figures are indices of grams of pollutant per km by vehicle type and Euro emissions standard at typical urban speeds. They are produced by the NAEI and are based on the DfT/TRL speed-related emission factor equations.

Particulate emissions (these are fine particles less than 10 micrometres or 0.01 millimetres diameter) are much lower for vehicles with petrol engines than they are for vehicles with diesel engines. For this pollutant, the index is against emissions from a pre-1993 diesel car (=100).

The DfT/TRL speed-related emission factor equations estimate how emissions of pollutants per kilometre vary with vehicle speed, for different types of vehicle, according to the characteristics of the vehicle (emissions standard, fuel type, engine size, etc). The equations are derived from a database of emissions measured from actual in-service vehicles, the measurements being carried out by different laboratories in the UK and the rest of Europe over different drive cycles. The DfT/TRL speed-related emission factor equations can be found at:

<http://webarchive.nationalarchives.gov.uk/20110109132113/http://www.dft.gov.uk/pgr/roads/environment/emissions/>

ENV0302 part (b)

These indices for CO₂ emissions from HGVs shown in part (b) of ENV0302 relative to pre-1993 petrol cars are based on year-on-year changes in the fleet averaged fuel economy of HGVs using data from DfT's Continuing Survey of Road Goods Transport (CSRGT). Similarly for buses part (b) provides indices for CO₂ emissions (g CO₂/km), derived from figures on fuel consumed by local bus services collated in DfT's Bus Service Operators Grant (BSOG) system. The CO₂ indices for HGVs are corrected for urban driving conditions for comparison with indices in part (a).

Aircraft noise: ENV0303 (TSGB0310)

Air transport movements are landings or take-offs of aircraft engaged in transport of passengers or cargo on commercial terms. All scheduled service movements (whether loaded or empty) are included, as well as charter movements transporting passengers or cargo. Air taxi movements are excluded.

The equivalent continuous sound level (Leq) is an index of aircraft noise exposure. It is a measure of the equivalent continuous sound level averaged over a 16 hour day from 0700 to 2300 hours BST and is calculated during the peak summer months mid-June to mid-September.

The 57dBA Leq represents the approximate onset of significant community disturbance, 63dBA Leq - moderate disturbance and 69dBA Leq - high disturbance. Leq is correlated with community response to aircraft noise, but it is recognised that the reactions of different individuals to aircraft noise can vary considerably. Changes in wind direction from year to year influence the area affected by aircraft noise.

The methodology underlying the calculation of the aircraft noise Leq contours is published in: The CAA Leq Aircraft Noise Contour Model: ANCON Version 1 (DORA Report DR 9120), The UK Civil Aircraft Noise Contour Model ANCON: Improvements in Version 2 (R&D Report 9842) and The CAA Aircraft Noise Contour Model: ANCON Version 2.3 (ERCD Report 0606).

Annual contour reports for Heathrow, Gatwick and Stansted, can be found at:

<https://www.gov.uk/government/publications/noise-exposure-contours-around-london-airports>

An updated version of the Integrated Noise Model (INM) was used to estimate noise contours for Luton airport in 2008 and this was updated further for 2009, 2010 and 2011. As a result, any year on year comparison since 2007 should be treated with caution, although the difference in outcome resulting from each update is small. Further information can be found in Luton's Annual Monitoring Reports at:

www.london-luton.co.uk/en/content/8/243/annual-monitoring-report.html

Abbreviations

ATOC = Association of Train Operating Companies

BST = British summer time

DECC = Department for Energy and Climate Change

DEFRA = Department for Environment, Food and Rural Affairs

DERV = Diesel Engine Road Vehicle fuel

DfT = Department for Transport

DUKES = Digest of UK Energy Statistics

NAEI = National Atmospheric Emissions Inventory

ORR = Office of Rail Regulation

TRL = Transport Research Laboratory

UNFCCC = United Nations Framework Convention on Climate Change

UNECE = United Nations Economic Commission for Europe

VAT = Value added tax