Report by the Office for National Statistics

The impact of UK households on the environment through direct and indirect generation of greenhouse gases

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Contents

The impact of households on the environment through the direct and indirect generation of greenhouse gases

1. Executive summary

The object of this Eurostat funded project was to look at the impact UK households made on the environment. Households can affect the environment through the use of its natural resources and through the generation of unwanted by-products such as greenhouse gas emissions[1] and household waste. This report looks at the generation of greenhouse gases by UK households in 2001 and attributes them to the use of energy products, the use of transport and to the demand for goods and services. The breakdown covers 2001 as this was the latest Input-Output year available at the time of compilation of the report.

The decision to focus this report on the generation of greenhouse gases was based on global concerns that increasing levels of greenhouse gas emissions are resulting in global warming and climate change. Initiatives such as the Kyoto Protocol seek to limit greenhouse gas emissions and the UK Government's Energy White Paper (Department for Trade and Industry, 2003) set a goal to reduce carbon dioxide emissions by 60 per cent by 2050. While for some industrial sectors greenhouse gas emissions are declining, emissions from households continue to rise.

The figures contained in this report are consistent with the *Environmental Accounts Spring 2004* publication. The *Environmental Accounts* are on a National Accounts basis and differ from the basis used to monitor progress against the Kyoto Protocol in that they include emissions from international aviation and international shipping and from fuels purchased abroad by UK residents, including those purchased by international shipping and aircraft on international flights. They exclude emissions from fuels purchased in the UK by non-UK residents.

UK greenhouse gas emissions 1990-2001

UK greenhouse gas emissions decreased from 777.3 million tonnes of CO_2 equivalent[2] in 1990 to 718.5 million tonnes in 2001, a fall of 7.6 per cent. Over the same period, emissions directly generated by UK households rose from 140.7 million tonnes of CO_2 equivalent in 1990 to 158.2 million

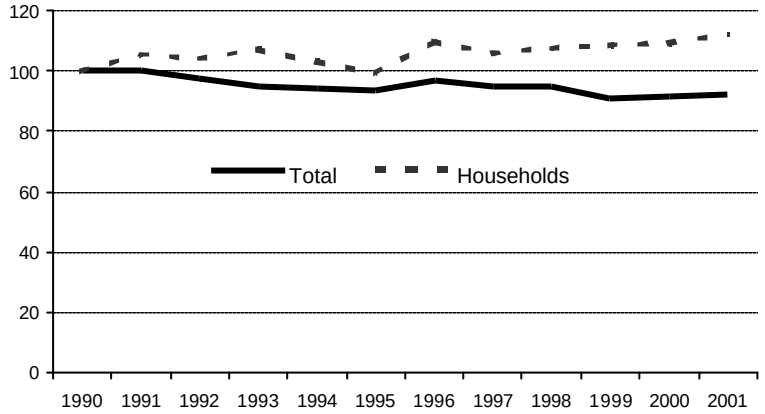
[1] Greenhouse gases comprise carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

[2] To aggregate the greenhouse gases covered in the accounts, a weighting based on the relative global warming potential (GWP) of each of the gases is applied, using the effect of CO_2 over a 100 year period as a reference. This gives methane a weight of 21 relative to relative to CO_2 and nitrous oxide a weight of 310 relative to CO_2. SF_6 has a GWP of 23,900 relative to CO_2. The GWP of the other fluorinated compounds varies according to the individual gas.

tonnes of CO_2 equivalent in 2001, a rise of 12.4 per cent. **Chart 1.1** shows the changes in direct emissions between 1990 and 2001 presented as an index where 1990=100. Apart from a two dips in the mid-1990s, emissions from households have risen steadily over the eleven year period.

Chart 1.1 - UK greenhouse gas emissions 1990-2001

1990=100



The household emissions shown in **chart 1.1** are those directly generated by UK households through cooking, heating and using their own vehicles. This report also includes is an estimate of emissions indirectly generated but nevertheless arising from household demand. These indirect emissions include those caused by the generation of electricity, through the use of public transport and from households' final demand for goods and services.

Data used to compile these estimates has come from a variety of ONS and non-ONS sources. Estimates of UK greenhouse gas emissions in 2001 were supplied to the ONS by the National Environmental Technology Centre (Netcen). Information on regional expenditure on energy products and other goods and services came from the results of the ONS *Expenditure and Food Survey (EFS) 2001-2002*. Regional travel information came from the Department for Transport's *National Travel Survey (NTS)*. International aviation passenger numbers came from the ONS *International Passenger Survey (IPS)* 2001. Detailed supply-use tables for 2001 and a 123 product breakdown of household final consumption expenditure taken from the *United Kingdom Input-Output Analyses* (2003 edition) were also used in the compilation of this report.

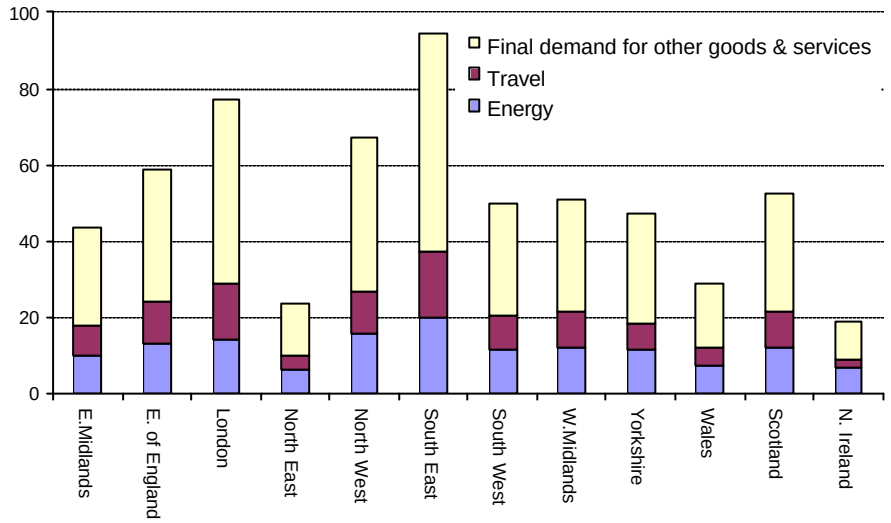
For 2001, the *Environmental Accounts* (spring 2004 edition) published total UK greenhouse gas emissions of 718.5 million tonnes of CO_2 equivalent of which 155.8[3] million tonnes were directly emitted by domestic households through heating, cooking, driving, etc. Indirect emissions from electricity generation, travel on public transport and final consumption expenditure are estimated to be

[3] A further 2.4 million tonnes were directly released from non-combustion sources such as metered dose inhalers and refrigeration and air conditioning systems.

456.6 million tonnes of CO_2 equivalent indicating that households were directly or indirectly responsible for 612.4 million tonnes of CO_2 equivalent[4]. Greenhouse gas emissions from household energy products such as oil, gas and electricity amounted to 140.4 million tonnes of CO_2 equivalent, emissions from domestic and international travel were 107.3 million tonnes and emissions from household final consumption expenditure for other goods and services were 364.7 million tonnes.

Chart 1.2 – Household greenhouse gas emissions in 2001

Million tonnes of CO_2 equivalent



Household greenhouse gas emissions in 2001

Chart 1.2 shows the greatest volume of greenhouse gas emissions are from households in the South East with a total of 94.6 million tonnes of CO_2 equivalent, 15 per cent of the UK household total. The next highest region is London at 77.2 million tonnes of CO_2 equivalent, 13 per cent of the total. London and the South East are responsible for 171.8 million tonnes of CO_2 equivalent, which equates to 28 per cent of the total direct and indirect emissions of UK households. The region with the lowest volume of emissions is Northern Ireland with emissions of 19.0 million tonnes of CO_2 equivalent or 3 per cent of the households total. The regional totals are obviously strongly affected by the number of households in each region. The South East has the most households at 3.5 million followed by London at 2.9 million, this compares with 0.6 million households in Northern Ireland.

Regional greenhouse gas emissions per household in 2001

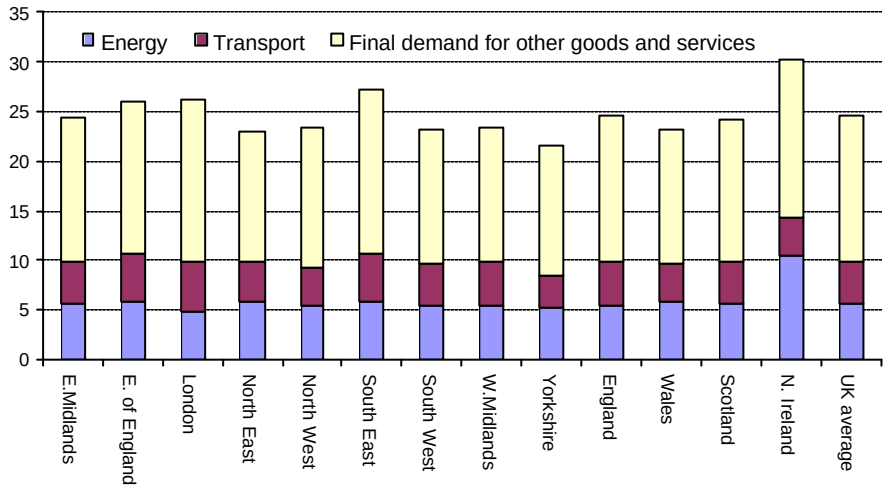
The highest level of emissions per household **(chart 1.3)** comes from households in Northern Ireland mainly due to the relatively high levels of fossil fuel products used for domestic heating and cooking compared with the rest of the United Kingdom. The average household in Northern Ireland is

[4] Emissions from final demand for other goods and services include emissions embedded in imports of goods and services (see chapter 7 for more detail).

responsible for 30.3 tonnes of CO_2 equivalent per annum compared with an UK average of 24.6 tonnes. Other regions exceeding the UK national average are the South East, the East of England and London. Households in Northern Ireland generate on average 10.5 tonnes of CO_2 equivalent from heating and cooking compared with 4.9 tonnes in London and a UK average of 5.6 tonnes. The burning of fuels such as coal and oil in Northern Ireland accounts for 7.4 tonnes of CO_2 equivalent compared with less than 0.1 tonnes in London and an average 0.7 tonnes for the UK. The region responsible for the fewest emissions per household is Yorkshire and Humberside at 21.5 tonnes. Yorkshire and Humberside have lower than average emissions from energy products, transport and final demand for other goods and services.

Chart 1.3 - Regional greenhouse gas emissions per household in 2001

Tonnes of CO_2 equivalent



Limitations

The majority of the regional allocations are based on the results of the *Expenditure and Food Survey* for 2001-02. Allocating emissions according to regional expenditure assumes that purchasing parity is the same throughout the country. Prices may vary from region to region and therefore to assume that £1 spent on a product in Scotland purchases the same volume of that product as in the South East is incorrect. However, due to time and resource limitations no attempt has been made to adjust for regional purchasing power.

The regional allocation of emissions from public transport is mainly based on the results of the *National Travel Survey*, which reports miles travelled per mode per region. Allocating emissions using miles travelled as a proxy assumes the same fuel consumption throughout the country. This is obviously not the case as fuel consumed in driving 50 miles in the heavy London traffic is likely to be far greater than driving the same distance on the open road of the Scottish Highlands. Consideration should also be taken for the average occupancy rate per vehicle. A high occupancy rate will reduce

the fuel consumption per passenger kilometre. As the occupancy rates in urban areas are likely to be greater than rural areas the overall fuel consumption rates per person may not be that different.

The methodology to estimate the level of emissions from household final demand for imports uses the same emissions coefficients as for UK production. This does not reflect the diverse production techniques used around the world.

2. Introduction

Eurostat have funded the ONS to produce a report on “The Impact of Household on the Environment”. The United Nation’s *Handbook of National Accounting – Integrated Environmental and Economic Accounting* (otherwise known as the SEEA) states that the environment provides three main “functions” to the economy, mankind and other living beings.

> ***Service functions*** provide the habitat for all living beings including mankind. Some aspects of habitat are essential, such as air to breathe and water to drink. These are called ***survival functions.*** If the quantity and quality of survival functions are diminished, biodiversity of species is threatened, not excluding the human species. Some service functions are not essential in the same way but improve the quality of life, for example by providing a pleasing landscape for leisure pursuits. These are called ***amenity functions*** and affect mankind only (or at least are the only ones measurable to us in human terms).
>
> ***Resource functions*** cover natural resources drawn into the economy to be converted into goods and services for the benefit of mankind. Examples are mineral deposits, timber from natural forests, deep sea fish.
>
> ***Sink functions*** absorb the unwanted by-products of production and consumption; exhaust gases from combustion or chemical processing, water used to clean products or people, discarded packaging and goods no longer wanted. These waste products are vented into the air, water (including sea water) or are buried in landfill sites. These three destinations are often referred to as “sinks ”.

This report looks at households' use of air as a sink function for emissions of atmospheric pollutants. There are a wide range of pollutants that contribute emissions to the atmosphere. They include greenhouse gases, regional pollutants and substances that are directly toxic such as heavy metals. These pollutants can be grouped according to their contribution to environmental themes such as climate change and acid rain.

The report focuses on the direct and indirect generation of greenhouse gases by UK households. There is a growing consensus that the rise of greenhouse gases in the atmosphere has led to changes in the global climate system. Initiatives such as the Kyoto Protocol seek to limit greenhouse gas emissions and the UK Government’s Energy White Paper (Department for Trade and Industry, 2003) set a goal to reduce carbon dioxide emissions by 60 per cent by 2050 with real progress by 2020. While for some industrial sectors greenhouse gas emissions are declining, emissions from households continue to rise.

Greenhouse gas emissions are generated by all economic sectors and arise from manufacturing, transportation as well as from natural sources such as livestock. Greenhouse gases are those covered by the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

The main source of **carbon dioxide (CO_2)** is from the combustion of fossil fuels, but it is also produced in some industrial processes such as the manufacture of cement. Carbon dioxide is a long-lived gas remaining in the atmosphere for between 50 and 200 years. It is the main anthropogenic greenhouse gas.

Methane (CH_4) is produced when organic matter is broken down in the absence of oxygen. Large quantities are produced by enteric fermentation in cattle and sheep, by the spreading of animal manure and from organic waste deposited in landfill sites. Methane is also emitted in coal mining, oil and gas extraction and gas distribution activities. Methane is a significant greenhouse gas.

Nitrous oxide (N_2O) is released in a few industrial processes and from the soil when nitrogenous fertilisers are applied in agriculture and horticulture. These are the main anthropogenic sources. It is a long-lived pollutant, lasting about 120 years in the atmosphere and is a potent greenhouse gas.

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are artificial fluids that contain chlorine and/or fluorine. Because of their low reactivity and non-toxicity they were widely used as refrigerants, foam blowing agents, aerosol propellants and solvents.

To aggregate the greenhouse gases covered in the accounts, a weighting based on the relative global warming potential (GWP) of each of the gases is applied, using the effect of CO_2 over a 100 year period as a reference. This gives methane a weight of 21 relative to relative to CO_2 and nitrous oxide a weight of 310 relative to CO_2. SF_6 has a GWP of 23,900 relative to CO_2. The GWP of the other fluorinated compounds varies according to the individual gas.

This report looks at three sources of emissions that are directly attributable to households.

> The generation of greenhouse gas emissions from the combustion of **energy products** such as natural gas, oil, coal and electricity. The combustion of fossil fuels in the home for heating and cooking produces large volumes of direct emissions. Household demand for electricity leads to the combustion of fuel in power stations resulting in indirect greenhouse gas emissions, which are attributable back to the households. For the purposes of this report emissions from the combustion of petrol and diesel have been allocated to the transport source rather than energy products.

Greenhouse gas emissions from **transport and travel** include those directly emitted by households through the use of privately own vehicles and those indirectly emitted through the use of public transport. Greenhouse gas emissions from public transport include emissions from buses, coaches, minicabs, taxis, trains, trams and civil aviation.

Household final demand for non energy and transport goods and services such as food and drink gives rise to emissions from the manufacturing and service sectors. These indirect emissions are then attributable back to the households whose demand generates them in the first place. Final demand is the term for sales to final consumers (households, government, exports, etc.). Sales between industries is termed intermediate consumption.

UK households also generate acid rain precursor emissions. These comprise sulphur dioxide, nitrogen oxides and ammonia which, when deposited, may cause acidification resulting in damage to ecosystems and buildings. These emissions are not covered in the report as they have decreased significantly over the past eleven years, down nearly 50 per cent since 1990, whereas emissions of greenhouse gases from the domestic sector have increased steadily over the same period.

Air is not the only sink function impacted upon by households. The household generation of waste has a significant impact upon the environment through the use of landfill site was waste disposal. Unfortunately, detailed information on household waste type is not available. The Department for Environment, Food and Rural Affairs (Defra) publishes regional information on municipal waste but this is not brokendown by household type.

Household demand for resource functions are not covered in this report but may feature in future work looking at material flows.

3. Data sources and definitions

Data used to compile this report came from a variety of government and non-government sources. Wherever possible the data relate to the period 2001. The breakdown covers 2001 as this was the latest Input-Output year available at the time of compilation of the report.

National accounts consistent emissions

The environmental accounts published by the ONS are published on a National Accounts basis. This allows for comparisons of emissions and material flows against mainstream National Accounts measures such as Gross Domestic Product and Gross Value Added. Data on a National Accounts basis means that all emissions by UK residents, whether generated in the UK or abroad, are included and all emissions by non-residents, whether generated in the UK or abroad, are excluded. ONS greenhouse gas emissions are on a National Accounts basis and therefore differ from those published by Defra, who include emissions generated in the UK regardless of nationality of source.

As the UK has a major civil aviation industry carrying both UK residents and non-residents the emissions generated should ideally be allocated both to UK households and foreign households. However, this has not been attempted for this report and all aviation emissions from UK resident operators have been allocated to UK residents. The rationale being that as non-residents travel on UK airlines so UK residents travel on foreign airlines and no attempt has been made to identify those emissions. The assumption is that UK residents travelling on foreign airlines and non-residents travelling on UK airlines go someway to netting each other off. The same can be said for other forms of transport such as trains, tubes, taxis and buses that are used by both UK residents and non-residents both in the UK and abroad.

Greenhouse gas emissions embedded in imports

Embedded emissions are those generated either directly or indirectly in the production of the goods or services consumed. There are a number of different sources of emissions associated with any one product. Emissions arise from the extraction of the raw materials, the manufacturing of the product, the transportation of the product and eventually its final disposal.

Household final demand is met by domestic production and by imports from the rest of the world. Emissions embedded in imports are an important factor to consider especially with the introduction targets such as the Kyoto protocol and the increase in production in less developed countries where environmental legislation is less restrictive. The UK has seen a steady increase in the volume of imports since the early 1990s, all of which contain embedded emissions in their production and transportation to the UK.

Ideally the estimation of emissions from household final demand should attempt to differentiate between emissions from final demand met by domestic production and emissions from final demand met by imports. Unfortunately it is not possible to identify the proportion of household final demand met by imports using existing datasets. Therefore, emissions from final demand include emissions from final demand met by imports. The estimation of emissions in imports is discussed in more detail in chapter 7.

Greenhouse gas emissions

The industry breakdown of atmospheric emissions is supplied to the ONS by the National Environmental Technology Centre (Netcen) and is primarily based on information compiled for their *National Atmospheric Emissions Inventory (NAEI)* and their *Greenhouse Gas Inventory.* Atmospheric emissions are estimated by multiplying detailed information on fuel consumption by emissions factors and then adding releases unrelated to fuel use such as methane arising from landfill. The NAEI data are used to identify the main processes and industries responsible for the atmospheric emissions. These are then allocated to individual sectors on the basis of information from a variety of sources. For example, emissions from diesel combustion by heavy goods vehicles are allocated to sectors using vehicle mileage information from the Department for Transport (DfT). Expenditure information is also used, for example emissions arising from the use of various industrial coatings are allocated to relevant sectors in proportion to each sector's expenditure on paints, varnishes and similar coatings, printing ink and mastics, using National Accounts Input-Output supply and use tables as the main source.

Household composition

Detailed information on household composition came from the dataset used to compile the *Expenditure and Food Survey*. The 2001 *EFS* household composition is not Census-2001 consistent as the Census results were not available at the time of the 2001 survey. The composition used in the report looks at households brokendown by

- Region (North West, South East, London, Wales, etc.);
- Size (one occupant, two occupants, three or more occupants);
- Age of the head of household (under 30, 30 to 64 and 65 and over)

No attempt has been made to identify emissions by the level of household income due to limitations in time and data availability. Future research and analysis could include a breakdown by income.

UK regions

The UK has been subdivided into the 12 regions shown in the table below consistent with the statistical regions used in *Regional Trends*.

Region	Coverage
North East	Cleveland, Durham, Northumberland, Tyne and Wear and Cumbria
North West	Cheshire, Greater Manchester, Lancashire and Merseyside
Yorkshire and The Humber	Humberside, North Yorkshire, South Yorkshire and West Yorkshire
East Midlands	Derbyshire, Leicestershire, Lincolnshire, Northamptonshire and Nottinghamshire
West Midlands	Hereford and Worcester, Shropshire, Staffordshire, Warwickshire and West Midlands
East of England	Cambridgeshire, Norfolk, Suffolk, Bedfordshire, Essex and Hertfordshire
London	Greater London
South East	Berkshire, Buckinghamshire, East Sussex, Hampshire, Isle of Wight, Kent, Oxfordshire, Surrey and West Sussex
South West	Avon, Cornwall, Devon, Dorset, Gloucestershire, Somerset and Wiltshire
Scotland	
Wales	
Northern Ireland	

Household expenditure

Information on household expenditure by region and household type came from the ONS *Expenditure and Food Survey*. The *Expenditure and Food Survey (EFS)* took over from the *Family Expenditure Survey (FES)* and the *National Food Survey (NFS)* in April 2001. It is a continuous survey of household expenditure, food consumption and income. The primary uses are to provide information about spending patterns for the Retail Price Index and about food consumption and nutrition. Like the *FES*, it also feeds into estimates of consumers' expenditure in the National Accounts.

Domestic travel

Information on UK household's domestic travel came from the Department for Transport's *National Travel Survey (NTS)*. The *NTS* is a continuous survey of personal travel. It provides the Department for Transport (DfT) with data to answer a variety of policy and transport research questions. The survey has been running on an ad hoc basis since 1965 and continuously since 1988. The *NTS* data used in the compilation of this report are based on a ten year average rather than just for 2001. Using data based on a ten year average removes some of the anomalies arising from small sample sizes for some households.

International travel

Data on UK household's international travel came from the *International Passenger Survey (IPS)*. The *IPS* is a survey of a random sample of passengers entering and leaving the UK by air, sea or the Channel Tunnel. Over a quarter of million face-to-face interviews are carried out each year with passengers entering and leaving the UK through the main airports, seaports and the Channel Tunnel.

Household final demand

Household final consumption expenditure, final demand, total demand and supply-use data came from *UK Input-Output Analysis (2003 Edition)*.

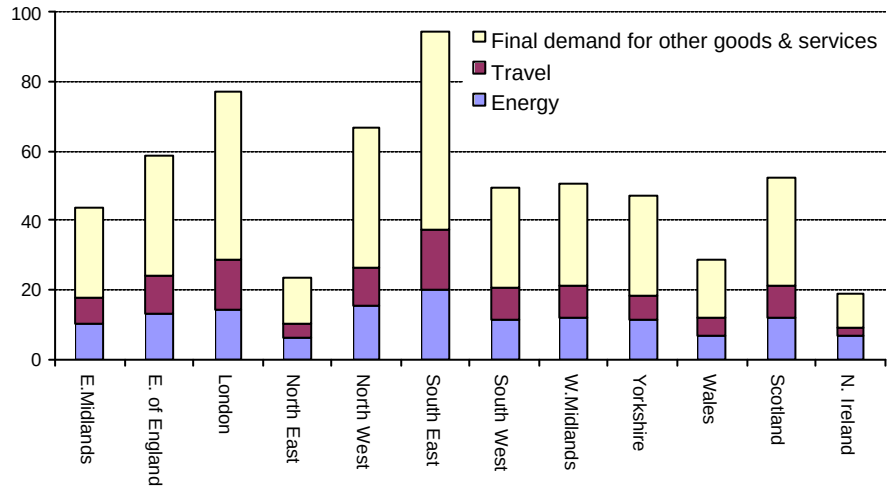
4. Summary results

Total greenhouse gas emissions attributable to households in 2001

For 2001, the *Environmental Accounts* (spring 2004 edition) published total UK greenhouse gas emissions of 718.5 million tonnes of CO_2 equivalent of which 155.8 million tonnes were directly emitted by domestic households through heating, cooking, driving, etc. Indirect emissions from electricity generation, travel on public transport and final consumption expenditure are estimated to be 456.6 million tonnes of CO_2 equivalent indicating that households were directly or indirectly responsible for 612.4 million tonnes of CO_2 equivalent[5]. Greenhouse gas emissions from household energy products such as oil, gas and electricity amounted to 140.4 million tonnes of CO_2 equivalent, emissions from domestic and international travel were 107.3 million tonnes and emissions from household final consumption expenditure were 364.7 million tonnes.

Chart 4.1 - Greenhouse gas emissions attributable to households in 2001

Million tonnes of CO_2 equivalent



Total regional emissions in 2001

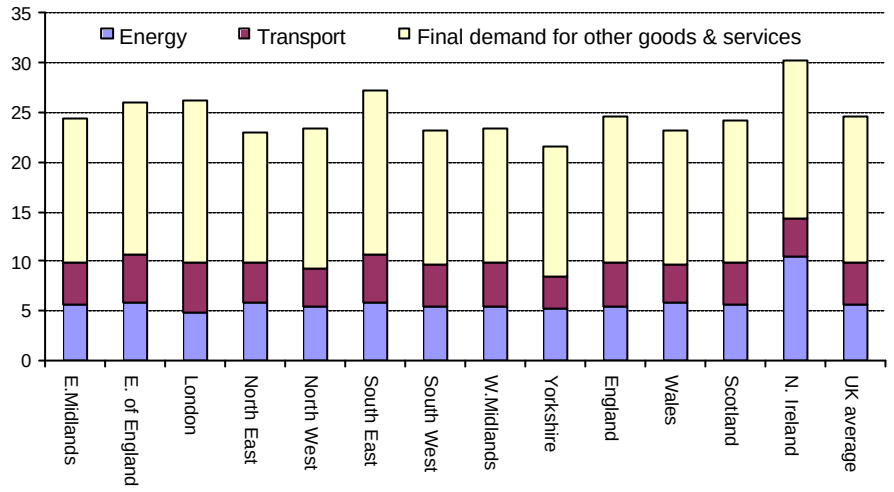
Chart 4.1 shows the greatest volume of greenhouse gas emissions come from the South East with a total of 94.6 million tonnes of CO_2 equivalent, 15 per cent of the UK household total. The next highest region is London at 77.2 million tonnes of CO_2 equivalent, 13 per cent of the total. London and the South East are responsible for 171.8 million tonnes of CO_2 equivalent, which equates to 28 per cent of the total direct and indirect emissions of UK households. The region with the lowest volume of emissions is Northern Ireland with emissions of 19.0 million tonnes of CO_2 equivalent or 3 per cent of the households total. The regional totals are obviously strongly affected by the number of households

[5] Emissions from final demand for other goods and services include emissions embedded in imports of goods and services (see chapter 7 for more detail).

in each region. The South East has the most households at 3.5 million followed by London at 2.9 million, this compares to 0.6 million households in Northern Ireland.

Chart 4.2 - Greenhouse gas emissions per household in 2001

Tonnes of CO_2 equivalent

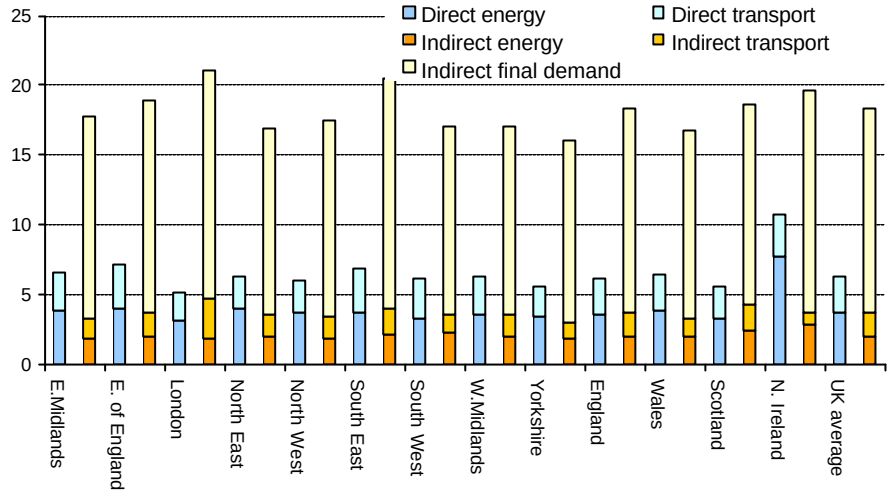


Regional emissions per household in 2001

The highest level of emissions per household **(chart 4.2)** comes from households in Northern Ireland mainly due to the relatively high levels of fossil fuel products used for domestic heating and cooking compared with the rest of the United Kingdom. The average household in Northern Ireland is responsible for 30.3 tonnes of CO_2 equivalent per annum compared with an UK average of 24.6 tonnes. Other regions exceeding the UK national average are the South East, the East of England and London. Households in Northern Ireland generate 10.5 tonnes of CO_2 equivalent from heating and cooking compared with 4.9 tonnes in London and a UK average of 5.6 tonnes. The burning of fuels such as coal and oil in Northern Ireland accounts for 7.4 tonnes of CO_2 equivalent compared with less than 0.1 tonnes in London and 0.8 tonnes for the UK. The region responsible for the fewest emissions per household is Yorkshire and Humberside at 21.5 tonnes. Yorkshire and Humberside has lower than average emissions from energy products, travel and household final consumption expenditure.

Chart 4.3 - Direct and indirect greenhouse gas emissions per household per annum in 2001

Tonnes of CO_2 equivalent

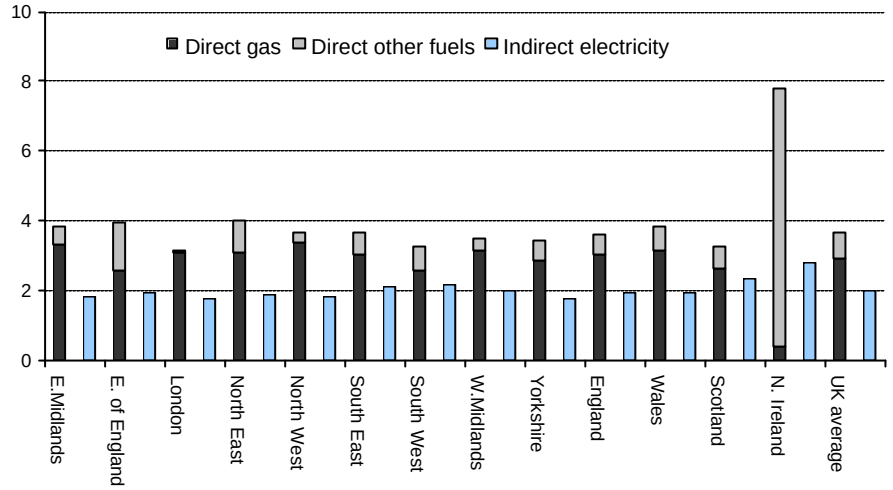


Direct and indirect greenhouse gas emissions in 2001

Direct greenhouse gas emissions from households are those caused by household use of fuels such as gas, oil, petrol and coal for heating, cooking and travel. Indirect greenhouse gas emissions are those arising through household demand for electricity, public transportation and demand for goods and services. Indirect emissions are considered to be embedded in the product purchased. Electricity contains the embedded emissions from the combustion of coal, gas, oil, etc. used in its generation. Similarly, food products contain indirect emissions from the use of pesticides and fertilisers as well as enteric emissions from livestock. **Chart 4.3** clearly shows that indirect emissions are far greater than direct emissions for all regions. The main source of indirect emissions is household consumption, which accounts for on average approximately 60 per cent of all emissions. Direct emissions from energy is the next highest followed by direct emissions from transportation.

Chart 4.4 - Direct and indirect greenhouse gas emissions per household from energy in 2001

Tonnes of CO_2 equivalent

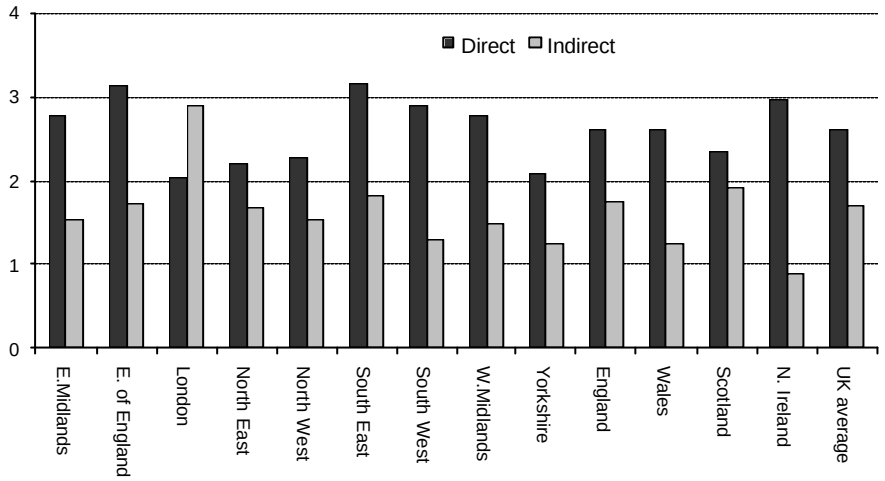


Direct and indirect emissions per household from energy

Chart 4.4 shows the breakdown of greenhouse gas emissions from the use of energy products. The combustion of petroleum products in private vehicles is included in the estimate of emissions from transport and travel. Energy products include gas, oil, coal, electricity etc. Direct emissions come from the combustion of fossil fuels such as natural gas, coal and oil and from the burning of biomass such a wood. The indirect emissions come from the use of electricity. Electricity is generated in numerous ways, many of which result in the production of greenhouse gases. Electricity generation using nuclear, hydro and wind power is emission free but it is not possible to identify regional generation sources. It is therefore assumed that each region has identical generation sources. Most UK regions have fairly comparable levels of direct and indirect emissions with the exception of direct emissions from Northern Ireland. The exceptionally high levels of direct emissions from other fuels in Northern Ireland is due to the extensive use of fossil fuels such as coal and oil for domestic heating. In all other UK regions, the greatest source of emissions is from the combustion of natural gas. Regional emissions are allocated using fuel expenditure information collected in the ONS *Expenditure and Food Survey*.

Chart 4.5 - Direct and indirect greenhouse gas emissions per household from transport and travel

Tonnes of CO_2 equivalent

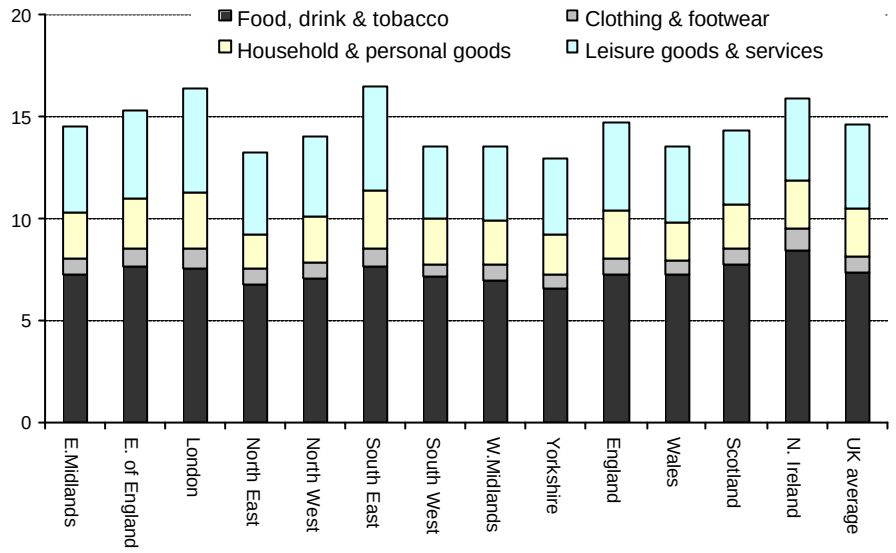


Direct and indirect greenhouse gas emissions per household from transport and travel

Greenhouse gas emissions from transport and travel arise through the use of privately own vehicles and from the use of civil aviation and public transport. For purposes of this report public transport comprises all forms of transport that are available to the public i.e. buses, taxis, trains, etc. **Chart 4.5** shows that, with the exception of London, there are more greenhouse gas emissions directly generated by household through the use of privately owned vehicles than through the use of public transport. The highest level of direct greenhouse gas emissions comes from households living in the South East with an annual average of 3.2 tonnes of CO_2 equivalent per household this compares with an average of 2.0 tonnes for households in London and 2.6 tonnes for the UK as a whole. Other the other hand, Londoners have the greatest responsibility for indirect greenhouse gas emissions from public transport at 2.9 tonnes of CO_2 equivalent per household compared with 0.9 tonnes in Northern Ireland and 1.7 tonnes for the UK as a whole. Overall, households in the South East have the highest level of transport emissions at 5.0 tonnes of CO_2 equivalent per household per annum compared with 3.3 tonnes for households in Yorkshire and Humberside and an UK average of 4.3 tonnes. Direct greenhouse gas emissions from private vehicles are allocated using regional expenditure information collected through the ONS *Expenditure and Food Survey*. Indirect emissions from public transport are allocated using information from the Department for Transport's *National Travel Survey* and the ONS *International Passenger Survey*.

Chart 4.6 - Indirect greenhouse gas emissions from household final demand for other goods and services

Tonnes of CO_2 equivalent



Indirect greenhouse gas emissions per household from final demand for other goods and services

All greenhouse gas emissions from household final demand for other goods and services are indirect, comprising the emissions generated through the production of the goods and services consumed by households. These emissions occur across all industrial sectors and can arise from natural sources such as enteric emissions from cattle or from industrial sources such as iron and steel casting. The vast majority comes from the manufacturing sectors but some greenhouse gas emissions are sourced to the service sectors. Greenhouse gas emissions generated by final demand are higher than those from energy and transport combined. **Chart 4.6** shows that the highest level of greenhouse gas emissions comes from the South East at 16.5 tonnes of CO_2 equivalent per household per annum closely followed by London at 16.4 tonnes. The fewest emissions are generated by households in Yorkshire and Humberside with average emissions of 13.0 tonnes of CO_2 equivalent per household per annum. Northern Ireland has the highest level of indirect emissions from food, drink and tobacco and clothing and footwear manufacturing while the South East has the highest level of emission from the production of household and personal goods and from leisure goods and services. The emissions are allocated using regional expenditure information collected through the ONS *Expenditure and Food Survey.*

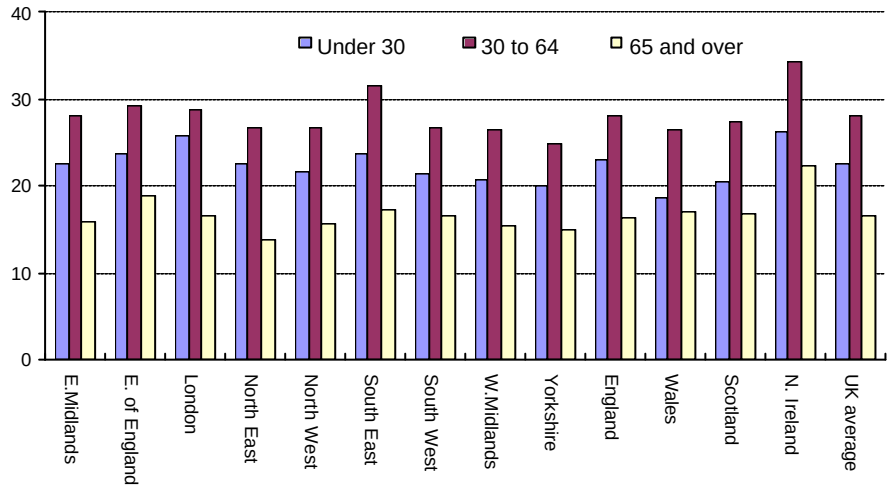
Greenhouse gas emissions per household by age of head of household

Throughout the UK, households where the head of the household is between 30 and 64 are responsible for generating the most emissions. **Chart 4.7** shows that households in Northern Ireland

are the highest with an average 34.3 tonnes of CO_2 equivalent per annum. The next highest region is the South East at 31.5 tonnes per annum. Households where the head is over 65 are responsible for the fewest emissions with the over 65s in the North East generating the fewest emissions at 13.8 tonnes of CO_2 equivalent per annum. There are numerous reasons why the 30 to 64 year old produce the greatest emissions, the most obvious being that they are probably the most affluent and have the largest households.

Chart 4.7 - Greenhouse gas emissions per household by age of head of household

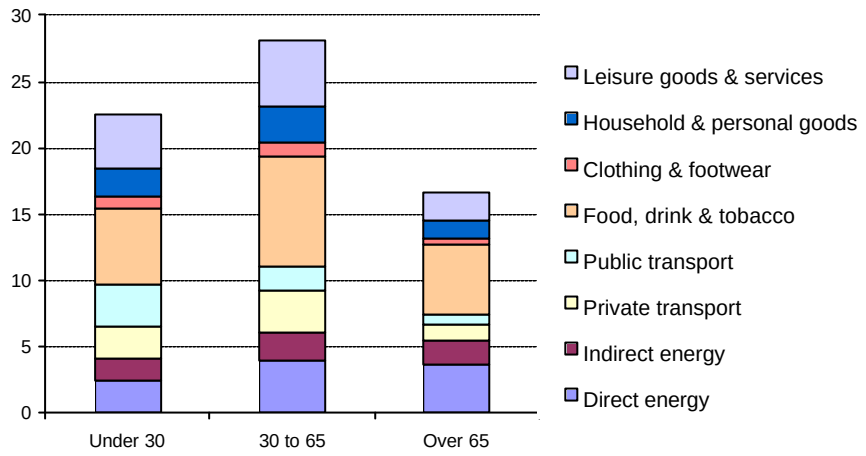
Tonnes of CO_2 equivalent



Looking at the average emissions per age group shows contrasting emission patterns across the various emission sources. **Chart 4.8** presents a breakdown of the greenhouse gas emissions by source showing that emissions from production of food, drink and tobacco products are the single highest source for all age groups, from between 25 and 33 per cent of all emissions, after that the emission pattern changes. For the under 30s and 30 to 64s the second highest source of emissions is from leisure goods and services whereas for the over 65s the second highest source is direct emissions from energy products. Greenhouse gas emissions from energy products are broadly comparable for the 30 to 64s and the over 65s but as a proportion of all greenhouse gas emissions they represent 22 per cent of all emissions for the 30 to 64s and 33 per cent for the over 65s. Greenhouse gas emissions from leisure goods and services represent 18 per cent for the under 30s and 30 to 64s but only 12 per cent for the over 65s.

Chart 4.8 - Greenhouse gas emissions per household by age of head of household and by source

Tonnes of CO_2 equivalent

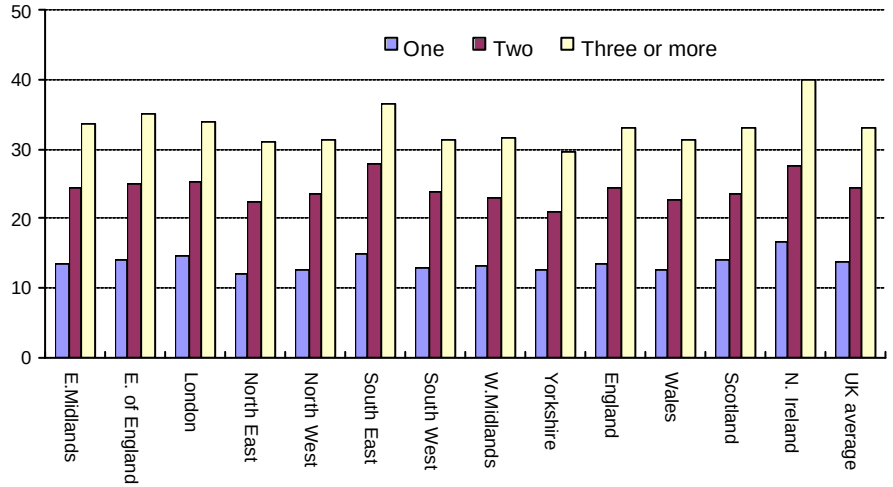


Greenhouse gas emissions per household by size of household

From **chart 4.9** it is clear that regional greenhouse gas emission per household by size of household follow very similar patterns throughout the UK. As you would expect, households where there are more than three occupants produce the most emissions with the highest level of emissions coming from Northern Ireland at 40.0 tonnes of CO_2 equivalent per household per year. This compares with an UK average of 33.2 tonnes of CO_2 equivalent per household per year for households with three or more occupants.

Chart 4.9 - Greenhouse gas emissions per household by household size

Tonnes of CO_2 equivalent



Greenhouse gas emissions per capita

Inevitably, households with three or more residents produce the greatest volume of greenhouse gas emissions. However, when looking at the emissions on a per capita basis, multiple occupancy households tend to produce the fewest emissions while households with single occupants produce the most.

The data used to compile the emissions shown in **charts 4.10** and **4.11** are based on information collected through various ONS and other government department inquires. It must be borne in mind that when analysing data at this level of detail the inquiry results are often based on relatively small sample sizes, thus introducing a far greater margin of error than when looking at more aggregated data.

Chart 4.10 – Greenhouse gas emissions: lowest 5 regions per capita compared with the UK average

Tonnes of CO_2 equivalent

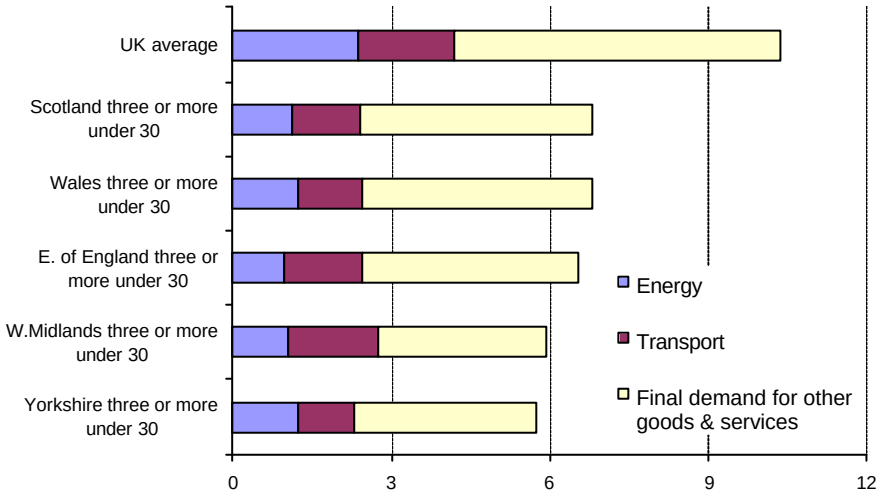


Chart 4.10 shows that on a per capita basis the fewest emissions tend to come from households with three or more occupants where the head is under 30. The fewest emissions per capita come from households in Yorkshire and Humberside with average emissions of 5.8 tonnes of CO_2 equivalent per capita compared with an average UK emissions across all household types of 10.4 tonnes. Looking at the constituent sources for Yorkshire and Humberside, greenhouse gas emissions from energy comprise 1.3 tonnes of CO_2 equivalent per capita compared with a national average of 2.4 tonnes per capita. Emissions from transport are 1.1 tonnes of CO_2 equivalent per capita compared with a national average of 1.8 tonnes per capita and emissions from final demand for other goods and services are 3.4 tonnes of CO_2 equivalent per capita compared with a national average of 6.2 tonnes per capita.

Chart 4.11 – Greenhouse gas emissions: highest 5 regions per capita compared with the UK average

Tonnes of CO_2 equivalent

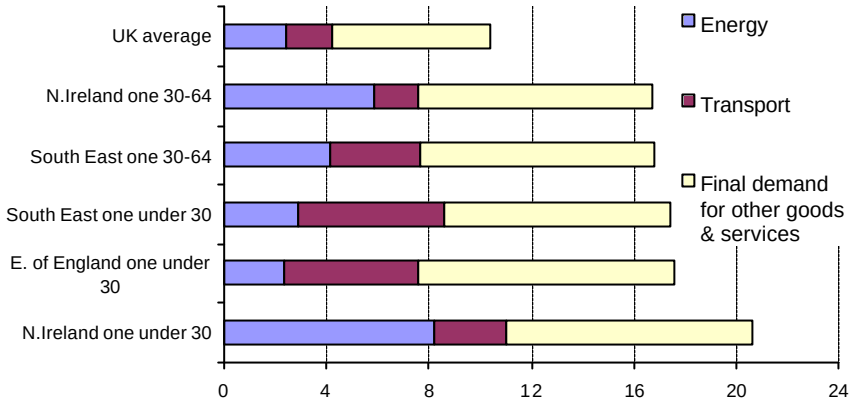


Chart 4.11 shows that the highest level of greenhouse gas emissions on a per capita basis come from single occupancy households occupied by the under thirties. The highest level of emissions come from the under thirties in Northern Ireland with an average emissions of 20.6 tonnes of CO_2 equivalent per capita. This compares with an average UK emissions across all household types of 10.4 tonnes of CO_2 equivalent per capita. The high level of emissions in the region are once again driven by the emissions from energy products at 8.2 tonnes of CO_2 equivalent per capita compared with an UK average of 2.4 tonnes per capita. Greenhouse gas emissions from transport are 2.8 tonnes of CO_2 equivalent per capita, which compares favourably with their equivalents in the South East who produces 5.6 tonnes per capita but is still above the national average of 1.8 tonnes per capita. Greenhouse gas emissions from final demand for other goods and services is 9.6 tonnes of CO_2 equivalent per capita compared with a national average of 6.2 tonnes of per capita.

5. Greenhouse gas emissions from household energy consumption

Greenhouse gas emissions from energy mainly arise from the combustion of fossil fuels such as coal, oil and natural gas. This combustion can either take place in the home (direct emissions) or in power stations to produce electricity (indirect emissions). Emissions from electricity generation amounted to 168.7 million tonnes in 2001, the largest single emissions source. The regional allocation of both direct and indirect emissions is based on regional expenditure on the different fuel types.

Expenditure on fuels 2000-01

Expenditure on gas, electricity and other fuels by age and by region are available on from the results of the ONS *Expenditure and Food Survey*, the results of which are published in the ONS *Family Spending* publication. Regional totals for expenditure on fuels by household type are possible by multiplying the number of households by the average weekly expenditure on each of the fuel types (gas, electricity and other fuels).

When allocating the greenhouse gas emissions, an assumption has been made that expenditure on other fuels represents expenditure on coke and coal products. For most UK regions expenditure on other fuels is relatively low compared with expenditure on gas. However, for Northern Ireland expenditure on other fuels is quite considerable and far outweighs expenditure on gas and electricity. This significantly impacts upon Northern Ireland when allocating greenhouse gas emissions from the combustion of coke and coal. The results are supported by research work on domestic energy use and published on the Defra website under *Domestic energy fact file: England, Scotland, Wales and Northern Ireland* (J I Utley, L D Shorrock and J H F Brown), which show Northern Ireland's reliance on fossil fuel for domestic heating.

Regional and household fuel use

From the total expenditure by household type, by age, by region and by fuel type, proportions are derived of the overall national expenditure on gas, electricity and other fuels. These proportions are then used to allocate the emissions to each of the household types. One limitation in using this methodology is that it assumes comparable regional purchasing power i.e. £1 spent on gas in Scotland purchases the same volume of gas as £1 spent in the South East of England. Another limitation is the lack of information regarding regional electricity generation sources i.e. all the electricity used in Wales could originate from wind farms with zero greenhouse gas emissions whereas all the electricity consumed in the South East could be sourced from coal fired power stations. To improve the estimates further we would need to know regional fuel prices to get a better idea of the volume of fuel purchased and regional electricity generation sources. Estimates of electricity generation by region are not available as data are currently collected on a company by

company basis and not on a station by station basis. Due to time and resource limitations no attempt has been made to adjust for regional purchasing power.

Allocating direct emissions from gas and other fuels

Identification of greenhouse gas emissions directly emitted by the domestic sector is relatively simple as the data are supplied by to the ONS by Netcen and are principally derived from their Greenhouse Gas Inventory. Direct emissions from non-travel related household activities are allocated to Environmental Account (EA) code 92. Direct emissions from travel related activities are allocated to EA code 93 and are covered in the Chapter 6, which looks at emissions from transport and travel. Emissions of HFCs and SF_6 were excluded from the total emissions as they are not derived directly from fuel consumption but tend to come from household appliances such as fridges and freezers. The data are further broken down into emissions from specific fuel types such as gas, oil, coke and coal. It is then possible to allocate the emissions generated from using these fuels by using the percentages of fuels purchased by household type.

Allocating indirect domestic emissions from electricity

The use of electricity in the home results in no direct emissions from households. However, the generation of electricity through burning coal, oil, gas, etc. creates large volumes of emissions from the power stations. The generation of electricity used by the domestic sector implies that emissions allocated directly to the electricity sector are indirectly attributable to domestic electricity usage. To indirectly attribute emissions to the domestic sector it is necessary to know the domestic take-up of electricity supplied by the electricity producers. Total demand for electricity in the UK amounted to 394004 of which 115336 GWh or 29 per cent was consumed by the domestic sector. This implies that 29 per cent of direct emissions from the electricity sector are indirectly attributable to the domestic sector.

Greenhouse gas emissions from electricity generation are supplied by Netcen under EA codes 51-55, which identify generation by type of station i.e. coal, gas, nuclear, etc. Total emissions from electricity generating power stations amounted to 168.7 million tonnes of CO_2 equivalent, of which 29 per cent or 49.4 million tonnes were indirectly attributable to domestic electricity usage.

These indirect emissions are then allocated to the individual household types using the percentages derived earlier for electricity purchases by household type.

Analysis of greenhouse gas emissions 2001

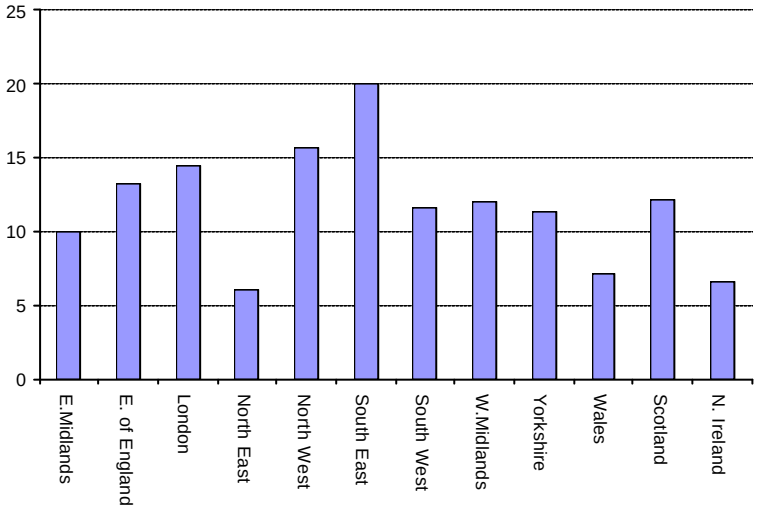
There are several analyses possible as the data are available by region, age, fuel and household size. This report includes five analyses based on the methodology previously described.

Total greenhouse gas emissions per region

Total emissions per region are shown in the **chart 5.1** It is clear that the lowest levels of emissions come from the North East (6.1 million tonnes of CO_2 equivalent) and Northern Ireland (6.6 million tonnes) with the highest emissions coming from the South East (20.0 million tonnes) and the North West (15.7 million tonnes). The volume of emissions per region is predominantly related to the number of households in that region. The South East has 3.3 million households compared with 0.6 million in Northern Ireland. A more informative comparison is to compare greenhouse gas emissions per household.

Chart 5.1 - Household emissions from energy products in 2001

Million tonnes of CO_2 equivalent

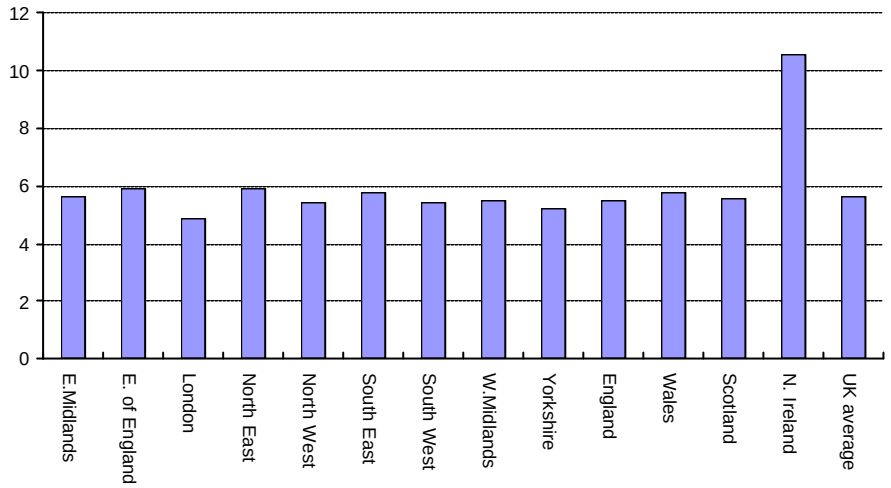


Greenhouse gas emissions per household

Comparing emissions per household tells a very different story. **Chart 5.2** shows that Northern Ireland has moved from having the fewest emissions overall to having the highest level of emissions per household. The main reason for the high level of emissions in the region is the greater use of fuels such as coke and coal for heating and cooking in Northern Ireland. These have higher emission levels than natural gas. London has the fewest emissions per household due to the relatively low expenditure on other fuels such as coke and coal. The remaining regions are broadly comparable with emissions of around 5.5 tonnes of CO_2 equivalent per year.

Chart 5.2 – Greenhouse gas emissions per household in 2001

Tonnes of CO_2 equivalent

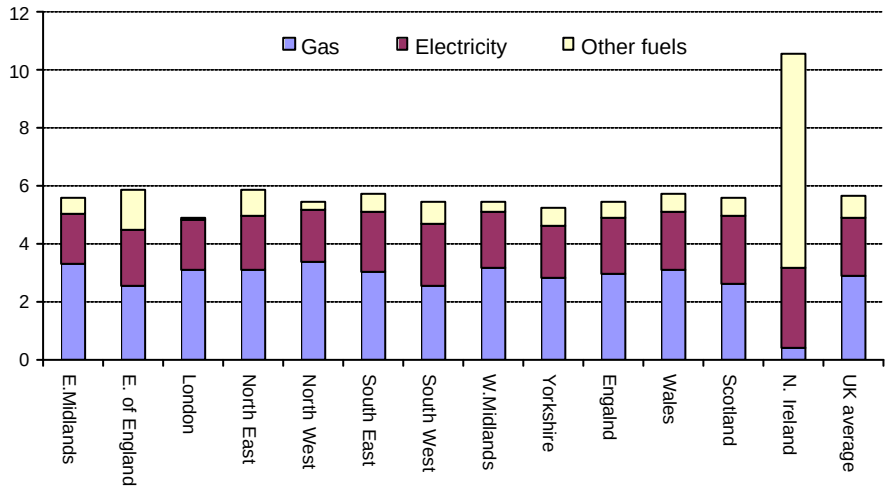


Greenhouse gas emission by fuel type

Chart 5.3 clearly shows that Northern Ireland's high level of greenhouse gas emissions per household is driven by the combustion of other fuels, such as coke and coal, for heating and cooking rather than natural gas as used in most of the other regions. Northern Ireland's emissions from the combustion of other fuels is 7.4 tonnes of CO_2 equivalent per household compared with London at less than 0.1 tonnes. Emissions from the combustion of natural gas averages around the 3 tonnes for most UK regions with the exception of Northern Ireland where it was just 0.4 tonnes. Indirect greenhouse gas emissions from electricity are broadly comparable for all regions at around 2 tonnes.

Chart 5.3 - Emissions per household in 2001 by energy type

Tonnes of CO_2 equivalent

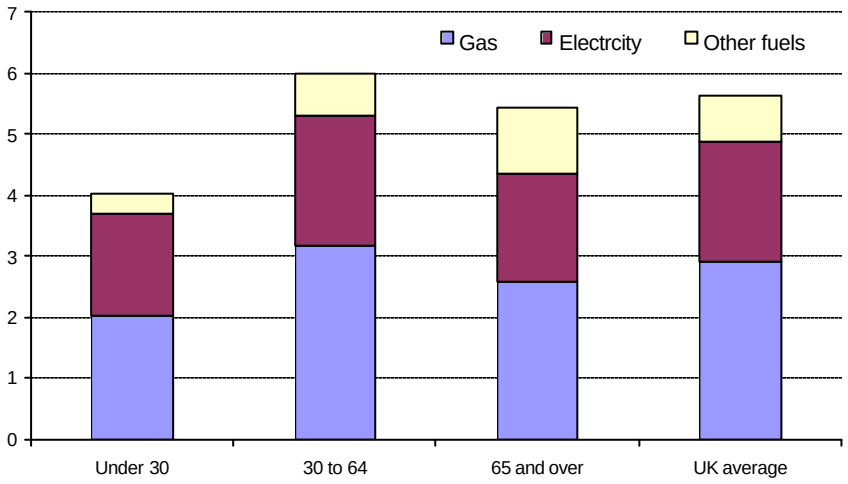


Greenhouse gas emissions by age of head of household

Chart 5.4 shows that households where the head of the household is under 30 generate the fewest greenhouse gas emissions with an average of 4.0 tonnes of CO_2 equivalent per household. This is due to lower levels of spending on energy products compared with other age ranges. The main source of emissions for the under 30s is from the combustion of natural gas closely followed by the indirect greenhouse gas emissions from electricity production. The highest level of greenhouse gas emissions come from households where the head is aged 30 to 64 with an average emission of 6.0 tonnes of CO_2 equivalent per household. The most likely explanation is that the 30 to 64 age range are likely to be part of multiple occupancy households so have proportionally more meals to cook and larger properties to heat and light. The 65 and over age range are responsible for an average 5.6 tonnes of CO_2 equivalent per household. The 65 and over have the highest proportion of emissions from other fuels such as coke and coal with an average of 1.1 tonnes of CO_2 equivalent per household compared with the under 30s 0.3 tonnes and a UK average of 0.7 tonnes.

Chart 5.4 - Emissions per household in 2001 by age of head of household

Tonnes of CO_2 equivalent

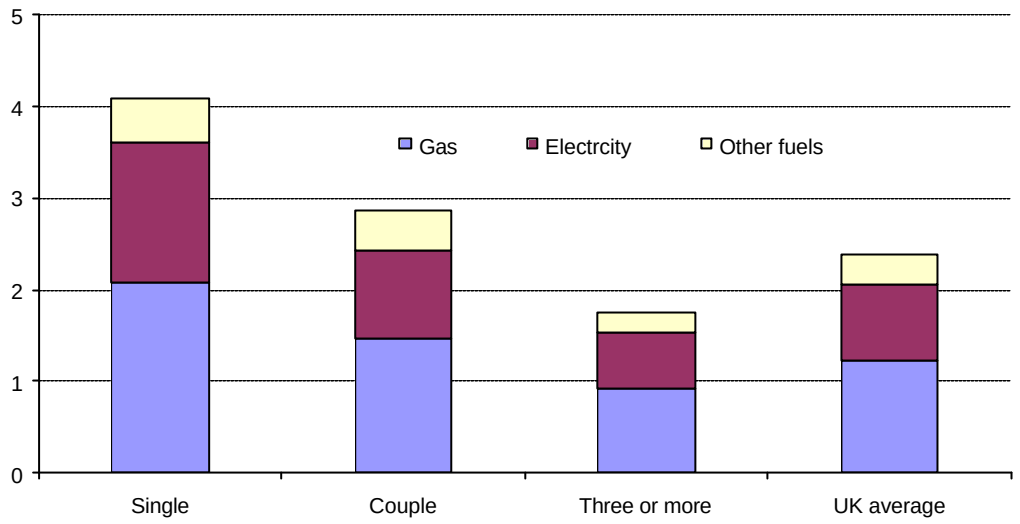


Greenhouse gas emissions by household size

It is clear from **chart 5.5** that households where there are three or more occupants are responsible for the fewest greenhouse gas emissions on a per capita basis. The average UK household is responsible for 2.4 tonnes of CO_2 equivalent per capita per annum while households where there are three or more occupants produce an average 1.7 tonnes of CO_2 equivalent per capita. Households where there is a single occupant produce an average 4.1 tonnes of CO_2 equivalent per capita and households with two occupants produce an average 2.9 tonnes of CO_2 equivalent per capita.

Chart 5.5 - Emissions per capita in 2001 by household size

Tonnes of CO_2 equivalent



Conclusions

The most influential factor in the regional breakdown of greenhouse gas emissions is the level of expenditure on other fuels such as coke and coal. This can clearly be seen in the emissions for Northern Ireland, which are significantly higher than any other UK region due to their high level of expenditure on other fuels. Households in Northern Ireland have until recently been heavily dependent on burning coal and oil for heating as many households did not have a piped supply of natural gas. The *Expenditure and Food Survey* data for 2001 shows that, on average, households in Northern Ireland spent £17.90 on fuel each week compared with the UK average of £11.70 and expenditure of just £10.50 in London. That expenditure was brokendown into £9.10 on other fuels, £8.10 on electricity and £0.70 on gas. This compares with an UK average of £0.90 on other fuels, £5.80 on electricity and £5.00 on gas. Having a fixed supply of natural gas significantly reduces household greenhouse gas emissions, as can be seen in **chart 5.3**.

6. Greenhouse gas emissions from transport and travel

Chapter 6 looks specifically at greenhouse gas emissions generated by household transport and travel. Transport and travel encompasses both the direct emissions from the use of private vehicles and indirect emissions from the use of civil aviation and public transport. For the purpose of this report public transport comprises railways, tubes, trams, buses, coaches, minicabs and taxis. No attempt has been made to allocate emissions from sea transport primarily due to the fact that most sea transport emissions come from freight transportation as opposed to passenger transportation, whereas the reverse is true for air transport. Air transportation is included as it is a major source of greenhouse gas emissions and is primarily used for public transportation.

The allocation of emission from transport is particularly difficult due to the diverse nature of the modes of transport and the need for various adjustments to exclude non-personal travel. Ideally, the report would exclude all emissions from business travel, freight transport and by non-residents using UK public transport. Similarly, adjustment should be included for UK residents use of transport outside the UK. Whilst there are cross boundary adjustments for the use of private vehicles, there are no adjustments for UK residents use of public transport while abroad or for non-residents use of public transport in the UK. Problems also arise when allocating emissions to each region based on average mileage per household. Without having detailed information on average speeds and fuel consumption per region it is assumed that fuel consumption across the regions is equal. Without doubt this is incorrect as the fuel consumed in driving 50 miles in the heavy London traffic is likely to be far greater than driving the same distance on the open road of the Scottish Highlands.

National accounts consistent emissions

The environmental accounts published by the ONS are published on a National Accounts basis. This allows for comparisons of emissions and material flows against mainstream National Account measures such as Gross Domestic Product and Gross Value Added. Data on a National Accounts basis means that all emissions by UK residents, whether generated in the UK or abroad, are included and all emissions by non-residents, whether in the UK or abroad, are excluded. ONS greenhouse gas emissions are on a NA basis and therefore differ from those published by Defra, which look at all emissions generated in the UK regardless of nationality of source. As the UK has a major civil aviation industry carrying both UK residents and non-residents the emissions generated should ideally be allocated both to UK households and foreign households. However, this has not been attempted for this report and all aircraft emissions have been allocated to UK residents. The rationale being that as non-residents travel on UK airlines so UK residents travel on foreign airlines and no attempt has been made to identify those emissions. The assumption is that UK residents travelling on foreign airlines and non-residents travelling on UK airlines go someway to netting each other off. The same can be said for other forms of transport such a trains, tubes, taxis and buses that are used by both UK residents and non-residents. The allocation of emissions from the London buses and the London

Underground should ideally be adjusted to reflect the considerable use by tourists. However, as mentioned earlier, UK residents use buses and the underground systems abroad and the overall emissions from buses and the underground are not especially significant at 4.3 million tonnes of CO_2 equivalents and 1.2 million tonnes of CO_2 equivalent respectively.

REWARD

A regional analysis of road transport emissions is included in the Regional and Welsh Appraisal of Resource Productivity and Development (REWARD) report entitled *Key Industrial Environmental Pressures – Air Emissions and Energy Use*. The REWARD report differs in that it only covers road transport in England and Wales whereas this report includes at all transport and travel by UK households. The methodology employed is very different in that the REWARD report uses point source, area and road transport mapping whereas this report attempts to allocate emissions on a household basis using data from the *National Travel Survey (NTS)* and the *International Passenger Survey (IPS)*. The results are also presented differently in that the REWARD report looks only at the regions but provides greater details on the individual emissions types (e.g. CO_2, CH_4, PM_{10}s, etc.) whereas this report looks at the individual households brokendown by region, number of occupants and by age of the head of household.

National Travel Survey

Estimates for domestic travel are based on information published in the Departments for Transport's *National Travel Survey (NTS)*. Chapter 6 of the *NTS* identifies average distance travelled by mode and by region. Detailed information on the travel characteristics of the nine different household types, consistent with the *NTS*, were supplied by the Department for Transport (DfT). The *NTS* data supplied by the DfT excluded business travel and included travel by children. Estimates for Northern Ireland were obtained, where possible, from the Department for Regional Development in Northern Ireland (DRDNI). Multiplying the average distance travelled per mode per household by the number of household type for each region gives a total mileage per household per mode per region. From there it is possible to derive total mileage travelled by each mode of transport and then regional household percentages i.e. London single occupier under 30's taxi travel as a percentage of total UK taxi travel. These percentages are then used to allocate the emissions from that particular mode of transport. The *NTS* data used in the compilation of this report are based on a ten year average rather than just for 2001. Using data based on a ten year average removes some of the anomalies arising from small sample sizes for some household.

Greenhouse gas emissions by mode of transport

Greenhouse gas emissions by mode of transport are supplied to the ONS by the National Environmental Technology Centre's (Netcen). The data on emissions are supplied by Environmental Account (EA) code which separately identifies emissions from the following transport sectors; railways, tubes and trams, buses and coaches, taxis and minicabs and air transport. The emissions are broken

down into the source emission e.g. CO_2, NH_4, etc. The inventory also identifies the actual source of emissions e.g. heavy goods vehicles, coaches, cars with catalytic converters, etc. Wherever possible, emissions generated by business travel and freight transportation have been excluded.

Railways (EA code 63)

Greenhouse gas emissions from the rail transport industry are a combination of both direct and indirect emissions. Direct emissions are primarily from inter-city and regional trains using gas_oil as fuel. Other sources include emissions from stationery sources and emissions from ancillary road transport such as cars and light goods vehicles. Indirect emissions associated with the railway industry's use of electricity are compiled using information on National Rail's electricity use published by the Department for Trade and Industry in the *Digest of UK Energy Statistics (DUKES)*. *DUKES* estimates National Rail's electricity consumption at 2700 GWh. Based on DUKES estimates of total electricity generation of 394004GWh and Netcen's estimates of emissions from electricity generators as 168699 kilotonnes of CO_2 equivalent, it is possible to derive a ratio of emissions per GWh of 0.428 kilotonnes of CO_2 equivalent. Therefore, 2700 GWh of electricity would generate approximately 1156 kilotonnes of CO_2 equivalent. Direct and indirect emissions are aggregated to derive an estimate of total emissions, which are then allocated to the households using the percentages derived from the *National Travel Survey* dataset. Greenhouse gas emissions from rail freight operations are separately identified in the dataset and are excluded, as are estimates for emissions from business travel. Estimates of business travel are derived from the results of the *National Travel Survey*.

Buses and coaches (EA code 64)

All the emissions from the bus and coach industry are direct emissions and predominantly come from the buses and coaches themselves. Other emissions are mainly from ancillary road vehicles and stationary sources. Emissions are then allocated to the households using the regional percentages derived from the *National Travel Survey* dataset. Adjustments are made to total emissions from buses to exclude any business travel. The adjustments are based on the proportion of personal to business travel using data from the *National Travel Survey*.

Tubes and trams (EA code 65)

As with rail transport, the emissions from the tube and tram industry are combination of both direct and indirect emissions. Direct emissions are from stationary sources and ancillary road vehicles. The indirect emissions come from the use of electrified track and overhead cabling. The allocation of indirect emissions from electricity proved difficult, as the information on electricity consumption by the tube and tram industry is not readily available. The largest tube operator is the London Underground (LU) who publish environmental information in an annual report. The report includes information on electricity consumption, passenger kilometres and train kilometres. The LU uses 1098 GWh of electricity enabling trains to travel 63.8 million km, which is equal to 17.21 GWh per million train km.

The Department for Transport publishes train km information on other tubes and light railway routes covering the following transport systems;

Altram-Greater Manchester Metro
Centro (West Midlands Metro)
Croydon Tramlink
Docklands Light Railway
Strathclyde Passenger Transport Executive, Glasgow Underground
Tyne and Wear Passenger Transport Executive
Stagecoach Supertram, South Yorkshire

Assuming that the energy consumption per train km is the same as for the LU, it is possible to estimate electricity consumption for the above transport systems by multiplying the train km by the GWh used per million train km. Then by using the ratio of greenhouse gas emissions per GWh mentioned earlier, it is possible to derive an estimate of indirect emissions generated through the use of electricity. These are then allocated to the households using the regional percentages derived from the *National Travel Survey*. The *National Travel Survey* contains separate estimates for travel on both London Underground and other light railways. Adjustments are made to total emissions from tube trains to excluded any business travel. The adjustments are based on the proportion of personal to business travel using data from the *National Travel Survey*.

Taxis and minicabs (EA code 66)

Most of the greenhouse gas emissions from the taxi and minicab industry are direct emissions and predominantly come from the vehicles themselves. Other emissions are mainly from stationary sources. The greenhouse gas emissions are then allocated to the households using the regional percentages of taxi travel derived from the *National Travel Survey*. An adjustment is made to exclude emissions from business travel. The adjustment is based on information on business travel taken from the *NTS*. No estimate is made to exclude empty running between fares or waiting time between fares as information on either variable is not readily available on a regional basis.

Aircraft (EA code 70)

Total greenhouse gas emissions from air transport industry includes those from both passenger and freight transport with passenger transport covering both business and personal travel. For purposes of this report an attempt has been made to identify only those emissions stemming from personal travel by applying adjustments to exclude emissions from both business and freight transportation.

Greenhouse gas emissions from airfreight are derived by identifying the different number of stage flights for passenger flights and freight flights. These are then split between domestic and international flights and the emissions are adjusted on a pro-rata basis.

The estimate of emissions from personal travel is based on using the business/personal travel split published in *Travel Trends*. There were approximately 43 million flights taken by UK residents in 2001 of which 6.3 million were business travel and 36.7 million were personal travel. Using this split to apportion the air passenger emissions results in personal travel emissions of 32.5 million tonnes of CO_2 equivalent.

The data supplied by Netcen separately identifies greenhouse gas emissions from domestic and international aviation allowing different methodology for the allocation of each. Emissions from domestic aviation are apportioned to the households using information on domestic air travel collected in the *National Travel Survey*. The allocation of emissions from international aviation is based upon regional passenger information collected through the ONS *International Passenger Survey (IPS).* The *IPS* collects travel information by region and by age of passenger. Apportioning these trips across the regional households enables an estimate the numbers of trips by each of the various households compositions (region x age x size). After the trips have be apportioned across the households, the emissions can then be pro-rated to the households use these proportions.

Unfortunately, whilst the *IPS* records the age of the passenger it does not record the household type in which they reside i.e. single occupant, couple, three or more. The *IPS* passenger numbers have been allocated proportionally across all household types within the composite age group. This assumes an equal propensity to travel across all household types, which may not be the case. An alternative methodology is to use information from the *Expenditure and Food Survey (EFS).* The *EFS* collects information on expenditure on package holidays, which could be used as a proxy for international aviation. **Chart 6.5** presents the results of both methodologies. At a total emissions per household level the results are broadly comparable with the exception of London and Northern Ireland. The *IPS* dataset has been used in the allocation of the air transport emissions as the *EFS* dataset is weakened by relative small sample sizes for some household types, which may distort the results. London comes out very low using the *EFS* dataset, which is surprising considering the relative affluence of the region and the high number of flights reported in the *IPS* dataset.

Another flaw in using the *IPS* methodology is that it assumes that same average mileage for each region. The likelihood is that most holiday flights are to the South (mainland Spain, Balearic Islands, Canary Islands, etc.) therefore households flying from the North of the UK will fly further than those in the South. However, without extensive investigation into average flight length, it is impractical to attempt to apply any adjustment and for the purposes of this report we will assume that all flights are of equal length. Similar problems would also occur if the *EFS* methodology were used.

Private vehicles (EA code 93)

All greenhouse gas emissions from private vehicles are in the form of direct emissions and come from the combustion of fuels such as petrol and diesel. Total greenhouse gas emissions from private

vehicles are reported in the dataset provided by Netcen and those allocated to the domestic sector are reported to the ONS under EA code 93. The household breakdown of these emissions is based on fuel expenditure information collected in the *Expenditure and Food Survey*.

One weakness with this methodology is that it assumes regional fuel purchasing parity throughout the UK, which is obviously not the case. There is also evidence of "tank tourism" between Northern Ireland and Ireland, where fuel is significantly cheaper.

Regional transport analysis

The results are presented excluding and including greenhouse gas emissions from civil aviation. Greenhouse gas emissions from civil aviation are by far the largest of the transport related emissions and would swamp the emissions from other sources such as railways and buses.

Chart 6.1 – Regional greenhouse gas emission from transport

Million tonnes of CO_2 equivalent

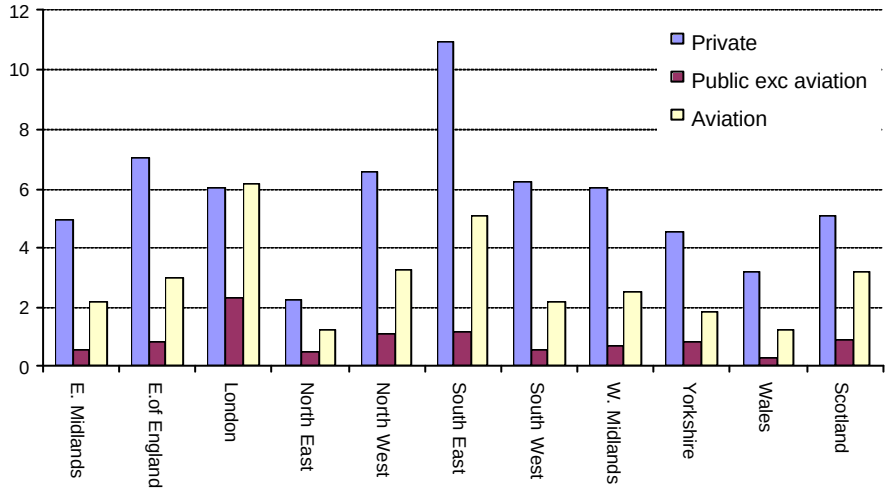
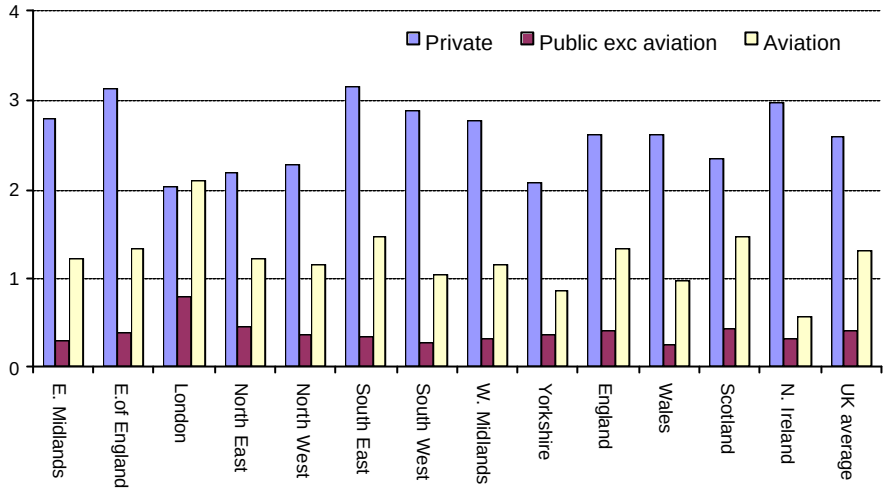


Chart 6.1 shows that the majority of greenhouse gas emissions transport come directly from household use of private vehicles. Emissions of CO_2 equivalent from private vehicles amounted to 64.8 million tonnes of which 17.0 million tonnes came from London and the South East. Total greenhouse gas emissions from civil aviation amounted to 32.5 million tonnes and public transport amounted to 10.1 million tonnes. London and the South East were responsible for 11.3 million tonnes of aviation emissions and 3.5 million tonnes public transport emissions, over a third of all emissions from those respective sources. Total greenhouse gas emissions from UK households personal use of transport amounted to 107.3 million tonnes of CO_2 equivalent, approximately 15 per cent of all UK generated emissions with London and the South East responsible for 31.8 million tonnes or 30 per cent of all transport related emissions.

Chart 6.2 – Emission per household from transport

Tonnes of CO_2 equivalent



Greenhouse gas emissions on an individual household basis are shown in **chart 6.2**. Emissions per household are fairly comparable across the regions. Interestingly, the results suggest that Londoners are responsible more emissions from the use of civil aviation than they are from using private vehicles. This is due to the relatively low levels of emissions from private vehicles as a result of the extensive availability of public transport in the capital. In all regions households are responsible for more emission from civil aviation than they are public transport.

Chart 6.3 - Regional emissions by mode of public transport excluding aviation

Million tonnes of CO_2 equivalent

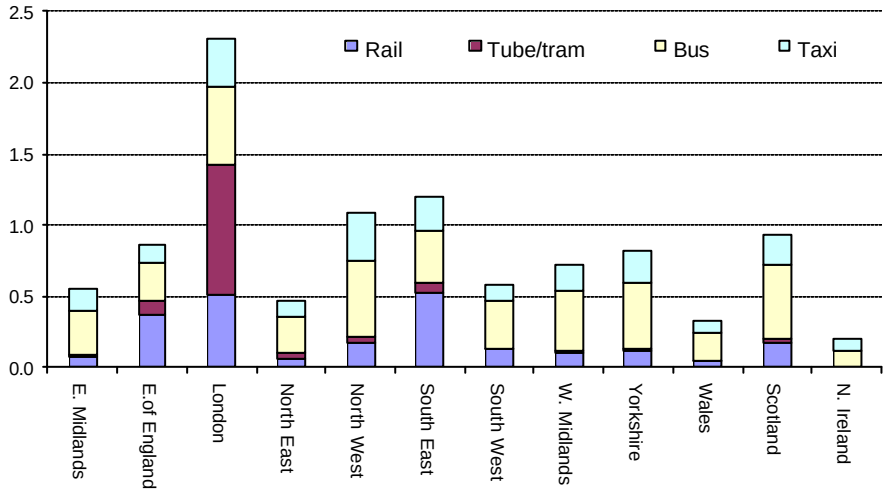
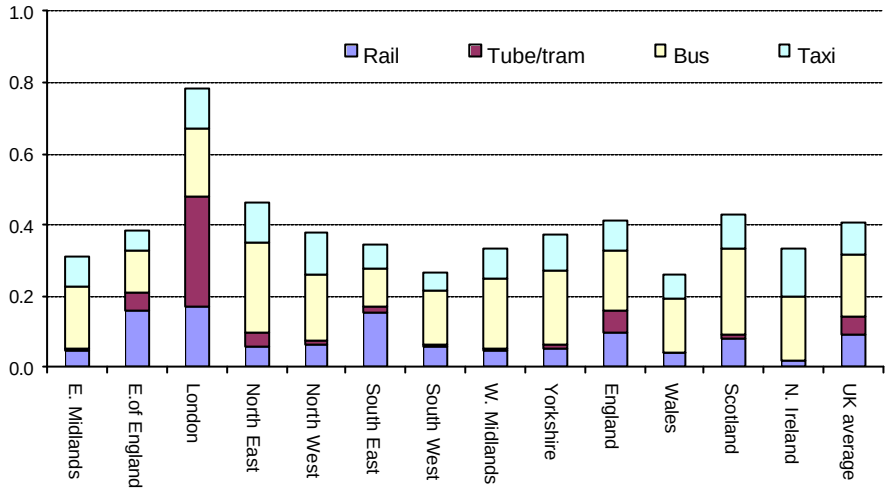


Chart 6.3 shows the highest levels of greenhouse gas emissions from public transport come from London and the South East. Emissions from bus, rail and tube are all significant and reflect the high level of commuting to work done using public transport. The high levels of emissions also reflect the fact that London and the South East have the highest number of households at 3 million and 3.3

million respectively. The lowest levels of emissions come from Northern Ireland and Wales respectively and reflect the greater use of private vehicles for commuting. Both regions also have a relatively low number of households at 0.7 million and 1.2 million respectively. A more informative measure is to look at emissions per household.

Chart 6.4 - Emission per household per mode of public transport

Tonnes of CO_2 equivalent



On an emission per household basis **(chart 6.4)**, London still comes out the highest reflecting the greater use of public transport as opposed to the use of private vehicles. Rail travel is significantly higher than most regions apart from the East of England and the South East. Indirect emissions from the underground network also significantly increase the level of emissions per household. The households with the fewest public transport emissions are in the South West and Wales due to the low levels of emissions from bus and rail transport and the lack of any tube/tram networks.

Chart 6.5 - Emissions per household per region from civil aviation

Tonnes of CO_2 equivalent

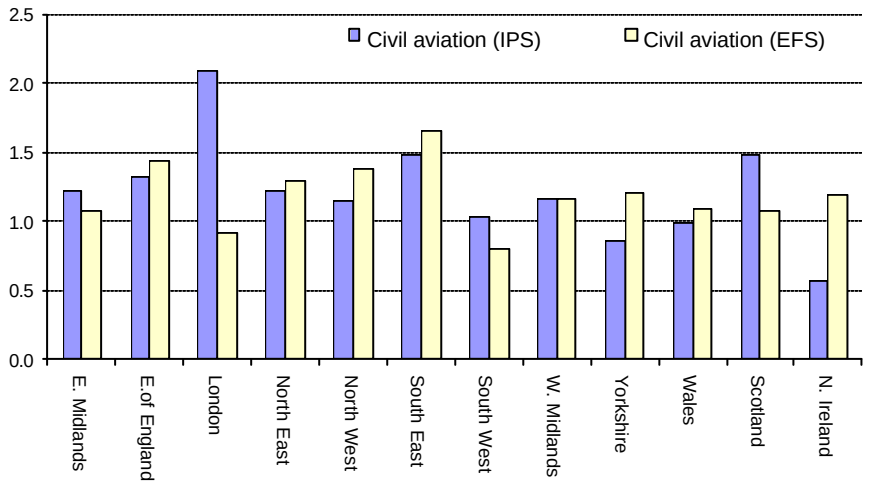


Chart 6.5 shows the results of using both the *NTS/IPS* and the *EFS* methodologies described earlier. Using the *NTS/IPS* datasets, emissions from civil aviation are highest for London, the South East and Scotland with the majority of the remaining regions broadly comparable. The exception being Northern Ireland which has significantly fewer emissions from the use of civil aviation. The allocation of emissions from civil aviation is based on the number of flights per region rather than the actual expenditure. International flights by Londoners amounted to 6.6 million visits whereas the number of visits by residents of Northern Ireland amounted to less than 0.2 million. On a visit per household basis, London households average two visits abroad per year whereas Northern Ireland household average less that one visit abroad per year. Using the *EFS* dataset suggests Londoners seldom flew, which is contrary to what the *IPS* dataset indicates.

Chart 6.6 - Non-aviation emissions per household by region by age of head of household

Tonnes of CO_2 equivalent

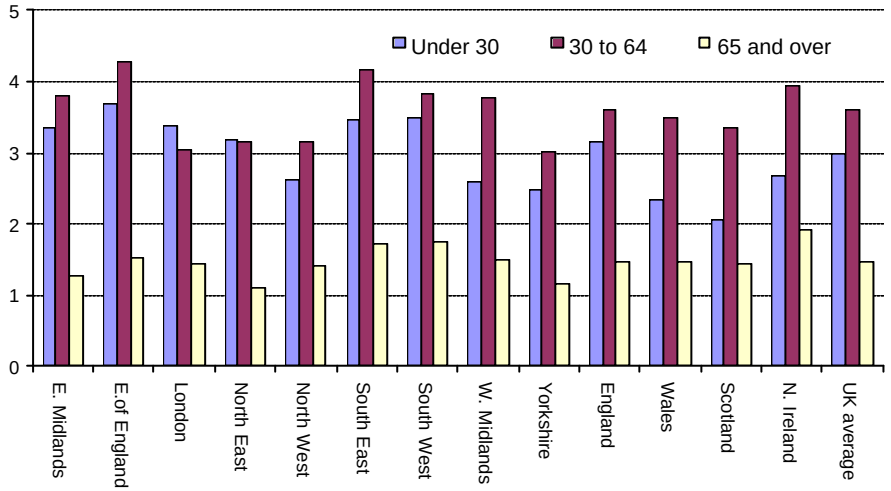
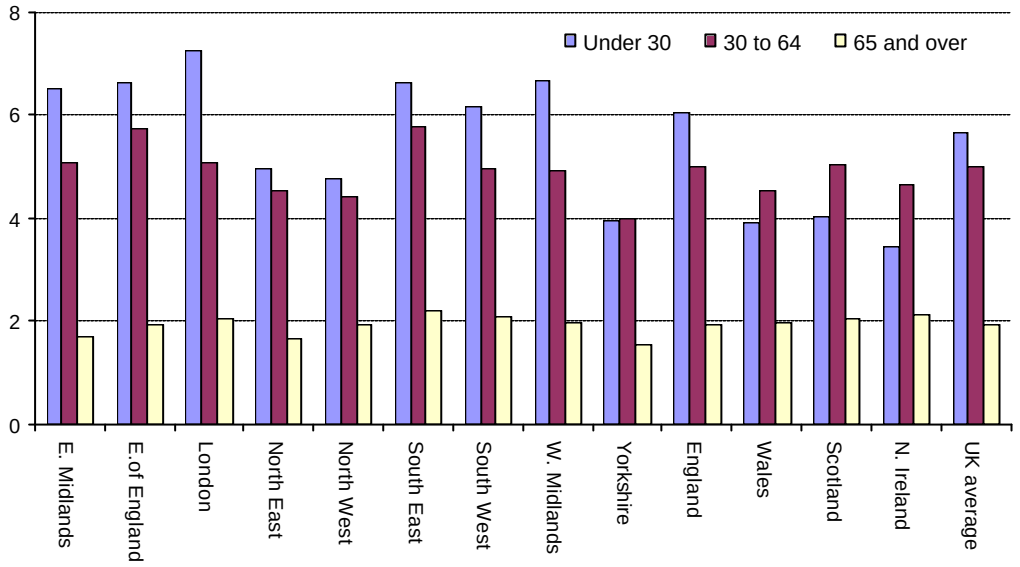


Chart 6.6 shows that non-aviation emissions per household by the age of head of household differ considerably from region to region. In London and the North East the greatest volume of emissions come from households where the head of the household is under 30. For the remaining regions the greatest emissions come from households where the head of the household in between 30 and 65. In all regions the over 65s are responsible for the fewest transport emissions

Chart 6.7 - Emissions per household by region by age of head of household including aviation

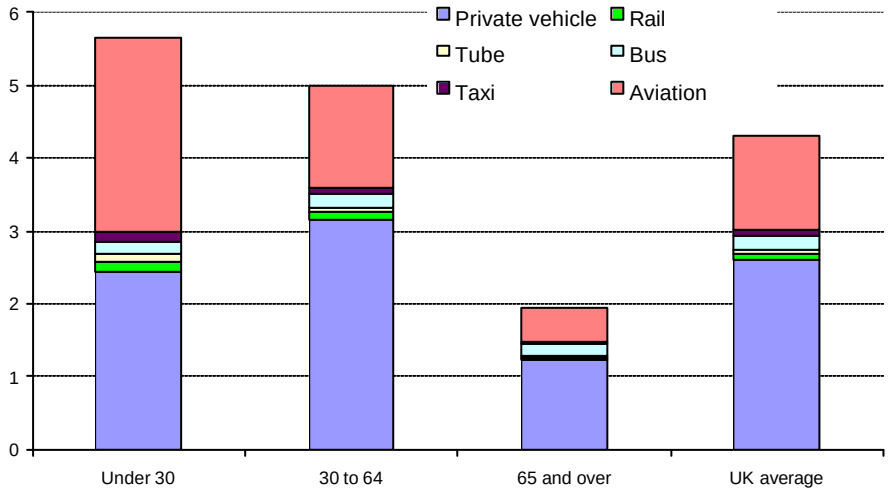
Tonnes of CO_2 equivalent



The inclusion of greenhouse gas emissions from civil aviation **(chart 6.7)** changes the story completely. In most of the English regions with the exception of Yorkshire and Humberside, the highest level of emissions now come from households where the head of the household is aged under 30. For Yorkshire and Humberside, Wales, Scotland and Northern Ireland the highest level of emissions come from the 30 to 64 age range.

Chart 6.8 - Emissions by mode by age of head of household

Tonnes of CO_2 equivalent



Looking at greenhouse gas emissions by age of head of household and source of emission (**chart 6.8**) shows that the main driver for the high level of emissions from the under 30s are the emissions from

civil aviation, at 2.7 tonnes of CO_2 equivalent per household compared with a national average of 1.3 tonnes. This is may be down to the propensity to take holidays due to the lack of family and financial commitments. For the under 30s, greenhouse gas emissions from civil aviation are greater than those from the use of privately owned vehicles. For the other two age ranges, greenhouse gas emissions from privately owned vehicles are the largest source of emissions outweighing the combined emissions from public transport and civil aviation. For the 30 to 64 age range, the proportion of greenhouse gas emissions from public transport is less that 9 per cent of the total emissions from transport and travel. For the 65 and over age range this proportion increases to just under 13 per cent. For the UK as a whole less than 10 per cent of all greenhouse gas emissions from transport and travel come from the use of public transport.

Chart 6.9 – Greenhouse gas emissions per capita by size of household

Tonnes of CO_2 equivalent

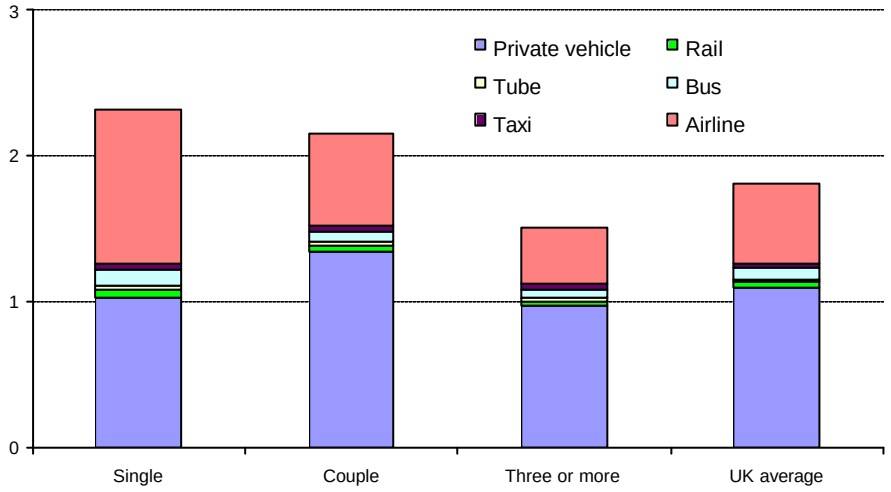


Chart 6.9 shows single occupancy households produce the highest level of greenhouse gas emissions per capita at 2.3 tonnes of CO_2 equivalent per annum compared with the national average of 1.8 tonnes per capita per annum. The largest contributory factor is the high level of emissions from civil aviation at 1.1 tonnes of CO_2 equivalent per annum compared with the national average of 0.5 tonnes. The lowest level of emissions per capita comes from households where there are three or more occupants. Greenhouse gas emissions from these households amount to 1.5 tonnes of CO_2 equivalent per capita with only 0.4 tonnes coming from civil aviation. For households with two or more occupants, the largest contributory factor are emissions from private vehicles at 1.3 tonnes. For all household sizes, the proportion of greenhouse gas emissions from the use of public transport amount to around 10 per cent of their total direct and indirect emissions from transport and travel.

Summary of emissions from transport and travel

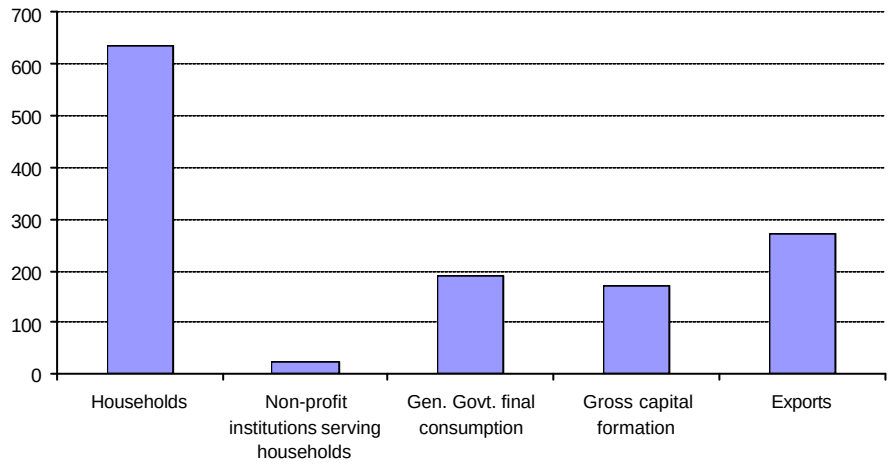
The level of greenhouse gas emissions from transport and travel is affected by two main factors; the availability and use of public transport and the use of civil aviation. The availability of public transport results in a reduction of private vehicle use for the day to day commuting to work leading to a reduction in direct transport emissions. The ever increasing use of private vehicles and air transport would suggest that the level of greenhouse gas emissions from both sources will continue to grow.

7. Greenhouse gas emissions from household final demand for non energy and transport products

The emissions generated by the manufacturing sectors generally arise from production needed to meet either intermediate or final demand. Final demand predominantly comes from households, general government, capital formation and exports of goods and services. The largest component of final demand is household final consumption expenditure. As can be seen in **chart 7.1**, household final consumption expenditure amounted to £636 billion in 2001, 49 per cent of total final demand. This consumption expenditure includes expenditure on food, drink, tobacco, clothing, household durables, household services and personal goods. By identifying the greenhouse gas emissions generated to meet total demand, it is possible to estimate the proportion of those emissions stemming from household final demand. Gross capital formation[6] is also responsible for the generation of emissions from housing construction, which could be indirectly attributable to households' demand for housing but are not included in this report.

Chart 7.1 - Final consumption expenditure in 2001

£ billion



Source: ONS, Blue Book 2003

Using the 123 product x 123 industry supply tables enables identification of which industries supply which products. For some products, such as agriculture, there is a straight 1:1 correlation with the agriculture industry whereas something like other food products are supplied by a range of different industries.

[6] Gross capital formation is the acquisition less disposals of fixed assets, improvement of land, change in inventories and acquisition less disposals of valuables

The breakdown of household final consumption expenditure (HHFCE) across the 123 products enables identification of which products are being bought by the households. HHFCE is brokendown across a range of products such as food, drink, tobacco, energy, transportation, furniture, etc. consistent with breakdown collected in the *Expenditure and Food Survey (EFS)*. By identifying the products consumed and the industries producing them, it is possible to estimate the final expenditure by product by industry on a 123 x 123 basis.

For the purposes of this chapter expenditure has been used for the following HHFCE items:

Food and non-alcoholic drinks
Alcoholic drinks
Tobacco
Clothing
Footwear
Household goods (household appliances, utensils, furniture, etc.)
Purchase of vehicles
Leisure goods (papers, magazines, televisions, etc.)
Leisure services & education (theatres, museums, sporting activities, etc.)
Personal goods (pharmaceuticals, personal care, etc.)

Household final consumption expenditure on energy products used in the home for cooking, heating and lighting and expenditure on transport and travel (petrol, fares, etc.) are not included here as they were covered in chapters 5 and 6 respectively. Data for supply-use, final demand and household final consumption expenditure are all consistent with Blue Book 2003, the latest version available at the time of compilation.

The Input-Output framework

The Input-Output (I-O) framework breaks the economy down to display transactions of all goods and services between industries and final consumers in the UK for one year. Information is presented in two key products: Annual Input-Output Supply and Use Tables (I-O SUTs), and Input-Output Analytical Tables (I-O ATs).

The I-O SUTs show the whole economy by 123 industries (e.g. motor vehicles industry) and 123 products (e.g. sports goods). The tables show links between components of gross value added, industry inputs and outputs, product supply and demand. The I-O SUTs link different sectors of the economy (for example public corporations) together with detail of imports and exports of goods and services, government expenditure, household expenditure and capital investment. Producing I-O SUTs allows an examination of consistency and coherency of National Accounts components within a single detailed framework and, by calculating Gross Value Added (GVA) for each industry group, sets

the estimate of annual Gross Domestic Product (GDP). GVA measures the contribution to GDP made by an individual producer, industry or sector.

I-O ATs are compiled from I-O SUTs data and other additional sources. These tables contain symmetric (product by product) tables, Leontief Inverse and other diagnostic analyses such as output multipliers. I-O ATs show separately the consumption of domestically produced and imported goods and services, providing a theoretical framework for further structural analysis of the economy, the composition and the effect of changes in final demand on the economy. The latest set of I-O ATs cover the year 1995.

Since 1992 ONS has used the I-O process to set a single estimate of annual GDP. This is achieved by reconciling various sources of data used in compiling the income, production and expenditure measures of GDP. The I-O work also plays a central role feeding into many key ONS items such as chain-linking the production measure of GDP, Producer Price Indices, Regional Accounts and the Environmental Accounts.

I-O codes to EA codes

Using a conversion table it is possible to convert from expenditure on 123 industry basis to expenditure on a 93 Environmental Accounts (EA) code basis. The main differences between I-O codes and EA codes are in the manufacturing industries where the I-O breakdown is more detailed and in the energy production and transportation sectors where the EA breakdown is more detailed. A conversion guide is attached at Annex A showing how the I-O breakdown has been converted to an EA breakdown. The additional information required for the EA codes is derived from a variety of different sources such as the Digest of UK Energy Statistics (DUKES) and ONS assumptions based on volumes of fuels consumed and the correlation of total greenhouse emissions to output and final demand.

There are some important features and assumptions implicit in input-output analysis that should be borne in mind when assessing whether and how they should be used. These assumptions are :

- industries have constant returns to scale
- industry output can be expressed as a linear combination of its inputs and;
- input-output industries and products are homogeneous.

Further assumptions are needed to operationalise environmental input-output analysis:

- the environmental pressures exerted by an industry are proportional to its gross output and;
- emissions from firms with an industry are homogeneous.

The importance of the homogeneity assumption is less extreme when industries are disaggregated to the extent they have been in the Environmental Accounts. Effort has been made to disaggregated industries where the environmental impacts are not homogeneous such as in the electricity generation industry where coal fired and nuclear fuelled power stations have very different environmental impacts.

Greenhouse gas emissions by manufacturing and service sectors

The sectoral breakdown of greenhouse gas emissions comes from the National Environmental Technology Centre (Netcen). The emissions data are supplied by EA code, which separately identifies greenhouse gas emissions by 93 sectors. EA codes 1-91 cover the manufacturing and service sectors while codes 92-93 cover the household sector. The data covers emissions from production for domestic demand and for export.

Direct and indirect greenhouse gas emissions from domestic production

Greenhouse gas emissions generated by final demand comprise both direct and indirect emissions. Taking food production as an example, direct emissions will include the direct emissions from any food preparation such as baking. The indirect emissions include those from lighting and heating the factory (emissions from the electricity generation sector) and from the production of the raw ingredients such a meat and vegetables (emissions from the agriculture sector). In order to estimate the total emissions generated through final demand it is necessary to derive an estimate of direct and indirect emissions per unit of total demand.

Greenhouse gas emissions from imports

Household final demand is met by domestic production and by imports from the rest of the world. Emissions embedded in imports are an important factor to consider especially with the introduction targets such as the Kyoto protocol and the potential increase in production in less developed countries where environmental legislation is less restrictive. The UK has seen a steady increase in the volume of imports since the early 1990s **(see chart 7.2)**, all of which contain embedded emissions in their production and transportation to the UK.

Chart 7.2 – Chain volume index of imports of goods 1980-2001

2000=100

Source: ONS, UK Trade

Ideally, the estimation of greenhouse gas emissions from household final demand should attempt to differentiate between emissions from final demand met by domestic production and emissions from final demand met by imports. Unfortunately it is not possible to identify the proportion of household final demand met by imports using existing datasets. If it were possible to identify household final demand for imports, further estimation would ideally need emissions coefficients from the exporting country. Such coefficients are not readily available. The alternative is to assume that import emission coefficients are the same as domestic coefficients, which is undoubtedly incorrect due to the many diverse production techniques used throughout the world. Nevertheless, if this assumption was made and applied to a split of household final demand met by domestic production and household final demand met by imports, the results would be identical as those published in this report.

For further information on techniques used to estimate emissions embedded in imports see "*Methodologies for estimating the levels of atmospheric emissions arising from the production of goods imported into the UK*" (ONS (Harris, R.), 2000). The OECD have also published a report on embodied trade emissions "*Carbon dioxide emissions embodied in international trade of goods*" (OECD (Ahmad, N and Wyckoff, A), 2003).

REWARD and REEIO

One of the main objectives of the Regional and Welsh Appraisal of Resource Productivity and Development (REWARD) project was the development of the Regional Economy-Environment Input-Output (REEIO) model to analyse the effects of economic trends and policies on resources and the environment. The REEIO model links economic policy and environmental and social impacts.

The REEIO is based on a detailed model of each regional economy, based on the widely used Local Economy Forecasting Model (LEFM). The economy is arranged in 50 sectors, each of which makes transactions with each other sector. The labour market is shown in 6 types of employment and 25 types of occupation. The REEIO then links economic and employment changes with key environmental and resource pressures – covering water, waste and energy and air emission impacts.

For more information on the REEIO model see *REWARD: Overview of the REEIO Model Development Programme* published by Cambridge Econometrics in August 2003.

Methodology

The estimation of greenhouse gas emissions from household final consumption expenditure (HHFCE) requires the estimation of emissions per industry, emissions per unit of output, emissions per unit of production, emissions per unit of final demand and finally emissions per unit of total demand. The following paragraphs explain the methodology in more detail and refer to the columns in the table contained in annex B. The methodology is based on similar work done to estimate waste generation in Portugal (Barata 2000) and CO_2 emissions from energy use in the UK (Gay and Proops 1993). Chapter 8 of the *UK Environmental Accounts 1998* looked at the compilation of *Environmental input-output tables for the United Kingdom*. The chapter, originally published in *Economic Trends* (Vaze 1997), described the compilation of environmental input-output tables from supply/use tables, their analytical use including two simulations to show potential policy use. This report has not replicated that work and does not attempt to differentiate between emissions from domestic production and imports, as discussed in the previous paragraph. This report makes use of the Leontief Inverse calculated at the time of the report and therefore does not reflect recent structural changes in the economy.

Total emissions per sector (Annex B, column C)

Total emissions of greenhouse gas per sector are supplied to the ONS by Netcen. The Netcen dataset identifies emissions from 93 sectors. Sectors 1-91 encompass the manufacturing and services industries while sectors 92-93 cover direct emissions from households. The 93 sectors correspond to the Environmental Account codes not the Input-Output (I-O) codes. For the purposes of this exercise we are only interested in emissions generated from sectors 1-91. The emissions data are consistent the data published in the spring 2004 edition of the Environmental Accounts and are presented in tonnes of CO_2 equivalent.

Direct emissions per unit of output (e) (Annex B, column G)

Emission coefficients per unit of output (e) are derived by dividing total emissions per industry (column C) by total output per industry in 2001 at basic prices (column D), taken from the 123 x 123 Combined Use matrix (table 3) published in the *UK Input-Output Analysis Edition 2003*. Total output of the 123

industries is reaggregated on to a 91 industry basis so as to be consistent with the 91 industry emissions data.

Direct and indirect emissions per unit of production demand ($e'(I-A)^{-1}$) (Annex B, column I)
Estimation of coefficients for direct and indirect emissions per unit of production demand are derived by using the "Leontief Inverse" $(I-A)^{-1}$. The transposed vector of direct emissions per unit of output (e) (column G) are postmultiplied by the Leontief Inverse $(I-A)^{-1}$ to derive total emissions per unit of production demand ($e'(I-A)^{-1}$) (column I). The Leontief Inverse used in this instance is one based on commodity output estimates for 1993 as this is the only 91 x 91 Leontief inverse readily available. A 1995 Leontief is available on a 123 x 123 basis but this is incompatible with the 91 sector emissions data.

Direct emissions per unit of final demand (e_y) (Annex B, column K)
Emissions coefficients per unit of total final demand (e_y) (column K) are derived by dividing total emissions per industry by total final demand per industry in 2001 (column E), taken from the final demand section of the Combined Use matrix (table 3) published in the *UK Input-Output Analysis Edition 2003*. Total final demand of the 123 industries is reaggregated on to a 91 sector basis so as to be consistent with the 91 sector emissions data.

Direct and indirect emissions from total demand (Annex B, column M)
Emissions coefficients per unit of total demand (column M) are an aggregate of direct and indirect emissions per unit of production demand (column I) and direct emissions per unit of final demand (column K).

$$e'(I-A)^{-1} + e_y$$

Emissions from household final consumption expenditure
Total direct and indirect emissions generated by household final demand are derived by multiplying total HHFCE per product per industry by the coefficient for emissions per unit of total demand for that industry. Total HHFCE for 2001 was taken from taken from the final demand section of the Combined Use matrix (table 3) published in the *UK Input-Output Analysis Edition 2003*. The emissions coefficient comes from column M of the table in annex B.

Household final consumption expenditure by COICOP heading
The detailed Classification of Individual Consumption by Purpose (COICOP) data are used to identify the individual products that make-up HHFCE and this product breakdown is in turn used to identify the industries meeting the HHFCE. By identifying the industries producing the products it is possible to allocate these direct and indirect industry emissions back to the households. COICOP data was taken from Household final consumption expenditure by COICOP heading published in the *UK Input-Output Analysis Edition 2003*. The COICOP data were adjusted to included net tourism expenditure in order to ensure consistency with total HHFCE.

Allocation of total HHFCE generated emission to individual household types

Households have been brokendown three ways:

by region (North West, South East, London, Wales, etc.);

by size (one occupant, two occupants, three or more occupants);

by age of the head of household (under 30, 30 to 64 and 65 and over)

The information used to derive this breakdown was taken from the *Expenditure and Food Survey (EFS)*. Expenditure by each household type was again taken from the *EFS* and used to identify regional proportion of expenditure. The regional proportions were derived by multiplying the number of each household type by the average expenditure by that household type. Household emissions from HHFCE were then allocated to the individual household types using these regional expenditure proportions. As with expenditure on energy products, no attempt is made to adjust for regional purchasing power parity. While some regions may have lower expenditure on certain products i.e. food and drink, the volume of purchases may be the same due to lower prices.

Regional greenhouse emissions from the demand for non energy and transport products

Chart 7.3 - Total greenhouse emissions per region per annum in 2001

Million tonnes CO_2 equivalent

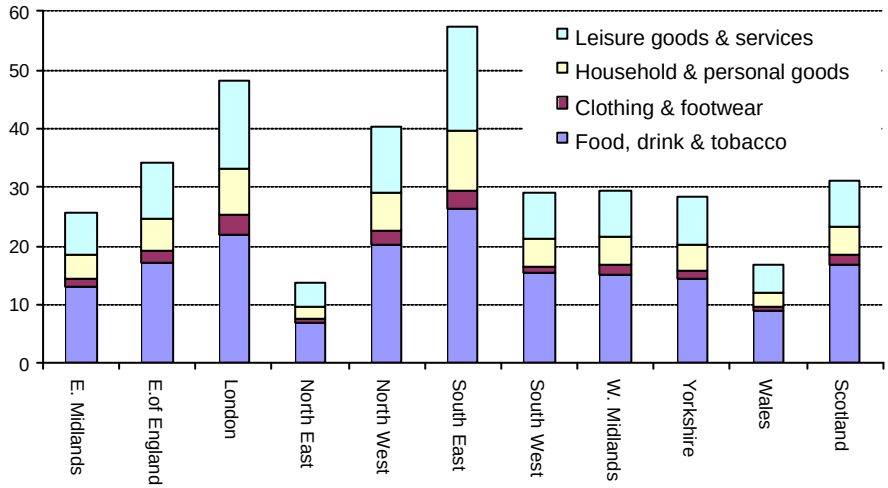
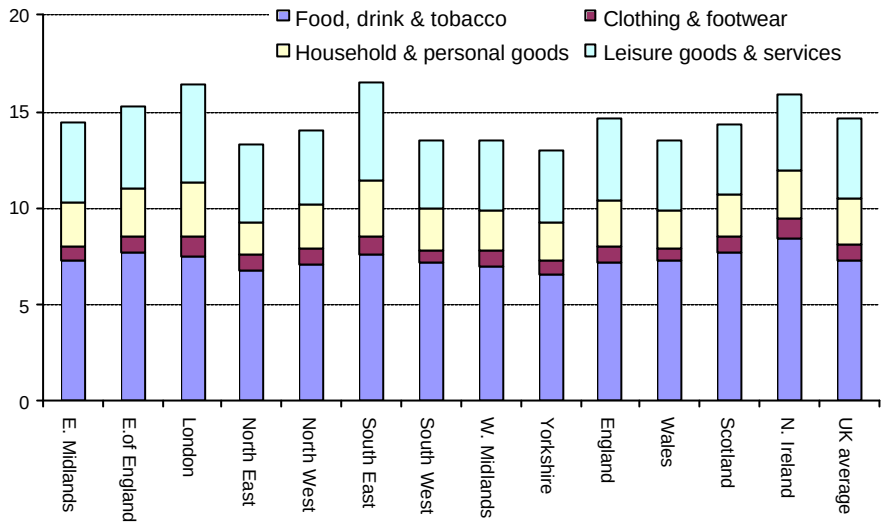


Chart 7.3 shows that the highest levels of greenhouse gas emissions comes from the South East and London due to the large resident population while the fewest emissions come from Northern Ireland and the North East due to the low resident population. A far more informative indicator is to look at greenhouse gas emissions per household.

Chart 7.4 – Greenhouse gas missions per household in 2001

Tonnes CO_2 equivalent



Greenhouse gas emissions per households shown in **chart 7.4** show a much greater comparability across the regions. The highest level of emissions per household comes from the South East at 16.5 tonnes of CO_2 equivalent per household per annum closely followed by London at 16.4 tonnes per household per annum. Northern Ireland has the highest level of emissions from the consumption of food, drink and tobacco while the South East has the highest level of emissions from household and personal goods and from leisure goods and services. Households in Yorkshire produce the fewest emissions from final demand with an average of 13.0 tonnes per household per annum. On average, emissions from household final demand in the South East are 27 per cent higher than those for Yorkshire.

Chart 7.5 - Greenhouse gas missions by age of head of household

Tonnes CO_2 equivalent

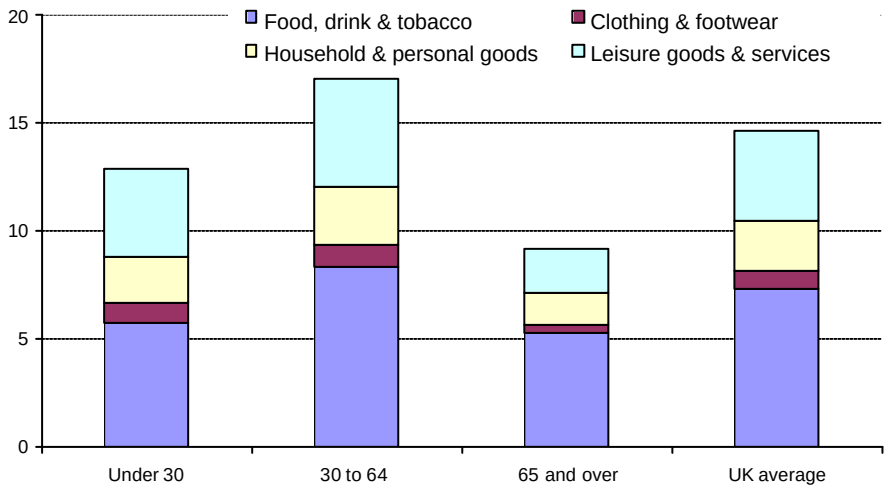
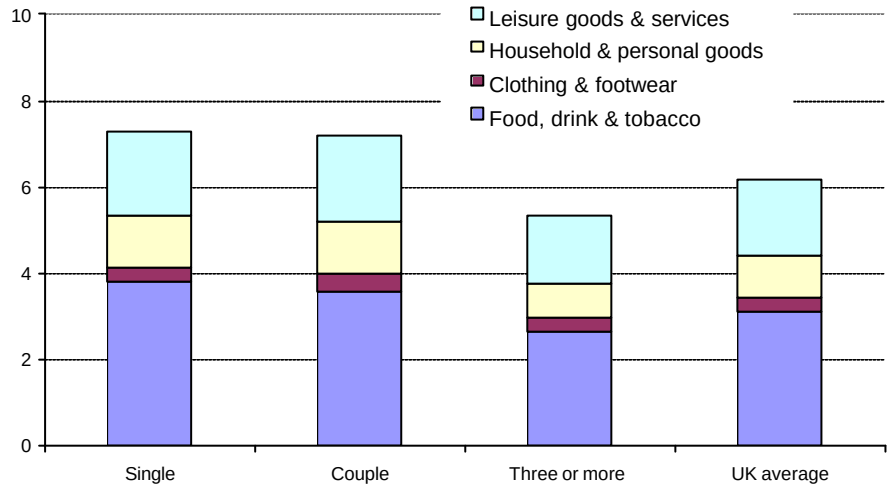


Chart 7.5 shows the highest level of greenhouse emissions come from the final demand of the 30 to 64 year olds with an average level of emissions of 17.0 tonnes of CO_2 equivalent per household compared with a national average of 14.7 tonnes. The greatest source of greenhouse gas emissions comes from the production of food, drink and tobacco products at 8.4 tonnes of CO_2 equivalent compared with a national average 7.3 tonnes. The other significant emissions source are leisure goods and services at 5.0 tonnes of CO_2 equivalent. The 65 and over are indirectly responsible for an average 9.2 tonnes of CO_2 equivalent per household with emissions from food, drink and tobacco at 5.3 tonnes and emissions from leisure goods and services at 2.1 tonnes.

Chart 7.6 – Greenhouse gas emissions per capita by household size

Tonnes CO_2 equivalent



On a per capita basis **chart 7.6** shows single occupancy households are responsible for the highest level of emissions from final demand for non energy and transport products at 7.3 tonnes of CO_2 equivalent per capita compared with a national average of 6.2 tonnes per capita. Households where there are three or more occupants are responsible for the fewest emissions per capita at 5.3 tonnes of CO_2 equivalent per capita, mainly due to lower levels of emissions from the production of food, drink and tobacco products and from leisure goods and services. Greenhouse gas emissions per capita are almost identical for single and two occupant households. Across all household types approximately 50 per cent of all greenhouse gas emissions from final demand for come from food, drink and tobacco production. This is due to the high level of expenditure on the products, over £85 billion in 2001, and the high emission factors for agricultural production.

Conclusion

Household final demand for non energy and transport goods and services are the largest single source of greenhouse gas emissions, greater than both emissions from energy products and transport and travel combined. Within the demand for goods and services, the greatest levels of emissions come for demand for food, drink and tobacco. Greenhouse gas emissions from final demand include

significant levels of emission from imported goods and services. The estimation of emissions from imports is complex and worthy of further investigation using the various methodological techniques discussed in "*Methodologies for estimating the levels of atmospheric emissions arising from the production of goods imported into the UK*" (ONS (Harris,R.) 2000) and "*Carbon dioxide emissions embodied in international trade of goods*" (OECD (Ahmad, N and Wyckoff, A), 2003).

Future work

There are numerous areas for further research and analysis on the impact of households upon the environment. As mentioned in the inroduction, households impact upon the environment through the use of resource and sink functions. This report only looks at the use of air as a sink for greenhouse gas emissions. Future work could look at household generation of other atmospheric pollutants, the generation of waste and its impact upon the environment through landfill, the demand for domestic or imported materials and the demand and use of water. Further analysis of greenhouse gas emissions by level of income would highlight differences in household travel and final demand.

Another area for research would be the identification of emissions from imports either in the form of the reduction in domestic emissions or in the estimation of actual embedded emissions. The latter approach is complex but would highlight the level of emission that the UK has shifted to the rest of the world.

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Annex A – EA and I-O codes

EA code	Industrial sector	IO codes
1	Agriculture, hunting and related service activities	1
2	Forestry, logging and related service activities	2
3	Fishing, operation of fish hatcheries and fish farms	3
4	Mining of coal, lignite and peat	4
5	Extraction of crude petroleum and natural gas	5
6	Mining of metal ores	6
7	Other mining and quarrying	7
8	Manufacture of food products and beverages	8-19
9	Manufacture of tobacco products	20
10	Textiles	21-27
11	Manufacture of wearing apparel; dressing and dyeing of fur	28
12	Leather tanning, luggage and footwear	29-30
13	Timber, wood products excluding furniture; cork and straw	31
14	Pulp, paper and paper products	32
15	Publishing, printing and production of recorded material	33-34
16	Coke oven products	35
17	Refined petroleum products	
18	Processing of nuclear fuel	
19	Industrial gases, dyes, pigments	36
20	Other inorganic chemicals	37
21	Other organic basic chemicals	38
22	Fertilisers and nitrogen compounds	39
23	Plastics, synthetic rubber, primary form	40
24	Pesticides, agro-chemicals	41
25	Paints, varnishes, printing ink etc	42
26	Pharmaceuticals and botanical products	43
27	Soap and detergents, cleaning and toilet preparations	44
28	Chemical products not elsewhere specified	45
29	Man-made fibres	46
30	Rubber products	47
31	Plastic products	48
32	Glass and glass products	49
33	Ceramic goods	50
34	Structural clay products	51
35	Cement, lime and plaster	52
36	Articles of concrete, stone, other non-metallic mineral products	53
37	Iron and steel	54
38	Non-ferrous metals excluding aluminium	55
39	Aluminium	
40	Casting of metals	56
41	Fabricated metal products, except machinery	57-61
42	Machinery and equipment	62-68
43	Office machinery and computers	69
44	Electrical machinery and apparatus	70-72
45	Radio, television and communications	73-75
46	Medical, precision and optical instruments, watches and clocks	76
47	Motor vehicles, trailers and semi-trailers	77
48	Other transport equipment	78-80
49	Manufacture of furniture, toys, sports equipment, other products	81-84
50	Recycling	84
51	Electricity production - gas	85
52	Electricity production - coal	

EA code	Industrial sector	IO codes
53	Electricity production - nuclear	
54	Electricity production - oil	
55	Electricity production - other	
56	Gas distribution; steam and hot water supply	**86**
57	Water supply	**87**
58	Construction	**88**
59	Garages, car showrooms	**89**
60	Wholesaler trade and commission trade except motor vehicles	**90**
61	Retail and repair trade, except motor vehicles	**91**
62	Hotels and restaurants	**92**
63	Railways	**93**
64	Buses and coaches	**94**
65	Tubes and Trams	
66	Taxis operation	
67	Freight transport by road	
68	Transport via pipeline	
69	Water transport	**95**
70	Air transport	**96**
71	Supporting and auxiliary transport activities, travel agencies	**97**
72	Post and telecommunications	**98-99**
73	Financial intermediation, except insurance and pension funds	**100**
74	Insurance and pensions	**101**
75	Activities auxiliary to financial intermediation	**102**
76	Real estate activities	**103-105**
77	Renting of machinery	**106**
78	Computer and related activities	**107**
79	Research and development	**108**
80	Other business activities	**109-114**
81	Public administration - not defence	**115**
82	Public administration - defence	
83	Education	**116**
84	Health and veterinary services, social work	**117-118**
85	Sewage and treatment of liquid waste	**119**
86	Solid waste	
87	Other sanitary services	
88	Activities of membership organisations	**120**
89	Recreational, cultural and sporting activities	**121**
90	Other service activities; dry cleaning, hair dressing, funeral parlours	**122**
91	Private households with employed persons	**123**
	Extra-territorial organisations and bodies	
	Natural world	
92	Consumer expenditure - not travel	**126**
93	Consumer expenditure - travel	**126**

Annex B – Emissions per unit of final demand in 2001

EA Code	Economic Sector	Emission	Total output	Final demand	Emissions (1000 tonnes) per total unit of Output	Production demand	Final demand	Total demand
		1000 tonnes	£m	£m	e	$e'(I-A)^{-1}$	e_y	$e'(I-A)^{-1}+e_y$
1	Agriculture	51031	18061	12025	2.8	4.0	4.2	8.2
2	Forestry	51	701	203	0.1	0.3	0.3	0.6
3	Fishing	447	1031	492	0.4	0.7	0.9	1.7
4	Mining of coal	5368	1334	541	4.0	5.3	9.9	15.2
5	Extraction of petrol and gas	25028	27374	11841	0.9	1.2	2.1	3.3
6	Mining of metal ores	7	0	40	0.0	0.3	0.0	0.3
7	Other mining	1100	4648	4869	0.2	0.9	0.2	1.2
8	Food and beverages	9602	58348	76020	0.2	1.4	0.1	1.5
9	Tobacco products	43	2378	15626	0.0	0.6	0.0	0.7
10	Textiles	2297	7969	16074	0.3	0.8	0.1	1.0
11	Clothing manufacture	266	4757	30959	0.1	0.4	0.0	0.4
12	Leather, luggage and footwear	139	1442	6960	0.1	0.8	0.0	0.9
13	Timber	4028	6189	1750	0.7	1.3	2.3	3.6
14	Pulp and paper	3791	3236	1134	1.2	2.2	3.3	5.5
15	Publishing and printing	1814	41507	21926	0.0	0.5	0.1	0.5
16	Coke oven products	3658	2873	4089	1.3	4.5	0.9	5.4
17	Refined petroleum products	16602	13039	18559	1.3	2.3	0.9	3.2
18	Processing of nuclear fuel	21	17	24	1.3	0.8	0.9	1.7
19	Industrial gases, dyes, pigments	2009	2343	985	0.9	1.6	2.0	3.7
20	Other inorganic chemicals	3048	1497	906	2.0	3.0	3.4	6.3
21	Other organic basic chemicals	7964	5691	5770	1.4	3.1	1.4	4.4
22	Fertilisers, nitrogen compounds	6306	724	549	8.7	9.7	11.5	21.2
23	Plastics and synthetic rubber	1437	4376	2293	0.3	1.3	0.6	2.0
24	Pesticides, agro-chemicals	191	1359	733	0.1	1.1	0.3	1.3
25	Paints, varnishes, ink etc	264	3270	2147	0.1	0.7	0.1	0.8
26	Pharmaceuticals	1853	12627	12904	0.1	0.6	0.1	0.7
27	Soap and detergents	261	5249	12895	0.0	0.7	0.0	0.7
28	Chemical products n.e.s	814	4606	6039	0.2	0.9	0.1	1.1
29	Man-made fibres	807	736	701	1.1	2.2	1.2	3.3
30	Rubber products	1295	2997	2813	0.4	1.2	0.5	1.7
31	Plastic products	3457	15814	5737	0.2	0.8	0.6	1.4
32	Glass and glass products	1285	2764	1657	0.5	1.2	0.8	2.0
33	Ceramic goods	469	1624	2387	0.3	0.9	0.2	1.1
34	Structural clay products	2026	632	256	3.2	3.1	7.9	11.0
35	Cement, lime and plaster	11083	982	282	11.3	12.6	39.3	51.9
36	Concrete, stone etc	750	5280	943	0.1	1.1	0.8	1.9
37	Iron and steel	26709	7082	3351	3.8	5.1	8.0	13.1
38	Non-ferrous metals	1810	2929	2186	0.6	1.6	0.8	2.4
39	Aluminium	1289	2086	1557	0.6	1.5	0.8	2.3
40	Casting of metals	935	1910	14	0.5	1.1	67.8	69.0
41	Fabricated metal products	1794	25398	13985	0.1	0.8	0.1	1.0
42	Machinery and equipment	1646	30641	41469	0.1	0.7	0.0	0.7
43	Office machinery, computers	159	13296	27135	0.0	0.3	0.0	0.3
44	Electrical machinery and apparatus	1279	13955	13892	0.1	0.6	0.1	0.7
45	Radio, television and communications	421	16567	36342	0.0	0.4	0.0	0.4
46	Medical, precision, optical instruments	494	12397	14524	0.0	0.4	0.0	0.4
47	Motor vehicles and trailers	2358	33018	58595	0.1	0.6	0.0	0.6
48	Other transport equipment	1035	20968	25037	0.0	0.4	0.0	0.5
49	Manufacture of other products	3054	11202	31869	0.3	0.8	0.1	0.9
50	Recycling	1661	4842	4617	0.3	0.9	0.4	1.3
51	Electricity production - gas	53439	12276	2715	4.4	7.6	19.7	27.3
52	Electricity production - coal	108120	11366	2516	9.5	13.0	43.0	56.0
53	Electricity production - nuclear	33	7770	1720	0.0	3.0	0.0	3.0
54	Electricity production - oil	1134	454	100	2.5	5.1	11.3	16.4

EA Code	Economic Sector	Emission	Total output	Final demand	Emissions (1000 tonnes) per total unit of Output	Production demand	Final demand	Total demand
		1000 tonnes	£m	£m	e	$e'(I-A)^{-1}$	e_y	$e'(I-A)^{-1}+e_y$
55	Electricity production - other	5973	1189	264	5.0	4.0	22.6	26.6
56	Gas distribution	10210	11458	5966	0.9	1.5	1.7	3.2
57	Water supply	2046	4426	2411	0.5	1.0	0.8	1.8
58	Construction	4481	125358	79623	0.0	0.5	0.1	0.5
59	Garages, car showrooms	2149	36935	11894	0.1	0.3	0.2	0.5
60	Wholesale trade except motor vehicles	7541	96252	1304	0.1	0.4	5.8	6.2
61	Retail & repair trade except motor	6263	85316	1905	0.1	0.3	3.3	3.6
62	Hotels and restaurants	3819	58577	80696	0.1	0.4	0.0	0.5
63	Railways	1768	8675	3408	0.2	0.8	0.5	1.3
64	Buses and coaches	4469	5066	1388	0.9	1.3	3.2	4.5
65	Tubes and trams	880	998	273	0.9	3.1	3.2	6.3
66	Taxis operation	2834	3213	880	0.9	1.2	3.2	4.4
67	Freight transport by road	23049	26127	7158	0.9	1.2	3.2	4.4
68	Transport via pipeline	250	284	78	0.9	1.2	3.2	4.4
69	Water transport	14832	4861	5187	3.1	3.8	2.9	6.6
70	Air transport	38240	13940	15502	2.7	3.3	2.5	5.8
71	Supporting transport activities	984	39970	3525	0.0	0.2	0.3	0.5
72	Post and telecommunications	1376	51155	16038	0.0	0.2	0.1	0.3
73	Financial intermediation	1829	67325	12657	0.0	0.2	0.1	0.3
74	Insurance and pensions	1169	44336	29333	0.0	0.3	0.0	0.4
75	Auxiliary finance activities	962	19832	14787	0.0	0.4	0.1	0.4
76	Real estate activities	927	106483	88328	0.0	0.1	0.0	0.1
77	Renting of machinery	1445	16456	9126	0.1	0.4	0.2	0.5
78	Computer and related activities	1238	43717	8272	0.0	0.3	0.1	0.4
79	Research and development	320	6175	3168	0.1	0.3	0.1	0.4
80	Other business activities	3754	148757	34995	0.0	0.2	0.1	0.3
81	Public administration, not defence	3415	26318	25269	0.1	0.3	0.1	0.4
82	Public administration, defence	7698	59328	56962	0.1	0.4	0.1	0.5
83	Education	5109	72145	58435	0.1	0.2	0.1	0.3
84	Health and vet services, social work	6322	149274	88935	0.0	0.3	0.1	0.3
85	Sewage, treatment of liquid waste	3012	2421	1373	1.2	1.5	2.2	3.7
86	Solid waste	11027	8863	5027	1.2	1.6	2.2	3.8
87	Other sanitary services	109	87	50	1.2	1.7	2.2	3.8
88	Activities of membership organisations	346	7546	4819	0.0	0.2	0.1	0.3
89	Recreation and sporting activities	1545	52178	36434	0.0	0.3	0.0	0.4
90	Other service activities	844	10376	8979	0.1	0.3	0.1	0.4
91	Private households	0	4159	4164	0.0	0.0	0.0	0.0

Table 1 - Total regional greenhouse gas emissions in 2001

Million tonnes of CO_2 equivalent

	E.Midlands	E. of England	London	North East	North West	South East	South West	W.Midlands	Yorkshire	England	Wales	Scotland	N. Ireland	United Kigdom
From energy														
Direct														
Gas	5.9	5.7	9.1	3.2	9.7	10.5	5.4	6.9	6.2	62.6	3.9	5.7	0.3	72.4
Other fuels	1.0	3.2	0.1	1.0	0.8	2.1	1.5	0.8	1.3	11.8	0.8	1.4	4.6	18.6
Indirect														
Electricity	3.2	4.4	5.2	1.9	5.2	7.3	4.7	4.3	3.9	40.1	2.4	5.1	1.7	49.4
Total	**10.0**	**13.3**	**14.4**	**6.1**	**15.7**	**20.0**	**11.6**	**12.0**	**11.4**	**114.5**	**7.1**	**12.1**	**6.6**	**140.4**
From transport														
Direct														
Private vehicle	5.0	7.1	6.0	2.3	6.5	11.0	6.2	6.1	4.5	54.6	3.2	5.1	1.9	64.8
Indirect														
Rail	0.1	0.4	0.5	0.1	0.2	0.5	0.1	0.1	0.1	2.1	0.1	0.2	0.0	2.3
Tube	0.0	0.1	0.9	0.0	0.0	0.1	0.0	0.0	0.0	1.2	0.0	0.0	0.0	1.2
Bus	0.3	0.3	0.5	0.3	0.5	0.4	0.3	0.4	0.5	3.5	0.2	0.5	0.1	4.3
Taxi	0.2	0.1	0.3	0.1	0.3	0.2	0.1	0.2	0.2	1.8	0.1	0.2	0.1	2.2
Airline	2.2	3.0	6.2	1.3	3.3	5.1	2.2	2.5	1.9	27.7	1.2	3.2	0.4	32.5
Total transport	**7.7**	**10.9**	**14.5**	**4.0**	**10.9**	**17.3**	**9.0**	**9.3**	**7.2**	**90.9**	**4.8**	**9.2**	**2.4**	**107.3**
From final demand														
Indirect														
Food, drink & tobacco	13.0	17.3	22.2	7.0	20.3	26.5	15.4	15.2	14.4	151.2	9.0	16.7	5.3	182.2
Clothing & footwear	1.4	1.9	3.1	0.8	2.4	3.1	1.3	1.8	1.5	17.4	0.8	1.8	0.7	20.7
Household & personal goods	4.1	5.6	8.0	1.7	6.5	10.1	4.7	4.6	4.2	49.5	2.4	4.6	1.5	58.0
Leisure goods & services	7.4	9.6	14.9	4.1	11.2	17.7	7.7	8.0	8.2	88.8	4.6	7.9	2.5	103.8
Total final demand	**25.9**	**34.4**	**48.3**	**13.7**	**40.4**	**57.3**	**29.1**	**29.5**	**28.3**	**306.8**	**16.8**	**31.1**	**10.0**	**364.7**
Total emissions	**43.6**	**58.7**	**77.2**	**23.7**	**67.0**	**94.6**	**49.7**	**50.8**	**46.9**	**512.2**	**28.7**	**52.4**	**19.0**	**612.4**
Total direct														
Energy	6.8	8.9	9.2	4.1	10.5	12.7	7.0	7.6	7.5	74.4	4.7	7.0	4.9	91.0
Transport	5.0	7.1	6.0	2.3	6.5	11.0	6.2	6.1	4.5	54.6	3.2	5.1	1.9	64.8
Total direct	**11.8**	**16.0**	**15.2**	**6.4**	**17.0**	**23.7**	**13.2**	**13.7**	**12.0**	**129.0**	**7.9**	**12.1**	**6.7**	**155.8**
Total indirect														
Energy	3.2	4.4	5.2	1.9	5.2	7.3	4.7	4.3	3.9	40.1	2.4	5.1	1.7	49.4
Transport	2.7	3.9	8.5	1.7	4.4	6.3	2.8	3.3	2.7	36.3	1.5	4.1	0.6	42.6
Final demand	25.9	34.4	48.3	13.7	40.4	57.3	29.1	29.5	28.3	306.8	16.8	31.1	10.0	364.7
Total indirect	**31.8**	**42.7**	**61.9**	**17.3**	**50.0**	**70.9**	**36.6**	**37.1**	**34.9**	**383.3**	**20.7**	**40.3**	**12.3**	**456.6**
Total direct and indirect	**43.6**	**58.7**	**77.2**	**23.7**	**67.0**	**94.6**	**49.7**	**50.8**	**46.9**	**512.2**	**28.7**	**52.4**	**19.0**	**612.4**
Total by age														
Under 30	3.2	5.0	12.7	2.8	6.5	8.2	3.7	2.8	5.1	50.0	3.0	5.6	1.9	60.6
30 to 64	33.0	42.6	56.0	17.4	48.8	71.6	35.1	39.4	32.7	376.6	20.6	38.6	13.6	449.5
65 and over	7.4	11.1	8.5	3.5	11.7	14.8	10.9	8.6	9.2	85.7	5.0	8.2	3.5	102.4
Total	**43.6**	**58.7**	**77.2**	**23.7**	**67.0**	**94.6**	**49.7**	**50.8**	**46.9**	**512.2**	**28.7**	**52.4**	**19.0**	**612.4**
By size														
Single occupant	7.2	8.2	11.3	3.4	10.5	14.2	8.2	8.8	8.1	79.9	4.3	9.0	2.6	95.9
Two occupants	15.4	21.2	24.5	7.6	23.1	37.9	19.0	16.3	16.4	181.6	10.1	17.6	5.5	214.7
Three or more occupants	21.0	29.3	41.3	12.7	33.4	42.4	22.4	25.7	22.5	250.7	14.2	25.9	10.9	301.8
Total	**43.6**	**58.7**	**77.2**	**23.7**	**67.0**	**94.6**	**49.7**	**50.8**	**46.9**	**512.2**	**28.7**	**52.4**	**19.0**	**612.4**

Table 2 - Total regional greenhouse gas emissions per household in 2001

Tonnes of CO_2 equivalent

	E.Midlands	E. of England	London	North East	North West	South East	South West	W.Midlands	Yorkshire	England	Wales	Scotland	N. Ireland	United Kigdom
From energy														
Direct														
Gas	3.3	2.5	3.1	3.1	3.4	3.0	2.5	3.1	2.9	3.0	3.1	2.6	0.4	2.9
Other fuels	0.6	1.4	0.0	0.9	0.3	0.6	0.7	0.4	0.6	0.6	0.7	0.6	7.4	0.7
Indirect														
Electricity	1.8	1.9	1.8	1.9	1.8	2.1	2.2	2.0	1.8	1.9	2.0	2.4	2.8	2.0
Total	**5.6**	**5.9**	**4.9**	**5.9**	**5.5**	**5.8**	**5.4**	**5.5**	**5.2**	**5.5**	**5.8**	**5.6**	**10.5**	**5.6**
From transport														
Direct														
Private vehicle	2.8	3.1	2.0	2.2	2.3	3.2	2.9	2.8	2.1	2.6	2.6	2.3	3.0	2.6
Indirect														
Rail	0.0	0.2	0.2	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.0	0.1
Tube	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Bus	0.2	0.1	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Taxi	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Airline	1.2	1.3	2.1	1.2	1.2	1.5	1.0	1.2	0.9	1.3	1.0	1.5	0.6	1.3
Total transport	**4.3**	**4.9**	**4.9**	**3.9**	**3.8**	**5.0**	**4.2**	**4.3**	**3.3**	**4.4**	**3.9**	**4.3**	**3.9**	**4.3**
From final demand														
Indirect														
Food, drink & tobacco	7.3	7.7	7.5	6.8	7.1	7.6	7.2	7.0	6.6	7.2	7.3	7.7	8.4	7.3
Clothing & footwear	0.8	0.9	1.1	0.8	0.8	0.9	0.6	0.8	0.7	0.8	0.7	0.8	1.1	0.8
Household & personal goods	2.3	2.5	2.7	1.7	2.3	2.9	2.2	2.1	1.9	2.4	1.9	2.1	2.4	2.3
Leisure goods & services	4.2	4.3	5.1	4.0	3.9	5.1	3.6	3.7	3.8	4.3	3.7	3.6	4.0	4.2
Total final demand	**14.5**	**15.3**	**16.4**	**13.3**	**14.1**	**16.5**	**13.6**	**13.5**	**13.0**	**14.7**	**13.5**	**14.3**	**15.9**	**14.7**
Total emissions	**24.4**	**26.0**	**26.2**	**23.1**	**23.3**	**27.3**	**23.2**	**23.3**	**21.5**	**24.6**	**23.2**	**24.2**	**30.3**	**24.6**
Total direct														
Energy	3.8	4.0	3.1	4.0	3.6	3.7	3.2	3.5	3.4	3.6	3.8	3.2	7.8	3.7
Transport	2.8	3.1	2.0	2.2	2.3	3.2	2.9	2.8	2.1	2.6	2.6	2.3	3.0	2.6
Total direct	**6.6**	**7.1**	**5.2**	**6.2**	**5.9**	**6.8**	**6.1**	**6.3**	**5.5**	**6.2**	**6.4**	**5.6**	**10.7**	**6.3**
Total indirect														
Energy	1.8	1.9	1.8	1.9	1.8	2.1	2.2	2.0	1.8	1.9	2.0	2.4	2.8	2.0
Transport	1.5	1.7	2.9	1.7	1.5	1.8	1.3	1.5	1.2	1.7	1.3	1.9	0.9	1.7
Final demand	14.5	15.3	16.4	13.3	14.1	16.5	13.6	13.5	13.0	14.7	13.5	14.3	15.9	14.7
Total indirect	**17.8**	**18.9**	**21.0**	**16.8**	**17.4**	**20.4**	**17.1**	**17.0**	**16.0**	**18.4**	**16.8**	**18.6**	**19.6**	**18.3**
Total direct and indirect	**24.4**	**26.0**	**26.2**	**23.1**	**23.3**	**27.3**	**23.2**	**23.3**	**21.5**	**24.6**	**23.2**	**24.2**	**30.3**	**24.6**
Total by age														
Under 30	22.5	23.7	25.9	22.6	21.6	23.7	21.4	20.6	20.2	23.0	18.6	20.5	26.3	22.6
30 to 64	28.1	29.2	28.8	26.7	26.7	31.5	26.7	26.6	24.8	28.0	26.5	27.5	34.3	28.0
65 and over	15.8	19.0	16.7	13.8	15.7	17.4	16.7	15.4	15.0	16.4	17.0	16.8	22.3	16.6
Regoional average	**24.4**	**26.0**	**26.2**	**23.1**	**23.3**	**27.3**	**23.2**	**23.3**	**21.5**	**24.6**	**23.2**	**24.2**	**30.3**	**24.6**
By size														
Single occupant	13.6	14.1	14.8	12.2	12.6	15.0	13.0	13.3	12.5	13.6	12.7	14.1	16.8	13.7
Two occupants	24.5	25.2	25.4	22.5	23.6	27.8	24.0	23.1	21.0	24.5	22.9	23.5	27.5	24.4
Three or more occupants	33.6	35.0	34.0	31.0	31.5	36.6	31.3	31.6	29.8	33.0	31.3	33.2	40.0	33.2
Regoional average	**24.4**	**26.0**	**26.2**	**23.1**	**23.3**	**27.3**	**23.2**	**23.3**	**21.5**	**24.6**	**23.2**	**24.2**	**30.3**	**24.6**