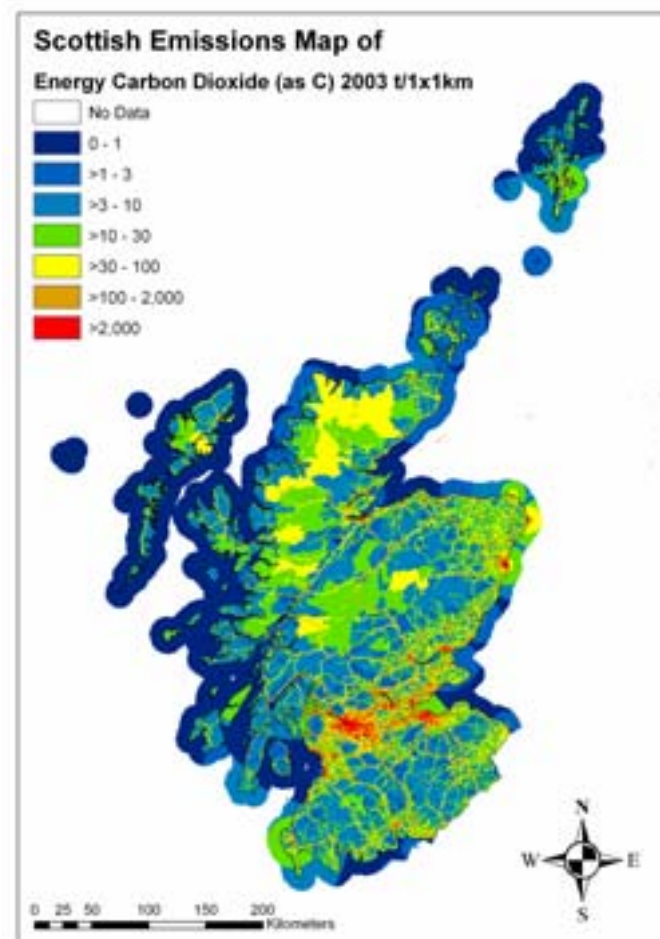


Scottish Energy Study

Summary Report

A Summary of Volumes 1 and 2



January 2006

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For the Scottish Executive

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BACKGROUND TO THE STUDY

The Scottish Energy Study is the first major study of energy supply and demand to be conducted in Scotland for nearly 15 years.

The aim is to supply the Scottish Executive with an understanding of the present energy situation, the factors that influence it and how it might change. This can then be used to develop an appreciation of the opportunities open to Scotland, in the context of a drive for the more sustainable use of energy, and what needs to be done to secure success. The study focuses on initiatives that will succeed at the Scottish level, and so can capitalise on and develop Scotland's natural resources and industrial capability, along with the skills of its workforce.

The study has been conducted in a number of stages, each of which will be published as separate volumes. These will cover:

Volume 1 Energy in Scotland: Supply & Demand

Presenting data describing Scottish energy supply and demand, together with associated CO₂ emissions. Information is also given on how the data were derived.

Volume 2 A Changing Picture

Addressing how the Scottish energy picture has changed in recent years: the results derived in Volume 1 are compared with the findings of an earlier study based on 1990 data.

Volume 3 Energy Demand Database

A brief guide to an energy database: summarising Scottish energy use by sector.

Volume 4 Issues, Opportunities and Barriers

Considering the many factors that influence energy use in Scotland today. This volume considers key drivers. Based on this understanding it identifies the opportunities to improve energy use within Scotland and the barriers which must be overcome if this is to be achieved.

Volume 5 Looking Forward

Considering how Scotland's energy use could change in the medium term to 2020, using projections of demand and supply informed by different scenarios that will influence energy use in the future.

The first two of these volumes have now been published. The information contained therein is summarised in this document.

OVERALL ENERGY USE IN SCOTLAND

Overall in 2002, Scotland consumed approximately 175 TWh of energy, covering a wide range of different energy uses. This overall energy figure was distributed amongst a range of different consumers, Scotland's energy can be categorised into a set of four distinct sectors which account for the majority of energy use:

- **Domestic** – individuals and families in their homes.
- **Transport** – those using public and private transport.
- **Industry** – individuals and companies involved in various industrial processes.
- **Services** – those involved in other business activities such as tourism and financial services.

The distribution of consumption between these various sectors, and how this has changed with time, is considered in the sections that follow.

Relative to 1990, overall consumption fell in 2002 by just over 2%. This reflects a number of factors, including improvements in energy efficiency leading to a reduction in consumption, balanced by the increased use of energy for transport. A further feature is the UK trend out of “heavy” industries with high energy use (such as engineering) towards less energy-intense sectors (such as services). The closure of the Ravenscraig facility in the early 1990's is a clear example in the Scottish context.

OVERALL CARBON EMISSIONS IN SCOTLAND

Consumption of certain fuels for energy production (e.g. coal, gas) results in the emission of carbon dioxide (CO₂), which contributes to global warming. The Scottish Climate Change Programme has a number of initiatives in place aimed at reducing the emissions of this, and other, gases.

In 2002, Scotland emitted 44 million tonnes of CO₂ resulting from the production and consumption of energy. This is around 9% of the equivalent UK emissions, which is proportionate to the 8.5% of the UK population that live in Scotland.

CO₂ emissions from energy use were around 5% less than those in 1990. This is again a reflection of a number of aspects, including a reduction from energy efficiency improvements balanced by increases from the greater use of fuel for transport. A further important feature here is the change in the mix of different fuels used by end consumers and used to generate electricity at Scotland's power stations.

Before leaving the issue of CO₂ emissions, it is worth noting that CO₂ can also be emitted from activities other than the generation and use of energy. In particular, it is emitted from various land-use activities, especially from disturbances to peaty soils. The overall picture for energy related CO₂ emissions is illustrated in Figure 1.

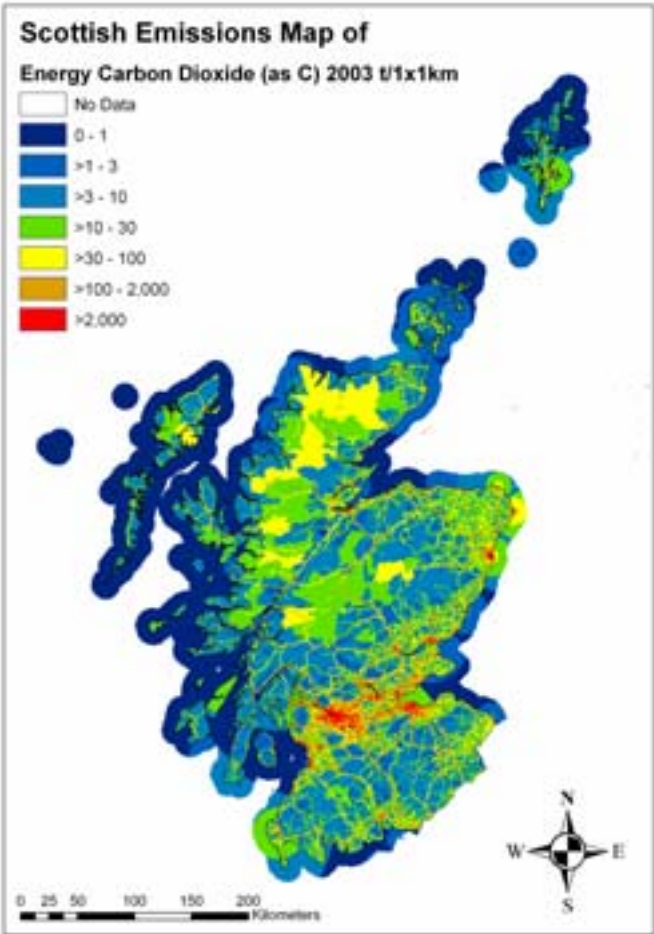


Figure 1: Emissions of energy-related CO₂ in Scotland in 2003¹

This was developed from the UK’s National Atmospheric Emissions Inventory dataset. The figure illustrates the concentration of high emissions in the main urban areas, where houses, businesses and factories are located together. Areas such as Lanarkshire, the Ayrshire coast, Grangemouth, Dunfermline and the South Fife coast can be seen. The effects of transport are also visible, in terms of both road links and marine transport.

¹ This mapping of CO₂ data for Scotland is only available for 2003, the main sets of data in the Scottish Energy Study are for 2002, the base year, and are compared with 1990.

ENERGY USE BY DIFFERENT TYPES OF CONSUMER

The distribution of energy use across the four broad end use sectors² identified above is shown in Figure 2. The significance of domestic and transport energy users can be seen. Further comments on each sector are presented below.

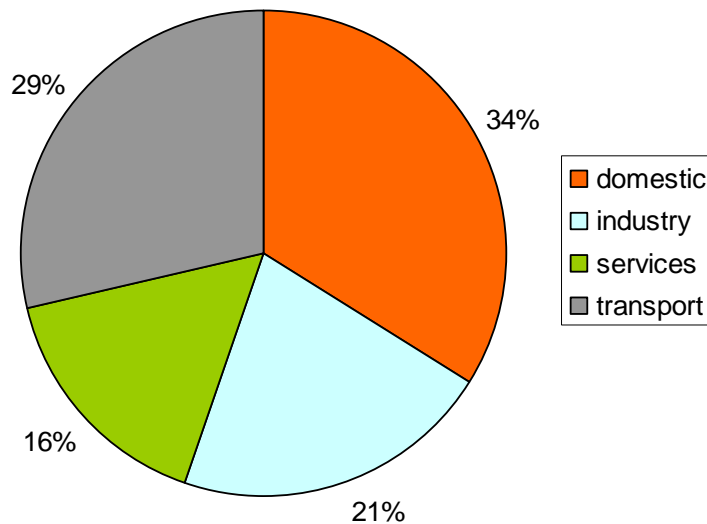


Figure 2: Scottish energy demand by sector in 2002

Domestic

The domestic sector is the largest consumer of energy. Energy demand for domestic uses in Scotland is greater than the UK average, mainly because of the harsher climate. It also reflects the differences in the condition of Scotland's building stock. For example, evidence suggests that the fraction of Scottish homes without loft insulation is more than twice that in England. Balancing this is the fact that around 30% of dwellings in Scotland are flats (requiring less energy for heating) compared to only 20% in England.

Energy consumption in this sector in 2002 rose by around 15% relative to that in 1990. This is dominated by the increased use of gas for heating but also reflects the increased use of electricity for various household goods, entertainment systems, etc. The use of coal was almost half the 1990 figure.

Transport

This is a significant growing sector in the developed world and Scotland is no exception to this trend. Transport energy use has grown year-on-year over the past two decades, initially in road transport (both private car use and haulage) and more recently in air travel. The latter reflects the increased availability of cheap airfares and the rise in use of regional airports. These two modes dominate transport energy use in Scotland.

² Fuel use for electricity generation is covered later in this report

Overall energy use in this sector in 2002 has increased by around 10% relative to 1990. The principal fuel use is oil.

Industry

Energy consumption in Scottish industry has declined in recent years. As noted earlier, this reflects the general trend in the UK towards less energy-intensive, higher added value products and services. Nonetheless, Scotland continues to have a strong presence and high energy consumption in specific industrial sectors, particularly food and drink, chemicals, engineering and paper.

In 2002, energy consumption in the sector fell by around 30% relative to 1990.

Services

Energy consumption in a range of business activities (e.g. offices, banks, retail outlets, warehousing), public sector services (e.g. public buildings, hospitals, schools) and tourism dominates this sector.

Energy use here rose by around 10% relative to 1990, reflecting the growth in employment in the services sector. Gas and electricity consumption has grown while that for oil and coal has decreased. The increased gas consumption is associated with heating buildings. The increase in electricity use reflects the changing nature of the services sector over the past decade or so; for example, more use of refrigeration (shops and warehouses) and wider use of some office equipment (PCs, printers and photocopiers).

THE DIFFERENT FUEL TYPES

The contribution of different fuels to the overall picture in 2002 is shown in Figure 3. This includes the fuels used to generate electricity. The importance of oil and gas can be seen. Further commentary on each fuel is presented below. Some of this fuel use is directed at generating electricity; separate consideration is therefore given to this.

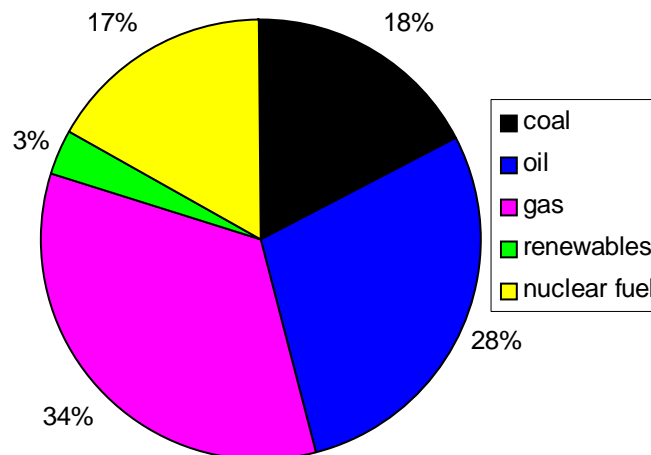


Figure 3: Distribution of all fuels used in Scotland in 2002

Gas

Gas is used directly for heating in the domestic, industry and service sectors. Demand has grown in all sectors. Domestic users were the largest consumers in both 1990 and 2002. Gas is also used to generate electricity at Peterhead power station. A large volume of gas (almost 400 TWh in 2002, compared to Scotland's total energy consumption, in 2002, across all sectors of 175 TWh) is extracted and transported through Scotland each year. Most of this export goes to England, with some going to Ireland.

Between 1990 and 2002, consumption of gas for electricity generation has grown markedly; it was essentially zero in 1990. Direct consumption for heating has risen by over 22%.

Oil

A large quantity of oil (around 1,150 TWh) is produced in Scotland each year. Most of this is exported as crude oil but almost 10% is refined at Grangemouth. The majority of the energy products from oil (e.g. petrol) used in Scotland is consumed for transport purposes, although some are used for heating in the industry, domestic and service sectors.

Oil-based fuel consumption fell by around 15% between 1990 and 2002. This reflects a large decline in the use of oil in the industry and service sectors, which outweighs the significant increase associated with transport.

Coal

The majority of coal consumption in Scotland is related to electricity generation at Longannet and Cockerhills. Scotland exports much of its coal production to England and Ireland.

Coal use for electricity generation rose by just over 50% between 1990 and 2002. Some of this electricity is, however, exported. On the other hand, the direct use of coal dropped substantially (by around 75%). This is largely due to the closure of Ravenscraig in the early 1990s, although energy users switching from coal to gas also had an effect.

Nuclear fuel

In 2002, there were three nuclear power station sites in Scotland, at Torness, Hunterston and Chapelcross. The latter has now closed.

Consumption of energy derived from nuclear fuels fell by around 16% between 1990 and 2002, essentially reflecting the loss of generating capacity over that period.

Renewables

The main sources of renewable energy in Scotland are the hydroelectric generators built in the mid-20th century. There are, however, increasing contributions from wind, newer small-scale hydro schemes and thermal renewable sources.

Over the 12-year period since 1990, the contribution from renewables has increased by around 13%. The contribution from hydro schemes is similar to the level in 1990. The overall increase reflects newer schemes for wind and thermal sources.

Electricity

In 2002, Scotland had six major power plants: two fuelled by coal, one by gas and three from nuclear fuel. These generated the majority of the electricity. In addition, Scotland has a number of hydro schemes, along with wind and thermal schemes, two pumped-hydro storage facilities and many small-scale generators (including combined heat and power (CHP) systems).

Of the total fuel used in Scotland over 43% is used in the generation of electricity. The distribution between the fuels used in the major power plants³ is shown in Figure 4.

³ This does not include smaller generators e.g. CHP or small oil fired schemes

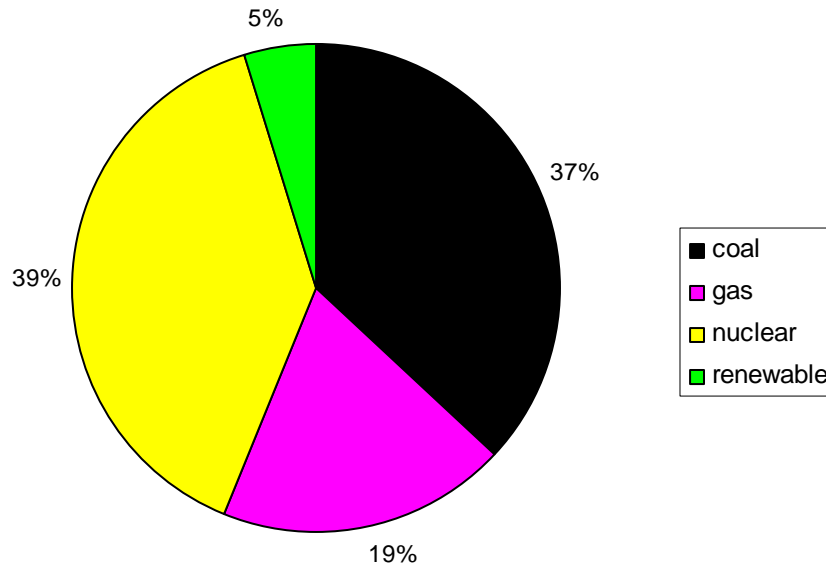


Figure 4: Fuels for electricity generation in Scotland in 2002

The process of generating electricity entails energy losses due to the thermal efficiency of the different types of power station. For example the coal fired plant is estimated to have a thermal efficiency of 37%. The average efficiency of electricity generation in Scotland is 41%.

The share of generation output by fuel used in the major power plants is shown in Figure 5. Those forms of electricity generation which have a higher than average efficiency have a higher share of the electricity output, e.g. renewables which has 5% of fuel input yet 11% of output. Of the electricity generated in Scotland, 70% is used in Scotland, the remainder is accounted for by losses in the electricity grid and exports to the rest of the UK.

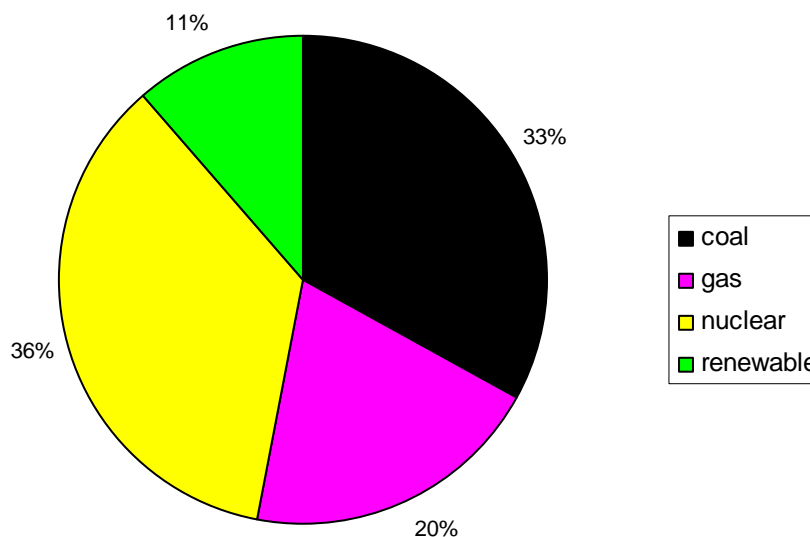


Figure 5: Electricity output in Scotland in 2002 by fuel type

In 2002, Scotland exported about 20% of electricity generated to England and Ireland. According to current plans many of the major power plants are, however, expected to stop generation in the next 10-20 years. If these plans were implemented, in 15 years' time, only two of Scotland's existing large plants would be in operation: Peterhead (gas-fired) and Torness (nuclear).

By 2020, Scotland aims to generate 40% of its electricity needs from renewable sources. While future plans for some of Scotland's major power stations have been made known, these may change in response to market conditions. Similarly, plans for new power stations are commercial decisions for the electricity generation sector. Their decisions will take into account factors such as: future energy prices, electricity demands, the regulatory environment and new technical developments.

Over the 1990 to 2002 period, the nature of electricity generation changed considerably. This is characterised by:

- More coal-fired generation at Longannet and Cogenzie; an increase of around 66%.
- New additional gas-fired generation at Peterhead, from a very low level in 1990.
- Less nuclear generation; a decrease of around 16%.
- Virtual elimination of oil-fired generation.
- More use of renewable sources; an increase of around 13% in saleable electricity.

Energy Use by End Consumers

The distribution of energy sources consumed by end consumer is shown in Figure 6.

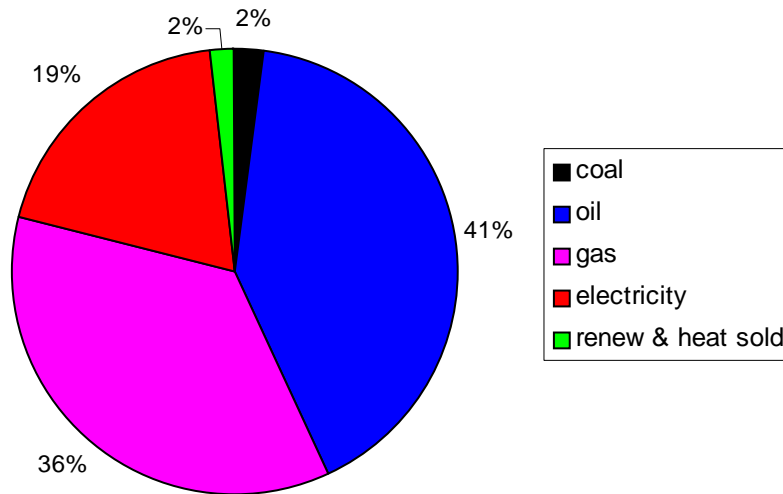
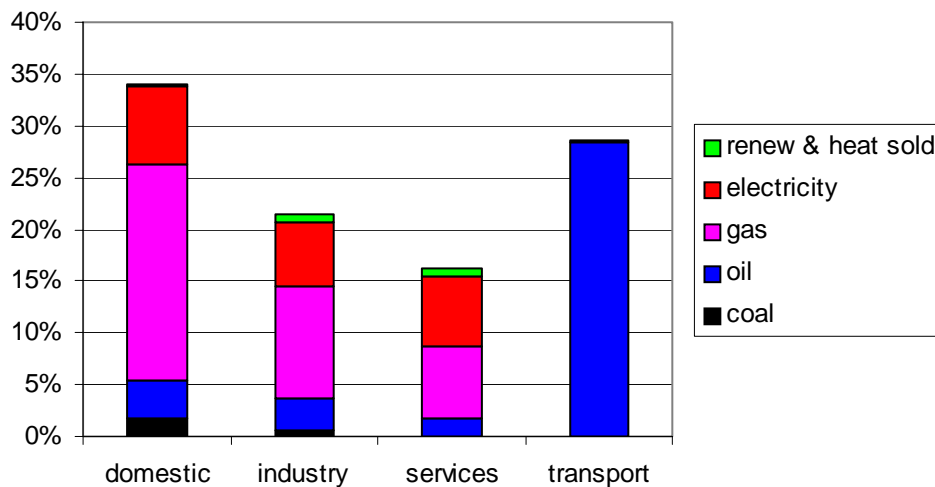


Figure 6: Energy use by end consumers in 2002

The distribution of energy sources used by each of the main groups of end consumers is shown in Figure 7, this is shown as the percentage of the total energy use by all end



consumers.

Figure 7: Distribution of energy use by end consumer in Scotland in 2002

This shows a number of key features:

- The largest use of gas is in the domestic sector, with significant use in industry and services.
- The dominant use of oil in the transport sector.
- Electricity use split evenly across the domestic, industry and service sectors.

- A small share for solid fuel, with the most significant use in the domestic sector, for those homes without access to other energy supplies.

COMPARING SCOTLAND TO THE UK

It is of interest to compare some of the energy generation and use characteristics for Scotland with the overall UK position.

In 2002, Scotland consumed slightly more energy per head of population than the UK: Scotland consumes 9.1% of UK energy but has 8.5% of the UK population. The distribution of energy use per head across the various sectors is shown in Figure 8⁴.

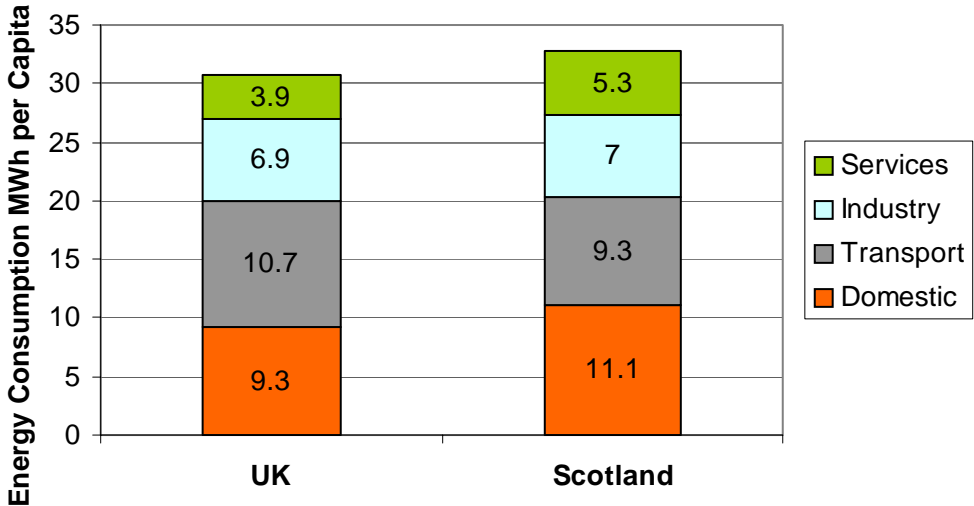


Figure 8: Energy consumption per capita, UK & Scotland in 2002

Scotland consumes more energy per head in all sectors except transport. This reflects a greater use of energy for heating which, in turn, reflects Scotland’s harsher climate and differences in building stock. It also derives from the above-average use of energy in oil refining.

The distribution of overall energy use across different fuel types is fairly similar between Scotland and the UK, although there is a slightly lower demand in Scotland for coal and a higher consumption of gas and electricity.

⁴ This shows consumption by end consumers, hence electricity exported from Scotland to the rest of the UK is included in the UK data but not the Scottish data.

IN CONCLUSION

This summary report draws out a number of key points from Volumes 1 and 2 of the Scottish Energy Study. These include comparison of energy use in 1990 and 2002 by sector, by fuel and in electricity generation. Full details of the results, and the data collection methodology, are presented in Volumes 1 and 2 and the associated appendices.

This summary report will be revised to incorporate the results from Volumes 3, 4 and 5 of the Scottish Energy Study.

Hence, the final summary report will include views on the influences on energy use in Scotland. This will include details of the opportunities to reduce energy consumption, along with the barriers to the implementation of these opportunities.

The final summary report will also provide results of the analytical work to project how energy supply and demand in Scotland may change in the future.