Chapter 2: Current Trends in Energy Usage

Summary

- **There are conflicting trends in household energy use. An ageing population, increasing numbers of households, increased single-person living, and growing demand for electrical appliances result in increases in demand, while improvements in housing stock reduce it.**
- **Overall electricity consumption in Scotland is relatively static, reflecting recent improvements in energy efficiency. However, transport use is rising, in particular vehicle kilometres travelled and diesel consumption in road transport.**
- **There has been an overall reduction in emissions since 1990, but much more needs to be done to meet the Climate Change (Scotland) Act targets.**
- **Data on energy trends in Scotland is patchy. Currently the most up-to-date way to estimate energy trends is to use disaggregated UK data.**

Overview

2.1 We currently use energy to heat and light homes, to run businesses and public services, to power appliances and cooling systems, and to transport goods and people. Understanding trends in energy consumption and efficiency, both in Scotland and further afield, helps us to assess the scope of the task in setting and achieving our efficiency targets, to take into account the issues that will affect our progress, and to target better our efforts.

2.2 This chapter uses the most up-to-date data available to present a review of the underlying energy trends in the UK and Scotland. The evidence reported illustrates the clear need for a well-developed energy efficiency action plan to help reduce overall consumption. Data from a number of sources has been used; the reliance on disaggregation of UK data for Scotland is discussed under monitoring and evaluation in Chapter 4. Throughout this chapter, a mixture of UK and Scottish data has been presented. In areas where the level of detail is not available at a Scottish level, UK data is used, with appropriate commentary surrounding any expected deviations between Scottish and broader UK trends.

Broad Demographic and Behavioural Trends

2.3 Looking forward, energy consumption and efficiency are likely to be driven by the following broad trends:

- an ageing population and an increase in the number of retirees, meaning that more people spend more time at home, hence increasing consumption. In 2008, there were 1,016,931 people of pensionable age in Scotland (accounting for 19.7% of the population). This is projected to increase to 1,163,217 by 2026 (21.7% of the population). If significant numbers of retirees relocate from cities and towns to more rural areas, this will have also implications for distribution of electricity in Scotland.[24]
- an increasing number of households in Scotland, meaning that the need for energy efficiency will become increasingly important in the domestic sector in particular - since 1991 there has been an increase of over 14% in the number of households (see Figure 2.1).[25]

[24] General Register Office for Scotland, 'Projected Population of Scotland', 2006-based (www.gro-scotland.gov.uk/ statistics/publications-and-data/popproj/projected-population-of-scotland-(2006-based)/list-of-tables.html).

[25] General Register Office for Scotland, 'Estimates of Households and Dwellings in Scotland', 2008 (www.gro-scotland.gov.uk/statistics/publications-and-data/household-estimates-statistics/estimates-of-households-and-dwellings-in-scotland-2008/index.html).

Figure 2.1 Mid-year population and household estimates

	Mid-Year Estimates					Projections
	1991	2000	2006	2007	2008	2031
Population	5,083	5,063	5,117	5,144	5,169	5,374
Households	2,043	2,177	2,291	2,314	2,331	2,731

- increasing numbers of single-person households, which means that consumption per head will continue to rise as fewer people share living space, appliances and private means of transport.
- an increase in mobile working, meaning that some workers may be travelling more in order to collaborate with clients and others. An increase in home working may also mean that more people choose to live further from the office, again requiring more travel. They may seek larger homes to accommodate office space, leading to increased domestic consumption. However, some offices may be able to reduce their office space and save on energy use.
- an increased demand for energy from emerging economies, especially China. This rising global demand, with these economies accounting for an increasing proportion of global oil and energy demand, could mean fluctuating and increasing prices for energy, affecting the security of supply in Scotland for fuels that must be imported. Emerging economies have also traditionally used less efficient technologies than advanced economies, which additionally contributes to increased overall demand.
- a large increase in the size of the global middle class (from under 8% in 2000 to 16.1% in 2030) and hence an increased demand for international goods and services. This can lead to an increased demand on resources, including energy, and rising or fluctuating prices when supply does not match.[26]
- an increased awareness of the interconnectedness between the environment and human activity and industry, with natural events beginning to have increasing consequences for businesses and the economy (e.g. flooding, extreme weather events). This may lead to a growing role for environmental or ecological economics, and a stronger shift towards energy efficiency and sustainability.[27]
- attitudes and behaviour, and whether people believe that their own behaviour and lifestyle contribute to climate change and that they can make a difference.
- improvements in technology and smart materials, leading to improvements in the efficiency of machinery and materials.

Global and European Energy Usage

2.4 World consumption of energy is clearly increasing, much of it driven by demand in the developing world. The most rapid growth in energy demand in the period to 2030 is projected for countries outside the OECD nations.

2.5 Liquids are expected to remain the world's dominant energy source in the next two decades, given their importance in the transportation and industrial end-use sectors.[28] World use of liquids and other petroleum is projected to grow from 85 million barrels per day in 2006 to around 91 million barrels per day in 2015, and around 107 million barrels per day in 2030.

[26] World Bank, 'Global Economic Prospects 2007: Managing the Next Wave of Globalisation'.
[27] See Office of Science and Innovation, Horizon Scanning Centre, 'Economics as if Nature Mattered', 2006 (http://89.234.28.218/DeltaScan/ViewIssue.aspx?IssueId=186).
[28] The term 'liquids' refers to all petroleum products, natural gas liquids, biofuels, and liquids derived from other hydrocarbon sources (coal to liquids and gas to liquids). It does not include compressed natural gas (CNG), liquefied natural gas (LNG), or hydrogen.

2.6 The imperative to improve energy efficiency remains a priority for all countries. Recent meetings of the G8 Leaders reaffirmed the critical role that improved energy efficiency can play in addressing energy security, environmental and economic objectives. European evidence suggests that efficiency improvements have not been uniform across EU member states, indicating that they are to a large extent still dependent on policy developments at a national level.

Box 2.1 How is energy measured?

Energy, or work, is normally measured in calories, joules or watt-hours (Wh). One watt-hour is equivalent to about 840 calories and 3,600 joules. Domestic energy bills are measured in watt-hours. This is normally the unit used when referring to energy use in businesses and energy produced by power stations. A Watt measures power, as opposed to work. It is an international standard, defined as one joule per second. Being a small unit, it is usually used as a multiple, such as kilowatts or megawatts:

- 1 kilowatt-hour (kWh) = 1,000 Wh
- 1 megawatt-hour (MWh) = 1,000,000 Wh
- 1 gigawatt-hour (GWh) = 1,000,000,000 Wh
- 1 terawatt-hour (TWh) = 1,000,000,000,000 Wh

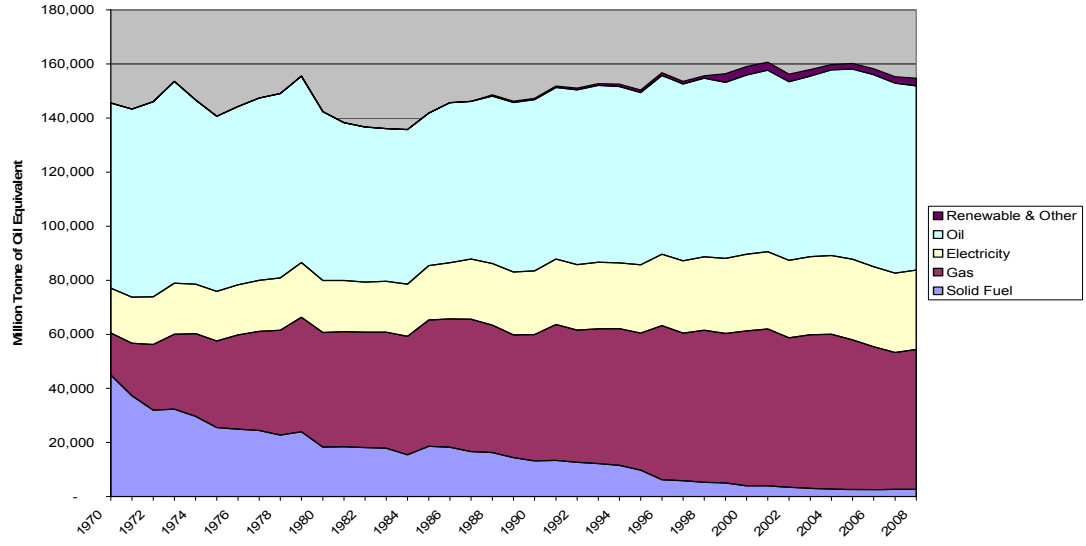
For example, the capacity of a power station to produce energy is measured in megawatts. The amount of energy it produces is measured in megawatt-hours or terawatt-hours.

Energy consumption in the United Kingdom and Scotland

2.7 Figure 2.2 illustrates final UK energy consumption by fuel over the last four decades. At a UK level, there has been around a 6% increase in energy consumption over the period. However, since 2005 energy consumption has decreased by over 3%.

2.8 Based on UK regional data for Scotland, the most recent estimates report that in 2006 Scottish final energy consumption was 172.8 TWh.[29] This equated to 8.5% of UK consumption in 2006, a level approximately proportional to Scotland's share of the UK population.

Figure 2.2 Final UK Energy Consumption by Fuel 1970 - 2008



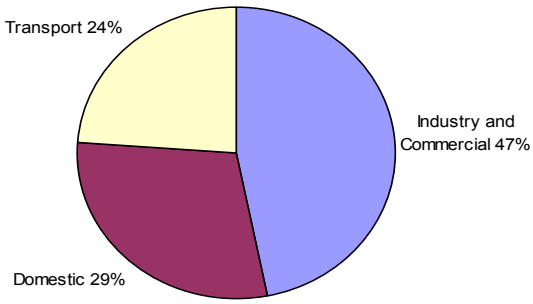
Source: DECC, UK Energy Consumption, 2008 Updated Tables (Table 1.5)

2.9 Figure 2.3 below identifies the share of final energy consumption in Scotland, split into the three main consuming sectors. It illustrates that 47% of consumption is from the

[29] Department of Energy and Climate Change (DECC), 'Total Final Energy Consumption at regional and local authority level', updated June 2009 (www.berr.gov.uk/files/file48643.xls).

industrial and commercial sectors, with domestic consumption accounting for around 29% of the total.

Figure 2.3 Scottish Final Energy Consumption (%) by Demand Sector 2006

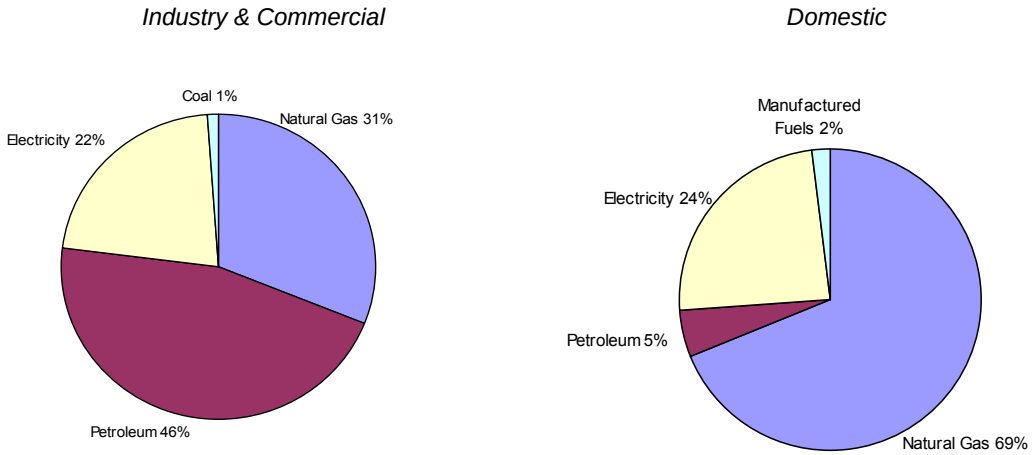


Source: DECC, Regional Consumption Data 2006, June 2009 update

2.10 These sector demand shares are based on DECC regional energy consumption allocated to final consuming sector. The proportional shares differ to some extent from those in the Scottish Energy Study, which estimated the shares for 2005 to be domestic 33%, transport 30%, industry 21% and services 15%.[30] This is due to the methodology behind the DECC regional allocations and because the Scottish Energy Study is based on 2002 data.[31]

2.11 A comparison of the fuel usage in the industrial/commercial and domestic sectors in 2006 can be observed in Figure 2.4.

Figure 2.4 Fuel Usage by Final Consuming Sector in Scotland



Source: DECC, Regional Energy Consumption (2006)

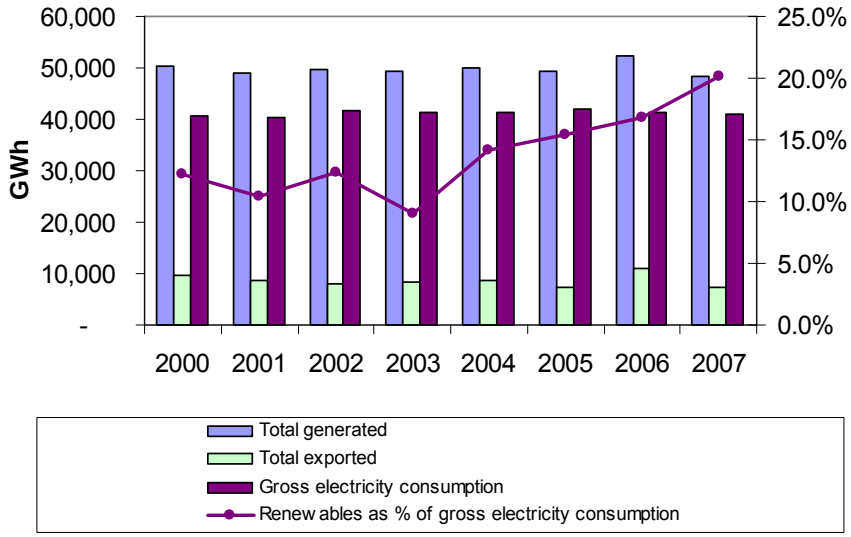
[30] See Scottish Government, 'Scottish Energy Study, Volume 5: Energy and Carbon Dioxide Projections for Scotland' (http://www.scotland.gov.uk/Publications/2008/11/14093227/0). This was used as a basis for final energy demand forecasts in the Renewables Action Plan, published June 2009.

[31] It is recognised that there are statistical inaccuracies in DECC's regional allocation of energy demand to final consuming sectors. However, these data sets are currently the best source of annually updated consumption data for Scotland.

Electricity

2.12 There were 48.2 TWh of electricity generated in Scotland in 2007. The equivalent of 7.4 TWh, or 15%, was exported to the rest of the UK. On average, between 2000 and 2007 Scotland exported around 17% of the electricity it generated to the rest of the UK. It is a net exporter of electricity, and improvements in energy efficiency would allow it to export an increased proportion of its generated electricity.

Figure 2.5 Electricity Generated, Consumed and Exported



Source: Scottish Government Energy Statistics

2.13 Figure 2.5 shows that levels of gross electricity consumption have remained fairly steady over the period in Scotland. This trend does not mirror the increase in electricity consumption that we might have expected as a result of the broad demographic and lifestyle trends outlined at the beginning of this chapter. To some extent, this demonstrates how existing improvements in the energy efficiency of products and building standards have helped to maintain consumption at a steady level.

2.14 It is also projected that electricity generation will continue to become less carbon-intensive, with the renewable percentage now at 20.1% of gross electricity consumption. In the context of the current generation mix, further increases in renewable generation would allow Scotland to export an increased amount of its electricity to the rest of the UK.

Electricity Consumption in Households

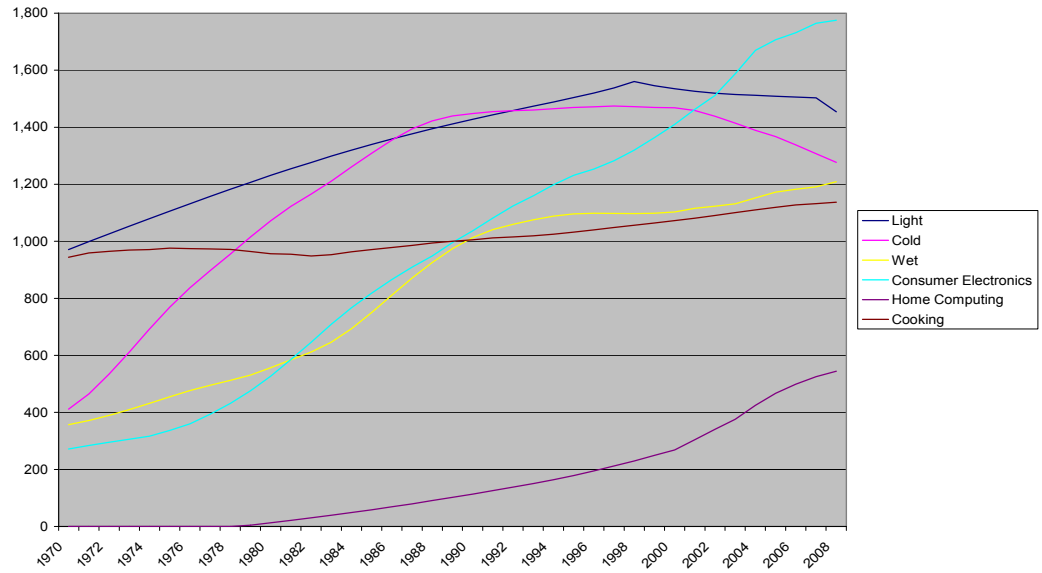
2.15 Assuming Scottish household electricity consumption by domestic appliances is broadly similar to the UK trends, Figure 2.6 illustrates how consumption by appliance type has altered since 1970.[32] This provides an indicative view of the overall trends in appliance use in the United Kingdom. However it is important to note that there are key differences between the Scottish population demographic and the rest of the UK. One example of this is that Scotland's population has reduced by 1.3% over the period since 1970, whereas the UK experienced a population growth of 9% over the same period.

2.16 Overall electricity consumption from household appliances has increased over the last three decades. Figure 2.6 shows that electricity consumption across a range of

[32] DECC, Energy Consumption in the United Kingdom (updated tables) (www.decc.gov.uk/en/content/cms/statistics/publications/ecuk/ecuk.aspx).

products has increased. This can be attributed to a number of factors, such as increased ownership of domestic electrical appliances and behavioural tendencies to leave some electric products on standby. The increase in lighting energy consumption has been mainly due to the shift away from rooms lit by single ceiling bulbs towards multi-source lighting from wall and table lamps, as well as multi-ceiling lights. However, in recent years there has been a reduction in electricity use from lighting, perhaps a result of increased uptake in energy efficient light bulbs.

Figure 2.6 UK Electricity Consumption by Household Domestic Appliances 1970 - 2008



Source: DECC, Energy Consumption in UK (Updated Tables)

Transport

2.17 With transport, improving energy efficiency is tied very closely to reducing CO_2 emissions from burning fossil fuels contained in petrol and diesel.

2.18 Figure 2.7 illustrates the energy consumed by different modes of transport between 1999 and 2006. Over that period, the amount of energy consumed rose in all modes. However, within the transport sector, road transport (the largest consumer of energy) saw a smaller rise (8%) in energy consumed compared with the rises in national navigation and civil aviation.

Figure 2.7 Energy consumption by transport mode (TWh)[33]

	1999	2000	2001	2002	2003	2004	2005	2006	Growth 1999 - 2006 (%)
Road transport	40.4	40.9	40.8	42.1	42.3	42.8	43.1	43.8	8.3
Railways	1.0	0.9	0.9	0.8	0.9	1.0	1.0	1.0	5.5
National navigation	3.0	2.9	2.3	1.9	3.0	2.9	3.2	3.9	28.2
Domestic civil aviation	2.0	2.2	2.4	2.4	2.6	2.7	2.9	2.8	39.2
Total	46.4	46.9	46.4	47.3	48.7	49.3	50.1	51.5	10.8

Source 1: Scottish Government, Scottish Transport Statistics, 2008 Edition.
Source 2: DECC, Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, 2008.
Please note that figures have been rounded up or down and that the rounded total for each year may not equal the sum of the rounded figures by transport mode.

[33] Energy consumption figures have been calculated using CO_2 to energy conversion factors used by DECC in its 'Greenhouse Gas Policy Evaluation and Appraisal in Government Departments', 2008.

2.19 Figure 2.8 shows that within road transport, cars are the source of the greatest emissions and energy consumption, accounting for over half the energy consumed in road transport in 2006. HGVs and LGVs also account for a relatively high consumption of energy.

Figure 2.8 Emissions and energy levels in road transport by source

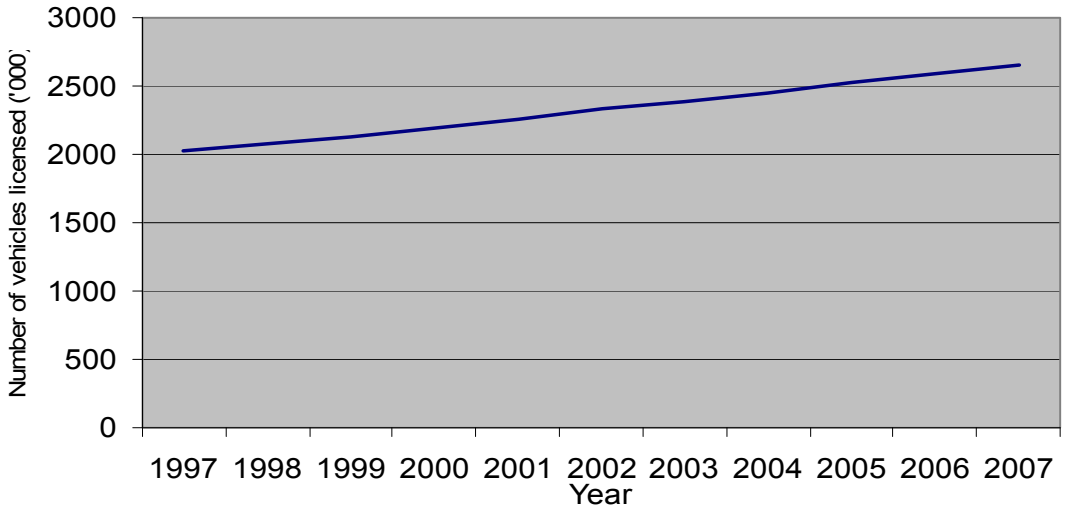
	Emissions 2006 (ktCO2)	Energy 2006 (TWh)	% of road transport energy consumption
Cars	6055	25.2	57.6
HGVs	2221	9.3	21.1
LGVs	1716	7.2	16.3
Buses and coaches	421	1.8	4.0
Other	53	0.2	0.5
Motorpeds and Motorcycles	39	0.2	0.4
Total	10506	43.8	100.0

Source 1: Scottish Government, Scottish Transport Statistics, 2008 Edition.
Source 2: DECC, Greenhouse Gas Policy Evaluation and Appraisal in Government Departments, 2008.
Please note that figures have been rounded up or down and that the rounded total for each column may not equal the sum of the rounded figures by transport source.

2.20 There are a number of ways to improve energy efficiency, to reduce the consumption of fuel, and to achieve subsequent reductions in emissions from the transport sector. The focus in this consultation is on reducing the demand for travel, shifting to less energy-demanding modes of transport and reducing the energy consumed by different modes. In meeting our climate change targets the carbon intensity of modes of transport will also be considered, but this is not the main focus of energy efficiency objectives.

2.21 Turning to demand for travel, Figure 2.9 illustrates that the total number of motor vehicles licensed has continually increased over the past decade. Licensed vehicles have risen from 2.02 million in 1997 to 2.65 million in 2007, a rise of 31%. This provides evidence to suggest that demand for road transport has increased over that period.

Figure 2.9 Number of vehicles licensed in Scotland



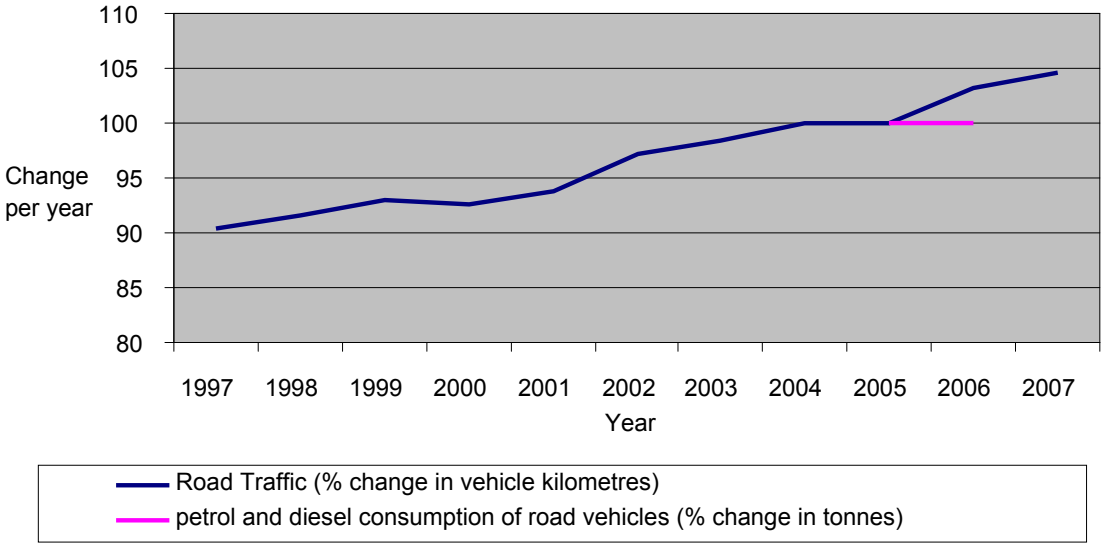
Source: Scottish Government, Scottish Transport Statistics, 2008 Edition

2.22 Figure 2.10 suggests that there has been a continual increase in the use of motor vehicles over the past decade. Between 1997 and 2007, annual vehicle kilometres travelled increased from 38.6 billion vehicle kilometres to 44.7 billion vehicle kilometres. Figure 2.9 also shows that between 2005 and 2006, petrol and diesel consumption by road transport increased marginally from 3.11 million tonnes to 3.14 million tonnes.[34] With vehicle

[34] Fuel consumption only included from 2005 onwards. Data is available from 2002, but is not comparable.

kilometres increasing at a faster rate than fuel consumption, this gives an early indication that the average energy efficiency of road vehicles may be improving, even though total energy consumed for road transport in Scotland is increasing.

Figure 2.10 Change in vehicle kilometres travelled and fuel consumed by road transport in Scotland

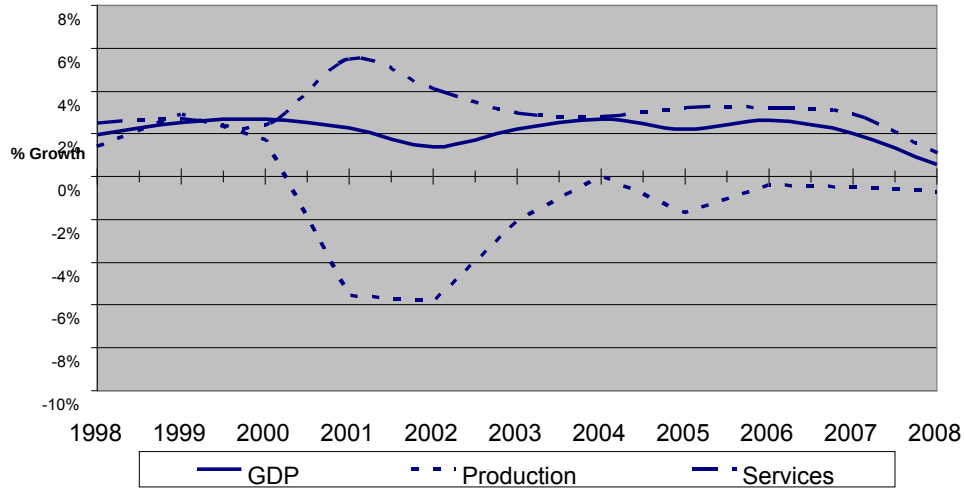


Source: Scottish Government, Scottish Transport Statistics, 2008 Edition

Industry

2.23 Since 1990, manufacturing production has declined as a proportion of the Scottish economy as a percentage of GDP, as Figure 2.11 shows. This has been mirrored by a fall in energy consumption within this sector. By contrast, the service and transport sectors have seen increases in terms of both GDP and energy consumption.

Figure 2.11 Change in GDP by sector

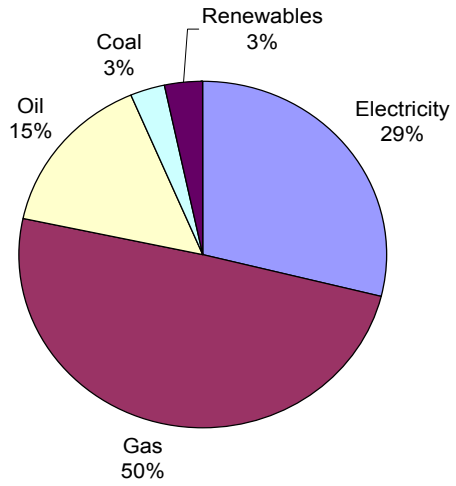


Source: Scottish Government Economy Statistics

2.24 The Scottish Energy Study, with a baseline year of 2002, provides some useful information regarding final energy consumption in the various sectors of the Scottish

economy, though there may have been some change since then. Figure 2.12 illustrates the consumption of the industrial sector in Scotland by fuel type.

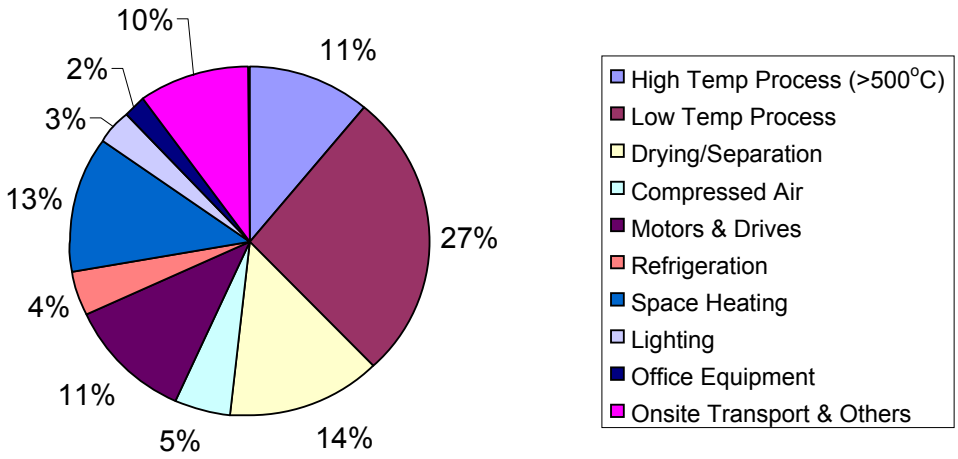
Figure 2.12 Indicative Fuel Split in the Industrial Sector



Source: Scottish Energy Study Volume 5: 2002 baseline data

2.25 Using the same data on energy consumption in Scotland, a clear picture of energy use by sub-sector can be observed in Figure 2.13. This illustrates that over half of the energy consumption in the industrial sector is used in High Temperature and Low Temperature processes and drying/separation activities. However, it also indicates that 16% of energy is used for space heating and lighting.

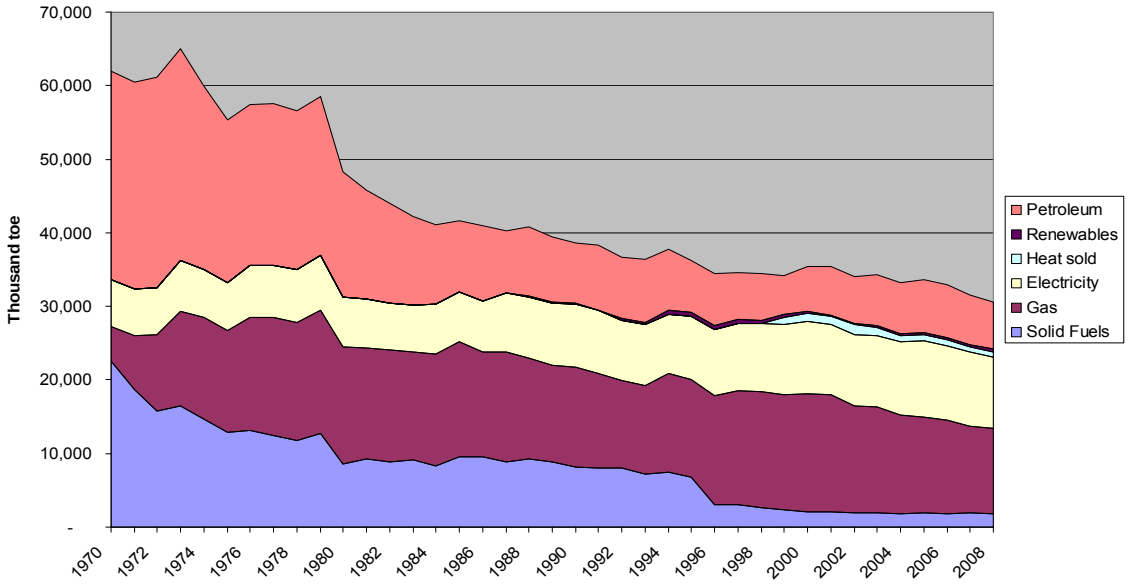
Figure 2.13 Estimated industrial sub-sector share of energy demand



Source: Scottish Energy Study Volume 5: 2002 baseline data

2.26 In addition, there have been considerable changes in the industrial sector since 1970, presented at a UK level in Figure 2.14.

Figure 2.14 UK Industrial Energy Consumption by Fuel



Source: Energy Consumption in UK, Industrial Data Tables (2009 update)

2.27 These figures reflect the broad UK trend away from energy intense industries. It would appear that, across the UK, new jobs have been created in less energy-intense sectors, such as the less energy-intensive parts of engineering or the service industries.

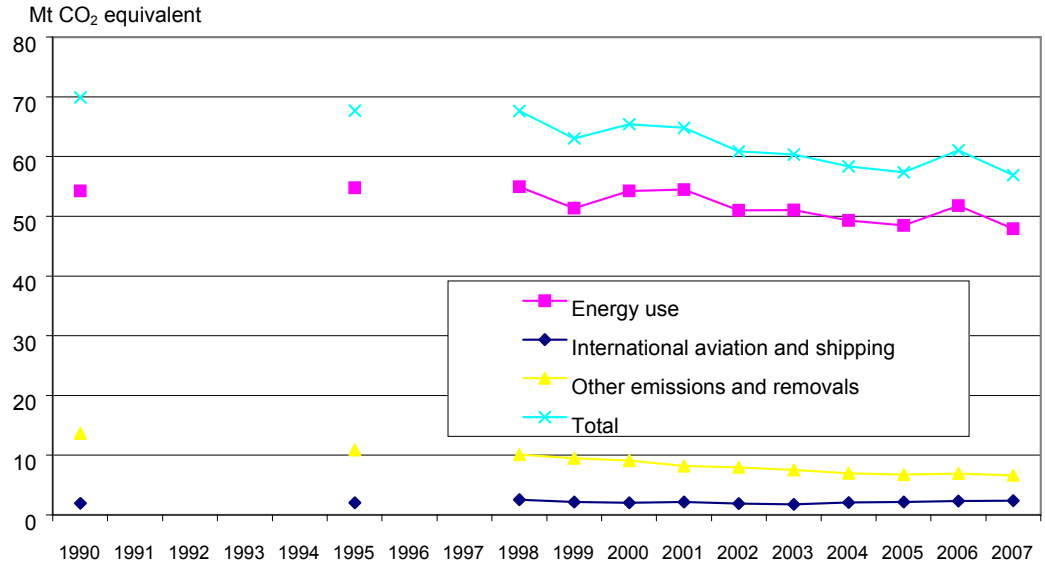
2.28 In addition, the fuel mix has moved away from coal and petroleum fuels. Combined consumption of these fuel sources has declined by 50% in the UK industrial sector. This trend has also moved towards much greater use of gas and electricity. Again, this in part reflects changes to the structure of industry and its sub-sectors.

Emissions

2.29 Emission trends for Scotland since 1990 can be observed in Figure 2.15. These show an almost 12% reduction in emissions from energy use over the period from 1990 to 2007.

2.30 One key aim of energy efficiency is to reduce energy use and emissions without constraining productivity and performance within the economy. The data below shows that Scotland's greenhouse gas emissions have been falling in recent years with the exception of 2006. However, the trends provide an incomplete picture in terms of more detailed trends and actions taken in Scotland. For example, factors such as the closure of Ravenscraig Steelworks and improvements in energy efficiency are masked by rising emissions from road transport and increased power generation activities. Environmental factors, such as improved sequestration as a result of increased numbers of trees being planted, also add complications to evaluation of emissions trends.

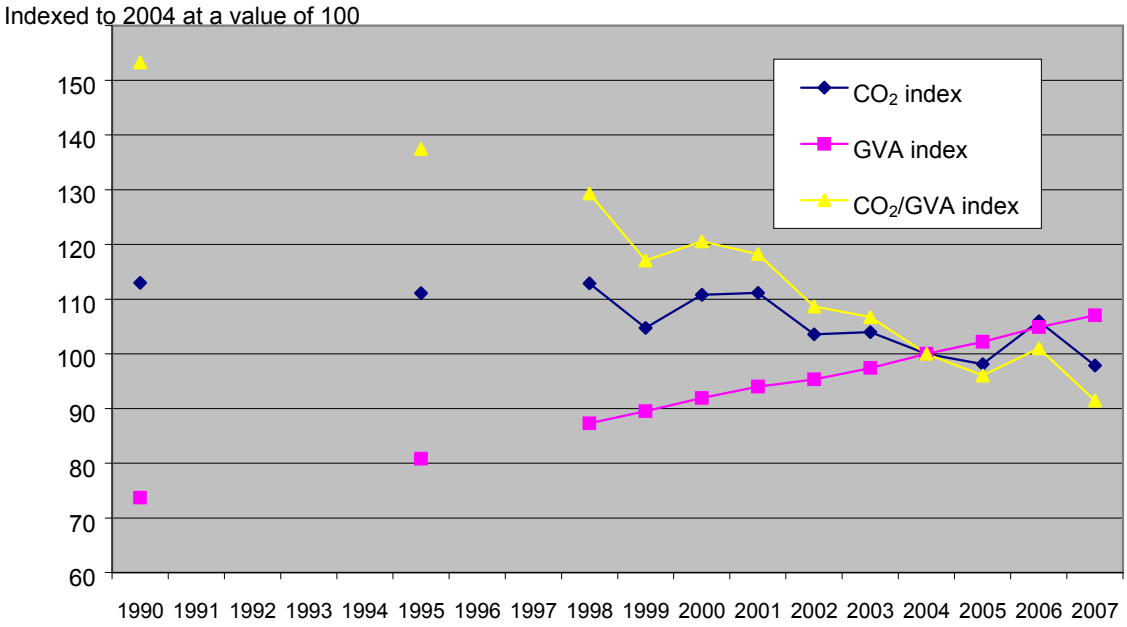
Figure 2.15 Greenhouse gas emissions in Scotland (including international aviation and shipping)



Source: Scottish Government Environmental Statistics

2.31 To measure the trends in economic performance and emission levels, a useful indicator is to observe an indexed value of CO_2/GVA (Gross Value Added). Figure 2.16 below illustrates this where both measures are indexed to 2004 at a value of 100.

Figure 2.16 CO_2 emissions and GVA in Scotland



Source: Scottish Government, Scottish Greenhouse Gas Emissions 2007, (www.scotland.gov.uk/Publications/2009/09/07145629/0) and Scottish Government, Gross Domestic Product for Scotland, Quarter 4, 2008 (www.scotland.gov.uk/stats/envonline/_data/GENgdp.xls)

2.32 This illustrates the trend away from energy intensive sectors, showing a steady increase in Gross Value Added (GVA) in the Scottish economy and a downward trend in CO_2 emissions. When combined as a CO_2/GVA index, this shows a fairly steady downward trend, producing a decrease of around 40% over the period. To achieve further reductions in the levels of CO_2 relative to GVA, energy efficiency measures are needed, along with decarbonisation of the electricity supply.

2.33 Several observations can be drawn from these overall energy trends. Whilst energy efficiency in Scotland is improving, this is clearly being outstripped by our consumption in key sectors, as well as across the world. Energy efficiency has an impact upon many areas beyond simple energy supply and consumption, and there are significant opportunities, at low cost, to improve the efficiency of our energy use across business and society. Action is needed now to facilitate the changes required to improve energy efficiency, and we need to ensure that these measures are treated with the appropriate urgency.