DOMESTIC SUPPLY-A General Overview

The energy demand for the domestic sector seen an increase of 15.7% between 1970 and 1995. The main reason for the change in demand is the increase in population size, the decline in household size and the corresponding rise in number of households as is determined more by number of households, than by number of persons in a population. The main end use for domestic energy is for space heating, typically 50-60% over the past 30 years, the energy required to heat unit volume of space is unrelated to the number of people living in that space. The energy consumed by space heating is also determined by three other factors:

External temperature: A lower external temperature will mean more heat loss from a building due to the greater temperature difference. Yearly and seasonal temperature fluctuations therefore have a short-term effect on the amount of energy required to reach a sufficient temperature within a home. This has been reflected by small fluctuations in the energy consumed by space heating over the last 30 years.

Installation of central heating: Central heating consumes a large proportion of domestic energy, thus an increase in households with it installed has led to greater energy consumption. The proportion of houses with central heating installed has grown, due to increased personal wealth, and lower installation costs.

Better insulation: Insulation measures (discussed later) theoretically lower the energy consumption by space heating, as less heat is lost to the external environment. However installation of insulation is likely to mean an increase in internal temperatures as people seek a higher level of thermal comfort, so the reduction in energy consumed is less than expected.

Approximately 25% of domestic energy is used for water heating. This reflects the size of the population, rather than number of households, and the energy for this end use has varied by a small amount over the past 30 years.

Cooking accounts for 5% of the total domestic energy demand. Whilst this is partly influenced by the size of a population, the effect of a larger population in the UK has been balance by a change in lifestyle, for example, hectic lifestyles has meant a rise in the ‘ready meal’ food market and the popularity of socialising and eating out, a consequence of the improved wealth of the nation means fewer people stay in and cook for themselves every night.

Energy consumed by lights and appliance has increased rapidly over the past 30 years due to increased levels of ownership, technological developments in new appliances, and the trend to more lights in a single room rather than a single fitting with regard to lighting. Despite the massive rise in energy consumed by appliances and lighting, this has had a relatively small impact on the overall domestic energy demand because lighting and appliances accounts for a small proportion of the total demand, approximately 13%.

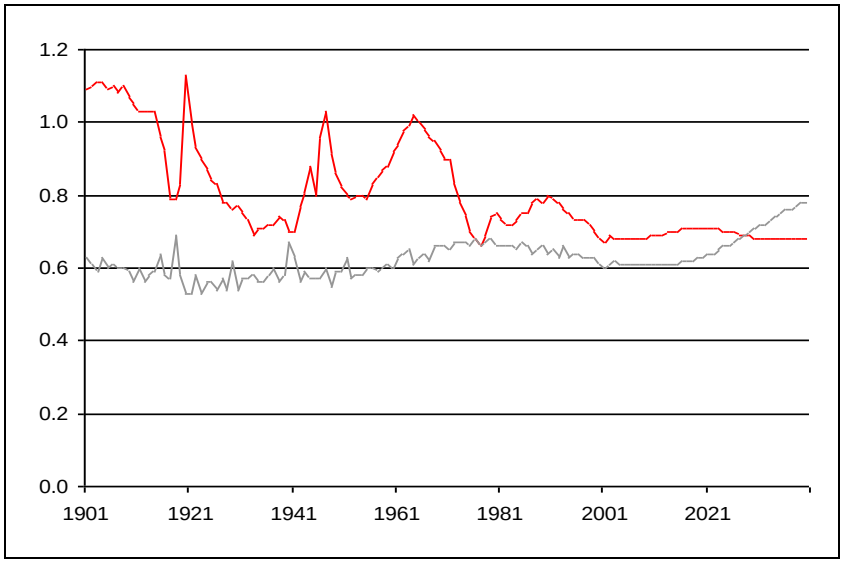
The increase in population size and number of households has been offset by the uptake of energy conservation measures. The proportion of households with loft and hot water tank insulation has increased over the past 30 years and appears to have

reached a saturation level of around 77% with these measures installed. This is because these are the most cost-effective insulation measures and people are more willing to invest in insulation when they can see a short-term cost benefit.

Cavity wall insulation, double glazing and draught proofing are expected to follow the pattern of loft and hot water tank insulation and also reach a saturation level by 2010. It is unlikely that 100% of homes will have insulation measures installed in the near future because installing insulation in the older portion of the housing stock could be time consuming and expensive. It may be more cost-effective to wait until these homes reach the end of their lifespan and are demolished, to be replaced by new energy efficient houses.

One of the main factors affecting the installation of insulation measures is the change in the size of the UK's housing stock. Currently 180,000 new homes are built each year, with a replacement rate of 0.7%, the rest of the houses used to accommodate the growing number of people in the population. The decreasing household size is also a factor in the growing need for new houses. It is more cost-effective to install insulation measures at the time of construction and 2002 Building Regulations have made new homes energy efficient. However new houses are far outweighed by the older proportion of the housing stock thus it will take at least 15 years for the savings in energy consumption of new houses to have a significant effect on the domestic sector's energy demand. If internal temperatures stayed the same, 30-50% of the energy consumed could be saved by installation of conservation measures; however people seek a higher level of thermal comfort when they install insulation, so there will be an increase in average internal temperature as more homes become insulated. Therefore it is likely only a 5% in energy consumption will actually be seen. I have calculated that a well-insulated home saves approximately 4.135×10^{-6}PJ per annum, compared to a house with no insulation installed and this figure has been used in the calculation of future domestic energy demand.

Aside from the increasing number of households, the other main factor affecting the rise in energy consumption of the domestic sector over the past 30 years has been the growth of the population of the UK (accompanied by the growth in number of households). The population of the UK increased by 6.5% between 1971 and 2003, mainly as a result of natural population change, and migration. The number of births per annum currently outweighs the number of deaths; therefore there is an increase in the natural population change, figure 1. It is predicted that by 2030 the number of births and deaths may be equal, before a period of population decline occurs. Figure 2 shows that the inflow of migrants to the UK is around 150,000 persons higher than the number of migrants leaving the UK per year; therefore there is a positive net migration to the UK. These two factors combined with the decrease in household size, figure 3 have resulted in the increase in number of households in the UK. The change in size of an average household is due to changing social patterns, with females concentrating on careers rather than families, and couples being less likely to live together than 30 years ago.



Births Deaths

Figure 1: UK Births and deaths, 1901-2002, projections 2003-2040. Number of births/ deaths is in millions.

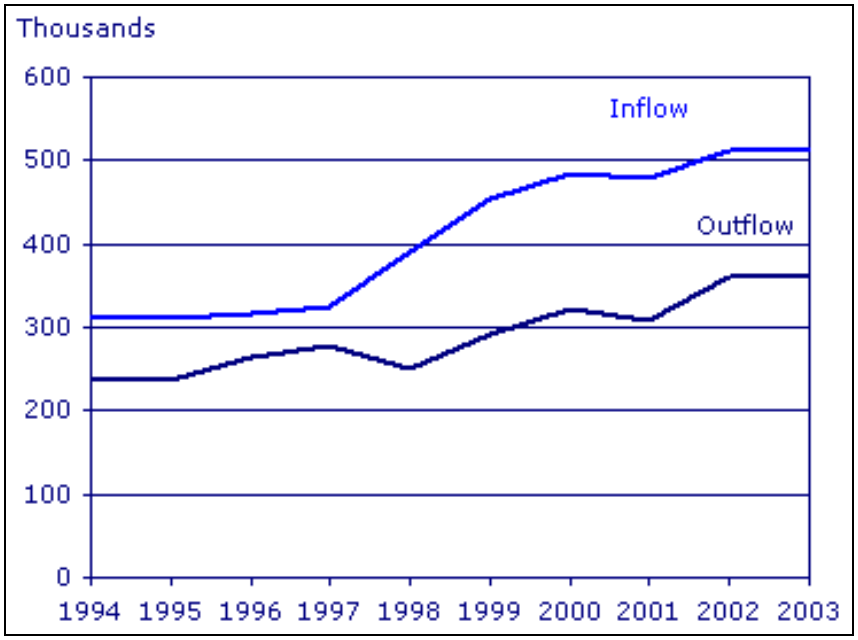


Figure 2: Migration to and from UK, 1994-2003.

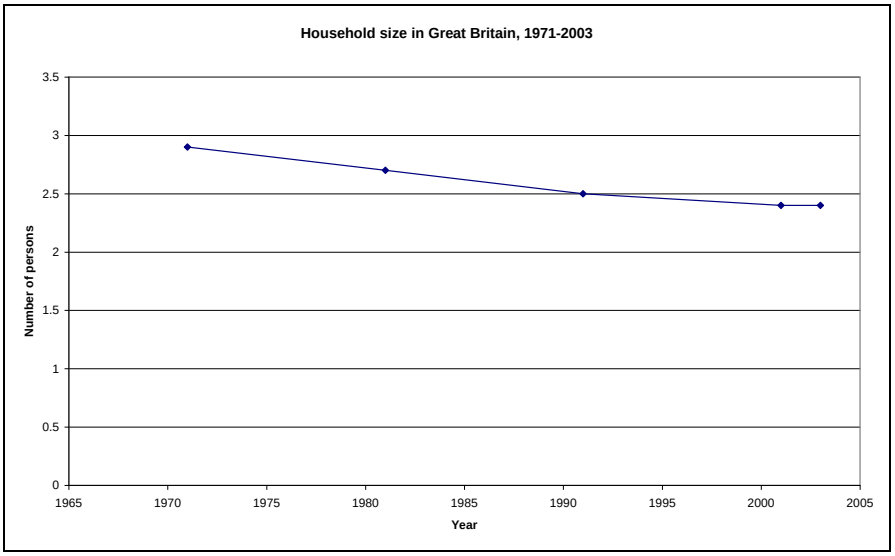


Figure 3: Household size in the UK, 1971-2003.

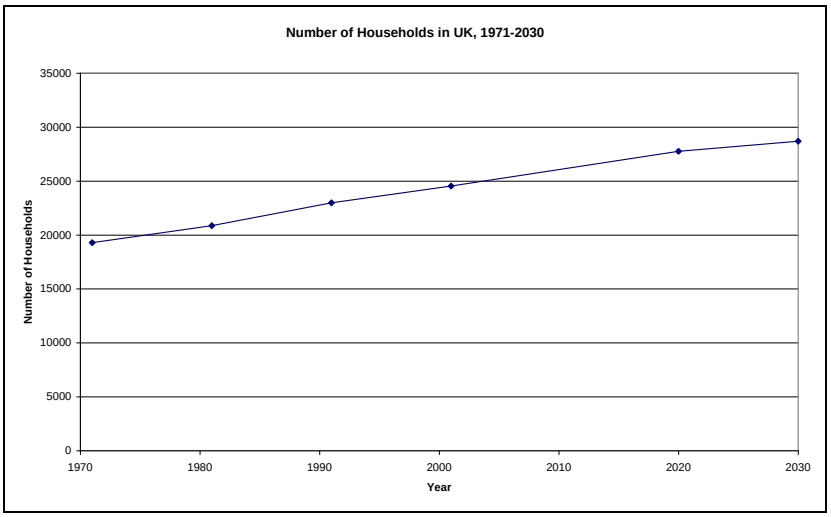


Figure 4: Number of households in the UK, 1970-2003, and projections of number of households, 2005-2030.

The increased number of households, figure 4, in the UK has resulted in the need for more homes to house the growing population. There are other factors that may have an impact on energy demand. For example, there are currently an increasing proportion of detached houses in the housing stock, figure 5, which have a larger heat loss than semi-detached and terraced homes due to a greater surface area to volume ratio. However this is off-set by the increasing number of flats resulting from the conversion of unused, large, old buildings, which have a relatively low heat loss.

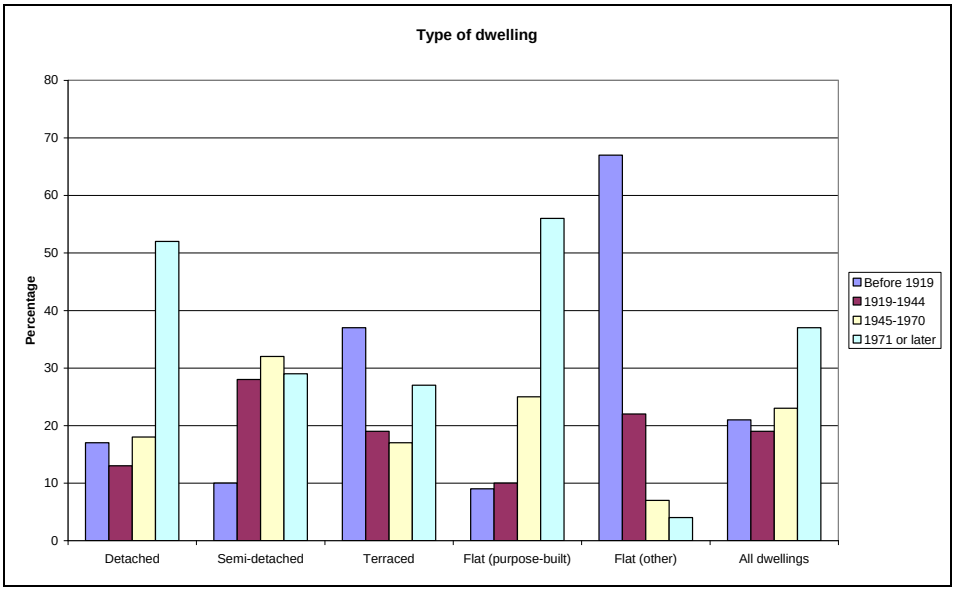


Figure 5: Percentage of each type of dwelling in total housing stock, pre-1919 to present.

Projections of future energy demand, figure 6, based on historical trends were made by disaggregating the components for which energy in the domestic sector is used, and the various conservation measures and legislation by which energy could be saved. The fuel mix was also projected from 2005 to 2030, figure 8, based on the pattern by which fuel mix has changed over the past 30 years.

	Total Demand (PJ)		
	Maximum	Minimum	Probable
2005	1752	1670	1757
2010	1874	1690	1799
2015	2018	1707	1944
2020	2175	1728	1982
2025	2293	1728	2028
2030	2412	1723	2126

Figure 6: Projections of future domestic energy demand, 2005-2030.

Over the past 30 years there has been a change in the main fuel supplying domestic energy demand, from coal being the dominant supplier in 1970, to natural gas in 2000, figure 7.

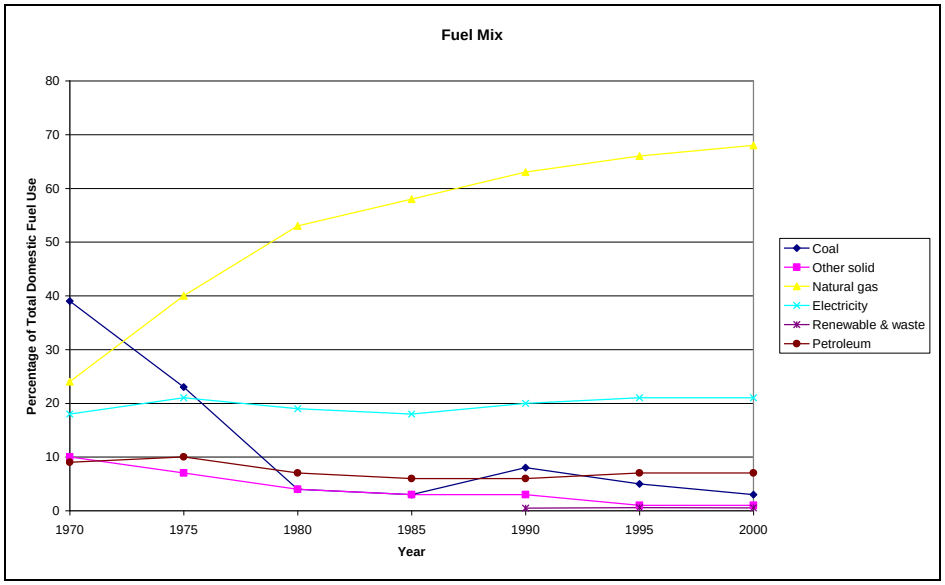


Figure 7: Change in fuel mix of UK domestic sector, 1970-2000.

The decline in the use of coal is due to competition from other fuels, which are generally more convenient, cleaner, more flexible and cheaper (prices of other fuels have fallen relative to the cost of coal). Natural gas is the main competitor, and the use of coal is now confined to areas where it is not economically viable for a gas connection to be made. The use of oil has seen a less dramatic decline over the past 30 years, partly because its use was proportionally less in 1970 than coal. The other factor causing a decrease in percentage of oil of the total fuel mix was the increase in use of natural gas. The increase in ownership of electrical appliances would have caused a great increase in electricity consumption, and this would have been added to by the switch from solid fuels to electricity for water and space heating. However the percentage of electricity of the total fuel mix has remained relatively static since 1970 due to competition from natural gas.

The previous paragraph has shown that natural gas has had a large effect on the overall fuel mix of the domestic sector. In the early 1960s British Gas developed a low cost process for making a cheap feedstock, whilst there was an improvement in the effectiveness and efficiency of space and water heaters using gas. This has meant that gas has provided a low cost fuel, which is abundant, clean and easy to transport. 85% of households in the UK are in an area that could feasibly be gas-connected therefore the relative proportion of natural gas in the fuel mix will continue to rise in the future.

	PJ Required					
	Coal	Other solid	Natural gas	Electricity	Renewable & waste	Petroleum
2005	53	18	1230	351	11	123
2010	45	18	1277	360	11	126
2015	39	19	1400	389	14	136
2020	20	0	1447	396	15	139
2025	20	0	1501	406	16	142
2030	0	0	1595	425	21	128

Figure 8: Projections of future domestic energy fuel mix, 2005-2030.

There are various other factors which could have an effect on future energy demand which should be taken account of to further refine the future projections. The stand-by facility on electrical appliances is responsible for up to 12% of domestic energy consumption; campaigns to tackle this problem could have a large effect on electricity consumed in a short period of time. Whether a dwelling is owner-occupied or rented has an effect on the insulation measures installed, owner-occupied houses are more likely to be energy efficient as home-owners are more willing to invest in conservation measures in their own homes. The thickness of the insulation measures installed i.e. thickness of loft, cavity wall and hot water tank insulation is also relevant- thicker insulation is more expensive but conserves more energy. Heat loss cannot be prevented entirely but thicker insulation reduces the heat loss.

	Energy consumed per person per annum (PJ)
1971	0.0000293
1976	0.0000299
1981	0.0000324
1986	0.0000355
1991	0.0000359

Figure 9: Energy consumed per person in the UK domestic sector, 1971-1991.

	Energy consumed per household per annum (PJ)
1971	0.0000849
1981	0.0000875
1991	0.0000897

Figure 10: Energy consumed per household in the UK domestic sector, 1971-1991.

The energy consumed per person in the UK increased by 22.5% between 1971 and 1991, figure 9, whilst the energy consumed per household increased by 5.6% over the same period, figure 10. Therefore it is the increasing number of households in the UK which is the main factor for the rise in UK domestic energy consumption, together with the increasing size of the population causing the overall increase in domestic energy demand.

References:

www.dti.gov.uk

www.statistics.co.uk

www.bre.co.uk

An economic assessment of some energy conservation measures in housing and other buildings, Pezzey, J., Building Research Establishment, 1984.

Energy consumption in the UK, Department of Trade and Industry, 2002.

Energy forecasting methodology, Department of Energy: Economics and Statistics Division v.29, London: H.M.S.O. 1978

Energy use and energy efficiency in the UK domestic sector up to the year 2010, Evans, R.D., Herring, H.P.J., London: H.M.S.O. 1990.