Chapter 6

REDUCING ENERGY USE

What are the main factors that have driven rising demand for energy? What needs and aspirations for energy-related services still remain to be satisfied? What potentials exist for greater efficiency? What are the long-term prospects for reducing the amount of energy used in the UK? What instruments should governments deploy in order to reduce energy use?

6.1 If society could reduce its use of energy, that would reduce the burning of fossil fuels, the threat of climate change and other damaging impacts of energy production and supply. Yet many of the things most closely associated with progress – sustained increases in living standards, rising longevity, large gains in health and welfare, increased opportunities to travel – have been associated with increasing consumption of energy.

6.2 In the UK, energy consumption rose through the 20th century, driven by the rising output of goods and services and growth in population, household numbers, personal travel and freight transport. But while primary energy consumption increased by 24% between 1965 and 1998 and final energy consumption by 16%, the UK's real gross domestic product rose by 147% over the same period (figures 5-I and 5-III).[1] A progressive reduction in energy intensity is a worldwide phenomenon (3.29), and largely a response to the continual pressure to cut costs by reducing the amount of material and energy used to produce services and goods.

6.3 Over and above improvements in the efficiencies with which energy is used by individuals, businesses and public bodies at the stage of final consumption, further very large reductions in the total use of energy, that is use of primary energy (3.33), could be achieved by cutting losses within the energy system (5.7), for example by greater use of combined heat and power plants. We deal with that aspect of the matter in chapter 8.

6.4 In this chapter we consider whether it would be possible to enhance the trend of declining energy intensity to the point where energy use begins a gradual, sustained decline without unacceptable effects on the quality of life, including social equity and cohesion. A distinction must be drawn at the outset between 'energy conservation' and 'energy efficiency'. The former implies reductions in the consumption of energy services. That could be achieved simply by 'making do' with less energy – by turning thermostats down and tolerating lower temperatures, for instance. The latter implies obtaining more useful heat, light or work from each unit of energy supplied, either as a result of technological improvements or by reducing waste; in other words, obtaining the same services with less use of energy. We consider that attempts to protect the environment and prevent climate change based principally on exhorting people to make sacrifices in comfort, pleasure and convenience in order to consume less energy are unlikely to succeed.

6.5 A crucial consideration is that even in a nation as wealthy as the UK, the basic energy-related needs of a significant part of the population are still not being met. The UK experiences about 30,000 more deaths each winter than would be expected given the average death

rate for the entire year, the majority among the elderly population.[2] Some nations and regions with much colder climates than the UK's have smaller increases in winter mortality.[3] The difference can be partially attributed to low temperatures in UK dwellings occupied by elderly people on low incomes. Thousands of lives are shortened each year by weeks, months and years in one of the world's richer nations because a substantial proportion of the elderly population cannot afford adequately to warm their homes.

6.6 *Fuel poverty,* as defined by government, is experienced by households needing to spend at least 10% of their income in order to provide adequate warmth in the home. The government estimates that in 1996 there were 4.4 million households – more than a fifth of the total – who suffer fuel poverty in England[4] and the proportions in other parts of the UK are similar. Their low incomes, and the fact that many of them live in homes which are poorly insulated or have highly inefficient heating systems, mean that such households would need to spend this high proportion of their incomes to maintain adequate warmth. Many cannot afford to do so and the elderly, children and chronically ill among them are at risk of a range of cold-related diseases as a consequence. Half of the households in fuel poverty consist of people aged over 60. **Major improvements in the energy efficiency of UK housing are required.** Without them the eradication of fuel poverty would involve substantial increases in energy consumption and in carbon dioxide emissions.

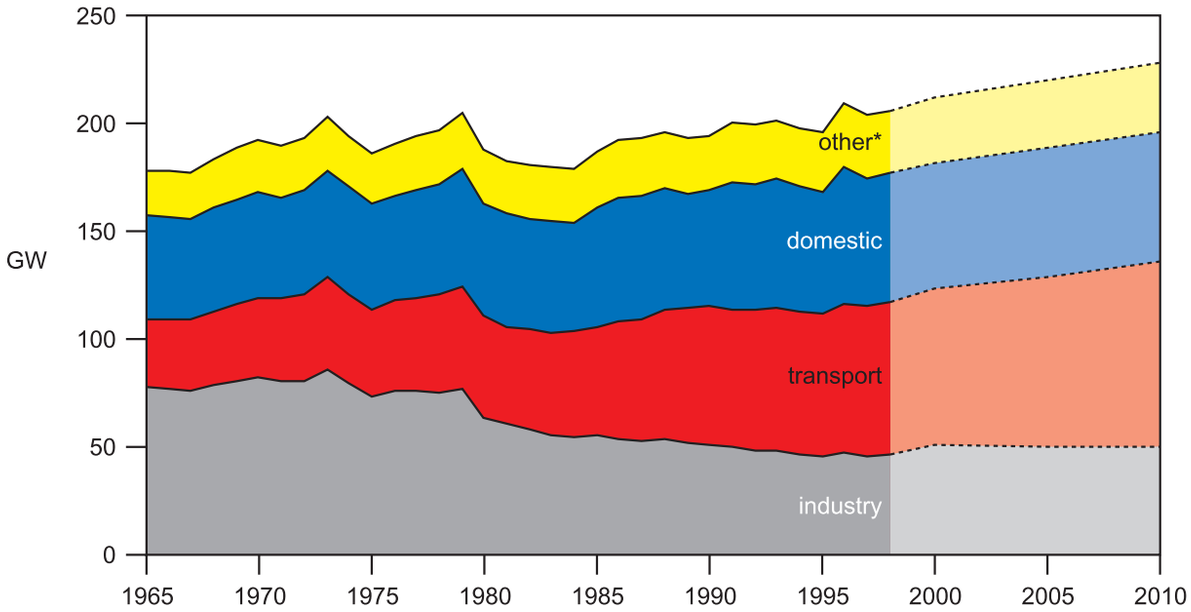
6.7 The gradual long-term reduction in UK energy intensity referred to above (6.2) accelerated in the past quarter century following the first oil price shock in 1973. UK primary energy consumption in 1998 was only 5% higher than in 1973, and final energy consumption only 2% higher, while real GDP rose by 63% over this 25-year period.[5] It is sometimes supposed that a collapse in the most energy-intensive heavy industries has played a dominant role in the decline in energy intensity. It is the case that manufacturing's share of UK output has declined, while that of the less energy-intensive services sector has risen. It is also the case that some of the most energy-intensive industries have contracted. But the Department of Trade and Industry (DTI) has estimated that only one twelfth of the reduction in the UK's overall energy intensity between 1973 and 1995 was due to structural change in the economy.[6]

6.8 Since 1984, however, the rate of decline in UK energy intensity has slowed markedly. Total primary energy consumption rose by 20% between 1984 and 1998 and total final energy consumption by 15% while real gross domestic product rose by 43%.[7] In this more recent period, the trend has been for UK primary energy use to rise by a little over 1% a year. The trend reflects generally low energy prices over this period (although global oil prices have risen markedly in the short interval since early 1999). The government's latest projections for energy trends over the next 20 years are discussed in chapter 5 (5.8-5.11).

6.9 There is a strong economic argument in favour of raising energy efficiency. Repeated analyses have shown that in every sector of the economy large quantities of energy are wasted and that apparently highly cost-effective investments for making energy savings are forgone.[8,9] Improvements in energy efficiency also offer environmental benefits which extend beyond curbing greenhouse gas emissions and other fossil fuel-related pollutants. Nuclear power and renewable energy resources have environmental impacts which can be lessened if energy consumption is reduced. If, furthermore, new energy-saving technologies can be transferred to developing nations this may enable them to raise standards of living while avoiding some of the environmental damage previously associated with industrialisation.

6.10 In this chapter we first review the final energy use of four sectors-manufacturing industry (6.12-6.35), public and commercial services (6.36-6.51), households (6.52-6.106) and transport (6.107-6.131). The changes in their energy consumption since 1965 and the DTI's latest projections for the period to 2010 are shown in figure 6-I. For each, we review recent patterns of energy use and policies, regulation and economic instruments which are currently influencing energy consumption. We consider the short- to medium-term scope for reducing energy demand in each sector, and make some recommendations. We then consider the combined potential for energy savings of all four sectors and the longer-term prospects for reducing energy consumption (6.132-6.148). We consider economic instruments in general (6.149-6.154) before proposing a carbon tax (6.155-6.169). We conclude by considering what kind of changes in regulation and institutional structures might enable the UK to reduce its overall energy use in the long term (6.170-6.174).

Figure 6-I
UK rate of energy consumption by final user, by sector 1965-2010



*mainly public and commercial services

6.11 In assessments of the scope for energy savings in the four sectors, a distinction is normally drawn between the technical and the economic potentials for reducing energy consumption. The *technical potential* refers to reductions which could be achieved by the universal application of energy-saving equipment and technologies that are already on the market or proven to the point where they are near market. It is the proportion or quantity of energy which could be saved given current technology and knowledge. The *economic potential* is an estimate of the energy savings that could actually be made with this technology if all improvements and investments in energy-saving equipment which covered their costs were made. In making assessments, both types of potential are considered to be fulfilled over a 10-25 year period as new, higher-efficiency plant and products replace existing ones. The analyses require assumptions to be made about 'business as usual' energy consumption over this period, future energy prices, the discount rates employed in appraising investments and future economic growth. They are illustrative projections, and cannot be regarded as precise estimates of what would actually be saved if the economic or technical potential were fulfilled.

Manufacturing industry

6.12 The peak year for energy consumption by UK manufacturing industry was 1973, the year of the first oil price shock. Its share of final energy use had been fairly stable for more than a decade before then, hovering close to 42%. But after 1973 it fell away and by 1998 it stood at only 22% of total final energy use. The absolute figure for UK industrial energy consumption also declined by 46% over this same period.[10] Yet industrial output rose by 46% between 1970 and 1996; 59% less energy was required to produce each unit of manufacturing output than was the case in 1970.[11]

6.13 The government considers that efficiency gains were the main reason for this sector's spectacular reduction in energy intensity but the decline in the output of some energy-intensive manufacturing industries such as iron and steel has also played a part. (As was mentioned above (6.7) structural change in industry has played a relatively minor role in the reduction of energy intensity in the economy as a whole.) The chemicals sector, another heavy consumer of energy, more than doubled its output (in terms of total value, adjusted for inflation) between 1970 and 1996 but its use of energy (excluding fuels used as feed stocks) fell by 21%.[12] This was partly due to major gains in efficiency, but also due to restructuring within this sector with the output of higher added value products expanding relative to basic, bulk chemicals.

6.14 Since the late 1980s levels of energy efficiency have improved much more slowly in manufacturing industry than they did in the previous decade. The decline in manufacturing industry's overall energy use appears to have come to a halt. This stagnation is found, to a lesser or greater extent, in all of the major manufacturing sectors and it coincides with a period of low energy prices. In his report for the government on *Economic instruments and the business use of energy* Lord Marshall concluded that there was a causal connection.[13]

6.15 There are three broad approaches to improvement, with some degree of overlap between them. The first is to make existing plant and processes run more efficiently without any major modifications. This is largely a matter of good housekeeping, ensuring that buildings are not overheated and overlit and that equipment is well maintained and never operating unnecessarily or over-performing. To be effective this approach requires management to measure energy consumption widely and frequently, to make and update plans for reductions and to involve staff. In some manufacturing sectors a large proportion of the total energy consumption is devoted simply to heating and lighting buildings. This gives ample scope for housekeeping measures to reduce energy use. According to an analysis by ETSU commissioned by the Department of the Environment, Transport and the Regions (DETR), just under half of the vehicle manufacturing sector's energy use is for heating and lighting.[14]

6.16 The second approach, which also requires investment in management and staff time, is to modify or retrofit existing plant, by replacing individual components such as boilers with higher efficiency alternatives, by installing insulation around pipes and furnaces, and by improving or replacing control systems. The third approach is to invest in larger and more expensive modifications to existing plant or to purchase entirely new plant. There may sometimes be a case for bringing forward the replacement of an entire plant by a few years instead of retrofitting immediately. Major improvements in energy efficiency can often be part of improvements in product quality and productivity.

The potential for reducing energy consumption

6.17 The ETSU analysis (6.15) projected that under a business as usual scenario UK manufacturing industry's energy consumption would rise by 18% between 1995 and 2020.[15] This bottom-up projection, based on trends in output and efficiency improvements in each manufacturing sector, pre-dated the government's proposed climate change levy, and assumed the various sectors continued to make efficiency improvement at the same low rate as they did between 1990 and 1995, at a time of recession and low energy prices. ETSU also projected industrial energy consumption under a scenario in which all cost-effective energy saving measures and technologies were phased in gradually (that is inefficient equipment was not scrapped earlier than usual). This analysis of economic potential assumed industry would only invest if there were fairly short payback periods for the initial investment-just one to two years in the case of retrofit measures and 2-15 years in the case of new plant. Under this scenario manufacturing industry's energy consumption fell initially but eventually rose by 4% between 1995 and 2020 due to growth in output overwhelming gains in efficiency. In a third, technical potential scenario, all existing plant and equipment were assumed to be replaced immediately by state-of-the-art, high efficiency alternatives. Energy consumption then fell by 8% over the 25-year period.

6.18 Just over a quarter of manufacturing industry's energy requirement is for electricity.[16] Greater use of combined heat and power (CHP) stations (3.40), which supply both electricity and heat for industrial processes and space heating (usually in the form of steam or hot water), is assumed to play a leading role in reducing manufacturing's total demand for energy in all of these scenarios, including business as usual. In 1990 CHP supplied 11% of industry's own electricity demand.[17] Under ETSU's business as usual scenario, this is projected to grow to 18% in 2020. Under the economic potential scenario the contribution is put at 76%. The speed at which CHP spreads through industry will depend heavily on the terms on which surplus electricity can be marketed into the grid. It may also depend on expanding opportunities to export heat to nearby homes and businesses (8.8-8.9).

Measures for reducing energy consumption

Taxation-the climate change levy

6.19 The ETSU projections suggest that UK manufacturing industry could gradually reduce its total energy consumption while expanding the value of its output. The government's planned climate change levy, which will come into force in April 2001 and apply to almost all use of gas, coal and electricity outside the household sector, will encourage industry to move onto this path by raising energy prices and providing accompanying incentives for investments in energy efficiency. The bulk of the revenue will be allocated to reducing employers' National Insurance Contributions (NICs), but the government's intention is to devote some 15% (£150 million a year) to incentives for improvements in energy efficiency and for switching to non-fossil fuel alternatives; £100 million will be taken up in the form of 100% first year capital allowances for approved energy-saving investments. The £50 million balance will be used to fund energy efficiency advice, particularly to small and medium enterprises, to increase training in energy efficiency, and to increase research, development and deployment of energy saving technologies and renewable energy sources. The levy will impinge 'downstream', at the point of sale, and households will be exempted from it. Companies which find their overall costs increase as a result of the levy may pass some or all of these on to consumers but for many less energy-intensive companies overall costs will fall, because of the reduction in employers' NICs.[18,19]

6.20 Fears have been expressed that the international competitiveness of UK manufacturing industry will be damaged by the levy but this seems unlikely. According to DTI, there are only four sectors – water, iron and steel, cement, lime and plaster manufacture and brick making – in which energy expenditure exceeds 10% of total production costs. It exceeds 20% in none of them.[20] Furthermore, industrial gas prices in the UK are among the lowest for OECD countries, while UK industrial electricity prices are in the middle of the range.[21] The illustrative rates for the climate change levy set out in the Chancellor of the Exchequer's Pre-Budget Report of November 1999 would add 11% to the average industrial user's annual electricity bill and 27% to its annual gas bill but rebates of 80% of the tax have been offered to energy-intensive sectors that negotiate agreements with government to save energy or to reduce carbon dioxide emissions (6.22).[22] The reduction in employers' NICs will also tend to increase industrial competitiveness.

Negotiated agreements between the government and industry

6.21 In 1997 DETR and the Chemical Industries Association signed an agreement to improve the industry's specific energy use (energy consumption per tonne of product) by 20% between 1990 and 2005. This was the first agreement of its kind in the UK. The association estimated that its members had already achieved a 14% reduction from the 1990 baseline in the years before the agreement was signed; thus it was already well over half way to the target before half time.[23] Government undertook to provide verification of the improvements and some free guidance and advice, including up to five consultant days for each manufacturing site.

6.22 The government is now planning a major expansion of such agreements, with energy-intensive manufacturing sectors undertaking to make specified energy savings (or reductions in carbon dioxide emissions) per unit of output in return for an 80% rebate from the planned climate change levy. Such agreements will only be effective if the trade association includes all, or almost all, of the companies in a sector among its membership. They are unlikely to work if many small and medium enterprises are involved because of the problems in monitoring all of their performances.

6.23 The agreements will need to be underpinned by a credible threat to apply the full weight of the levy in the event of a company failing to achieve its agreed reduction. There may, however, be scope for firms achieving less than their commitment to purchase the balance from those exceeding their target figure through trading arrangements, which we discuss below. The energy consumption of firms in the sectors involved will need to be monitored closely to ensure compliance. **We recommend that a body with a degree of independence from government, such as the Environment Agency or the new Sustainable Energy Agency we recommend, undertake or audit the monitoring of negotiated agreements to reduce energy use and be given adequate funding to do so. We also endorse the House of Commons Environment, Transport and Regional Affairs Committee's recent recommendation that draft negotiated agreements be made publicly available.**[24]

6.24 Individual firms and entire sectors will differ in the ease with which they can make energy efficiency gains. In negotiating energy- and carbon-saving agreements, government will find it difficult to judge what target reduction in consumption it should bid for without reliable, detailed information on the economic potential for saving energy across each sector. Negotiated agreements with manufacturers will only prove a worthwhile alternative to taxation (6.19-6.20) or regulation (6.25-6.31) if they achieve substantial reductions in emissions with equal or greater cost-effectiveness.

Regulation – the IPPC Directive

6.25 Regulations implementing the European Union's new Integrated Pollution Prevention and Control Directive (the IPPC Directive) will soon cover the energy consumption of much of the UK's manufacturing industry. This builds on the concept of integrated pollution control advocated in the Commission's 5th Report in 1976 and introduced in the UK in 1990. The Directive seeks to minimise the overall environmental impacts of the most polluting installations by compelling their operators to demonstrate that they have adopted best available techniques (BAT) and that they are meeting plant and site-specific emission limits for significant pollutants. By 2007 it is expected to cover some 6,000 installations in the UK, which, between them, are responsible for some 60% of the manufacturing sector's total energy use.[25]

6.26 Under the IPPC Directive, EU Member States are charged with ensuring – through their pollution control agencies – that industrial sites and plants are operated in such a way that energy is used efficiently. They must also ensure that the determination of BAT for a particular process takes energy efficiency into account. The UK government's current thinking is that the Directive's requirements for energy efficiency should be met mainly through site-specific permit conditions based on lists of technologies and benchmarks of cost-effective energy efficiency measures developed by ETSU, DETR's energy efficiency consultants.

6.27 However, the government intends to treat industrial sites which have undertaken to cut their energy consumption as having demonstrated compliance with the energy efficiency aspects of the IPPC Directive. They will be exempted from site-specific conditions. These undertakings would be made as part of agreements negotiated between energy-intensive industrial sectors and the government under which the former avoided most of the climate change levy (6.22).

6.28 What impact the Directive will have on manufacturing industry's energy demand remains to be seen. Many small and medium enterprises do not come within the IPPC Directive's remit. Furthermore, major advances in the energy efficiency of industry have arisen – and will continue to arise – from redesigning products to reduce their embodied energy content as well as from changing manufacturing processes. The IPPC Directive is restricted to regulating the latter and has little influence on this crucial area of product design. We note, however, that an integrated product policy is under discussion within the EU.

6.29 The UK's three main pollution control agencies (the Environment Agency, the Scottish Environment Protection Agency and the Northern Ireland Environment and Heritage Service) and local authorities, which have a role in applying IPPC to less polluting industries, are unlikely to go beyond insisting on energy efficiency measures whose cost-effectiveness is proven and which have relatively short payback periods. If the agencies went any further, they would risk accusations of driving industries out of business or overseas.

6.30 However, given the evidence that many companies fail to implement all cost-effective energy-saving measures, we believe that the UK's environmental regulators could, in implementing the IPPC Directive, play a new and important role in raising industry's baseline standards of energy efficiency. **Government must encourage and enable the Environment**

Agencies to raise industry's baseline standards of energy efficiency in implementing IPPC. Energy efficiency achievements of more advanced operators should be used as benchmarks in order to raise the standards for laggards.

6.31 **Emissions of carbon dioxide and other greenhouse gases from a site should be considered as pollutants in authorising processes subject to IPPC. As soon as it can be established that disposal of carbon dioxide into deep geological strata (3.10-3.11) is environmentally and legally acceptable, consideration should be given to designating technology for removing carbon dioxide from the emissions from large combustion plants (3.6) as the best available technique for the purposes of IPPC.**

Carbon trading

6.32 The government and a business group led by the Confederation of British Industry and the Advisory Committee on Business and the Environment have been discussing the establishment of a trading scheme in carbon dioxide emission permits as a means of cost-effectively reducing industrial emissions.[26] A firm would be able to enter such a scheme if it accepted a quota of carbon dioxide emission rights for a given period; in effect a cap on its emissions. Those firms which found it cheapest to save energy and reduce emissions would have an incentive to emit below their quota and sell the balance to firms which found it more expensive to do so and preferred to exceed their cap. The price of quota would be established in an open market. Such a trading scheme ought to minimise the overall costs to manufacturing industry of increasing energy efficiency and reducing emissions.

6.33 We would welcome a trading scheme if it achieved this purpose, and also because it could help the UK to play a leading role in the international trade in emission permits which is expected to ensue (box 4A and 4.53). It will require some form of incentive to encourage firms to join. It will also require complex rules, close monitoring and sanctions against companies which fail to comply with their obligations. It will also need to achieve substantial emission reductions by 2012. We note that stringent application to participating firms of the IPPC Directive's energy efficiency requirements would tend to reduce the scope for trading by pushing all companies towards the same high standard.

Advice and information

6.34 Another influence on manufacturing industry's energy consumption – and on the service sector's – is government advice and information campaigns. The Energy Efficiency Best Practice Programme (EEBPP), launched in 1989 and overseen by DETR, promotes energy efficiency in the manufacturing, services, household and transport sectors through good practice guides and case studies, demonstration projects, support for research and development and benchmarking. The latter involves recording the energy consumption of a sample of operators in particular sectors and processes, then disseminating this information to highlight the energy savings which the best performers are achieving.

6.35 Government spending on energy efficiency best practice activities is expected to rise, using revenues from the climate change levy. The government has estimated that by 1998 the programme was saving primary energy worth more than £650 million a year, equivalent to an average rate of about 6 GW.[27] DTI, DETR and the devolved administrations also run a similar, but smaller Environmental Technology Best Practice Programme which promotes the adoption of clean technologies and waste minimisation.

Commercial and public services

6.36 The final energy consumed by public and commercial services in the UK rose by 24% between 1973 and 1998. The sector's share of total UK final energy use rose slightly, from 11 to 13% over those 25 years.[28] As with the manufacturing and domestic sectors, there have been large shifts between energy sources with gas and electricity growing at the expense of solid fuels. The services sector's dependence on electricity is higher than any other's with 37% of all the final energy it consumed in 1998 arriving in this form.

6.37 Almost all of the increase in energy use has been on the commercial side of the services sector, where there has been trend growth of almost 3% a year since the early 1970s. Total consumption by primarily state-funded services such as health and education barely rose over this period.[29] The commercial side now accounts for some 60% of the sector's total energy use with shops, offices and hotel and catering establishments together accounting for well over half of commerce's consumption.[30]

6.38 Both the commercial and the public, state-funded parts of the services sector have increased output faster than energy consumption over the past two decades. However, since 1990 the trend towards decreasing energy intensity has been stagnant and may even have gone into reverse.[31] Several explanations have been advanced for this. A period of relatively low fuel prices following a recession removed earlier incentives to cut energy consumption. A growing proportion of large and medium sized buildings are centrally cooled as well as heated; more than a quarter of the non-domestic floorspace constructed since 1991 has full or partial air conditioning.[32] The amount of electrically powered equipment used in offices, particularly computers, printers, photocopiers and vending machines, has also been growing very rapidly and is expected to continue to do so. All of this equipment sheds heat, which increases the demand for the air conditioning needed to maintain tolerable indoor temperatures on hot days.

6.39 The bulk of all energy demand from both public and commercial services is for space heating and hot water, just as it is in households. But in some sub-sectors a large proportion of the total energy consumption is attributable to other uses. In shops, a third (including more than half of electricity consumed) is used for lighting. In offices, 10% of final energy use is devoted to cooling and 10% to computers and other information technology equipment.[33]

The potential for reducing energy consumption

6.40 An analysis of the prospects for saving energy in the services sector was carried out for the Commission, using the Building Research Establishment's Non-Domestic Energy and Emissions Model.[34] This model provides estimates of total energy consumption in ten sub-sectors, based on surveys of the energy use in individual buildings and businesses. The Commission's consultants concluded that if the technical potential was fulfilled the service sector's annual final energy consumption would fall by 18% between 1996 and 2010. If the economic potential was fulfilled the fall over this 14 year period would be 3%, with the reductions brought about by improvements in energy efficiency only just outweighing the increases associated with rising output. In the absence of any improvements in the rate at which the sector implements energy efficiency measures, its annual energy consumption would continue to rise by 0.5 to 1% a year.

Measures for reducing energy consumption

6.41 As with manufacturing, ways of reducing demand in the services sector range from simple housekeeping measures to the replacement of major infrastructure – including entire

buildings-with more energy efficient alternatives. Improvements in heating, cooling ventilating and lighting offer the largest scope for energy savings in existing buildings. Often, this is a matter of improving controls so that buildings, or parts of buildings, are not overlit, overheated or overcooled. Sensors which switch off lights if no one stands or sits nearby for some time have been on the market for several years. Raising the efficiency of electrical appliances can also make a substantial contribution to reducing energy consumption in existing buildings-we discuss this further below (6.80-6.87). Combined heat and power (CHP) plants (3.40), generally with a much lower output than those used in manufacturing facilities, also offer energy savings by providing both warmth and electricity for a building at high efficiencies. As with the manufacturing sector, the spread of CHP in the services sector will depend largely on the ease and profitability with which surplus heat and warmth can be distributed and sold to other users.

Improving the energy efficiency of public and commercial buildings

6.42 In the long term, the greatest scope for advances in saving energy comes in the construction of new services buildings designed to consume a small fraction of the energy per square metre or per occupant which their older equivalents require. Several such buildings now exist in the UK (see box 6A). Devices such as light wells, atria and reflective surfaces are used to bring daylight into the centre of large floorplans, reducing electricity requirements. Sunshine is also used to provide much of these buildings' warmth, heating interior air behind glass. Ventilation systems, passive or forced, distribute this warmth through the building and-in combination with equipment which prevents too much solar energy entering-keep the interior comfortably cool in summer without the need for air conditioning. Such buildings generally feature high levels of insulation on all their external surfaces and advanced glazing with special coatings.

6.43 The main influences on the service sector's future energy consumption will be its underlying growth, the price of energy and the Building Regulations which set standards for the energy efficiency of new public and commercial buildings and for housing. These regulations are currently being reviewed by government for England and Wales, and amended ones setting higher standards are expected to be introduced in 2001. The Scottish Executive plans to consult in the autumn of 2000 on its proposals for higher energy efficiency standards for buildings.[37] Most commercial buildings are either demolished or extensively refurbished within 20 years of construction, so the application of higher standards to new build and refurbishment could have a major impact on energy demand over the medium to longer term. **The regulations should be amended to set more demanding criteria for the energy efficiency of lighting and introduce rigorous standards for air conditioning systems as well as heating systems, thereby encouraging architects and engineers to find less polluting ways of keeping buildings adequately lit and at comfortable temperatures.** They should also include requirements that ensure these systems are properly commissioned. And they should have a standard for ventilation; the UK is the only member of the EU to have no guideline for ventilation in public buildings.[38] The government is considering whether there is scope, under existing legislative powers, to raise energy efficiency standards in buildings already in existence.

6.44 **We recommend that government join with the construction industry to find an effective way of increasing the awareness and understanding of energy-saving methods and technologies among architects, engineers, surveyors and the building trades.** UK buildings which have been designed to attain high levels of energy saving have sometimes failed

BOX 6A LOW ENERGY BUILDINGS

A university[35]

The University of East Anglia's Elizabeth Fry Building near Norwich contains offices, seminar rooms and lecture theatres (photograph V). It consumes less than half the energy of an air-conditioned building of comparable size and function while maintaining comfortable internal temperatures throughout the years.

The four-storey, 3,250 square metre building uses night cooling to keep temperatures down to comfortable levels on hot summer days. During the night, external air is pumped into the offices, seminar rooms and lecture theatres through cavities within the concrete slabs which form the ceilings and floors. This fresh air cools these slabs and the remainder of the building fabric. The slabs then act as a heat sink or 'cool store' during the day, reducing the build up of heat from people, electrical equipment and the sunlight streaming in through the windows. Warm external air pumped into the building for ventilation during hot summer days is also cooled by the slabs. Occupants can also open office windows or use integral sun blinds (which are sandwiched between the panes of glass) to adjust the temperature in their immediate surroundings.

In winter, the building is sealed at night to retain the daytime heat gains from people, lights and other and electrical equipment. During the day, the external air which has to be pumped through the building for ventilation is first warmed by outgoing, stale air in a heat exchanger and then further heated, if necessary, using three gas-fired boilers. Most of the heat required to warm the building is generated by occupants and equipment; the boilers are ordinary household-sized, high efficiency condensing types and all three are rarely required to operate. The walls contain 200 mm of insulation and the building, completed in 1995, is well sealed. Electricity consumption is reduced by making maximum use of sunshine to light the rooms, stairs and an atrium.

As well as having a low overall average energy consumption (some 90 KWh per square metre per annum), the Elizabeth Fry building also cost significantly less to construct than an air-conditioned equivalent and is easier and cheaper to maintain. Surveys of staff have found high levels of satisfaction with the building.

A supermarket[36]

J Sainsbury's new supermarket on the Greenwich peninsula site, in south east London, has been designed with the aim of having half the energy consumption of a conventional new foodstore of equivalent size (photograph IV). Supermarkets are among the most energy-intensive of buildings because they are air-conditioned, brightly lit, poorly insulated and have a great deal of refrigeration. The industry average is 1,087 kWh per square metre per annum from electricity and 152 kWh per square metre per annum from gas.

The store, which opened in September 1999, has its own 500 kW gas-fired combined heat and power plant which provides its base electricity requirement; any extra demand is met by importing power from the grid. Hot water from this CHP plant is used to pre-warm incoming air for ventilation and is also circulated in a network of pipes in the building's floor, providing space heating. In hot weather, cooling is provided by cold water pumped up from two boreholes; this cold water pre-cools the air used for ventilation and circulates through pipes in the floor.

Most of the time there is no need to force ventilation air through the building with fans. Instead, the air is drawn in from a void beneath the floor then, as it warms, it rises upwards to the roof. Winds flowing above the building create a suction effect, drawing the stale air out through vents whose aperture is varied by a control system. Conventional practice in supermarkets is to force cooled or warmed air down into the building from large ducts in the roof void. The Greenwich store also breaks with convention (and pleases both staff and customers) by having large skylights throughout the roof instead of relying entirely on artificial lighting.

For visitors and passers by, the most obvious sign that this £13 million building uses less fossil fuel is two wind turbines flanking the entrance which also carry photovoltaic panels. Their presence is largely symbolic, however, because they only supply enough electricity to power the store's external illuminated signs.

The energy saving elements are estimated to have added about £2 million to the construction costs. Even if energy consumption is halved, as is hoped, these improvements cannot be justified in conventional accounting terms. The supermarket chain broke with convention in order to develop energy efficiency technologies for use in future stores.

to realise them because of poor workmanship, lack of attention to detail and failure to understand specifications.[39] **We mean this recommendation to apply as much to the housebuilding sector, which we discuss below, as to larger commercial, industrial and public buildings.**

6.45 Tenure arrangements can also be inimical to energy efficiency improvements in buildings. The landlord may be responsible for the maintenance of boilers, air conditioning, insulation and other energy-related aspects of the building but has only a weak incentive to invest in improvements if she or he does not pay the fuel bills for a tenant's use of energy. If, however, the landlord does pay these bills and then passes them on to the tenants in fixed rental or services charges which do not reflect their precise, individual levels of energy consumption then the tenants have no incentive to reduce waste and use energy carefully. This suggests that tenants should pay individual, metered bills. Technical advances in metering (such as remote reading) and the liberalisation of meter reading services (box 5A) open up new opportunities for this.

6.46 But even if tenants did pay individual, metered bills they might face restrictions on the energy saving alterations landlords allowed them to make to buildings. Furthermore, they would have little incentive to make such improvements unless they were certain of remaining in occupancy for long enough to cover the investment through reduced fuel bills, or were awarded some offset to any dilapidations charge at the end of their lease.

6.47 In principle the energy efficiency of a building and its heating system and the landlord's energy billing arrangements might be reflected in the rent obtainable on the property, thus providing an incentive for mutually beneficial improvements. In practice, this rarely seems to happen.

6.48 **We recommend that government join with major property owners to develop means of tackling the 'landlord-tenant' problem which plagues attempts to raise energy efficiency in the services sector.** The starting point is to give tenants of offices, shopping centres and other multi-tenanted buildings information about how much energy they are consuming; only then will they have an incentive to reduce their own consumption and put pressure on their landlords to invest in measures which conserve energy. **We propose that government work with the property and energy industries to devise an incentive scheme which would encourage both landlords and tenants to move to individual meters for each tenant.**

6.49 **Where tenants cannot be individually metered, the landlord should be required to inform them of their building's overall annual energy consumption and fuel bill. At the same time, the landlord should be required to inform existing tenants and prospective tenants of the energy consumption and fuel bill for the average building with the same function and floor area as the one in which they rent, or propose to rent, space, as well as the equivalent figures for a high efficiency 'good practice' building of similar function and floor area.** The benchmark energy consumption figures required to make these comparisons have already been collected by the Building Research Establishment, which should be tasked and funded by the government to supply them free of charge to all landlords. The comparisons would motivate both landlords and tenants of low and average energy efficiency buildings to seek savings and could influence rent levels.

The climate change levy

6.50 DTI has estimated that average expenditure on energy in the services sector is only 0.9% of gross output and 0.6% of total production costs.[40] Therefore energy bills are not generally a major concern for management while most small enterprises give energy efficiency

scant consideration. Given the fairly low price elasticities for energy in this and other sectors, which we discuss further below, the price increases resulting from the government's climate change levy are – on their own – likely to cause only small reductions in consumption. Advice, information and incentives will have an important role to play if demand is to be reduced.

6.51 We welcome the government's intention to use part of the £50 million fund from the climate change levy to improve energy efficiency advice and give more help to small and medium sized enterprises; these have proved to be the most difficult to influence. **The government should consider introducing to the rest of the UK the energy saving loan schemes which the Energy Saving Trust runs in Northern Ireland and Scotland.** These lend money to small firms at low rates of interest, enabling them to carry out energy efficiency investments with payback periods of up to five years.

Households

6.52 Households' share of UK final energy consumption stands at 29%, higher than the shares of the industrial and service sectors and second only to transport's.[41] Final energy consumption in this sector rose by just under a quarter between 1973 and 1998.[42]

6.53 Over the same period, however, the final energy consumed within the home by the average UK household fell by about a tenth.[43] This fall is mostly attributable to a decline in the average number of people per household, to an increase in insulation and draught proofing as new homes are built and existing dwellings are improved, and to the introduction of more energy efficient heating systems (gas central heating is much more efficient than open coal fires). But this gradual reduction in final energy consumption per household has not been sufficient to outweigh the rapid increase in the number of households. That growth is projected to continue, with an increase of nearly a fifth over the next quarter century.[44]

6.54 Four fifths of this final energy is used to heat rooms and water. The reduction in energy consumption per household brought about by improved insulation and heating systems has been offset by rising electricity consumption as the number of lights and the number and variety of electrical appliances grows. Given the very large amounts of energy wasted in fossil-fuel based electricity generation, the rise in household power consumption adds significantly to UK carbon dioxide emissions. Increasing ownership of freezers and fridge freezers, washing machines, clothes dryers, dishwashers, televisions and computers has been mainly responsible. The quantity and the proportion of total household energy consumption devoted to lighting and running appliances have almost doubled during the past quarter century[45] and households now consume a quarter of all UK electricity.[46]

6.55 A household's total energy consumption depends heavily on levels of insulation and draught proofing and the heating system it uses. The government's Standard Assessment Procedure (SAP) for the energy costs rating of dwellings is now widely used to measure the basic energy efficiency of UK homes (see box 6B) for space heating and hot water.[47] Although the existing housing stock has steadily improved, most of it is still far from having cost-effective levels of insulation.

The potential for reducing energy consumption

6.56 The Commission's consultants considered three recent studies into the technical and economic potential for saving energy in the UK's existing housing stock.[48] These concluded that savings of between 25 and 34% would be made on total current household energy

BOX 6B SAP – ENERGY LABELS FOR HOUSING

A flat or house's SAP rating is based on its estimated annual fuel costs for space and water heating, assuming standard heating patterns and a standard number of occupants. The rating is normalised for floor area so house size does not strongly affect the result (a large house might have higher energy bills than a small one, even though the former was more energy efficient). The rating runs from 1 (extremely poor) to 100 (highly efficient) and while a highly-efficient house would achieve a rating above 100 the practice is to round the score down when this happens. The formula used is:

$$SAP = 115 - 100 \times \log_{10} E$$

where E is the dwelling's estimated annual space and water heating bill divided by its floor area in square metres. This estimate is made by taking account of the insulation levels in a dwelling's windows, walls, roofs and floors, its ventilation rate, the type of heating system and the unit price of the fuel it uses, the amount of solar heating the house will obtain through south facing windows and sheltering by other buildings. A site visit by an energy surveyor lasting about half an hour is needed to gather the necessary data (although it can also be obtained by viewing a building's plans and specifications). This is then followed by a series of calculations – usually made using a computer programme – based on the Building Research Establishment's Domestic Energy Model. A house with a SAP rating of 20 would have heating bills about twice as high as a similar sized dwelling with a 50 rating (slightly over the UK average) and four times as high as one with a 77 rating.

Compliance with the 1995 Building Regulations requires the builder of a property to estimate its rating but not to pass the information to prospective purchasers, although the government intends to amend the regulations to require this. The government's House Condition Surveys in England, Scotland and Northern Ireland now include SAP surveys on a large sample of dwellings. Combining the findings from the three nations, a picture of the energy efficiency of the UK housing stock emerges.

SAP rating	number of homes (millions)	%
0-20	1.8	8
20-39	6.1	27
40-59	11.4	51
60-79	3.1	14
80 plus	0.1	0
	22.5	

Analysis of SAP ratings from these surveys demonstrates that lower income households – those who can least afford to waste energy – live in the most inefficient, hardest to heat property. In all three nations the privately rented sector has a lower rating than owner-occupied, council and housing association homes. There is also a strong correlation between age of housing and SAP ratings with pre-1919 housing (which generally lacks cavity walls) having an average rating of 37. A new gas-heated home conforming to current building regulations would achieve a SAP rating of about 75. This improvement over time reflects successive revisions to the Building Regulations, which have gradually set higher standards of energy efficiency.

consumption if every household employed a range of energy saving equipment and techniques which are already on the market. In these analyses of technical potentials, the bulk of savings would come from improved wall insulation (either fitted to solid masonry walls in older buildings, or within the wall cavities of more modern ones) and from a switch to high efficiency boilers for central heating systems. Smaller reductions would come from the use of more efficient electrical appliances, insulation of lofts and hot water cylinders (many homes have too little of this most basic type of insulation, while a minority still lack any), the replacement of

low efficiency, incandescent lighting with the modern, compact fluorescent type, universal installation of a higher standard of double glazing (with low emissivity glass), improved heating controls and draught proofing. These estimates of technical potential are conservative. They omit the small but not negligible reductions in the sector's overall energy consumption which could be made by installing small CHP power plants in existing blocks of flats (the type of housing where CHP could be most easily and cost-effectively fitted).[49]

6.57 As for the economic potential for saving energy, this depends on the period under consideration. The most favourable time for investing in energy efficiency is when old, worn out equipment and material – such as boilers, appliances and windows – have to be replaced in any case. But the installation of loft, hot water cylinder and cavity wall insulation, compact fluorescent light bulbs and draught proofing of windows and doors is generally cost-effective at any time. The three studies produced estimates for the economic potential of household energy savings ranging from 17% of current consumption in the short term to 34% over 20 to 30 years.

Measures for reducing energy consumption

6.58 We now consider existing government policies, regulation and economic instruments which influence household energy use and levels of investment in domestic energy efficiency.

Household energy prices, taxes and levies

6.59 While energy taxes have been increased on road users and will be on industry and commerce – both justified on environmental grounds – the government has been anxious to exempt households, arguing that to tax them would lead to increases in fuel poverty (6.6). On these grounds it cut VAT on electricity and gas from 8 to 5% in 1997.

6.60 But even setting aside this VAT cut, household electricity, gas and heating oil bills have fallen sharply in the UK in recent years, due to privatisation and market liberalisation at home, reinforced by statutory regulation, and low prices globally (see figure 5-IV). The declared aim of the government and the regulator of the gas and electricity industries is to bring about further price reductions for electricity. Spending on non-transport fuel accounts for only 4% of average household expenditure (while spending on transport fuel amounts to about 5%).[50]

6.61 A growing number of domestic consumers make fixed monthly payments by direct bank debit. Combined with the relatively low cost of fuel, this weakens the price signal and keeps consumers' attention focussed on the price per unit of energy rather than the amount they consume and their options for reducing this total. Changing supplier rather than investing in energy conservation measures has become the obvious way to cut fuel bills. The House of Commons Environmental Audit Committee recently commented that 'falling energy prices appear to send stronger signals than awareness campaigns and seem likely to overwhelm current efforts to promote energy efficiency.'[51]

6.62 A small energy efficiency levy has, however, been imposed on all households. From 1994 they paid £1 extra a year on their electricity bills. The 14 major electricity supply companies (the public electricity suppliers, see box 5A) have been required to use the revenue raised by this levy to finance measures and equipment which increase the efficiency with which electricity is used by households.

6.63 This Energy Efficiency Standards of Performance Scheme (EESOP) has been run by the public electricity suppliers and overseen by the regulator, with support from the Energy Saving Trust. It was the regulator who approved the £1 per customer figure. EESOP was introduced when the UK gas and electricity industries were privatised in order to enhance incentives for energy efficiency improvements by users. After the UK signed the UN's Framework Convention on Climate Change in 1992 the then government wanted to give EESOP a leading role in reducing household sector carbon dioxide emissions. But given the absence of any legislative backing for this role both the electricity and gas regulators resisted; hence the small size of the electricity levy and the absence of one for gas.

6.64 The National Audit Office has shown that EESOP has succeeded in bringing about cost-effective reductions in electricity consumption.[52] The total savings through reduced bills for customers have been considerably higher than the total cost of making the savings. About half of the households that have benefited have been in the low income bracket. The EESOP scheme has been, in effect, a small, hypothecated and broadly redistributive energy tax which very few consumers are aware of; it is not mentioned in their bills.

6.65 The new joint regulator of the gas and electricity industries has now extended this scheme to cover the gas supply industry as well as electricity, and it embraces all but the very smallest suppliers. The new scheme is to run from April 2000 to March 2002 as an interim measure, before new legislation on the regulation of utilities comes into force. The regulator envisages the scheme costing about £75 million a year, financed mainly by an annual charge of £1.20 on all domestic gas and electricity bills. Help with energy efficiency measures will continue to be focussed mainly on disadvantaged consumers who have difficulty paying their fuel bills.[53]

6.66 The government is planning to take over the running of future EESOP schemes, using powers set out in its Utilities Bill. It intends to launch a new scheme to run from 2002 to 2005, achieving about three times the level of annual household energy savings under the regulator's 2000 to 2002 scheme (equivalent to a reduction in carbon dioxide emissions of 0.75 million tonnes of carbon (MtC) a year).[54] This 'EESOP 4' scheme will continue to prioritise low income households. Because most of the savings will be taken up in increased warmth it is likely to achieve only a modest reduction of some 2% in total household energy use.[55] The government acknowledges that much larger annual savings in household energy consumption and carbon dioxide emissions – of the order of 10% – could be made by 2010 'with a substantial net saving for consumers and major financial and health benefits for low income householders in particular.'[56] In its draft Climate Change Programme, it says it intends to work towards these savings, taking into account the experience of the EESOP 4 scheme.

6.67 Electricity and gas suppliers will have an obligation to deliver specified energy savings under EESOP. Each will have to devise and then implement an energy efficiency programme, with the quantity to be saved determined by the regulator (from 2000 to 2002) and then the government (2002 to 2005) based on how many customers each has. If, under such a programme, all energy suppliers are required to deliver energy savings they will almost certainly pass some or all of the costs of achieving these onto their domestic customers. But their customers will have no way of knowing how much of their bills these costs represent. And, unless the programme reaches every household, some customers will pay towards an EESOP but derive no benefit from it.

6.68 We have concerns about the government relying mainly on EESOP-type schemes to deliver the bulk of reductions in energy consumption and carbon dioxide emissions in the household sector. On the plus side, energy suppliers would seek to improve the cost effectiveness of the energy saving investments they are obliged to carry out. They would want each pound they spend to produce the largest possible savings in kilowatt hours. The scheme might also prompt some of them to begin to position themselves as energy services companies, selling warmth and light, rather than as enterprises selling gas and electricity (5.23).

6.69 On the minus side, some of their customers might miss out on the benefits of energy savings even though all are likely to make a contribution to these through increased bills. Customers may, furthermore, be confused and wary when suppliers that had previously been offering them lower prices per unit, and incentives (including Air Miles) to consume more, begin to offer them the means of consuming less energy. A carefully monitored, well-publicised and broadly-based EESOP scheme which enables most gas and electricity customers to benefit can play an important part in reducing households' energy use. But further measures, which we discuss below, will also be necessary.

Improving the efficiency of the existing housing stock

6.70 The replacement rate of old homes by new, more energy-efficient ones in the UK is extremely slow; less than one tenth of 1% of the UK housing stock is demolished each year.[57] This means that there will have to be major improvements to the energy efficiency of the existing stock if household energy consumption is to be reduced. The EESOP schemes aim to deliver such improvements and various advice, promotion and incentive programmes run by the Energy Saving Trust and Environment Departments have also encouraged householders to undertake energy efficiency improvements. Successive government House Condition Surveys reveal a gradual improvement in the energy efficiency of the UK housing stock.[58]

6.71 The largest programme in this sphere is the Home Energy Efficiency Scheme (HEES) and its counterparts in other parts of the UK, which pay for the installation of energy-saving measures in households receiving state benefits because of low incomes or disabilities. Expenditure on HEES is increasing from £75 million in 1999/2000 to £175 million in 2001/02 and the maximum grant per dwelling is being raised from £700 to £1,800 in England for low income pensioner households; enough to cover the cost of installing a central heating system and some insulation. **We recommend that maximum grant levels in other parts of the UK should be raised to those applying under the new HEES in England.** The new HEES scheme will be concentrated on neglected and dilapidated homes in the owner-occupied and privately rented sectors, where most of the UK's fuel poverty is now to be found. The aim is to make 250,000 dwellings a year more warm and comfortable by cutting their energy wastage. We welcome the expansion of HEES and the reduction in fuel poverty it should bring. The scheme will not, however, have a large impact on energy consumption because most of the savings will be taken as extra warmth rather than reduced fuel consumption.

6.72 Improvements in the energy efficiency of low income households, particularly pensioner households, may bring important health benefits which could reduce demands on the National Health Service. There has already been some modest NHS expenditure on schemes which improve the heating and energy efficiency of housing.[59]

6.73 **We recommend that government set up a nationwide scheme which enables medical practitioners who believe their patients' health is being put at risk by fuel poverty to put their names forward for prompt attention under HEES.**

6.74 **We further recommend that government fund epidemiological research aimed at establishing how effective home energy efficiency measures are in terms of improving health and reducing overall health service expenditure.**

6.75 The Home Energy Conservation Act 1995, which originated as a Private Member's Bill but won government support, requires UK local housing authorities to draw up strategies for cost-effectively raising the energy efficiency of private and public sector homes in their area. Authorities have to submit their strategies to the Minister, as well as providing regular progress reports on implementation. The guidance they were given was to aim for a 30% reduction in household energy use by 2011 (34% in Northern Ireland). They were given no substantial new resources to achieve this; instead they were expected to act as facilitators and co-ordinators, encouraging householders and landlords to take advantage of cost-effective conservation measures.

6.76 A recent study indicates that the Act is unlikely to achieve such an improvement.[60] Most local authorities devote less than half of one officer's time to implementing the strategy. Many feel that 30% is an unrealistic target given the current resources available for improvements, and that central government lacks commitment to the Act and the target. The government, for its part, has complained that a quarter of the local authorities' strategies were inadequate and needed modification, that many had misunderstood or ignored their role as facilitators and that progress towards the 30% target was insufficient.

6.77 Local authorities can only have a strong influence on the energy efficiency of the dwellings they own; these constitute a dwindling minority of the total stock. They have little leverage on the privately owned majority. They also have problems in knowing how much energy is consumed by housing in their area – utilities do not provide that information – and therefore in knowing how much progress is being made towards the 30% target.

6.78 Domestic energy prices will need to rise and other incentives for domestic energy efficiency measures will have to be increased if household energy consumption is to be substantially reduced. We discuss the scope for price increases below (6.156-6.159). As for other incentives, we note that the government intends to legislate for 'sellers' packs' – a package of information which all house sellers in England and Wales will be required to make available to potential purchasers, giving them the information required before a final valuation can be established and a firm decision to purchase made.[61] A pilot scheme which has been run in Bristol aimed to include information on SAP ratings (box 6B) and energy efficiency in sellers' packs for 250 vendors. **We recommend that SAP survey findings should be part of information packs provided by sellers to house buyers, together with basic information explaining the SAP and general advice on making energy efficiency improvements.** This requirement would make SAP surveys mandatory at the point of sale. Within a decade of it being introduced a substantial proportion of the housing stock would have an energy label, given current rates of housing turnover. If this labelling began to influence the market value of homes it would lead to a higher take-up of energy efficiency equipment and measures. Home owners would know that an energy saving investment would not only cut their fuel bills immediately but give some lift to the sales price when they came to sell. The UK's high levels of home ownership would add to labelling's overall impact on energy consumption. The demand for new, more energy efficient housing would be stimulated which could, in turn, speed up the rate at which the most energy inefficient stock is upgraded and replaced. But energy labels for homes are unlikely to have much influence against a background of low and falling domestic energy prices.

6.79 **We recommend that purchasers who can demonstrate that they have raised the SAP rating of their property by 20 points should be entitled to a stamp duty rebate (up to a maximum of 1% of the purchase price).** A body such as the Energy Saving Trust could be tasked and resourced to administer this scheme. The purchasers would have to carry out the improvement works within a specified period of purchasing the dwelling, and submit energy surveyor's reports to the trust recording the SAP rating before the purchase and the new, higher rating. A system of audit and inspection run by the trust would prevent fraud.

Higher efficiency in household electricity use

6.80 A minority of homes are heated with electricity, which is expensive compared to gas and produces about two and a half times as much carbon dioxide per unit of heat.[62] So long as most UK electricity is generated by burning fossil fuels, gas is strongly preferable to electricity as a fuel for space and water heating on environmental grounds. (This would, however, change under the scenarios we consider in chapter 9 in which electricity generation is dominated by non-carbon sources.)

6.81 The quantity of electricity consumed by households is rising (6.54). This is mainly because the number of lights and electrical and electronic appliances has grown steadily. It has been estimated that universal use of the most efficient lights and appliances now available would cut domestic electricity consumption by a third.[63] The ordinary incandescent light bulb, little changed in almost a century, still consumes more than 80% of the energy used for lighting in UK homes, even though compact fluorescent lights which use a quarter of the electricity have been mass-marketed for a decade.[64] Although more expensive than incandescent bulbs they last much longer and achieve considerable savings over their lifetime.

6.82 Households should be inclined to buy the more energy efficient appliances and be prepared to pay a higher price for them. But when electricity bills are only a small proportion of most households' budgets and falling, other aspects such as appearance, price and performance assume greater importance. Governments have sought to raise efficiency levels for some products through mandating minimum energy efficiency standards, or negotiating voluntary agreements on standards with manufacturers. Prominent labels which give clear, simple information about a product's energy consumption and its rank order compared with its rivals also encourage consumers to buy more efficient appliances, provided these labels are on display in showrooms and sales staff have had the training required to discuss energy efficiency issues with prospective purchasers.

6.83 The UK's ability to act alone in this field is limited because of the legal requirements for a single European market within the EU. Progress on energy labelling, minimum standards and voluntary agreements with manufacturers has depended on the pace at which agreements can be reached between the EU Member States. So far, minimum standards have been set only for refrigerators and freezers and for oil and gas-fired boilers. Energy labelling has been introduced for refrigerators and freezers, washing machines, dryers and dishwashers; these labels rank each model on a scale from A (most efficient) to G (least). Energy labels for household lights will be introduced in 2001. Voluntary agreements have been reached with manufacturers covering the 'stand-by' power consumption of televisions and video cassette recorders and the removal of the most inefficient washing machines from the European market.

6.84 DETR runs a Market Transformation Programme with a budget of £500,000 a year. This aims to develop a consensus among manufacturers, consumers and government on achieving

improvements in energy efficiency covering both domestic and office appliances and some electrical equipment used by industry, including motors. It has identified a large potential for improvement which could halt the overall rising trend in energy consumption by this spectrum of products.[65]

6.85 To enable this potential to be fulfilled, **we urge the government to take a lead within the EU in pressing for a broader range of household and office appliances to have mandatory energy labels and minimum energy efficiency standards.** Particular attention should be paid to those products which use the most electricity (such as refrigerators) and those with the fastest growing markets (such as computers and digital televisions with integrated decoder receivers). Standards should be set at the level achieved by the best performing appliances, then brought into force a specified number of years later; the process should then be repeated. This is the Japanese 'front runner' concept, which encourages manufacturers to innovate in improving energy efficiency.

6.86 At home, **we urge UK manufacturers and retailers to take a lead in marketing more energy efficient products, and government to encourage them to do so. Government Departments, local authorities, the NHS and government agencies should bulk purchase the more energy efficient products, expanding their market and helping to bring down costs.** The HEES (6.71) and EESOP (6.62-6.69) programmes have an important role to play in this.

6.87 **We recommend that the government consider subsidising some of the most energy efficient appliances;** the concept has already been applied to gas condensing boilers and cavity wall insulation. The subsidies could be funded from the revenues of the climate change levy or the carbon tax which we advocate below. Alternatively, VAT could be reduced to 5% for the highest performing appliances; this would, however, require a change in EU taxation law.

Higher efficiency standards for new housing

6.88 If new homes are constructed with high levels of energy efficiency they will tend to reduce energy consumption, to the extent that they gradually replace existing stock. But only some 10% of the new houses and flats completed in the UK each year replace existing homes; the remainder are additions to the stock. Nonetheless, given the projected increase in the number of UK homes between 1996 and 2021 of more than four million,[66] higher standards for new dwellings could make an important contribution to reducing energy consumption.

6.89 New houses can be designed with fuel saving as a leading objective, built in from the outset. The extra labour costs required to install energy saving equipment are lower than they would be for an existing dwelling because this can be combined with the rest of the construction work.

6.90 There are now ultra-energy efficient homes in the UK whose heating and lighting bills are negligible compared to their conventional counterparts; box 6C describes a current development. Internal spaces are heated by sunshine during the day (a domestic greenhouse effect) while the fabric of the building stores this heat and warms the interior through the night. Such homes have very high levels of insulation on all exterior surfaces. Instead of having radiators in every room, some use one or two small point sources of heat to keep the cold at bay in winter. The body warmth of the occupants and cooking heat also help to keep temperatures up. These houses tend to be well-sealed in winter, in order to retain warmed air. Some have mechanical ventilation systems with heat exchangers to recover warmth from the outgoing stale air.[67]

BOX 6C NEW LOW ENERGY HOUSING

A pioneering development

The construction of the most ambitious low energy housing development in the UK to date began in Sutton, south London, in March 2000 (photograph VI). The 80 town houses, maisonettes, and apartments in the high density, mixed use Beddington Zero Energy Development will be heated mainly by sunlight streaming in through all-glass south facing walls. Additional warmth is provided by the body heat of the occupants and by cooking and electric lighting. Warmth gained during the days will be retained through the nights, due to the large thermal mass of the development (its fabric stores heat) and high levels of insulation. The buildings, which also include offices, are well sealed to prevent cold air leaking in. Ventilation is supplied through large wind cowls on the roofs, which draw in external air. As this cool air flows down ducts into the buildings it is warmed by stale internal air rising up through another duct enclosed within.

The heat for hot water supplies is generated by a small (110 kW) combined heat and power (CHP) station fuelled by wood chips derived from tree prunings from the streets and parks of the neighbouring borough of Croydon. Some of the heat is used to dry the wood chips. Each dwelling's hot water tank is uninsulated, but stowed in a well-insulated cupboard with louvres which can be opened to provide top-up space heating during particularly cold weather, or after the home has been left empty for some time. The electricity from the development's CHP station will be used for lighting and to power domestic and office appliances, all of which will meet high energy efficiency standards. Surplus electricity can be exported to the grid and power can also be imported when the CHP station is shut down or unable to meet peak loads.

The housing is being laid out on the site of an old sewage works, in seven parallel terraces running east west. The homes will be on the south facing, sunnier side with office accommodation on the north. The intention is to reduce the heating requirements to 10% of those of a conventional home; they would achieve a SAP rating (see box 6B) of well above 100. The office spaces, which also have high insulation and thermal mass and a passive ventilation system, will be kept at a comfortable temperature year round by exploiting the body warmth of the workers and the heat leakage from computers and other electrical equipment.

The transport-related carbon dioxide emissions associated with the BedZED should be considerably reduced compared to a conventional housing development of the same size. It is close to a station, a new tram line and four bus routes. It is hoped that some residents will work from home, or at the offices within the development. The developers plan to set up a car pool which will have several electrically powered vehicles, to be charged by photovoltaic panels on the roofs. Residents who keep a car on the site will pay a parking charge.

Despite this being a high density development, every dwelling will have its own garden (many of which will be roof gardens). The great majority of homes will be for sale on long leaseholds but at least 15% will be reserved for social housing. 300 potential purchasers had already expressed an interest before construction began. The BedZED is being developed by the Peabody Trust, one of Britain's oldest and largest housing associations, with architect Bill Dunster and a locally based environmental enterprise group, Bioregional.

A more conventional approach

Located two miles from the site of the BedZED, an ordinary looking home built by a volume housebuilder in Cheam, Sutton, uses about 40% less energy than the typical new dwelling built to the energy efficiency standards of the 1995 building regulations and of equivalent size. The former has a SAP rating of 100; the latter would achieve about 75. One of the three storey, 110 square metre town house's most important energy saving features is that it is part of a terrace; this substantially reduces heat losses through the walls. The 75 mm gap between the outer brick and inner masonry blocks is slightly wider than the industry norm and this cavity is filled with blown mineral fibre. There is also a layer of under-floor insulation. Space heating and hot water are provided by a high efficiency gas condensing boiler. The remainder of the three bedroom house's energy saving features, such as double glazing and loft insulation, are typical of all new homes. The company estimates that the extra energy saving features added £216 to the total construction costs.[68]

6.91 But levels of energy efficiency performance in the vast majority of new housing are determined chiefly by the Building Regulations. Revisions to these have gradually raised the standards of new housing over the past three decades. These regulations, which also affect commercial and public sector buildings and were being reviewed at the time of completing this report (6.43), have a central role to play in reducing UK carbon dioxide emissions.

6.92 The introduction of new regulations is preceded by lengthy discussions with the house building industry, landlords and others with an interest; this is a statutory requirement. House builders have, to date, resisted innovative energy conservation requirements that would achieve substantial gains in the energy efficiency in new housing. They have argued that these would push costs too high and that the introduction of any new technology in construction brings a risk of defects emerging a few years later on. The house building industry is reluctant to install insulation in the air gap within cavity walls, one of the most obvious and cost-effective energy conservation measures, in the more rainy and windswept areas of the UK because of problems with rain penetrating and being carried through to the inner wall. We believe that the house building industry should see this as a problem to be solved rather than an inescapable obstacle.

6.93 The latest, 1995 version of the regulations are meant to achieve a cost-effective level of energy conservation, with the extra expenditure on construction being covered by reduced fuel bills. Compared to the previous version, the 1995 regulations were estimated to reduce the energy consumption of a typical new house by 25% to 35%, worth £130 to £180 a year in savings to the householder, while imposing only an extra £675 to £1,350 (1.5% to 3%) on its construction costs.[69]

6.94 The government has estimated that a 26% reduction in the energy consumption of new detached and semi-detached homes could be achieved with further energy efficiency improvements beyond the 1995 Building Regulations level which added £1,200 to £1,300 to average construction costs per house.[70] This would imply a reduction in annual fuel bills of about £130; thus even with the current low level of domestic energy prices, major reductions in energy consumption are cost-effective, or close to being cost-effective. New regulations could deliver further, substantial gains in energy efficiency for new homes with only moderate increases in construction costs. Some of the modifications needed to conventional building practice have been discussed above (6.56-6.57). Others include more floor insulation and a wider cavity within the external walls allowing more insulation to be installed.

6.95 Building regulations in Scandinavian nations, the Netherlands and Canada have long set standards for energy conservation in new housing well in advance of those applying in the UK. We received evidence from the Royal Institute of British Architects indicating that a house built to the existing English and Welsh building regulations in 1993 would consume about four times as much energy for space heating as an identically sized house built to the then current Swedish regulations, and twice as much as one built to the Danish regulations.[71] These comparisons were made on the basis that the houses were exposed to the same climate. English and Welsh energy efficiency standards have been lifted since, but nowhere near enough to close the gaps.

6.96 The main objection raised by UK house builders to a substantial uprating of energy efficiency requirements is that it would require them to adopt alternative construction techniques. To achieve the necessary levels of insulation without resorting to extremely thick walls, they might have to abandon the traditional double masonry layer and move to timber or

steel frame construction and single masonry layers instead. Some companies are wary about using timber frame construction after defects emerged in new homes built on this principle some years ago. However, almost half of new dwellings in Scotland are timber framed. The house building industry fears such major changes would prove unpopular with purchasers and might lead to problems emerging after the building has been completed and sold. The fact that it has to sell its products in competition with an enormous second hand market of conventional homes increases its resistance to innovation.

6.97 These arguments are tantamount to saying that UK households wish to be permanently disadvantaged in comparison to those of other north west European countries. **We recommend that government revise the Building Regulations to mandate much higher standards of energy efficiency in new homes and commercial and public sector buildings. For new housing Regulations that deliver a SAP 80 rating should be introduced forthwith. We further recommend that government announce its intention to move to a higher standard, based on achieving a SAP 100 rating, by 2005. We also recommend that the practice cease of rounding down very high SAP ratings to 100, in that a growing number of homes can exceed that level, or that the SAP formula be revised to take higher standards better into account.** A 100 rating would cut the energy consumption of new homes by a further third compared to a SAP 80 standard. The five year delay would allow the house building industry time to research and develop the most cost-effective and reliable ways for achieving the new standard.

6.98 The government intends to consult on a proposed new energy efficiency index for housing which would be used by builders as a basis for compliance with the regulations. This would be based on the overall carbon dioxide emissions associated with a building's energy consumption rather than its space and water heating costs. It would be similar to SAP and, in the great majority of cases, it would make only a small difference to a house's rating relative to other dwellings. **We support the introduction of a new energy efficiency index for housing based on carbon dioxide emissions and urge government to make this change as quickly as possible. But there is a strong case for retaining a rating based on energy costs when homes are sold because prospective purchasers wish to know about likely energy bills.** Government intends to retain the requirement for builders to calculate SAP for new homes, for the purposes of informing prospective purchasers.

6.99 The drive for much higher energy efficiency standards in housing will depend largely on improvements in insulation, draughtproofing and ventilation systems. But housebuilders should also be encouraged to install equipment for reducing fossil fuel use which, although fairly novel in the UK, is widely used elsewhere and could be as cost-effective as insulation improvements once a market was established. Subsidies, financed by the taxation measures we discuss below, could play a part in this. Sales of high efficiency gas condensing boilers have been boosted by Energy Saving Trust grants to individual owner occupiers.

6.100 Looking further ahead, **the UK government and devolved administrations should launch a long-term programme to bring about major reductions in the energy requirements of buildings. As well as reducing wastage, this will embrace wide use of technologies that enable occupiers of buildings, including householders, to obtain their own heat and electricity from renewable or energy-efficient sources such as solar heating, solar electricity, heat pumps and small-scale combined heat and power plants.[72] An integrated approach to heat management should become a central feature of the design of all new houses and other buildings, and should be applied to existing buildings wherever**

practicable, and building control legislation and the Building Regulations should be amended to bring that about. Also of great importance will be heat distribution networks, which we discuss further in chapter 8.

6.101 **We recommend that government investigate the carbon-saving potential and cost-effectiveness of heat pumps and solar water heating at the level of individual homes and larger buildings, with a view to devising subsidy arrangements, both for existing and new buildings, should the findings prove favourable. We further recommend that government provide greater incentives for the installation of small-scale CHP plants in existing and new blocks of flats.**

6.102 **The UK government and devolved administrations should examine the institutional, economic and social barriers to the large-scale growth of heat networks; consider, in conjunction with plant manufacturers, heat consumers and potential investors, what incentives could overcome such barriers; and support demonstration schemes.**

6.103 Intense debate surrounds the questions of how many new dwellings are required in the UK to provide for the underlying increase in the number of households, what form the new housing should take and what proportion should be accommodated within existing urban areas. A shift towards higher densities in new housing areas, with workplaces, shops, schools and other facilities provided as close to people's homes as possible, has been widely advocated and the government now wishes to see compact, mixed use development along these lines.[73] Whether this takes the form of new urban quarters built on brownfield sites within towns and cities, or urban extensions on their edge, this type of development offers scope for reducing households' energy use.

6.104 This comes partly from reducing the demand to travel, especially by car. Compact urban forms offer more facilities within walking and cycling range of homes and public transport services (which are, overall, considerably more energy efficient per person kilometre than cars) are likely to be more frequent and comprehensive in densely populated areas. But there is no certainty that simply raising density reduces travel demand, as was pointed out in the 18th Report.[74] Other factors, including the quality of public transport, the degree of restraint on car use and previous trends in land use, come into play.

6.105 There are other reasons why new, more compact neighbourhoods could consume considerably less energy than conventional post-war development. Homes which share walls share warmth. The building form can be used to create wind shields and microclimates which reduce the space heating requirement. Heat distribution networks become more economically viable as density rises; shorter lengths of pipe are needed, which reduces initial capital costs and heat losses. The priority should be to install heat networks in urban extensions and major brownfield sites which are being redeveloped.

6.106 **We endorse the impetus to higher densities and greater use of urban brownfield sites given in England by the revised Planning Policy Guidance on housing, and urge the devolved administrations to adopt similar policies.** A reduction in carbon dioxide emissions is one of the benefits that could flow from this change in direction.

Transport

6.107 The transport sector's final energy consumption rose by two-thirds between 1973 and 1998.[75] Its share of total UK final energy consumption grew from 21% to 34% over that period. These increases were largely due to rising volumes of road traffic which now accounts for 77% of the transport sector's energy use.[76]

6.108 During the recession of the early 1990s the growth in traffic volumes and in the sector's energy consumption halted briefly. Between 1992 and 1998, however, road traffic (in vehicle kilometres) increased by 11% while transport's annual energy consumption rose by 9%.[77, 78] Its share of UK carbon dioxide emissions rose from 22% to 24% between 1992 and 1998.[79]

6.109 These are worrying trends. In its 18th Report in 1994 the Commission argued that a change of direction and a new strategy were needed in order to avert the rising economic, social and environmental damage arising from the rapid growth in road traffic and to achieve sustainable development of the transport system. The Commission was particularly concerned with transport's fast growing contribution to UK carbon dioxide emissions. There are now a few hopeful signs. The growth in road traffic is slower than during previous periods of strong economic growth, and the number of railway passengers has grown rapidly since 1995, indicating that some drivers are switching from road to rail.[80] The government has published an important White Paper on transport policy[81] and, at the end of 1999, introduced a Bill in Parliament. However, the change in direction which the Commission believed was imperative has not yet taken place.

The potential for reducing energy consumption

6.110 Making estimates of the technical and economic potential for reducing this sector's energy use is particularly difficult because of the very broad scope for improvements in efficiency. Potentially cost-effective measures include raising the fuel efficiency of vehicles, reducing road congestion and motorway speed limits, sharing cars (car pooling) for the journey to work and reducing car use by making more use of alternative modes including public transport. Further contributions can come from telecommuting and tele-conferencing, reorganising distribution systems to reduce the empty running of freight vehicles and changing planning rules and guidelines to encourage more mixed-use, compact developments which reduce the need for travel (6.103-6.106).

6.111 The Commission's consultants estimated that, if the technical potential for reducing transport's energy consumption was fulfilled, the sector's demand in 2010 would be 28% lower than it was in 1996.[82] If the economic potential was fulfilled, energy demand in 2010 would be between 22% lower and 14% *higher* than the 1996 level. These estimates assumed that, under a business as usual scenario, transport's energy consumption would rise by 35% between 1996 and 2010. DTI's latest projection is that transport's energy consumption will rise by 28% over this period under a business as usual scenario, while carbon dioxide emissions from road transport would rise by 18%.[83]

6.112 DETR has recently published projections for road traffic volumes, congestion and carbon dioxide emissions in England in 2010[84] which are in contrast to DTI's. They are based on implementing, with varying degrees of intensity, measures set out in the 1998 Transport White Paper.[85] These illustrative scenarios range from modest and partial implementation of the policy options to widespread implementation, strong disincentives to private car use and much higher investment in public transport and other alternatives to the car. The scenarios project that overall road traffic volumes will increase by 16-29% between 1996 and 2010; none of them

projects a decrease. All of them, however, project a decrease in annual carbon dioxide emissions from road vehicles, ranging from 1-10%. This divergence between the forecast growth in road traffic and the reduction in overall emissions is largely due to the expected major reduction in the fuel consumption of new cars which the European Commission has negotiated with manufacturers (6.123-6.124).

Measures for reducing energy consumption

6.113 In addition to the measures mentioned above, the transport sector's energy consumption can be influenced by the price of road fuels and the price of travel by public transport. The latter has been rising more rapidly than private motoring costs.[86] Improvements in the reliability, frequency and quality of public transport (cleanliness, better information systems, higher comfort and speed) can be important in persuading people to prefer it to their own cars. But relative cost is also a factor.

Taxation on vehicles, fuel, road use and workplace car parking

6.114 Successive governments have used annual, pre-announced increases in motor fuel duty – the fuel duty escalator – in order to encourage the development, marketing and purchasing of more fuel-efficient vehicles. This policy, introduced by the previous administration in 1993, was intended to let motorists and vehicle manufacturers know that the pump price of road fuel (the final price on petrol station forecourts) would continue to rise by well above the rate of inflation until at least the year 2000. The escalator started at 3% a year, rose after just one year to 5% and, after the change of administration in 1997, was steepened to 6% a year. Surveys of recent estimates of price elasticity suggest that in the long run (5 to 10 years), each 10% increase in fuel price causes a reduction in overall vehicle fuel consumption of about 6%.[87]

6.115 But the increases in duty have been offset, to some extent, by falls in the underlying price of crude oil and refinery products. After adjusting for general inflation, the pump price of diesel and petrol rose by some 20% between 1994 and 1999 while duty rose by more than 30%.[88] For most of this period there has been no detectable reduction in the overall fuel consumption of cars sold in Britain[89] and sales of high fuel consumption vehicles, especially 'all-terrain' four wheel drive cars, have been rising. Improvements in the energy efficiency of car engines and drive trains have been offset by increases in vehicle weights (as manufacturers install more safety and accessory equipment, such as air conditioning) and consumers' preference for larger models.

6.116 The Society of Motor Manufacturers and Traders has reported that the carbon dioxide emissions of the average new car sold in the UK in 1999 were 2.2% lower than in 1998 (following a 0.9% reduction over the previous year). It has said that the new car market is shifting towards smaller, more fuel-efficient vehicles. This trend is welcome, but the rate is not sufficient to achieve the very large reductions in new car emissions which manufacturers have agreed with the European Commission.

6.117 Recent increases in underlying fuel prices, combined with the steepened escalator, have led to a particularly sharp increase in pump prices and much criticism of the policy, particularly from the road freight industry which feared it would lose business to continental competitors. In November 1999 the Chancellor of the Exchequer announced that the escalator would end with immediate effect, and that future increases in fuel duty would be determined on a Budget

by Budget basis. These will be less than 6% (after inflation adjusted duty increases are taken into account) and the revenue raised will go into a dedicated fund for improving public transport and modernising the road network.[90] The Budget in March 2000 increased fuel duty only in line with inflation. Before this change of policy, DETR had been projecting that continuing the fuel duty escalator up to 2002 would have reduced transport's annual energy consumption by some 5 to 12% by 2010, compared to what it would have been in the absence of these price increases.[91]

6.118 Government has introduced legislation which would enable local authorities to set up local road pricing schemes and workplace parking charges. Such schemes would be part of the new local transport plans (local transport strategies in Scotland). Under these, local authorities introduce packages of measures to improve transport and reduce congestion, including improvements to bus services, traffic management and walking and cycling facilities. The new charges are intended to reduce local road traffic (by raising the price of car travel) and to raise revenues which would fund local transport improvements, including alternatives to car use.

6.119 The government's draft Climate Change Programme includes a reduction in carbon dioxide emissions of up to 3.3 MtC a year below 'business as usual' levels in 2010, based on implementing integrated transport policies set out in the Transport White Paper. This reduction would be achieved by the most intensive application of policies envisaged in DETR's scenarios. Every urban local authority would have to introduce road pricing (cordon toll systems) and/or workplace car parking charges at the top end of the price range envisaged in these scenarios. There would also be tolls on the most congested 4% (by length) of inter-urban motorways and A roads accompanied by the construction of extra lanes on these roads. The real cost of fuel duty would rise by 19% between 1999 and 2010. There would also be a large increase in rail freight, a significant transfer of road freight to coastal shipping and a large transfer of drivers and passengers from cars to rail.[92]

6.120 If, however, only the lowest intensity implementation of policies envisaged in DETR's scenarios was applied, in which only 11 large urban areas introduced congestion charging, the reduction in annual carbon dioxide emissions would be 0.6 MtC.[93] Given the slow pace of implementation to date, this latter scenario seems by far the more likely of the two.

6.121 **If these new charging schemes are to be introduced on a scale that can make a significant national contribution to reducing transport's rising carbon dioxide emissions, local authorities which are considering implementing them will need sustained political and financial support from the UK government and devolved administrations. Progress will also depend on adequate government support for other aspects of local transport plans.**

6.122 The government has reduced vehicle excise duty (VED) for cars with smaller engines which generally produce less carbon dioxide per kilometre in the hope that some purchasers will switch from larger vehicles. It intends to introduce a graduated VED system for new cars, in which vehicles will be placed in one of four VED rate bands according to their carbon dioxide emissions per kilometre; owners of the highest emission vehicles will pay the highest rate. We welcome this decision, but **we urge a wide differential in VED between the highest and lowest bands and an increase in the number of bands or a sliding scale. We endorse the House of Commons Environment, Transport and Regional Affairs Committee's proposal for a revenue-neutral graduated purchase tax on new cars, with subsidy for low emission vehicles financed by tax on high emission vehicles.**[94]

Negotiated agreements with manufacturers

6.123 In 1998 the European Commission reached agreement with ACEA, the European Automobile Manufacturers Association, to reduce the average fuel consumption of new cars sold in the European Union by 25% between 1995 and 2008. This is expected to be achieved by selling a greater proportion of smaller cars and by improvements in technology, with an emphasis on diesel engines and direct injection petrol engines. The European Commission has now concluded similar agreements with Japanese and Korean car manufacturers. The UK government maintains that these agreements, together with the graduated VED (6.122) and proposed reforms to company car taxation, will make one of the largest contributions to the UK's programme for reducing carbon dioxide emissions. It estimates they will achieve a 4MtC reduction in annual emissions by 2010 (2.6% of total UK emissions in 1997).[95] **It is crucial that manufacturers comply with the agreements negotiated with the European Commission on reducing carbon dioxide emissions from new cars; and that, if they do not, mandatory standards are introduced rapidly.**

6.124 The European Union has a further target for a 35% reduction in the average fuel consumption of new cars by 2005, and by 2010 at the latest, compared to a 1995 baseline. This would be achieved not only through the agreements with manufacturers referred to above, but through giving car purchasers more information about the relative fuel economy of cars and by fiscal incentives.

THE 18TH REPORT AND ITS AFTERMATH

6.125 The Commission's 18th Report recommended a comprehensive package of measures which addressed the profound social, economic and environmental problems posed by current transport trends. The 20th Report considered progress since 1994 and made further proposals. The key objectives and recommendations are summarised in box 6D.

6.126 **We welcome the Transport White Paper, which adopted policies in line with much of the Commission's thinking.[96] But we continue to be disappointed at the slow progress in implementing the measures required and the delay in introducing the necessary legislation.**

6.127 The 18th Report recommended that the real price of road transport fuels should be doubled by 2005 through increases in duty. The Commission believed that the then current levels of taxation on motor fuels were below the level warranted by the external effects of noise, accidents, air pollution, congestion and global warming. Increases in fuel duty are especially important as an incentive to reducing fuel use; the Commission regarded it as essential that the intention to raise the price of fuel substantially over a period should be signalled in advance to give manufacturers and consumers an incentive to manufacture, market and purchase more fuel efficient vehicles. The Commission further suggested that much of the revenue raised by the increases should be spent on a package of measures which gave people improved alternatives to car use, especially public transport. We regret that the operation of the fuel duty escalator to date appears to have had little success in raising fuel efficiencies; with large increases in duty being partially offset by falls in the pre-tax price of oil. **We particularly regret that successive governments have not devoted more of the revenues from the fuel duty escalator to improving alternatives to car use. We welcome the recent increases in investment in public transport and hope these will be further enhanced.**

6.128 Now that the fuel duty escalator has been abandoned, or greatly scaled down, **we urge the government to do all it can through the EU to ensure further substantial reductions in carbon dioxide emissions from vehicles for the period beyond 2008.**

BOX 6D REDUCING CARBON DIOXIDE EMISSIONS FROM TRANSPORT

The Commission's 18th report, published in 1994, called for a fundamentally different approach to transport policy based on eight objectives, four of which had a direct bearing on reducing the quantities of energy used in transport. These were:

1) To ensure that an effective transport policy at all levels of government is integrated with land use policy and gives priority to minimising the need for transport and increasing the proportion of trips made by environmentally less damaging modes.

2) To increase the proportion of personal travel and freight transport by environmentally less damaging modes and to make the best use of existing infrastructure.

3) To reduce carbon dioxide emissions from transport.

4) To reduce substantially the demands which transport infrastructure and the vehicle industry place on non-renewable materials.

The report set out targets for moving towards these objectives, and recommendations for the measures required. Together these amounted to a programme which could slow the increase in passenger and freight travel by all modes to 10% a decade while stabilising road traffic at current levels. Targets for reducing annual carbon dioxide emissions from surface transport by 20% from their 1990 level by 2020 and for increasing the average fuel efficiency of new cars sold by 40% between 1990 and 2005 were proposed. A doubling of the real price of road fuel by 2005 through fuel duty increases and a steeply graduated annual excise duty on cars, based on their fuel efficiency, were also proposed to stimulate the development, marketing and purchase of more fuel-efficient vehicles.

The Commission called for major improvements in the quality, reliability and frequency of public transport services between and within towns and cities in order to give car users an alternative to private vehicles. To achieve this large increases in investment in public transport and in revenue expenditure would be necessary; up to £1 billion a year more on investment at 1994/95 prices and up to £2 billion a year on revenue. The Commission believed much of these increases would need to be financed by public expenditure and noted that by 2000 the additional revenue raised by the fuel duty increases it advocated 'would comfortably exceed the additional requirements for public expenditure identified in this report'. It also recommended that if road-pricing schemes were introduced for motorways and urban areas then the surplus revenue once the installation and running costs had been covered should be spent on increasing the attractiveness of alternatives to the car.

The Commission proposed a target for raising the proportion of personal travel which used public transport from 12% of total person kilometres in 1993 to 30% by 2020 while the proportion of urban journeys made by bicycle should increase from 2.5% to 10% by 2005. The 18th report also proposed targets for shifting substantial proportions of freight from road to rail and water. For air travel, the Commission recognised that the UK had little scope for unilateral action. It urged the government to negotiate within the European Union, and more widely, for an aviation fuel levy that would reflect the environmental damage caused by air transport.

Three years later the Commission returned to the subject, devoting its 20th report to developments since 1994. This found that, although there were signs of hope, the fundamental change in policies advocated in the 18th report had not occurred. Nor were there any signs of large changes in previous trends that had been pointing towards an unsustainable transport system – rapidly rising road traffic levels, declining patronage of public transport and freight shifting from rail and water onto roads. The 20th report stressed the need for an integrated transport system covering all modes and for transport policies to be closely linked to other relevant policy areas, especially land use planning.

Aviation and shipping

6.129 Ships and aircraft make a large contribution to rising greenhouse gas emissions. Aircraft manufacturers have steadily improved the fuel efficiency of their products over the years, and the newest large passenger aircraft consume only one third as much kerosene per passenger kilometre as those built 40 years earlier. But the rapid growth in global passenger air travel – currently some 5% a year – has outweighed this technological improvement.[97] Aircraft greenhouse gas emissions are projected to increase by some 3% a year between 1990 and 2015. Aviation's share of total anthropogenic carbon dioxide emissions is about 2%, and rising. IPCC has projected that, in the absence of policy interventions designed to limit this growth, the total radiative forcing (or warming effect) due to aircraft will increase about fivefold between 1992 and 2050.

6.130 Because aviation and shipping movements are predominantly international it is extremely difficult for the UK or the European Union to act unilaterally in restraining the growth in the emissions. There is a case for internationally harmonised climate change taxes on aviation and shipping fuel, but to date there has been no serious attempt to negotiate one. Air passenger duty has been introduced in the UK in recent years, justified largely on environmental grounds. At the March 2000 Budget the Chancellor announced a halving of this tax for economy flights from the UK within Europe. This will substantially reduce the UK's overall tax take from air passenger duty, and we regard it as a retrograde step which sends entirely the wrong price signal.

6.131 **The government should press for an international tax on aircraft fuel while maintaining or increasing its own taxes on aviation. If, as seems likely, global agreement proves impossible in the current decade, then the government should use its best efforts to secure an OECD aviation fuel tax or, if that also proves impossible, a harmonised climate change levy on landing fees. Either of these could be applied solely within the European Union if a wider agreement cannot be negotiated.** The revenues raised by such taxes would be distributed among national governments for them to spend as they saw fit, but a proportion of these might go into a collaborative fund which supported international projects addressing the threat of climate change.

Combining the potential for reducing energy use from all four sectors

6.132 Combining the economic potentials for saving energy in the four sectors discussed above provides an estimate of the UK's overall potential for cost-effective savings in final energy consumption in the short to medium term. The projections are set out in table 6.1 below. This suggests that by 2010 the UK's final energy consumption could be 2-15% lower than the 1998 figure if households, manufacturing industry, the transport sector and public and commercial services undertook those energy conservation measures that would save them money. In contrast, the government's most recently published 'business as usual' forecast projected growth in final energy consumption of 8-23% over this period.[98]

6.133 We conclude that UK final energy consumption could be reduced over the coming decade without any impact on competitiveness and with a strong benefit to the economy and living standards. Many other 'bottom up' analyses of the potential for energy conservation, carried out in the UK and other nations, have reached the same conclusion.[103]

6.134 These broad findings have changed little with the passing of time. After 10 or 20 years, a fresh analysis of a sector will generally find that there remains ample scope for cost-effective

Table 6.1

The scope for reducing UK final energy consumption

Sector	Final energy consumption rate in 1998 (actual), GW	Projected energy consumption rate in 2010 (business as usual), GW	Projected energy consumption rate in 2010 if economic potential for efficiency gains fulfilled, GW	% change, 1998 to 2010 – business as usual	% change, 1998 to 2010 – economic potential fulfilled
Domestic[99]	61.1	61	52	0	-15
Manufacturing[100]	46.4	51	44	+10	-6
Transport[101]	71.1	86	54-80	+21	-23 to +12
Services[102]	28.8	32	27	+11	-5
Total	207.4	230	177-203	+11	-15 to -2

energy saving measures – even though many such measures have already been undertaken during the intervening years. It has been commented that: 'It seems a curious feature of energy efficiency studies that they seem regularly to identify cost-effective potentials of around 20-30% of current demand, almost irrespective of the potential already exploited.'[104]

6.135 There is little mystery about this. As existing energy saving technologies are adopted, new ones are continuously being developed. In absolute terms the scope for savings will decline; a vehicle must consume some energy in order to move and a house will consume some energy in winter in order to maintain comfortable warmth. But the large, current potential for savings, and the fact that the most energy-efficient products are so far ahead of the rest of the field, suggests that demand reductions could continue for many decades to come.

6.136 Some analysts believe that a range of emerging or vigorously developing technologies, notably microelectronics, biotechnology and nanotechnology, could allow much more rapid gains in the efficiencies with which we exploit natural resources and energy in the 21st century than have occurred in the 20th. They envisage these advances leading to enormous reductions in the flows of materials and energy required to provide goods and services. They argue that companies will need to take advantage of these improvements in resource efficiency in order to remain competitive. Reductions in wastage will come about through changing the products and services on offer and through changing the ways they are made or delivered. Services, especially those related to information, will take an ever growing share of the global economy relative to manufacturing.

6.137 Proponents of these 'Factor Four' and 'Factor Ten' reductions in the natural resources required to produce each unit of output emphasise that a single efficiency improvement in a process or machine can permit further improvements, which can in turn allow yet more.[105] The example often cited is the car. Only one-fifth of the energy content of the fuel burnt in a conventional car's cylinders is actually used to propel the vehicle – the remainder is wasted. The engine's maximum power output is also much higher than the vehicle requires for most of the time it is running, in order for it to be able to accelerate and climb hills; the engine is heavier as a

result. Once ways are found of making the car much lighter and of reducing its aerodynamic drag, the engine's power capacity and weight can be reduced which, in turn, allows further reductions in power capacity and weight.[106]

6.138 The demand for travel – one of the main drivers of rising energy consumption – may itself be reduced by technological progress. Major advances in the quality of private, real-time transmission of images and sound, and large cost reductions, can be expected in the next decade. These improvements may give much greater scope for conducting virtual meetings between two or more people without them having to travel to a meeting place. But while the need to travel for work purposes may be reduced, there is no reason to believe that the trend for people to travel more for pleasure as economies grow will be reversed.

6.139 There will continue to be very large gains in energy and resource efficiency but *on current trends* we find no reason to believe that these improvements can counteract the tendency for energy consumption to grow. Even if energy consumed per unit of output were reduced by three-quarters or 'Factor Four', half a century of economic growth at 3% a year (slightly less than the global trend for the past quarter century) would more than quadruple output, leaving overall energy consumption unchanged.

6.140 There are significant barriers to progress in improving energy efficiency. Individuals, businesses and public services routinely fail to use available equipment and known procedures which are blatantly cost-effective – they would pay back the initial investment through energy savings in five years or less. People leave lights burning in empty rooms and overfill electric kettles. Companies struggling to make profits in highly competitive market places miss obvious opportunities to make savings.

6.141 There is no reason to believe that people are more wasteful of energy than they are of any other abundant, relatively cheap commodity. But, for many, economising is a boring, even a depressing subject with penny-pinching and miserly associations. Our culture encourages consumption and expenditure, not thrift. Those who would promote the conservation cause need to be aware of these negative associations.

6.142 Among the barriers to energy efficiency improvements is a lack of information. Individuals and businesses are often unaware of how much energy they are wasting and the extent to which they could cost-effectively reduce this. Gathering and processing information takes time and effort; individuals and firms lack the motivation to do this. They may not know whom to turn to for trustworthy, independent advice.

6.143 Many business decision-makers and households demand much higher rates of return for investments made to cut costs than they do for investments which increase income. Energy conservation investments generally have to pay back their costs through savings within three to five years if they are to be justified. It is difficult to explain this preference, but it acts as a high barrier to energy efficiency improvements.

6.144 Capital may be lacking. In theory, low income households ought to be strongly motivated to conserve energy, for they spend a large proportion of their incomes on fuel. And they often end up paying more per unit of energy than better off consumers because they are unable to pay bills by bank direct debit (and thereby obtain a discount) or are compelled to use prepayment meters. As we have seen, they also tend to live in more dilapidated and less energy efficient housing (box 6B). Thus energy saving would be highly cost-effective for poor households, but they lack the savings and the ability to borrow which are required to make worthwhile energy conserving investments.

6.145 They also face a further hurdle if they rent from private sector landlords with little interest in making investments on their tenants' behalf. The tenure with the highest proportion of households suffering from fuel poverty is private renting.[107] We noted above (6.45-6.47) that the 'landlord tenant' problem is also an important factor in the services sector.

6.146 In the 20th century, the outcome of the interaction between these various barriers to, and drivers of, energy efficiency improvements, set against a background of growth in output, population, and household numbers, was a long-run growth in energy consumption. The UK's population is expected to stabilise in the next few decades; this will improve the prospects for halting the rise in energy consumption. Latest government projections suggest some slowing down in the rapid growth in the number of households.[108]

6.147 The question is whether shifts in public attitudes and government policy could accelerate the rate of improvement in energy efficiency so that energy consumption will stabilise and then begin to fall. The current trends (6.139) would have to change, the barriers to energy efficiency improvements be lowered. The scenarios for energy supply and demand for 2050 which we discuss in chapter 9 demonstrate that a gradual reduction in UK final energy consumption could make a crucial contribution to major, long-term reductions in UK carbon dioxide emissions over the next half century. Indeed, it is very difficult to see how the UK could make the emission cuts necessitated by a contraction and convergence approach and a 550 ppmv upper limit for atmospheric carbon dioxide concentration (see table 4.1) without reducing its overall energy use.

6.148 We now consider policies which could help to overcome some of the barriers discussed above and deliver such a reduction in energy use.

General measures for reducing energy use

Economic instruments

6.149 Economic analysis suggests that one way of dealing with the situation in which the use of any fuel causes pollution or other environmental degradation is to levy a corrective tax on it. Its users would thus be charged an amount that reflects the costs they impose on others, as externalities.

6.150 Several problems arise with this approach to 'making the polluter pay'. First, credible estimates of the damage caused by fuel cycles are extremely difficult to make because of the wide range of impacts on buildings, ecosystems, landscapes, human health and longevity, and problems in measuring the size of these impacts. Assessments of the damage caused by the climate change resulting from human activities are more problematic still (4.22-4.27). Deciding the level of an appropriate corrective tax is thus not an easy matter, just as deciding appropriate targets for emission reductions is difficult.

6.151 Second, such a tax could also cause energy-intensive UK-based industries to lose markets to rivals based in environmentally less friendly nations where the fuel tax is lower or non-existent. Such industries might contract as a result, or investment in these industries might be diverted to other nations; in the latter case there would be no overall reduction in carbon dioxide emissions, and possibly even an increase.

6.152 Third, such a tax is likely to impinge differentially on people of different means. Some of the things people use fuel for, such as heating the home, are necessities on which they spend relatively little more as they become wealthier and many poorer households occupy poorly insulated, inefficiently heated property which is relatively expensive to keep warm (box 6B). Thus some form of compensation, whether by raising their net incomes or, preferably, improving the relevant features of their homes, has to be a first charge on the revenues generated by the tax.

6.153 A similar argument can be applied to industries whose competitiveness in international markets would come under threat as a result of a fuel tax. It may be possible to use the tax revenue to limit the effect on competitiveness, for instance by cutting employers' National Insurance Contributions (NICs), as the government proposes with the climate change levy. Whether such compensation should apply to a relatively narrow group of industries, for instance by cutting NICs more for industries which are more intensive users of the fuel in question, or more widely, possibly at the level of the whole economy, involves difficult judgements.

6.154 In its 21st Report the Commission concluded (paragraphs 6.56-6.59) that economic instruments such as corrective taxes on particular fuels should be used in conjunction with other instruments. In the present context other instruments deployed would include, as a means towards democratically determined ends, regulation, the training of house builders, advice to fuel users, incentives for raising energy efficiency, the setting of targets, monitoring of performance and research and development of energy-saving technologies.

A CARBON TAX AS PART OF A PACKAGE OF MEASURES

6.155 We believe such a combination of policies and instruments, including taxation, could reduce the UK's primary and final energy consumption in the medium to long term without damaging competitiveness or inflicting hardship.

6.156 We have noted that no energy source is entirely benign and that a wide range of policies have been used to counter the harmful effects associated with various fuel cycles (5.29-5.37). Controls on emissions of carbon dioxide, which is emerging as among the most significant of the threats to the environment associated with energy use, are still at an early stage. We strongly favour a carbon tax placed on fossil fuels, based on the carbon dioxide produced, because it would encourage a shift to low-carbon and non-carbon energy sources. But it would also bring about an increase in the average cost of energy which would bring about some reduction in consumers' energy use, partly by increasing the attractiveness of energy saving measures and equipment.

6.157 The climate change levy, as currently planned, will be based on the energy content, rather than the carbon content, of fuels. This is mistaken. We welcome, however, the decision to exempt electricity generated by some renewable sources and some CHP installations from the levy. If the climate change levy is to be introduced, it should be seen as an intermediate stage in the introduction of a carbon tax.

6.158 A carbon tax would be applied upstream, and should cover all fuels including transport fuels and all sectors. Applied upstream, when the fuel is initially purchased, it would give all companies converting and distributing energy an incentive to do so more efficiently, as well as giving energy consumers an efficiency incentive, because some of the costs of the tax would be passed on. The operator of a fossil fuel power station would, for instance, have an additional incentive to raise its efficiency if the fuel it burnt was taxed.

6.159 **The government is mistaken in keeping domestic fuel cheap for all households in order to help a minority of households who suffer from fuel poverty, when there are growing concerns about the environmental damage caused by indiscriminate, inefficient consumption of fossil fuels.** Climate change may make its most devastating impacts on the poorest and most vulnerable of the world's peoples. The effectiveness of other measures to raise energy efficiency in the household sector is reduced when they take place against a background of cheap and falling fuel prices.

6.160 **There should not, therefore, be a blanket exemption for households from taxation measures aimed at limiting climate change.** But if they were to be included, the tax would fall hardest on low income households. We would expect the government to give careful consideration to this matter. **At the very least, the numbers of people suffering fuel poverty should not be allowed to increase when a carbon tax is introduced. We urge the government to adopt a programme with the aim of eliminating fuel poverty over a specified time period.**[109] It will need a better indicator of fuel poverty than the one it currently employs, and more information about the extent of the problem.

6.161 Cold weather payments are currently available for pensioners and households reliant on state benefits when average temperatures fall below freezing for a week and all pensioner households are now entitled to a £150 fuel payment each winter. These payments would have to be increased when a carbon tax was introduced, as would mainstream state benefits, and there would need to be outreach systems in place which ensured all eligible claimants were aware of their entitlement to these benefits and could take them up promptly. It might prove necessary to widen the eligibility for some of this help to low income households which, while not qualifying for state benefits nor depending on the state old age pension, would be at risk of being moved into fuel poverty by a carbon tax.

6.162 It would be preferable for households to be lifted out of fuel poverty through energy efficiency improvements which enable them to waste less heat rather than through recurring benefits which enable them to consume more energy. Given the dilapidated state of the UK housing stock (and particularly the private sector stock), using either of these routes to eliminate fuel poverty would be costly – although the revenues from a carbon tax could finance such a programme over the medium to long term. We appreciate that it will be difficult for government to achieve the right balance between the two strategies. With both, it will be necessary for government to work closely with a range of bodies, including local authorities and charities, to ensure that households entitled to help are reached.

6.163 However, **there is a pressing need for further expansion of government programmes for raising energy efficiency and increasing warmth in low income homes, going beyond the existing EESOP and enhanced HEES schemes.** This expansion would increase the rate at which homes are improved as well as aiming for a higher standard of energy efficiency. It would take several years for any programme of energy efficiency improvements to reach all eligible dwellings. **It should be integrated with programmes for urban regeneration and for more general renovations or replacement of run-down housing.**

6.164 Until fuel poverty is eliminated, a substantial proportion of the revenues from a carbon tax would need to be ring-fenced for low income households, funding benefit increases and a programme of domestic energy efficiency improvements. Some of the revenue should also be used to promote energy efficiency improvements among households in general, in industry,

public and commercial services and the transport sector, and to promote the deployment of low-carbon and non-carbon energy resources.

6.165 This range of energy-related programmes could absorb most of the revenue from a carbon tax. Remaining revenues should be used to reduce taxes on employment and investment, limiting any decline in the international competitiveness of UK commerce and industry caused by the tax.

6.166 The price elasticities of demand for energy appear to be generally fairly low in both the long and short term.[110] This would imply that a carbon tax would have to be very large if it was to bring about appreciable reductions in final energy consumption (although much of the reduction in carbon dioxide emissions which it brought about would come through a switch to no-carbon and low-carbon fuels). Using DTI's estimates of price elasticities and its energy model, DTI's Energy Advisory Panel estimated what levels of carbon tax would be required to achieve various reductions in annual carbon dioxide emissions. According to this analysis, the carbon tax required to bring about a 20% reduction in emissions (compared to a 1990 base year) by 2010 would cause a 72% increase in domestic gas prices, a 23% increase in domestic electricity prices, a 125% increase in industrial gas prices and a 41% increase in industrial electricity prices.[111]

6.167 But, as the panel pointed out, this analysis relied simply on the price mechanism to achieve demand reduction and fuel switching. We believe price rises of this magnitude would not be politically acceptable and would be economically and socially damaging. As we argued above, a range of incentives, advice and publicity is required, to evoke a much larger response than could be obtained by the price mechanism alone and, in effect, alter the price elasticities. Businesses and households should be given more help than is currently available in reducing their energy consumption. This help should take the form of credible, easily understood advice on equipment and measures which increase energy efficiency, and subsidies for the most cost-effective, practicable and reliable of these. If these measures were combined with a carbon tax, announced in advance of its introduction, sales of existing energy-saving equipment would increase. The development of new technologies would be stimulated. Consumers would pay more attention to the energy consumption of new appliances, cars and homes when making purchases.

6.168 Recent experience with taxation of road fuels gives some useful guidance. As we noted above, the fuel duty escalator appears to have had a very limited effect in reducing road fuel consumption. From the consumers' perspective, governments failed to use the large extra revenues to make an appreciable improvement to alternatives to the car or lorry. Indeed, public transport fares rose more rapidly than private motoring costs.[112] Yet, in what is probably the most effective use of an economic instrument in UK environmental policy to date, the introduction of lower fuel duty for unleaded fuel *did* evoke a strong response from consumers and manufacturers. A small incentive for people to switch to a less environmentally harmful alternative and a clear message about the need for change were successfully used by government to phase out leaded petrol.

6.169 **A carbon tax should be announced at least a year in advance of its introduction, be set at a modest level initially, and be preceded by or launched alongside the other measures we recommend for raising energy efficiency, reducing energy consumption and reducing fuel poverty.** It would also have to be integrated with the existing taxes on road fuels; either

they would have to be reduced correspondingly at the time of its introduction, or an increase in fuel duty would have to be forgone. As well as designing and implementing new energy policies and monitoring their effect, the government will have a leading role to play in bringing about the shift in attitudes required to achieve sustained, long-term reductions in energy use. We now consider whether its existing energy efficiency programmes and institutional arrangements are up to this task.

Institutional arrangements and existing energy efficiency programmes

6.170 We described the arrangements for promotion of energy efficiency briefly in the previous chapter (5.44 and figure 5-VI). There was a general view in the evidence we received that government must take the lead in promoting energy efficiency. We were told that DTI and DETR worked well together and that having two major Departments involved did not compromise government's ability to deliver effective programmes.[113] But the slowing down of the rate at which energy intensity has been decreasing (6.8) suggests the recent achievements and current objectives of government across the board in energy conservation are far from adequate.[114] We are not alone in this opinion. The Trade and Industry Committee and the Environmental Audit Committee of the House of Commons have recently made strong criticisms of government energy efficiency policies.[115,116] The International Energy Agency's 1998 review of UK energy policies concluded that 'the efficiency programmes in place are unconvincing.'

6.171 In order to change public attitudes and bring about a gradual reduction in energy consumption, energy efficiency needs to be at the heart of government energy policies. This is not the case at present. We accept that the current administration inherited a marginalised energy efficiency policy from its predecessor and we note the progress made since 1997. We welcome the Chancellor's decision to reduce vehicle excise duty for smaller, less polluting cars which, together with higher fuel prices, should induce a welcome shift away from larger vehicles. We welcome increases in funding for the Home Energy Efficiency Scheme and the Energy Saving Trust announced in the 1998 Comprehensive Spending Review. And we welcome the decision announced in the March 2000 Budget to reduce VAT on the installation by contractors of energy saving equipment from 17.5% to 5%, the same rate as applies to domestic gas and electricity. However the high rate of VAT on the materials remains a disincentive to householders who might want to improve the energy efficiency of their homes by carrying out work themselves. **We urge the government to press for changes in EU VAT law that would enable VAT to be reduced to 5% for sales of energy saving equipment direct to consumers.**

6.172 Despite the progress that has been made on some specific fronts the general conclusion we have reached is that the arrangements for improving energy efficiency across all sectors need to be reconsidered. We discuss in the final chapter of the report (10.33-10.48) how present institutions need to evolve. Other changes in approach are also required. **A range of targets should be developed for raising energy efficiency in all sectors of the economy.** Some targets are already implicit in the projected reductions in carbon dioxide emissions which underpin the government's draft Climate Change Programme; but the process of setting targets and monitoring progress against them should be given a much higher profile.

6.173 The targets set should be based on prioritising the most cost-effective energy savings. That will require agreement on what the best indicators of progress are and collection and compilation of the necessary data. The government is to be commended for producing a fairly

detailed commentary on UK energy efficiency performance and matters related to energy and the environment in its annual Energy Report.[117] We hope this practice continues. The Energy Report could be the document in which progress in raising energy efficiency is reported year by year.

6.174 The targets should be the core of a long-term strategy for gradually reducing energy consumption. This strategy will, in turn, be an essential component of a climate change strategy extending beyond 2012.

Sustained reductions in energy use are achievable, and should form an important part of the UK's response to the threat of climate change. Bringing these reductions about will require new policies and instruments and much higher governmental priority for improvements in energy efficiency