Chapter 10

ADOPTING A LONG-TERM STRATEGY

What policies should the government now adopt to begin the fundamental reshaping of the UK's energy system that is essential for the long term? How do present institutions and programmes need to evolve in order to create the impetus for radical change?

Why a long-term strategy is needed

10.1 When we announced our decision to study the interaction between energy and the environment (appendix A), the responses we received (see appendix B on the conduct of the study), and the seminar we held in July 1998 (appendix C), led us to the view that the most important issue to investigate was the prospects for energy use over the long term in the light of the threat posed by climate change. In September 1998 we invited evidence on what the implications would be of considerably reducing the use of fossil fuels as energy sources in the UK by 2050, or even phasing them out altogether. We posed a number of specific questions (listed in appendix A) covering not only the technological possibilities but the social implications of different energy policies and the environmental impacts that the alternatives to fossil fuels would themselves have.

10.2 We also invited evidence on the global context. In part I of this report we considered the causes and effects of climate change, the possibility of preventive measures, the actions so far taken by the world community to counter the threat and the prospects for a much more far-reaching international agreement in future. We concluded that it will probably be necessary for the UK to make very large reductions in the long run in emissions of greenhouse gases, and of carbon dioxide in particular.

10.3 Over the next decade the UK will not have difficulty in meeting its legal obligations to reduce emissions of six greenhouse gases in the years 2008-2012 to 12.5% below their 1990 level (5.52). Some of the favourable circumstances which have helped ensure that however will not persist into the following decade. This is strikingly true for carbon dioxide, the most important greenhouse gas. On the basis of present trends, and the policies that would be sufficient to meet the UK's legal obligations, carbon dioxide emissions will soon begin to rise again, and by 2020 are projected to be less than 2% below their 1990 level (5.51).

10.4 Compliance by developed nations with legal obligations stemming from the Kyoto Protocol (4.8) is important, not so much for the reductions in emissions that it will deliver, but as the first step towards more comprehensive and extensive global action to counter climate change. Even though it is not certain as yet that the protocol will be effectively implemented by all developed nations (4.55), it is right to proceed on the basis that this will indeed be the case, and observing the limit on emissions which the UK has accepted is an immediate priority.

10.5 In terms of energy policy, however, a decade is not a long time. Experience during the 1990s shows the dangers of regarding a specific international commitment covering a relatively short period as the main driver for government policies. Because the UK's carbon dioxide

emissions were being reduced by favourable short-term trends, insufficient attention was paid to the fundamental changes that will be needed in the long run.

10.6 The present government's goal of reducing carbon dioxide emissions to 20% below the 1990 level by 2010 was an attempt to remedy that. It is much more demanding than the UK's share of the EU's obligation under the Kyoto Protocol, not only because of the larger percentage, but also because reductions will be more difficult to achieve for carbon dioxide than for the other five gases in the basket (box 2C). **The goal of reducing annual carbon dioxide emissions by 20% from their 1990 level by 2010 is a major step in the right direction. It should become a firm target and government should produce a climate change programme that will ensure it is achieved** (5.60). Even if the 20% goal for 2010 can be achieved, there will be strong upward pressures on UK carbon dioxide emissions after 2010, as we noted above.

10.7 Government policies must now begin to address the longer-term questions: what kind of international agreement might follow the Kyoto Protocol, what the implications will be for the UK, and how it can put itself in the position to respond. We have recommended (4.68) that **the UK should continue to play a forceful leading role in international negotiations to combat climate change, both in its own right and through the European Union. The government should press for further reductions in the greenhouse gas emissions of developed nations after 2012, and controls on the emissions of developing nations.**

10.8 The implication is that further large reductions will be required in the UK's own emissions of carbon dioxide and other greenhouse gases. The key issue is the basis on which the burden will be shared internationally. **The government should press for a future global climate agreement based on the contraction and convergence approach** (4.47-4.50), **combined with international trading in emission permits** (4.53-4.54). **Together, these offer the best long-term prospect of securing equity, economy and international consensus** (4.69).

10.9 The scale of the reductions required will also depend on the date by which national emission quotas converge and on the agreed objective for the carbon dioxide concentration in the atmosphere. We have proposed (4.32) that 550 ppmv, twice the pre-industrial level, should be regarded as the upper limit for the concentration of carbon dioxide in the atmosphere, and that convergence should take place in 2050. On that basis, the UK would be required to reduce carbon dioxide emissions by about 60% between 1997 and 2050, and by about 80% between 1997 and 2100 (table 4.1). Even if a much riskier objective were agreed for atmospheric concentration, the reduction required from the UK by 2050 would be very large: upper limits of 750 ppmv, or even 1,000 ppmv (more than three and a half times the pre-industrial level), would still require carbon dioxide emissions to be reduced by more than 40% from the 1997 level (table 4.1).

10.10 **The Government should now adopt a strategy which puts the UK on a path to reducing carbon dioxide emissions by some 60% from current levels by about 2050. This would be in line with a global agreement based on contraction and convergence which set an upper limit for the carbon dioxide concentration in the atmosphere of some 550 ppmv and a convergence date of 2050.** There will be some flexibility over how to comply with the eventual national limit because of mechanisms such as trading in emissions permits contained in the Kyoto Protocol. That does not alter the fundamental fact that far-reaching modifications to the UK's energy system will be essential.

The content of a long-term strategy

10.11 In chapter 9 we analysed some illustrative scenarios for the UK's energy system in the middle of the 21st century. That exercise showed why a long-term strategy is crucial if there is to be any prospect of cutting carbon dioxide emissions by 60% while continuing to meet requirements for energy in its various forms. It also indicated what areas the strategy needs to cover. Change of the kind envisaged in the scenarios will be far-reaching and take many years to bring about. That does not justify pessimism about its feasibility. The 20th century has seen several radical transformations in energy use: electrification, the internal combustion engine, gas central heating. They have typically taken place with a half life of 30 years. In view of the scale of the transformation now required, it is essential, not only that a long-term strategy is drawn up, but that implementation starts immediately and rapidly achieves considerable momentum.

10.12 Over the coming decades there will in any event be massive investments in the energy system in order to respond to changing demands and replace installations that reach the end of their lives. The decisions taken about these new assets will have big implications for future carbon dioxide emissions. For example, a major power station for which planning starts in the next few years may still be in operation in 2050. A looming issue is how the UK's present nuclear power stations will be replaced (7.102-7.105). **While UK carbon dioxide emissions are falling at the moment, they are expected to begin rising again. All but one of the nuclear power stations, the main source of carbon-free energy at present, are expected to close by 2025. The government should set out, within the next five years, a programme for energy demand reductions and development of alternative energy sources that will prevent this from causing an increase in UK emissions.**

10.13 There are even more daunting lead times for bringing about any significant changes in the present urban fabric and stock of buildings. The UK carries the massive historical burden of a housing stock that is very inefficient in energy terms by comparison with other north European countries. Part of the major improvement in energy efficiency that will be needed has to come through changes to existing buildings. For the small proportion of buildings that are of architectural or historic interest or located in conservation areas, that will require particular care and sensitivity. But the standards of energy efficiency that will have to apply generally in future cannot be achieved through modifications to existing buildings. There need to be substantial improvements in the standards set for new homes being built today, many of which are likely to be in use at the end of this century, with further improvements to follow in the coming decades. The need for radical improvements in energy efficiency may become a factor in determining the rate at which existing homes are demolished and replaced. It is not only design of individual buildings that is important, but the infrastructure of neighbourhoods. To make extensive use of combined heat and power plants possible, district networks for the supply of heat have to be established on a very wide scale. Neighbourhoods must also be planned in ways that reduce the distances people have to travel, and encourage them to reduce carbon dioxide emissions by walking or cycling or using public transport.

10.14 Decisions taken now about such long-lasting investments must have full regard to the long-term implications for the environment. Designing in energy efficiency is much less expensive than achieving the same level of efficiency through subsequent alterations, even where that is feasible. A high proportion of the relatively recent housing and other buildings now being demolished have been rejected because they were built to poor standards in one or

other respect. If improvements in efficiency are to be obtained on the scale required, in a timely way and without excessive cost, a start needs to be made as soon as possible. **Both for the building stock and for other capital assets, maximum advantage must be taken of new construction and the replacement cycle in order to make major improvements in energy efficiency.**

10.15 To provide a consistent framework which will give companies confidence in making long-term plans and putting them into effect, it is essential that the long-term strategy adopted should reflect a broad national consensus, and should be pursued continuously, in its essentials, through a number of Parliaments. There must be the social and political will to face the radical challenge posed by climate change.

10.16 The long-term strategy will have at its core a set of long-term targets. These are essential to provide a clear framework for investment decisions. At the moment no such targets exist. Renewable energy is an example. The government has proposed as a target that 10% of electricity should come from renewable sources by 2010 (7.106), with corresponding obligations placed on electricity suppliers (7.111). But nothing has so far been said about any further increase beyond 2010. A 10% contribution would fall far short of the minimum contribution from renewable sources envisaged in the scenarios for 2050 discussed in the previous chapter (see box 9A). Nor are there long-term targets for improving energy efficiency or (reflecting the continuing failure to appreciate the importance of heat as a component of energy demand) for establishing combined heat and power schemes.

10.17 Absolute reductions in energy demand and a large deployment of alternative energy sources will be needed if the UK is to make deep and sustained cuts in carbon dioxide emissions while protecting its environment and quality of life. Longer-term targets should be set for expanding the contribution from renewable sources well beyond 10% of electricity supplies to cover a much larger share of primary energy demand (7.106). A range of targets should be developed for raising energy efficiency in all sectors of the economy (6.172). A central policy objective must be a very large reduction in demand for energy for heating and cooling, achieved through much more sophisticated management of heat and much wider use of combined heat and power schemes for both the industrial and the domestic market (8.15).

10.18 The other essential ingredient of a long-term strategy is instruments that will make it possible to achieve the targets adopted. They will not come about through the unaided operation of the present liberalised markets for gas and electricity (5.27-5.28). Indeed, there are respects in which the operation of those markets has been inconsistent with environmental objectives (5.22). We discuss below what we see as the key instruments for implementing the long-term strategy: economic instruments, creation of a new agency, powerful research and development programmes, and new approaches in other key areas of policy such as building control.

10.19 One contribution to reducing emissions could be recovering the carbon dioxide produced at fossil fuel power stations and disposing of it in underground strata (3.4-3.11). Fossil fuel stations with such equipment could be considered as an alternative option to nuclear power stations for meeting baseload demand for electricity (8.31). But, before this approach is adopted, confirmation is needed that it will not itself give rise to environmental hazards.

10.20 Stimulating vegetation growth and increasing the organic content of soils help limit the concentration of carbon dioxide in the atmosphere (3.15-3.22). Because the UK has a relatively small land area however, these forms of action can have only a small effect on its net emissions of carbon dioxide. Nevertheless, tree-planting programmes bring some benefit in limiting emissions and other benefits as well, provided they are carefully planned with regard to all aspects of their impact on the environment. **The targets in the UK's long-term strategy should cover protection and expansion of carbon sinks through tree planting and appropriate land use policies.**

10.21 Whatever the ultimate success of international agreements in limiting concentrations of greenhouse gases in the atmosphere, some change in climate and a rise in sea level now seem inevitable as a result of emissions that have already taken place or will take place before further preventive measures can have an effect (2.39). Although the exact consequences for the UK are difficult to predict, they are likely to be significant (box 2D). Another part of the long-term strategy therefore must be to avert or minimise the more damaging consequences of climate change. **We welcome the start the government has made in developing policies to minimise consequential damage in the UK as a result of climate change.** Comprehensive monitoring and further research will be needed to underpin those policies (10.54).

10.22 Adaptive measures will have to be taken in a wide variety of fields, including town and country planning, flood protection, coast protection, agriculture, forestry, nature conservation and countryside recreation. As part of the study of environmental planning we are now conducting, we intend to examine how legislation and administrative procedures should be modified and extended in recognition of this issue.

The European dimension

10.23 The European Union has an important role in international negotiations on countering climate change, and has moved further and faster than other parts of the developed world in setting targets for reducing greenhouse gas emissions (4.8). **The sharing out between Member States of the EU's limit under the Kyoto Protocol must now be given a firm legal basis, and effective mechanisms must be established for monitoring compliance with their respective limits, with sanctions for non-compliance.**

10.24 Some key measures needed to achieve deep cuts in carbon dioxide emissions require action by the EU rather than Member States. Reductions in the fuel consumption of personal vehicles, for example, are dependent on the European Commission's agreements with associations of manufacturers (6.123). In general the European Commission has not been proactive in putting forward proposals for reducing carbon dioxide emissions. There are important fields in which the EU could be making major contributions to countering the threat of climate change, but is not doing so at present. They include economic instruments; for example, proposals have been put forward for either an EU carbon tax or an EU energy tax, but so far without success. Another aspect is fundamental reform of the Common Agricultural Policy, which may be a necessary condition for realising the full potential of energy crops as an energy source. **The government should continue to press for thoroughgoing integration of environmental considerations into EU policies, both in the energy field and in other fields.**

Economic instruments

10.25 Incentives must be provided to encourage both firms and individuals to act in ways that will help reduce carbon dioxide emissions. Corrective taxes provide a way of ensuring that decisions by those using a resource take into account, not only its market price, but also the

external costs being imposed through its use. The case for a corrective tax is especially strong in the case of energy because the effect of low, and falling, energy prices (5.28) may have been to encourage inefficiency in energy use. Any use of energy is likely to impose some external costs, if not at the point of use then through the chain of activities by which energy is supplied.

10.26 Emissions of carbon dioxide are expected to impose very high external costs on the world. Corrective taxes in the energy field therefore should be targeted directly towards fuels that give rise to carbon dioxide emissions. This will bring about some reduction in the amounts of energy used by firms and individuals, and it will provide a direct incentive for them to use those energy sources which do not contribute, or contribute less, to carbon dioxide emissions. We criticised the government's original proposals for a 'climate change levy' because they amount to an energy tax rather than a carbon tax, and because they do not cover domestic use of energy. Although energy from renewable sources and from the most efficient combined heat and power plants will now be exempt, this tax will still be a very imperfect instrument for bringing about the far-reaching changes needed in order to achieve deep cuts in carbon dioxide emissions (6.157). The number of energy sources and consumers covered by exemptions, reduced rates and negotiated agreements has been growing in the run-up to the levy's introduction. We agree with the description of it by House of Commons Environment, Transport and Regional Affairs Committee as 'an extremely complex and cumbersome market instrument which will result in a relatively modest emissions reduction.[1] **The UK should introduce a carbon tax, replacing the climate change levy which is due to begin next year. It should apply upstream and cover all sectors.** It should be set at a modest level initially.

10.27 We appreciate the concern for vulnerable groups in society that has led many people to oppose any tax that would affect energy prices for ordinary customers. But keeping energy prices low for all domestic customers is not the right way to deal with the particular UK problem of 'fuel poverty'. The tax we are advocating can provide funding for measures that will be much more effective in improving quality of life for the vulnerable (6.159-6.160). **The first call on the revenue from this carbon tax should be to further reduce fuel poverty by benefit increases and more spending on household energy efficiency measures.**

10.28 Even with the carbon tax in place, some measures that would be effective in reducing carbon dioxide emissions may not be sufficiently attractive to elicit an adequate response from firms or individuals, and additional incentives may be required. **The remainder of the revenue should be used to raise investment in energy efficiency measures in all sectors, to increase the viability of alternative energy sources, and to reduce the impact of the new tax on UK industrial competitiveness.** This use of the revenue builds on what the government is already proposing; devoting the bulk of the revenue to reducing employers' National Insurance Contributions while retaining £150 million a year for improvements in energy efficiency and promotion of alternative sources.[2]

10.29 A carbon tax would improve the economic viability of nuclear power as well as renewable energy sources. But cost is not the only consideration. Before any new nuclear power plants are built in the UK, the problem of managing nuclear waste must be solved to the satisfaction of the scientific community and the general public (7.19). It seems unlikely that public opinion will permit the construction of new nuclear power stations unless they are part of a strategy which delivers improvements in energy efficiency and gives equal opportunity for the deployment of other alternatives to fossil fuels which can compete in terms of cost and reduced environmental impacts.

10.30 Several EU Member States now have energy taxes aimed at reducing carbon dioxide emissions. There would be less ground for concern about the impact of such a tax on the international competitiveness of UK firms if it were being levied on a consistent basis across the EU. If the UK acted unilaterally by introducing a domestic carbon tax, it would be imposed on fossil fuels sold in the UK, both imported and domestically produced. Any imports of electricity which had been generated using fossil fuels would then have a price advantage over electricity generated in the UK from fossil fuels. One solution to this anomaly would be to impose a 'shadow carbon tax' on imports of electricity, to reflect the quantity of carbon dioxide emitted during their generation. That could, however, fall foul of EU laws.[3] **If there is not to be an EU-wide carbon tax, EU law ought to be amended to enable Member States which wish to impose internal carbon taxes to levy reasonable shadow carbon taxes on imported electricity.**

10.31 At present the only substantial electricity imports into the UK are from France. If a carbon tax is introduced in the UK, those imports would gain a price advantage over UK electricity generated from fossil fuels. The great majority of French electricity however is generated at nuclear power stations, and would not therefore be subject to a carbon tax.

10.32 **The UK should press for a carbon tax within the European Union, but proceed on its own if agreement cannot be reached within the next few years.** Taking into account the other measures we are recommending, a package of policies that includes a carbon tax could reduce the UK's carbon dioxide emissions significantly in the medium to long term without damaging competitiveness, or increasing hardship.

Effective institutions

Whitehall Departments

10.33 The long-term strategy for deep cuts in carbon dioxide emissions that we are advocating will be drawn up and successfully implemented only if there is a comprehensive and far-sighted vision at the heart of government about energy policy and its environmental dimension. The Department of Trade and Industry (DTI) is responsible for the energy industries (5.44) throughout Britain (but not in Northern Ireland). The Department of the Environment, Transport and the Regions (DETR) is responsible for negotiation of, and compliance with, international environmental agreements and EU environmental legislation, and for energy efficiency in England. The division of responsibilities between the two Departments could be regarded as cutting across both the essential nature of the challenge posed by climate change and the promotion of key concepts that span energy use and energy supply, such as energy service companies and making use of waste heat (through large-scale development of combined heat and power, including micro-scale plants).

10.34 The House of Commons Trade and Industry Committee has spoken of 'a crying need for the integration of environmental priorities with energy policy, rather than the one being a tardy intrusion into the latter'.[4] We have considered whether the situation would be improved by a transfer of responsibilities between Whitehall Departments. One option would be to recognise the critical importance of energy issues by creating once again a Department of Energy. The retention of a Department of Energy in the USA provides part of the explanation for the comprehensiveness of the research and development programmes the US government continues to carry out in this field. In responding to the threat of climate change, on the other hand, the USA has often shown signs of dragging its feet. We did not find the idea of a separate Department attractive in a UK context. With the completion of privatisation and liberalisation,

and the extensive powers given to the energy regulator, a Department of Energy would now have, at most, far fewer functions than the former UK Department with that title. It is doubtful whether it would be large enough to be viable as a separate Department. It would certainly carry little influence in Whitehall or Westminster.

10.35 Another option would be to bring together in DTI all the surviving functions of the former Department of Energy. That would mean transferring responsibility for energy efficiency from DETR. This would have the disadvantage of weakening the crucial links between energy efficiency and DETR's responsibilities for building control, housing and transport. It would be interpreted as signifying a lack of political will to make fundamental changes in the way the UK obtains and uses energy.

10.36 Denmark provides the alternative model of a ministry (formed by merger in 1994) which combines responsibility for energy and the environment. The counterpart in UK terms would be to transfer from DTI to DETR sponsorship of the energy industries and responsibility for promoting new energy technologies, and probably also responsibility for the energy regulator. We would see serious objections however to combining in the same government Department sponsorship of industries which are potentially major sources of pollution and DETR's primary function of protecting the environment. Support for UK energy technology firms in world markets could also suffer from the change. In Denmark, policy-making and administration are largely located in subordinate agencies such as the Danish Energy Agency, leaving the combined ministry with an oversight role. While that extent of delegation would go beyond normal UK practice, the key to improvement may well lie in creating a more effective executive body in the energy field, rather than in reshuffling responsibilities within Whitehall. We propose such a body below.

10.37 There is one respect in which we have concluded that existing responsibilities should be changed. At present the Energy Minister gives consent for new generating plants with a capacity of 50 MW or more and separate approval for new overhead transmission lines (5.32). This seems undesirable for two reasons. First, it means proposals for generating plants can be examined and approved in advance of any consideration being given to the infrastructure needed to link them to the transmission system. Second, it represents an undesirable exemption from the normal land use planning system. **We recommend that all proposals for new generating plants and overhead transmission lines should in future be considered under land use planning legislation, and that planning applications for generating plants should be required to cover all the transmission lines and other infrastructure that will be needed for their operation.** In cases where transmission lines would cross the areas of several local planning authorities, it would be appropriate for the Environment Minister to call in the case and take the decision on it.

The Gas and Electricity Markets Authority

10.38 Because the distribution networks for gas and electricity give rise to residual natural monopolies, creating and maintaining competitive markets in those industries in itself requires a high degree of regulation. The issue is the terms on which economic regulation should be conducted. There has been much discussion about the extent to which economic regulation of the electricity and gas industries ought to concern itself with environmental objectives, in particular with energy efficiency.

10.39 Although there were originally separate regulators the Office of Gas and Electricity Markets has been established administratively, and the current Utilities Bill[5] will create the Gas and Electricity Markets Authority.[6] This will have the primary duty to exercise its functions in a manner best calculated to protect the consumer interest. The duty will relate to the interests of gas and electricity consumers taken together, and will extend to non-domestic consumers, potential consumers, and consumers who are not customers of licensed suppliers. It will 'subsume' the present duty to ensure that reasonable demands for gas and electricity are met. The regulatory authority will have to pay particular regard to the interests of groups of consumers who are most vulnerable to difficulties in obtaining satisfactory energy supplies: those on low incomes, the elderly, the chronically sick and disabled, and those living in rural areas. The secondary duties which the regulator has at present to promote efficiency and economy and to take environmental effects into account will be retained. The removal of the duty hitherto placed on the electricity regulator to exercise his functions so as to promote research and development in the fields of generation, transmission and supply[7] can be regarded as acceptance of inevitable changes in the role of the regulated companies in funding research and development (5.64).

10.40 The government nevertheless recognises 'the importance of the utility industries in helping to achieve social and environmental objectives, and the importance of securing the right engagement of the regulatory system in that process'. It therefore intends to follow the model already established in the water industry and issue guidance to the regulator on social and environmental matters, after full consultation and subject to parliamentary approval. Although there will be a statutory duty to have regard to this guidance, it will be for the regulatory authority to decide how these social and environmental objectives 'are to be reflected in the way they carry out their functions'.[8]

10.41 Experience with nationalised industries and the Environment Agencies shows it is difficult to frame ministerial guidance or directions in such a way as to be precise and effective. Where social or environmental measures will have significant financial implications, the government will not rely on guidance to the regulatory authority, but will introduce specific legal provisions. One measure already identified as requiring that approach is the energy efficiency standards of performance scheme for gas and electricity,[9] discussed earlier in this report (6.62-6.69).

10.42 We do not consider it part of the economic regulator's function to form an independent view about what is desirable or undesirable in environmental terms. Environmental objectives should be formulated explicitly and clearly by those responsible for environmental policy, after full consultation. The extent to which those objectives are taken into account in decisions affecting the energy industries should be deliberated openly and recorded publicly. With particular reference to environmental interests, the government has said it is taking measures to ensure that 'all parties with an interest in regulation . . . have a full opportunity to participate effectively in the decision-making process, and . . . understand the outcome'.

10.43 While the proposed structure for economic regulation of the electricity and gas industries is logical in principle, there are worrying signs that sufficient weight is not being given to environmental objectives and the achievement of long-term policy goals. In particular, the new electricity trading arrangements, which will provide the framework for the wholesale electricity market in England and Wales (8.48), have very unfavourable consequences for the competitive position both of renewable energy sources and of combined heat and power schemes. This experience highlights the need, not only for a comprehensive and far-sighted vision at the heart of government, but also for an effective executive body which can act as a powerful and well informed advocate for the creation of a more sustainable energy system.

A Sustainable Energy Agency

10.44 Improving energy efficiency is a crucial dimension of energy policy. There is widespread agreement that the present arrangements for achieving that aim are complex and fragmented (see figure 5-VI). The Environmental Audit Committee has concluded that: 'While Government believes its arrangements can be made to work, this view is not shared by significant partners outside Whitehall.'[10] The Committee's suggested solution was 'a new unit with a dedicated staff' reporting jointly to DETR and DTI Ministers which would be given responsibility for 'driving and co-ordinating policy on energy efficiency; its integration into other policy areas; and for identifying barriers to effective action'.[11] The government response to that recommendation said that the Energy, Environment and Waste Directorate of DETR already fulfils the role envisaged.[12] DTI and DETR officials assured us that they work well together, and that the division of responsibilities between the two Departments (10.33) does not have any adverse effect on the content or implementation of government policies.[13] We have reached the conclusion however that the achievements of present policies in this field have fallen well short of what will be required from now on (6.170).

10.45 Rather than some fine tuning of responsibilities in Whitehall, what is needed is an effective executive body charged with carrying forward sustainable energy policies. Much excellent work has been done by bodies such as the Energy Saving Trust (which is itself about to be reviewed), and DETR is justified in claiming that 'no single agency could cover all aspects of energy efficiency'.[14] There are nevertheless important functions related to energy efficiency which would benefit from a higher profile, sharper focus and better targeting.

10.46 A similar conclusion can be reached about the effectiveness of arrangements for promoting renewable sources of energy. Moreover, we share the view of the Environmental Audit Committee that there is 'the potential for synergy between efforts to promote energy efficiency and efforts to promote the development of renewables'.[15] **We recommend that a Sustainable Energy Agency should be set up to promote energy efficiency more effectively in all sectors and co-ordinate that with the rapid development of new energy sources.** This Agency would be in essence a money-moving and promotional body. Its principal statutory aim should be to promote the development and implementation of sustainable energy options. It should be required to take account of the economic and social consequences of its activities, and have among its specific aims reducing inequalities in access to warm homes.[16] For comparison, the Netherlands Agency for Energy and the Environment (Novem), with rather similar functions, has an annual budget of about £65 million and 400 employees.[17] We were also impressed with the effectiveness of the Energy Conservation Centre which promotes energy efficiency in Japan.

10.47 The Sustainable Energy Agency would take over from government Departments responsibility for funding research and development on efficient use of energy, renewable energy technologies, fuel cells and system integration issues. It would negotiate for inclusion of provision for renewable energy projects in regional and structure plans. It would take over staff from the Energy Saving Trust, and possibly from the Energy Technology Support Unit of AEA Technology plc (ETSU), DETR and DTI. It would provide funding to EAGA and related fuel poverty organisations.[18]

10.48 The initial annual budget of the Agency would be about £150 million. The largest element would be the funding provided to EAGA for the Home Energy Efficiency Scheme. Other elements would be DTI's research and development budget for new and renewable

energy, the funding for ETSU and the Building Research Establishment Conservation Support Unit (BRECSU), and the funding for schemes administered at present by the Energy Saving Trust. The bulk of its budget therefore would be channelled to other organisations as grants or contracts. The Agency would have freedom to decide how its resources could be divided most effectively between renewable sources and end uses of energy.

Transmission and distribution

10.49 Another area in which existing institutions may need to change is the operation of the electricity network. The National Grid Co plc is a private sector company answerable to its shareholders; so also are the companies operating the distribution networks, even though they are tightly regulated as monopolies and required to keep this activity separate from their other activities (5.26). It was shown in chapter 8 that development of renewable energy sources on a large scale will involve, indeed be dependent upon, far-reaching changes in the nature of the electricity network. There are at least four possible implications:

large-scale exploitation of wind, wave and tidal energy would involve significant extensions of the bulk transmission network because these resources tend to be remote from centres of demand (8.49)

widespread use of intermittent energy sources (8.35-8.38) and embedded generation (8.50), including combined heat and power plants, will require a new approach to the management of electricity networks

to meet temporary shortfalls in the supply of electricity from intermittent renewable sources, either novel technologies for storing electricity will have to be developed (8.59-8.64) and applied on a very large scale or substantial amounts of fossil fuel plant will have to be maintained in a reserve role (8.40-8.41); this could be supplemented by arrangements for changing as and when required the heat-to-power ratio in combined heat and power plants (8.12)

the rate at which new types of energy source will be developed may well depend on the terms on which they can sell electricity to the grid or purchase electricity from the grid when required, particularly so for photovoltaic cells and for combined heat and power plants.

10.50 This represents a major strategic challenge for the National Grid Co plc, both technically and financially, as well as for the distribution companies. We did not see any signs that the company had yet appreciated the scale of the challenge or begun to take the steps needed to place itself in a position to respond to it. **We recommend that the government should take the lead in a fundamental review of how electricity networks can best be financed, managed and regulated in order to stimulate and accommodate large contributions to energy supplies from combined heat and power plants and renewable sources, while maintaining reliability and quality of supplies.**

Devolution

10.51 While international and EU obligations are a matter for the UK government, as is energy policy, most of the policies in other fields that will be essential for achieving deep cuts in carbon dioxide emissions are the responsibility of the devolved administrations. We welcome the involvement of the Scottish Executive, the National Assembly for Wales and the

Department of the Environment in Northern Ireland in the preparation and publication of the draft UK programme, and their support for the UK goal of a 20% reduction in carbon dioxide emissions by 2010. There are reserve powers to allocate proportions of the UK's target on a mandatory basis to the devolved administrations, but no proposal to use those powers at this stage.

10.52 The need to clarify, and give additional impetus to, responsibilities for energy efficiency arises in all parts of the UK. We have analysed the extent to which responsibilities are fragmented in England, and recommended that a Sustainable Energy Agency should be established (10.46). Reflecting the low priority given to energy efficiency as a policy area, there was little thought about how the subject would be handled after devolution or what functions the devolved administrations would need in order to be able to handle it effectively. **We recommend that the devolved administrations should review and improve their arrangements for promoting energy efficiency and renewable energy, taking into account our recommendation that a Sustainable Energy Agency should be established, and if necessary should seek additional powers in this field.**

Research and development

10.53 One of government's responsibilities is to ensure that adequate research and development are undertaken. There are three aspects in which the knowledge base will be vital in enabling the UK to face the challenge of climate change: understanding of climate change itself; development of the technologies required in order to supply energy without emitting carbon dioxide and make more efficient use of energy; and better understanding of the economic and social science dimensions. Many research and development programmes have a much wider basis than the UK.

10.54 Although there is now a broad scientific consensus about the main features of climate change, there are many components on which our present knowledge is uncertain or imprecise. Investigation and monitoring must continue, both of the processes leading to climate change and of its effects. **Adequate long-term programmes of research and monitoring are vital to improve scientific understanding of the carbon cycle and the greenhouse effect, the consequences for the climate, and the repercussions those in turn will have, as well as of other environmental impacts of obtaining and using energy.** Much of the scientific work relating to climate change can best be carried out through international collaboration. The UK can make a considerable contribution because it retains a strong capability in atmospheric physics and chemistry, climatology, hydrology and ecology, and has research teams that are among the world leaders in climatological modeling. Research to elucidate the effects on the UK will also be essential so that the long-term strategy for averting or minimising consequential damage from climate change (10.21) can be kept under review, and modified or elaborated as necessary.

10.55 The rate of progress in bringing new technologies into widespread use will depend on the existence of programmes which are sufficiently broadly based in two, related directions. First, they must cover all stages through from strategic science to the post-development stage and arrangements for exploitation and commercialisation. Second, they must cover all the interdependent elements of novel energy systems, not merely particular devices or concepts considered in isolation. The analysis of patterns of supply and demand in chapter 8 illustrated the importance of this kind of interdependency if new technologies are to achieve wide practical application. We are impressed with how effective programmes sponsored by the Japanese government appear to be in that respect, for example in covering all the elements that will be needed for the successful commercialisation of fuel cells.[19]

10.56 Energy technologies requiring much further research and development include fuel cells (8.59-8.62 and box 8D), photovoltaic cells (7.39-7.43), and wave and tidal stream power (7.86-7.100). It is also likely that research will be able to raise substantially the productivity of energy crops. An important aspect of work on renewables is more detailed investigation of the natural environment so that the resources available, in total and over specific periods of time, can be more accurately assessed and predicted. At a more strategic level we have identified the need to develop innovative techniques for controlling electricity networks in which much of the supply comes from embedded or intermittent sources (8.54) and new technologies that will allow the output of generating plants to be stored for later use (8.63-8.65).

10.57 Much of the research on new energy technologies, as well as development and design, is undertaken by equipment manufacturers to create products for global markets. This is not a field in which UK-based companies are major players. There are certain renewable energy technologies at an early stage of development however, in particular wave and tidal stream power, in which small UK firms are world leaders (7.99-7.100). These are also energy sources which the UK is very well placed to exploit by reason of geography; and in exploiting them and also in exploiting offshore wind, it can draw on the expertise UK firms have developed in offshore and undersea technology. The UK is also well placed to develop new control and storage technologies, both in terms of its scientific expertise and as a world leader in developing a liberalised electricity market.[20]

10.58 There are also aspects of nuclear power on which work is required. The most pressing, because it stems from present nuclear power stations and the associated fuel cycle operations, is whatever further research and development may be needed to resolve the problem of waste management to the satisfaction of the scientific community and the general public (7.19). In addition, **research and monitoring are needed to establish that disposal of carbon dioxide into deep geological strata will be effective and not give rise to any new environmental hazards.**

10.59 In our view, some element of public sector involvement is essential in energy research and development programmes. Its purpose should be to ensure that they have a sufficiently long-term and strategic vision. We have drawn attention to the sharp decline in funding by the UK government (5.62). In 1997 government expenditure on energy-related research and development in the UK was 0.006% of gross domestic product, compared to the average for EU Member States of 0.024%. **We recommend that the fall in government spending on energy research and development should be reversed, and annual expenditure as a proportion of gross domestic product quadrupled over the next decade to bring the UK up to the present EU average.**

10.60 Although DTI has increased its research and development budget for new and renewable energy, the amount of money involved (£14 million this year, rising to £18 million next year) is still small given the need for such fundamental changes in the energy system over the next half century and the range of technologies and activities that have to be covered. Moreover, this modest programme is supposed to include contributions of up to 25% of the cost of demonstration projects, not only in electricity generation but in the heat and transport markets.[21]

10.61 The other main focus of government support for developing energy technology is the Foresight Programme. One of the main objectives of the new Energy and Natural Environment Panel is to foster collaborative networks and clusters in key areas so that the UK science base, business, public and voluntary sectors can together make a significant contribution to

challenges and opportunities in the fields of energy and the natural environment, and in the achievement of sustainable development.[22] We welcome the panel's intention to develop energy scenarios to 2020 out of the Foresight Environmental Futures Scenarios. Given that this is still a relatively short time-scale in energy terms however, and given also that the panel is dealing with other subjects besides energy, we conclude that government support on a much larger scale is required in order to address, at a sufficiently strategic level, the challenges for energy technology over the next half century.

10.62 There are some aspects that the research councils ought to be well placed to address, for example control technology in the case of the Engineering and Physical Sciences Research Council. We welcome the setting up by the research councils of an interdisciplinary climate change research centre. Here again however the resources available are very limited in relation to the scale of the challenge.

10.63 From industry, the Advisory Committee on Business and the Environment (ACBE) has called for tax credits for companies making capital investments in innovative 'low carbon' technologies which are not yet commercially mainstream; and relief against the climate change levy for companies making voluntary contributions to business-led *carbon trusts.*[23] The activities the carbon trusts are envisaged as supporting include demonstration projects, pre-competitive collaborative research and proof of concept; there would be public access to the results. A further proposal is that a business-led Climate Change Technology Centre should be set up as a carbon trust to focus on development of applied and near-market 'low carbon' technology, to tackle 'the wider barriers to technology take-up', and to provide a business interface with the research councils' centre mentioned above. ACBE suggests that tax relief for contributions to carbon trusts should initially represent in total 20% of the revenue from the climate change levy (that is, about £300 million a year), rising to 50%.

10.64 We commend ACBE's vision, and the strategic character of the proposal for a Climate Change Technology Centre. We would see this as complementary to the Sustainable Energy Agency we are advocating. The Agency should have a regulatory role in approving the creation of carbon trusts and prescribing the kinds of project they are permitted to undertake.

10.65 Like the joint working group of the Royal Society and the Royal Academy of Engineering we have been struck by 'a disjuncture between the magnitude of the problem and the research resource devoted to its solution'.[24] They saw this as different in kind to the research funding issues normally encountered. We agree with their conclusions that strategic research over the long time-scales involved will not be funded by the private sector, that the funding must therefore come predominantly from governments, and that this should be through international collaboration. **We support the proposal for an international body to fund research, development and design in the energy field.** The working group suggested such a body might have an eventual budget of the order of $25 billion a year, representing about 1% of annual global expenditure on energy; on the basis of gross domestic product, the UK's share of that might be about $450 million a year. The European particle physics research organisation, CERN, provides an excellent example of what can be achieved through international collaboration, and should be taken as the model for the structure of a new energy research organisation. Neither the supply technologies incorporated in the scenarios presented in chapter 9, nor the assumptions made about possible reductions in energy use over the next half century, depend on any advances in fundamental science, but such advances could be essential in creating viable energy systems for the even longer term.

10.66 There is a third, equally important aspect of the research required to underpin the long-term strategy we are advocating. Many of the key issues discussed in this report are not primarily scientific or technical. Economic and ethical considerations also inform policy choices, as chapter 4 showed. More generally, research in the social sciences has a crucial role in assessing the current situation and moving towards a more sustainable energy future. For example, we need to understand the extent to which the risks associated with obtaining and using energy are socially constructed, and why different groups respond to them in the ways they do. If we seek to modify patterns of production and consumption, an understanding of the social, cultural and political determinants of behaviour is vital. We have to develop a more sophisticated conception of how both natural and social scientific knowledge impinge on the policy process. In addressing these and many other issues, the need is to draw contributions from across the social sciences, and integrate them with scientific and technical perspectives. We welcome the interdisciplinary nature of the new jointly funded Climate Change Centre.

Implications for other policy areas

10.67 Many of the measures that will have to be taken in order to bring about deep cuts in carbon dioxide emissions involve fields other than energy policy. **The need to reduce emissions of greenhouse gases, particularly carbon dioxide, should be taken into account in all government policies. That is not the case at present.** There are four fields—the built environment, transport, agriculture and offshore development—in which we see it as especially important that a long-term strategic view should be taken.

10.68 We have emphasised the importance of the built environment, and the long lead times involved in bringing about the major changes needed in energy performance. **The UK government and devolved administrations should launch a long-term programme to bring about major reductions in the energy requirements of buildings. 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 schemes** (6.100). **It will also require the large-scale construction of district heating networks, so that advantage can be taken of larger-scale combined heat and power schemes.**

10.69 The Commission has previously produced two comprehensive reports on transport, covering all aspects of its effects on the environment. **Reducing carbon dioxide emissions should continue to be a central objective of transport policy.** Towards the end of this year we plan to review progress since the Commission's second report on transport in 1997.

10.70 The extent to which renewable energy sources can be developed successfully, both on land and offshore, will also depend on a strategic view being taken that goes well beyond conventional issues of energy policy.

10.71 **Growing crops for energy purposes should be regarded as a primary use for agricultural land, and policies and support measures should reflect that.**

10.72 A comprehensive strategy is needed for developing renewable energy sources offshore. This should cover assessment of environmental impacts, designation of appropriate areas, and the possibility of combining more than one technology within a single installation.

The choices before us

10.73 All energy policies have both some potential to damage the environment and wider social and economic implications. They must command public assent, be compatible with an improving quality of life, and where possible contribute to extending social inclusion.

10.74 In this report we have focused on an issue, trying to avert dangerous modifications to the world's climate, which we regard as critical, not only for environmental sustainability, but for all aspects of sustainable development. Some of the actions we have advocated will have favourable social or economic implications in the short term. Big improvements in the energy efficiency of housing, for example, will contribute both to limiting long-term energy demand and to eliminating fuel poverty. Both sets of criteria should be used in judging the effectiveness of the measures taken. Developing new energy technologies and new forms of delivery for energy services will not only benefit the environment but could also provide the basis for new industries, hopefully including some new UK industries supplying global markets.

10.75 There will be conflicts of objectives and conflicts of values as the debate over the UK's future energy system continues. In some cases the conflict will be between different concerns and values related to the environment, in other cases the conflict will be between environmental concerns and the interests of particular groups. The UK is a major producer of fossil fuels; numerous companies and employees will therefore have concerns about the substantial reductions in fossil use which we advocate for the coming decades.

10.76 Even if most people accept our argument that there must be very large reductions in UK carbon dioxide emissions, conflicts of values may well arise over the way in which that should be achieved. The analysis in chapter 9 of illustrative scenarios for 2050 showed that, while there are several possible approaches for achieving a 60% reduction in emissions, all have consequences that some people and interest groups might regard as strongly objectionable. It is difficult, for instance, to see how major reductions in transport-related emissions could be made over the next few decades without the growth in road traffic and in air travel being stabilised.

10.77 Proposals to construct new energy installations may also arouse intense opposition. Although the main focus for such opposition will be more local, some may come from people over a much wider area. The most fiercely contested cases have been proposals for nuclear power stations, which give rise to particular concerns over safety, the fuel cycle and waste management. But proposals for wind farms, plants to generate electricity from wastes and overhead transmissions lines have also met strong opposition.

10.78 Recovery of the carbon dioxide produced at power stations and its injection into underground strata could have a part to play in countering climate change. But that would also lead to significant increases in the price of electricity. There is likely to be debate about the safety and sustainability of disposing of carbon dioxide in this way, and there may be public opposition to the installations required for recovery, transport and injection.

10.79 Without a general acceptance of the need for major emission reductions there are likely to be continuing difficulties and delays in obtaining authorisation for any form of new energy project, while policies and financial instruments for reducing energy demand may also face strong opposition. There needs to be much greater awareness, and much more debate, about the challenge of climate change and the case for major reductions in emissions. We hope this report

will contribute to a much wider understanding of the issues involved. The ways in which this debate is conducted must allow for deliberations of a high standard and be capable of articulating deeply held values. We have described in our report on environmental standards some approaches that might be deployed in order to achieve that.

10.80 The great majority of recommendations in this report are aimed at government. We accept, however, that government will not be able to introduce the policies needed to achieve sustained and deep cuts in emissions without increased public awareness about the dangers of climate change and the means of addressing the challenge.

10.81 There is an important role for government in increasing that awareness, but it cannot act alone. It falls also to politicians of all parties, to the press and broadcasters, to local authorities, educators, voluntary organisations, local government, industry and commerce to spread awareness and understanding of the threat and of the options for countering it.

10.82 People and organisations should be encouraged to take responsibility for making their own reductions in fossil fuel consumption. But the framework in which energy and environment policies are devised must ensure that sectors which are emitting large quantities of carbon dioxide are likewise committed to reductions. If this is not the case, many people will not feel inclined to 'do their bit.'

10.83 In the medium term the measures needed to achieve the very large emission reductions that are necessary may add appreciably to the price of energy services, whether they take the form of regulation or economic instruments such as a carbon tax or tradeable emission quotas. The increased price of using fossil fuels would both substantially reduce the demand for energy and encourage the development of alternative energy sources or techniques for recovery and disposal of carbon dioxide. The higher price that would be paid by energy users would impose three distinct types of cost. The first would be borne by those who reduced their demand for energy, making some sacrifice as a result. Most people and businesses would, however, decide not to cut their energy consumption by the full amount needed to maintain their bills at the previous level. The second type of costs would be the payments made in taxes, if the higher price was the result of a carbon tax. These would provide extra revenues for the Treasury, which would be available to replace other taxes or finance additional public expenditure; there is therefore unlikely to be a substantial net cost to society over the medium to long term. The third type of costs is the cost of the additional resources required to supply energy without emitting carbon dioxide to the atmosphere.

10.84 From the evidence we have received it seems likely that a carbon tax that doubled the price of energy from fossil fuels could, in the medium to long term, very substantially reduce carbon dioxide emissions by reducing energy demand or by eliciting substitution of carbon free sources of energy. We estimate that, at present prices, energy accounts for about 7% of global economic output. An extreme case would be that of a carbon tax which doubled the global price of energy from fossil fuels, had no effect on overall energy use while inducing complete displacement of fossil fuels or complete capture and disposal of all of their carbon dioxide emissions. If so, it might almost double the resource cost of energy supplies. Thus 7 % would be an upper limit to the additional proportion of world resources required to achieve emission reductions of the magnitude required to respond to the challenge of climate change. If real global output grew by anything over 2% a year, this programme would, at most, set back the net production of other goods and services cumulatively by some three years. It would, in other words, absorb some three years worth of global economic growth. This seems a reasonable

price to pay to reduce the environmental dangers set out in Part I of this report. Given the scale of the risk humanity is running in altering climate, it would not be excessive as an insurance premium even if climate change turns out to have less impact than we currently envisage.

10.85 We are not arguing for a rapid doubling of fossil fuel prices; this would have unacceptable distributional effects and leave assets stranded. We are maintaining that a range of measures, including economic instruments, which substantially reduced the demand for energy and brought about the large-scale deployment of non-fossil fuel sources over the coming decades would be acceptable even if they did raise the price of energy services significantly, albeit gradually.

To knowingly cause large-scale disruptions to climate would be unjust and reckless. We stand on the threshold of doing just that. If the United Kingdom cannot demonstrate that it is serious about doing its part to address this threat, it cannot expect other nations – least of all those which are much less wealthy – to do theirs