FORGING AN ENERGY POLICY FOR SUSTAINABLE DEVELOPMENT

A Paper for the Energy Policy Review of the UK Government

from

THE SUSTAINABLE DEVELOPMENT COMMISSION

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Executive Summary

The Performance and Innovation Unit (PIU) of the Cabinet Office is currently engaged in an Energy Policy Review, for which this paper is a submission from the Sustainable Development Commission. The Review is focusing on the issues of diversity and security of energy supply, of meeting environmental objectives, especially in respect of large cuts in carbon emissions, and of managing the potentially conflicting economic and environmental policy goals for energy prices.

The Commission believes that sustainable development should be the central organising principle guiding policy choices on all issues and at all levels of government. For the purposes of this exercise we have derived six more specific criteria of sustainable development for energy policy, as follows:

- integrating the economic, social and environmental dimensions of quality of life
- respecting biophysical limits
- making the polluter pay
- protecting and enhancing UK competitiveness
- promoting social justice and inclusion
- achieving energy security.

In Part 1 of this paper we assess current energy policy, and three of the major low-carbon energy options for the UK – energy efficiency, renewables and nuclear power – against these criteria. The assessment draws on the detailed policy analysis which is in Part 2 of the paper. Our conclusion is that a combination of energy efficiency and new renewable energy sources performs strongly against all the sustainable development criteria and is the first choice when it comes to meeting the energy demand and supply challenges of the future in a manner consistent with sustainable development. The building of new nuclear power stations performs substantially less strongly against the sustainable development criteria used. To promote sustainable development, therefore, Government should concentrate its policies and resources on increasing energy efficiency and developing and deploying renewable energy technologies.

From Part 2 of the paper it is clear that, despite current Government policies and targets for energy efficiency and renewables, important barriers to their widespread implementation remain. The targets will be met, and further emission reductions achieved, only if the policies are extended and intensified, and an appropriate institutional framework is put in place, to manage the whole development of the UK energy system – including power generation, industry, households and transport – in an integrated, co-ordinated and consistent way. Recommendations follow as to the kinds of policies and other initiatives which the Commission believes to be necessary to achieve this.

The Commission is persuaded that, if these recommendations are followed, energy efficiency and renewables have ample technical and economic potential to put the UK economy on a low-carbon trajectory without harming its competitiveness and to satisfy the demand of UK citizens for energy services. The building of new nuclear stations should not be necessary to meet these objectives, and may only be perceived to become so if Government fails to realise the potential of energy efficiency and renewables. The Commission strongly expects the Government, in line with its commitment to sustainable development, to ensure that this does not happen.

RECOMMENDATIONS

Energy efficiency

- Much more ambitious energy efficiency measures than those in the Climate Change Programme (CEP) will be required if the UK is to achieve the annual reductions in carbon intensity of more than 4% pa (up to four times current rates of reduction) which will be needed to meet a 60% reduction in carbon emissions by the middle of this century.

Efficiency Potential and the Rationale for Intervention

- Energy efficiency scores highly against each of the sustainable development criteria and can simultaneously meet economic, environmental and social objectives. The Energy Policy Review should therefore give equal weight to issues of energy demand and energy supply. This will help redress the lack of attention to energy demand issues that has characterised energy policy to date.
- Evidence suggests that energy demand could be reduced by as much as a third through investments that are cost effective at current energy prices. However, investment in energy efficiency is inhibited by a range of market and organisational barriers. Many of these barriers can be cost effectively overcome through government intervention. For instance, the Advisory Committee on Consumer Products and the Environment has recommended a family of graded energy labels, comprising: a co-ordinated energy labelling regime covering cars, homes and domestic equipment; a car rating label for fuel efficiency and CO_2 emissions; home energy rating information for purchasers of all homes; and energy rating and labelling to be extended into other product ranges. (ACCPE, 1999) An effective policy response requires a combination of policies which can act in synergy.
- Internalising the environmental costs of energy use in energy prices will increase the cost effective potential and stimulate technical innovation and will be essential for the achievement of a transition to a low carbon economy. Economic instruments such as carbon/energy taxation and emissions trading therefore have a central role to play. Concerns over equity and competitiveness have some validity, but suitable measures are available to overcome them.

Policies for Industry

- The Climate Change Levy (CCL) and negotiated agreements represent the most important developments in UK energy efficiency policy since the 1970's, but have led to an over-complex policy mix. This could be resolved by making it clear that the negotiated agreements are a transitional measure. Future policy in the industrial sector should be based on a combination of emissions trading (with the progressive introduction of permit auctioning) and an upstream carbon/energy tax.

Policies for the Public and Commercial Sector

- The public and commercial sector is relatively neglected in the CCP, despite strong emissions growth. Measures are particularly required to overcome the landlord-tenant barrier in commercial buildings and to encourage the adoption of energy targets in public buildings.
- A critical issue is the increasing energy intensity of new non-domestic buildings. While building regulations have a role here, the delivery of innovative green buildings will require more far-reaching reforms in the organisation of the construction industry.

Policies for the Domestic Sector

- Energy use in the domestic sector is being driven upwards by a number of powerful trends. In addition, a wide range of barriers prevent households from making cost effective investments in energy efficiency, and the poor quality of the UK housing stock contributes to widespread fuel poverty. The initiatives in the CCP do not address these problems to an adequate extent. Future policy requires a systematic effort to overcome barriers, strict regulations on new construction, the accelerated development of energy service provision, and the introduction of domestic energy taxes with suitable compensation measures to protect low-income groups.

Policies for the Transport Sector

- Transport provides the greatest challenge to the transition to a low carbon economy. The extent of changes needed for a low carbon economy may require more fundamental reforms than are included in the 10 Year Plan. At present, the plan gives insufficient priority to bus services, walking and cycling.
- Long-term policy must simultaneously encourage alternative fuels, reduce energy intensity, promote modal shifts and reduce the need to travel, including through land use planning. Energy considerations need to be integrated into all aspects of transport decision-making.

Renewables

- A sustainable development assessment of renewables suggests that, provided these technologies can be developed to be broadly competitive, and they are sited and deployed with sensitivity to local concerns, they are the energy supply option most consistent with the sustainable development criteria applied.
- Both the Government's 2010 target of 10% electricity generation from renewables, and the renewables scenario to 2050 set out by the Royal Commission on Environmental

Pollution (RCEP), imply unprecedented rates of growth from these technologies. However, three barriers to the deployment of renewables threaten their short-term deployment and long-term development: planning constraints, which are especially affecting onshore wind projects, the treatment of embeddedness, and the New Electricity Trading Arrangements (NETA). Neither the 2010 target for renewables generation, nor their much greater deployment envisaged by the RCEP thereafter, will be achieved unless these problems are satisfactorily resolved.

- The Renewables Obligation (RO) may not give renewables generators the required signals and incentives to develop technologies that are currently further from market competitiveness, or the confidence to plan for the long term. The introduction of technology banding should be reconsidered for the RO, and higher obligations should be set for the years after 2010.

Policy Impacts And Institutional Implications

- Both Government data and economy-environment modelling suggest that the UK can make the transition to a low-carbon economy using a combination of energy efficiency measures and renewables which, over twenty years, will yield net benefits rather than costs to the economy.
- For the necessary policy measures to be forthcoming, however, a fundamental institutional reorganisation of bodies concerned with energy policy is likely to be required. While the Commission does not endorse any particular proposals for institutional change, a number of promising models have been put forward which seem to combine the necessary systems approach, co-ordination and integration. For instance, the RCEP has recommended 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". (RCEP, 2000) This is an area in which the PIU needs to make authoritative recommendations for timely implementation.
- Energy systems generally are now at a potential historical turning point, driven as much by technological changes as by environmental or other considerations, where they could either become consolidated in a centralised form following most of the experience of the last century, or begin a long-term process of decentralisation and dispersion in favour of more locally based forms of power generation, in particular. The UK is currently ill prepared for this latter possibility. The PIU Energy Policy Review should take the opportunity of showing how it could remedy this situation.

1. Introduction

- The role of the Sustainable Development Commission (SDC) is to advocate sustainable development across all sectors in the UK, review progress towards it, and build consensus on the actions needed if further progress is to be achieved. Our strategic objectives are:

- To advocate a compelling vision of a sustainable economy and society
- To review how far sustainable development is being achieved in the UK across all sectors.
- To identify the opportunities for, and obstacles to, step changes for sustainability by government, business and the media.
- To promote mechanisms which will deliver a sustainable society.
- To advance innovative approaches to policy making and encourage wider participation.
- To mainstream the principles and practices of sustainable development and to support and encourage leadership and best practice in all sectors of society.

This paper is based on work carried out for the Commission by Professor Paul Ekins of the Policy Studies Institute and Dr Adrian Smith and Steven Sorrell of SPRU, Sussex University. It first of all sets out, in the next section, what the Commission understands by sustainable development, in terms of both broad principles and some more specific criteria against which Government policies and practices may be evaluated. It then assesses in section 3 the broad thrust of current energy policies against these criteria and draws some conclusions as to how these policies should be changed, in general terms, in order to be consistent with sustainable development principles and to contribute to it more effectively in practice.

Section 4 contains sustainable development assessments of energy efficiency, renewable energy sources and nuclear power, which are the major options for reducing carbon emissions available to the UK. This section should be read in conjunction with Part 2, which considers the policy options in respect of energy efficiency and renewables in some detail, in the context of the Government's carbon reduction targets to 2010 and the recommendation from the Royal Commission on Environmental Pollution (RCEP) that the UK should seek to reduce its carbon emissions by 60% by 2050. Part 2 also sets out some of the issues relevant to nuclear power and sustainable development. And it identifies issues which need to be addressed and offers possible ways forward.

The final section of Part 1 draws out some broad conclusions and recommendations about the nature and shape of an energy policy that will promote sustainable development. The Commission will, in due course, evaluate the conclusions and recommendations of the Government's Energy Policy Review against its own.

2. Principles of Sustainable Development

The extensive work carried out by policy makers and others over the last ten years has resulted in the definition and clarification of the concept of sustainable development, such that there is now broad agreement that sustainable development is a process that exhibits the following characteristics:

- It enables people, now and in the future, to satisfy their basic needs, especially with regard to those people who are presently furthest from such satisfaction.
- It enables people, now and in the future, progressively to realise their potential and improve their quality of life, which is recognised to have economic, social and environmental dimensions.
- It protects and enhances the Earth's life-support systems, now and in the future, especially those which are fundamental to basic needs satisfaction and human quality of life.

At root, therefore, sustainable development is a process which seeks to ensure that the fruits of development are both widely shared across the current generation, and generated in such a way that future generations have at least the same development opportunities as exist at present, especially in respect of the environment and natural resources.

On the basis of such considerations, the Government has adopted four over-arching objectives of sustainable development:

- Social progress which recognises the needs of everyone;
- Effective protection of the environment;
- Prudent use of natural resources; and
- Maintenance of high and stable levels of economic growth and employment.

The Government considers that sustainable development requires that these four objectives be met at the same time.

The Commission notes that it is a radical departure for public policy to place environment and resource objectives at the same level of policy priority as economic (especially) and social objectives. It is to be hoped that this broadening of objectives will reveal many instances, hitherto overlooked, in which economic, social and environmental goals can be simultaneously pursued and achieved. The Commission is enthusiastic about this possibility and will always seek in its conclusions and recommendations to identify and promote such desirable outcomes. This integration of economic, social and environmental objectives will be one of the hallmarks by which sustainable development policies will be recognised and through which sustainable development will be achieved.

However, political realities suggest that the mere adoption of environmental alongside economic and social objectives will not enable all three sets of objectives to be achieved, for everyone, all of the time. Very difficult decisions about winners and losers, now and in the future, will remain. In particular, there will be times in the future when social and economic priorities will conflict with respect for environmental limits, as they have in the past. The Commission considers that, unless significantly more decisions in such cases are taken in favour of the environment than has hitherto been the case, and the necessary adjustments are made to economic and social objectives, there is little prospect of the reality of 'sustainable development' differing much from its unsustainable predecessor. In essence this means not just integrating environmental, economic and social dimensions of sustainable development into all policy processes, but of striking the balance between them in such a way that the environmental dimension is given substantially increased weight.

In order to pursue the objectives of sustainable development it is helpful to have some guiding principles and approaches. Those put forward by the Government are set out in Box 2.1.

It is clear that these principles still leave plenty of room for different interpretations of many of the key ideas which they embody, and therefore for different policy conclusions based on them. There will still be many difficult and contested decisions to be taken in respect of, for example:

- Sharing economic and environmental resources within and between different generations of people
- Arguing for long-term sustainable development objectives even when they conflict with other short-term aspirations
- Seeking to ensure that the aspirations of some people for an enhanced quality of life through increased consumption do not reduce the life opportunities of others, now and in the future.
- Defining the environmental limits which should not be breached.
- Deciding when to invoke the precautionary principle.
- Calculating how much polluters (consumers) should pay, and persuading or legislating for them to pay it, consistent with ability to pay and other considerations of social justice.

If much of development in the past has been unsustainable it is because policy makers have either not considered, or have shied away from, these difficult issues, for reasons which may be politically understandable but which, for the long-term public good, can no longer be allowed to be the main determinants of policy.

Box 2.1 UK Government: Guiding principles and approaches to sustainable development

Putting people at the centre. Sustainable development must enable people to enjoy a better quality of life, now and in the future. In the words of the *Rio Declaration*, 'human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature. **Taking a long-term perspective**. Sustainable development thinking cannot restrict itself to the life of a Parliament, or the next decade. Radical improvements have to begin now to safeguard the interests of future generations. At the same time we must meet today's needs — for example, people need warm homes, which, at present, means using predominantly fossil fuels. **Taking account of costs and benefits**. Decisions must take account of a wide range of costs and benefits, including those which cannot easily be valued in money terms. In pursuing any single objective, we should not impose disproportionate costs elsewhere. Public values, the timing of costs and benefits and risks and uncertainties should be taken into account. **Creating an open and supportive economic system**. Sustainable development requires a global economic system which supports economic growth in all countries. We need to create conditions in which trade can flourish and competitiveness can act as a stimulus for growth and greater resource efficiency. **Combating poverty and social exclusion**. Eradicating poverty is indispensable for sustainable development. We must help developing countries to tackle widespread abject poverty. In this country, everyone should have the opportunity to fulfil their potential, through access to high quality public services, education and employment opportunities, decent housing and good local environments.	**Respecting environmental limits**. Serious or irreversible damage to some aspects of the environment and resources would pose a severe threat to global society. Examples are major climate change, overuse of freshwater resources, or collapse of globally significant fish stocks. In these cases, there are likely to be limits which should not be breached. Defining such limits is difficult, so precautionary action needs to be considered. **The precautionary principle**. The *Rio Declaration* defines the precautionary principle as 'where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'. Precautionary action requires assessment of the costs and benefits of action, and transparency in decision-making. **Using scientific knowledge**. When taking decisions, it is important to anticipate early on where scientific advice or research is needed, and to identify sources of information of high calibre. Where possible, evidence should be reviewed from a wide-ranging set of viewpoints. **Transparency, information, participation and access to justice**. Opportunities for access to information, participation in decision-making, and access to justice should be available to all. **Making the polluter pay**. Much environmental pollution, resource depletion and social cost occur because those responsible are not those who bear the consequence. If the polluter, or ultimately the consumer, is made to pay for those costs, that gives incentives to reduce harm, and means that costs do not fall on society at large. At the same time, it may not always be possible for everyone to bear all such costs, particularly for essential goods and services.

Source: DETR 2001, p.19

The Commission believes that sustainable development should be the central organising principle guiding policy choices on all issues and at all levels of government. Within this overall approach, the Commission is developing its own set of sustainable development principles and criteria against which it will evaluate Government policy and practice. As an interim measure, and for the purposes of the current exercise only, we have devised the set of criteria set out below (Box 2.2).

Box 2.2 SDC criteria for judging energy policies for their contribution to sustainable development

- *Integrating the economic, social and environmental dimensions of quality of life*: have all these dimensions been explicitly considered in such a way as to exploit any synergies, and avoid any trade-offs, between them wherever possible?
- *Respecting biophysical limits*: where the policies are not designed actually to benefit the environment, do they at least ensure that the environment is protected and resources used in such a way that serious or irreversible environmental damage is avoided, potentially dangerous thresholds of environmental impact are not exceeded and important environmental functions are maintained for future generations to enjoy?
- *Making the polluter pay*: do the policies seek to ensure, where relevant, that environmental costs are progressively internalised into the activities responsible for them, and that incentives progressively encourage more environmentally sustainable behaviour and discourage the reverse?
- *Protecting and enhancing UK competitiveness*: where the policies are not explicitly designed to promote it, have the impacts of the policies on the competitiveness of the UK economy as a whole been evaluated, and the policies formulated to make these impacts as positive as possible? Where the impacts are potentially negative, have counter-measures been put in place to avoid this?
- *Promoting social justice and inclusion*: do the policies contain measures which enable those currently excluded from important aspects of economic and social life (such as employment) to gain access to or play a fuller part in them? And do they enable all of us to have more control over those elements which affect our lives most directly?
- *Achieving energy security*: do the policies ensure that the UK's essential needs for energy are securely met, in terms of security of access, distribution and supply, and in terms of vulnerability to accident or attack?

It is with these criteria in mind that the Commission proceeds to evaluate current energy policy.

3. Current UK Energy Policy and Sustainable Development

3.1 BACKGROUND

UK energy policy has gone through many permutations in the last forty years, in response to both changes in prevailing policy approaches and external events. The 1960s were characterised by cheap oil and the early, optimistic development of nuclear power. They were uncomplicated years in energy terms, which were brought abruptly to an end in the 1970s by the OPEC price rises, the emergence of environmental opposition to nuclear power, and the Three Mile Island nuclear accident in 1979.

The 1980s saw the UK emerge as a major oil producer, with the industry surviving an oil price which fell as abruptly in mid-decade as it had risen in the 1970s. The development of UK nuclear power was halted by a combination of excessive costs and public concern, heightened by the Chernobyl accident, which was reflected in enormously extended public inquiries. UK coal production went into long-term decline.

Towards the end of the decade the privatisation of the energy utilities and the liberalisation of energy markets got under way, and these were to prove the dominant UK energy themes of the 1990s. The UK enjoyed broad energy self-sufficiency in fossil fuels, the prices of which for businesses and households stayed low or fell. Gas replaced coal as the major fuel for power generation. Public support for the construction of new nuclear power plants was temporarily ruled out by the Government's nuclear review in 1995 (HMG, 1995), and the first significant public support for the market development of renewable energy sources was expressed through the Non-Fossil Fuel Obligation (NFFO). Such support was, however, exceptional and very much against the main grain of energy policy in this decade, which was broadly to leave decisions to the energy markets, with these being regulated where it was perceived that competition was not yet adequately developed. More recently a number of longer-term programmes were developed and then adopted in areas related to energy, most notably the Climate Change Programme (CCP, DETR, 2000a) and the Fuel Poverty Strategy (DETR, 2001b). While the CCP envisaged that significant cuts in CO_2 emissions from 1990 levels could be achieved by 2010, emissions were projected to rise again thereafter, partly as a consequence of the closure of nuclear power stations. This raised serious questions about the feasibility of the 60% cut in carbon emissions by 2050, as proposed in the twenty-second report of the RCEP, *Energy - the Changing Climate* (RCEP, 2000).

Towards the end of the decade it became clear that UK oil and gas production would decline in the following decade, leaving the UK once more a significant importer of oil and gas. By 2020 the great majority of these fuels would need to come from other countries. Their supply will also be increasingly geographically concentrated in OPEC countries or in countries with a recent history of political instability.

In June 2001, soon after the last General Election, the Government initiated an Energy Policy Review, to be conducted by the Cabinet Office's Performance and Innovation Unit (PIU). The Scoping Note of the Review (PIU, 2001a) defines the three key challenges which the Review seeks to address as:

- *Managing potential conflict with environmental objectives*. Meeting the long term targets for emissions reductions, whilst ensuring future projections for energy demand are met, will require fundamental changes in energy and fuel markets, the management of energy demand, the development of new technologies, and infrastructure and policy;
- *Ensuring continued security and diversity of energy supplies over the long term* including ensuring appropriate investment incentives to maintain sufficient spare capacity to be able to cope with supply shocks, especially within the regulatory regimes for the energy utilities; and
- *Managing potentially conflicting policy goals for energy prices*. Higher energy prices could be a potent instrument for advancing environmental objectives but they are in potential conflict with fuel poverty and industrial competitiveness objectives.

The relevance of these challenges to sustainable development is clear. The next section describes how current energy policy is seeking to respond to those challenges. Section 3.3 assesses this current policy in relation to the sustainable development criteria set out earlier.

3.2 CURRENT ENERGY POLICY

The Government describes its overall energy policy objective as "ensuring secure, diverse and sustainable supplies of energy at competitive prices" (DTI, 2000a, p.4), and envisages that competitive energy markets have a key role to play in achieving this objective. A major proportion of its energy policy efforts in the last two years has focused on bringing into force the Utilities Act 2000, which is mainly concerned with the creation, operation and regulation of gas and electricity markets, including provisions to ensure that social and environmental considerations can be taken into account.

Annex 1 of the PIU Scoping Note gives some basic facts about current UK energy use and projections, selections from which are given here with other relevant information for convenience. Primary energy use in the UK over the past two decades has risen steadily (at a rate of over 0.5% pa), though well below the trend rate of growth of GDP (of 2.5%). Within this, the contribution of different energy sources has changed considerably. Over the last two decades, coal's share has halved whilst that of gas has almost doubled. These trends are expected to continue over the next two decades, with nuclear power's share falling (as nuclear power plants are decommissioned) and renewable energy taking a modestly increasing share. By 2020, on current policies, nearly half of the UK's energy needs will be met by gas with coal accounting for just over 6%, renewables 4% and nuclear power 3%. The balance will be met by oil which accounts for a steady 35-40% of UK energy demand throughout the period.

The three major energy-using sectors are industry, households and transport. The main sectoral trends here are the substantial growth in energy consumption accounted for by transport and the more modest growth in the domestic sector (due both to increasing household numbers and increasing demand for energy in the home) and steady or declining energy consumption by industry.

UK CO_2 emissions come from four main sources: power stations (26% of 1998 emissions), industry, commerce and public administration (31%), transport (22%) and households (14%). The balance of 7% comes from land use change, forestry, military sources, and various fugitive emissions (DTI 2000c, p.252). A comparison between trends in primary energy consumption in the UK with trends in CO_2 emissions by fuel highlights the benefits of the switch from coal to gas in reducing CO_2 emissions but, by 2010, CO_2 emissions are projected to rise again as energy demand continues to increase and as nuclear's share falls. Data on trends in energy prices set out in Table 3.1 show that, compared with the price of other goods and services in the economy, energy prices have in general fallen considerably in real terms. This is partly because of favourable circumstances in global energy markets (e.g. low oil prices, at least until recently) and partly because of privatisation and the regulatory regime created for the energy utilities. Post-tax petrol prices are the exception to this picture of generally falling energy prices in recent decades – Table 3.1 shows that they increased by 44% in real terms between 1990 and 2000.

Table 3.1: Trends in Real UK Energy Prices by Fuel, 1990 – 2000 (1990 = 100)

	1990	**1995**	**1999**	**2000**
Domestic Sector				
Coal	100	100.6	94.8	94.7
Oil	100	75.7	68.0	93.7
Gas	100	94.7	80.5	77.2
Electricity	100	101.7	81.6	78.1
Industrial Sector				
Coal	100	73.1	60.6	59.9
Oil	100	95.8	85.2	126.3
Gas	100	76.1	55.0	58.6
Electricity	100	91.8	73.8	67.8
Transport				
Petrol	100	110.4	129.7	144.1

Source: PIU 2001, Annex 1, Table 4

The PIU Scoping Note splits current Government energy policies into two main areas:

1. *Policies to improve the security and diversity of energy supplies:*

- measures to promote energy efficiency and renewables;
- clean coal technology initiatives;

- reform of the operation of the electricity market to remove distortions which encouraged investment in gas-fired power generation at the expense of existing coal fired plant;
- a temporary policy of stricter consents for new gas-fired power stations from end 1998 to end 2000, followed by a short term subsidy for the UK coal industry, 2000/01-2001/02;
- the energy regulatory framework and its role in promoting competitive markets;
- a joint government/industry effort through PILOT to increase UK oil and gas production;
- promotion of greener transport fuels, including renewable biofuels.

2. *Policies to lessen the environmental impacts of energy consumption:*

- the UK Climate Change Programme to meet the UK's Kyoto target and move towards the domestic carbon dioxide goal (both described further below). Some of the key measures include:
  - ◊ implementation of the Kyoto Protocol of the UN Framework Convention on Climate Change;
  - ◊ a target for renewable energy of 10% of electricity generation by 2010;
  - ◊ the renewables R & D programme;
  - ◊ a target for Combined Heat and Power (CHP) of 10 GWe capacity by 2010;
  - ◊ support for the Energy Saving Trust and the establishment of the Energy Efficiency Commitment, and other measures to improve energy efficiency and tackle fuel poverty in the domestic sector;
  - ◊ the Climate Change Levy (CCL) and associated agreements to improve energy efficiency in energy-intensive sectors;
  - ◊ establishment of a UK emissions trading scheme;
  - ◊ the new Carbon Trust;
  - ◊ enhanced capital allowances for energy saving products;
  - ◊ the 10 Year Transport Plan and promotion of alternative fuelled vehicles.

It can be seen that some of the policies (on energy efficiency, renewables, alternative transport fuels) are included in both categories. Many of the policies are complex and several are considered in more detail in Part 2. Here the overall policy mix will be reviewed against the sustainable development criteria developed earlier. Individual policies will be outlined as necessary, and any policy gaps or conflicts briefly noted.

3.3 A SUSTAINABLE DEVELOPMENT ASSESSMENT OF CURRENT ENERGY POLICY

It is obvious that access to energy is fundamental to the social and economic dimensions of sustainable development. With regard to the former people need energy for warmth, light and power in their homes, and for mobility. With regard to the latter industry and commerce also need energy for heat, light and power and for transport of the goods they both need and produce. The first point to be emphasised is that the energy services of heat, light, power and transport are not delivered only by energy (fuels), but through *energy systems*, comprising infrastructure (for example, electricity grids and networks, gas supply networks,

buildings, roads and railways) and appliances (for example, freezers and washing machines, boilers and fires, light bulbs, and motor cars), as well as fuels. Delivering an energy service efficiently in both economic and environmental terms requires energy policy to address systematically the whole energy system, and not just the fuel supply.

A second initial point concerns the demand for energy. As noted above, and as described in more detail in Part 2, energy demand in both transport and the domestic sector has grown as demand for energy services in these sectors, and household numbers, have grown. Policy approaches in the past that have sought simply to accept and accommodate these demands have proven, especially in respect of road transport, to be unable to deliver the increased level of energy service demanded. For example, with respect to road transport congestion has proved an insurmountable barrier to many of people's aspirations for greater mobility through car ownership and use. Such policy approaches have also resulted in health-damaging levels of pollution and have increased the CO_2 emissions that are the principal cause of climate change. An energy policy that seeks to address these problems, and one that is consistent with the environmental dimension of sustainable development, will need to manage, and sometimes constrain, energy demand.

This is so because all energy technologies are associated with potentially damaging environmental impacts:

- The extraction of fossil fuels can damage landscapes, cause pollution and damage health; their combustion causes air pollution which is the major contributor to respiratory health problems, acid rain and global climate change.
- Nuclear power is associated with actual and potential negative environmental and health impacts at all stages of the nuclear fuel cycle, from the mining of uranium, to the fabrication of the fuel, to radioactive emissions and the risk of accidents during operation, to the disposal of nuclear wastes and the decommissioning of power stations.
- Renewable energy sources are delivered by a variety of technologies, all of which can have negative environmental impacts. Some of the most important are the visual impact and noise associated with onshore wind turbines, the potential ecological impacts of oceanic and tidal technologies, and the transport and agricultural issues associated with energy crops.

The Government's overall energy policy objective of "ensuring secure, diverse and sustainable supplies of energy at competitive prices" deals, therefore, at best with only half the energy policy picture. An overall energy policy objective more in tune with sustainable development might be:

> *"ensuring that the demand for energy services and the systems through which they are delivered are managed in such a way that the demand can be met by secure and diverse supplies of energy, which are delivered at competitive prices for industry, which are accessible to all households for the satisfaction of their basic needs, and which are produced and consumed in ways that do not damage human health or have serious and irreversible negative effects on the environment."*

In practice, as the PIU list of policies above reveals, the Government does have policies that address issues of energy demand and energy systems, as well as energy supply. But the policy as stated runs the risk of treating demand and system issues as an afterthought, or as independent issues, rather than as the fundamental issues for prior consideration, the outcomes of which determine the context for energy supply decisions, rather than the reverse. An example of this is the way the New Electricity Trading Arrangements (NETA) militate against renewables and combined heat and power (CHP), rather than making special provision to promote them, in line with Government policy. This will be discussed further below.

The policies will now be considered against the sustainable development criteria, which were set out above, in turn:

Integrating the economic, social and environmental dimensions of quality of life

- *have all these dimensions been explicitly considered in such a way as to exploit any synergies, and avoid any trade-offs, between them wherever possible?*

As noted above, the Utilities Act 2000, which now sets the framework for much energy policy, did explicitly contain provisions for social and environmental, as well as economic, issues to be considered in energy policy. Indeed, the Secretary of State is currently consulting on the first detailed social and environmental guidance to be given to the energy regulator, OFGEM. In addition, OFGEM has its own Social and Environmental Action Plans. Clearly there will be different views as to whether the guidance is adequately strong, and whether the Action Plans are both adequate in themselves and likely to be implemented adequately. Consideration of this is beyond the scope of this paper, but it is possible to argue that these institutions at least are set up to give due consideration to social and environmental as well as economic issues.

However, this potential for the integration of social, environmental and economic considerations into energy policy has dramatically failed to be realised in practice at the very first occasion when it might have been expected, in NETA, which were implemented in March 2001. The way in which NETA, and associated network connection conditions, have been set up are militating heavily against both renewables generation and CHP, such that an award-winning CHP scheme has stopped electricity exports to the grid, carefully worked out CHP proposals with planning permission have been scrapped, and much renewables capacity is being rendered uneconomic. In addition, most of the wind projects that were awarded contracts under the Government's NFFO5 programme cannot get planning permission. It is astonishing that the Government should have permitted the establishment of a regulatory system that has erected such a barrier to the achievement of two of its key energy targets – more generation from renewables and CHP – in this way. Unless the planning system starts delivering permissions to wind projects, and NETA is swiftly amended to be more favourable to CHP and renewables, the contribution of these sources to the UK energy mix will remain far below their potential – and the Government's targets for 2010.

Equally problematic is the overall institutional structure related to energy and energy policy, which exhibits a worrying degree of fragmentation. This issue is complex, but is discussed in Part 2. It seems important that the Energy Policy Review considers these institutional questions in detail and makes recommendations which will ensure that an appropriate institutional framework is created which can promote sustainable energy use across all sectors and activities.

Respecting biophysical limits

- *where the policies are not designed actually to benefit the environment, do they at least ensure that the environment is protected and resources used in such a way that serious or irreversible environmental damage is avoided, potentially dangerous thresholds of environmental impact are not exceeded and important environmental functions are maintained for future generations to enjoy?*

Historically the use of fossil fuels expanded in a way that paid little attention either to human health or to impacts on the environment. The first of these issues to be addressed was the health impacts of air pollution, such that air quality, especially in cities, is now much improved from a few decades ago. However, unacceptable health impacts from such pollution, especially from road transport, still remain to be addressed. In the 1980s and 1990s the impacts on ecosystems from acid gases from fossil fuel combustion also began to be addressed, such that these impacts are also now much reduced, but, again, there is still further to go before the environment may be said to be protected from 'serious or irreversible damage'. Most recently the focus has turned to climate change. The analysis in Part 2 suggests that, through its CCP, the Government has done much to address this issue, but that its targets for 2010 are by no means sure of achievement. Significant new policies will be required if the UK is to ensure that carbon emissions do not start to increase again after 2010. This is, of course, one of the key challenges being addressed by the Energy Policy Review.

Making the polluter pay

- *do the policies seek to ensure, where relevant, that environmental costs are progressively internalised into the activities responsible for them, and that incentives progressively encourage more environmentally sustainable behaviour and discourage the reverse?*

One of the principal thrusts of current Government policy, as noted above, has been to reduce energy prices through the creation and maintenance of competitive markets. However, since 1997 the Government has also introduced a number of policies to make energy prices more reflective of their environmental costs. Most important in this regard have been the annual increases (inherited from the previous Government) to 1999 in road fuel duties, which have ensured that road fuel prices are unique among fuels in having increased in real terms through the 1990s; and the Climate Change Levy (CCL), implemented in 2001 after lengthy consultation, which applies to the business and commercial use of energy. Other policies have included environment-oriented changes in

Vehicle Excise Duty (VED) and the taxation of company cars. These and other policies are discussed in more detail in Part 2.

However, there are a number of areas where current energy policies do not attempt further to internalise environmental costs. These include:

- The treatment of the household use of energy, which has a low (5%) rate of VAT and is exempted from any other energy taxation. The Government's stated reason for this policy is to avoid negative impacts on low-income people, many of whom suffer from fuel poverty. However, the households which benefit most from this exemption are those which use most energy and which generally do not have low incomes and are not in fuel poverty. The energy prices they face give them very little incentive to consider energy efficiency measures or lifestyle changes to conserve energy. A higher rate of taxation of household energy would both increase this incentive and generate financial resources which could be used both to compensate fuel-poor households for the tax increase and to address more vigorously the poor building quality that is responsible for much fuel poverty in the first place. It is hard to see how the Government's policy in this area is consistent with this criterion of sustainable development.
- The cessation in 1999 of the annual increase in road fuel duties and the cuts in road fuel duties, coupled with subsidies to the road haulage industry, implemented in 2000 and 2001. The reasons for these policies were the increases in world oil prices in 1999 and the road fuel tax protests in summer 2000. The freezing of the level of road fuel duty could have been justified in relation to sustainable development if it had been accompanied by a commitment to restart the increases if world energy prices fell. However, no such commitment was given and road fuel taxes have not been increased following recent oil price falls. The tax cuts and subsidies in this area were incompatible with this sustainable development criterion, and represented a political failure to present the increases in road fuel duty as a long-term environmental necessity rather than an opportunity to increase Government revenue by 'stealth'.
- The continuing zero taxation on aviation fuel (the result of complex international treaty obligations) and the failure to make this industry, which is emerging as the most rapidly increasing source of carbon emissions, internalise its environmental costs in other ways. This is a major failure in respect of this criterion of sustainable development, which may or may not be addressed in the White Paper on Aviation which the Government is currently preparing.

Protecting and enhancing UK competitiveness

- *where the policies are not explicitly designed to promote it, have the impacts of the policies on the competitiveness of the UK economy as a whole been evaluated, and the policies formulated to make these impacts as positive as possible? Where the impacts are potentially negative, have counter-measures been put in place to avoid this?*

Probably the strongest strand in current Government energy policy, which was at the heart of the Utilities Act 2000, is its attempts to create and maintain competitive energy markets. There is little doubt that this has contributed to the downward falls in energy prices since 1999 shown in Table 3.1, though with regard to oil and the industrial use of gas (but not yet electricity) these falls have been offset by increases in world prices.

Other things being equal, low industrial energy prices are usually considered to be good for competitiveness. However, expectations of continuing low fossil fuel energy prices have undoubtedly not promoted energy conservation, energy efficiency or alternative no-carbon fuels. This tension between the desirability of low energy prices for competitiveness reasons, and higher prices that internalise environmental costs and give incentives for energy conservation and efficiency, and renewables, is one of the central dilemmas of modern energy policy. It found its most contested expression in the Government's CCL, its tax on the business and commercial use of energy.

The CCL was strongly criticised by business as being harmful to UK industrial competitiveness. To address this the Government has negotiated Climate Change Agreements (CCAs) with 41 industrial sectors, which grant them exemption from 80% of the CCL if they achieve certain carbon reduction targets beyond business-as-usual projections. There have been no suggestions from the sectors concerned that these agreements, and the 20% CCL for which they are still liable, will have significant effects on their competitiveness. Indeed, there is some debate as to whether the CCAs are stringent enough in terms of the carbon reductions they require. Some sectors, which were not eligible for CCAs, have protested that the CCL will have a serious impact on their competitiveness.

The revenues from the CCL are mainly being returned to business through a 0.3% reduction in employers' National Insurance contributions (NICs). This means that many businesses (which have higher labour than energy intensities) are better off, and therefore more competitive, because of the CCL. This is an aspect of the CCL that is very rarely mentioned by business, but which is absolutely critical to the overall effect of the CCL on the UK economy. There are no reasons for thinking that the CCL as implemented will have a negative overall effect on the UK economy. In fact, because the NIC reductions lower the cost of labour to UK business, and may therefore be expected to increase employment, there are good reasons to believe that its overall effect on UK GDP will be small, but positive.

The Government should make clear in situations of this kind that promoting the competitiveness of the UK economy as a whole is very different from seeking to cushion every sector from the effects of environmental policies. Internalising environmental costs will inevitably affect some sectors (those that generate the costs) more than others. What is important is that the most affected sectors are given adequate time and incentives to make the transition towards sustainability, while the rest of the economy is also encouraged to innovate and develop in a way that reduces environmental costs. A tax shift such as the CCL is often an effective way to achieve this.

The CCL/CCA package shows that the Government gave very serious consideration to competitiveness issues in its implementation of the CCL. The judgement of the Commission on this issue is that valid concerns were effectively addressed, though at the cost of formidable policy complexity which is explored in some detail in Part 2.

Promoting social justice and inclusion

- *do the policies contain measures which enable those currently excluded from important aspects of economic and social life (such as employment) to gain access to or play a fuller part in them?Do they enable all of us to have more control over those elements which affect our lives most directly?*

It was noted above that the CCL was implemented in such a way that it was likely to promote employment, by decreasing the cost of labour. It may also be noted that the Government has two major home energy efficiency schemes (the New Home Energy Efficiency Scheme (New HEES) and the Energy Efficiency Commitment) which are oriented towards vulnerable households. Its Fuel Poverty Strategy (DETR, 2001b) commits it to eliminating fuel poverty in these households by 2010. This is an ambitious, but achievable, commitment, which is certainly in accordance with this criterion of sustainable development.

However, this sustainable development criterion goes beyond simply seeking to ensure affordable warmth for vulnerable households, important though this is. It is also concerned with enabling these, and all other, households to participate more in the social choices relating to energy, and to have more influence over the decisions in this area that affect their lives. New technological developments such as local renewables and domestic-scale CHP will offer unprecedented opportunities for more decentralised, community-based energy systems in the future, with large potential savings due to increased energy efficiency and reduced transmission and distribution losses. There is at present very little evidence that the Government is aware of these opportunities, and none that it is actively seeking to promote them. This is a major component of a sustainable energy policy in which the Government needs to make progress in the future.

Achieving energy security

- *do the policies ensure that the UK's essential needs for energy are securely met, in terms of security of access, distribution and supply, and in terms of vulnerability to accident or attack?*

The UK has enjoyed unprecedented energy security over the last twenty years, producing an increasing proportion of its needs for fossil fuels, in which it has been broadly self-sufficient in recent years, and possessing, if anything, excess electricity capacity. There has been no danger in the immediate past of California-style black-outs, nor will there be in the next two decades. There is time to give this area the full consideration it deserves.

As noted above, by 2020 on current forecasts the UK will need to import the great majority of its fossil energy – both oil and gas – which will together meet over 80% of the UK's primary energy demand. This could leave the UK vulnerable to cartel power or political insecurity in other countries.

Because of recent favourable circumstances the Government currently has no policy on energy security. With circumstances changing, it is one of the PIU's key tasks to make recommendations in this area for the future. There are a number of different considerations to take into account:

- The role of energy efficiency and demand-side management. The less energy demand, the less will need to be imported.
- The value of indigenous, non-depletable resources, such as renewables, or those which are at present plentiful and can be imported from many countries, such as uranium.
- The economic and security advantages of large, centralised, predictable sources of electric power, to be set against the considerable back-up sources these also require, in case one or more plants is out of action due to accidents or maintenance, and their vulnerability to attack.
- The economic and security advantages of small-scale, distributed power sources, to be set against the disadvantages of possible loss of economies of scale and, in some case, intermittency of generation.

The PIU will need to consider all these issues in detail. Some of them are discussed further below. However, it is worth noting at this point that at present the structure of the electricity grid effectively rules out extensive distributed power generation. At the very least, in ensuring that its 2010 targets for renewables and CHP are met, the Government must lay the foundations for a much more flexible grid which opens up the option of a largely decentralised electricity supply as a real possibility.

3.4 CONCLUSIONS

This very brief evaluation of current UK energy policy against principles and criteria of sustainable development suggests that much has been done to bring energy use more into line with sustainable development, but that certain opportunities to do this have been missed and that, as the Government itself knows, very much more remains to be done.

It is clear that in 2050 it is very likely that fossil fuels will still play an important role even in a low-carbon UK energy system, and that this role would be much enlarged by the development of CO_2 sequestration technologies. However, the focus of this paper is on the three major non-hydrocarbon carbon-reducing options available to the UK – increased energy efficiency, renewables, and nuclear power. In the next sections these are evaluated against the sustainable development criteria employed in the previous section, in order to form a judgement as to which performs best against these criteria and should therefore be favoured in energy policies for sustainable development.

4. Sustainable Development Evaluations of Energy Efficiency, Renewables and Nuclear Power

4.1 ENERGY EFFICIENCY

Energy efficiency is important for three over-arching reasons. First, increasing energy efficiency could greatly reduce the challenge of supplying enough low-carbon energy to cut emissions by 60% by 2050. Second, the technical and economic potential for improving energy efficiency in all sectors of the economy is very large. Studies have repeatedly demonstrated the existence of 'no-regrets' opportunities, where investment in energy efficiency is highly profitable for individuals and organisations, even when the wider social benefits are ignored. Third, energy efficiency has historically been marginalised within energy policy, both in terms of resources and policy initiatives. This needs to be redressed if energy policy is to move from a focus on supplying energy commodities, all of which have some damaging environmental impact, to the more cost-effective and less environmentally damaging provision of energy services.

The efficiency of energy use is primarily improved through investment by energy users in new vintages of energy-using technologies. Behavioural change can also play a role in some instances, but a distinction should be made between energy efficiency – using less energy to achieve the same level of energy service – and energy conservation, which may be achieved by reducing levels of energy service. The focus for most policy is the former.

Policies for energy efficiency are discussed in some detail in Part 2. There now follows an evaluation of energy efficiency using the sustainable development criteria of previous sections.

Integrating the economic, social and environmental dimensions of quality of life

Energy efficiency scores highly on environmental grounds. By providing the same energy service with less energy use, it avoids whatever environmental impacts are associated with energy production and conversion. The marginal benefits will depend on the type of energy being displaced - with electricity for example, we must include consideration of system losses and the fuel mix of displaced generating plant. These environmental benefits are not achieved without environmental costs, as efficiency improvements have environmental impacts associated with the production, use and disposal of the relevant energy-efficient technologies (including embodied energy use). In some cases these impacts will offset the benefits of energy saving, but it is unlikely that this is an important consideration for the majority of relevant technologies.

Energy efficiency can also have substantial economic benefits. As has been repeatedly shown, a large number of efficiency investments are cost effective at current energy prices. Many more would become cost effective if environmental externalities were reflected in

energy prices, or if external benefits such as the reduced need for investment in distribution networks could be captured by the investor. Energy efficiency may also improve social conditions for disadvantaged groups such as the fuel poor, at a lower private and social cost than increased energy supply. These multiple benefits do not apply to all technical opportunities to improve efficiency and they do not apply to behavioural change that reduces levels of energy service. But they do apply to a sufficiently large number of cases to make increasing energy efficiency a major means of delivering environmental, economic and social benefits in an integrated way.

Respecting biophysical limits

Use of energy from fossil fuels and nuclear energy sources is associated with serious and potentially irreversible environmental damage, dangerous exceedance of impact thresholds and the disruption of important environmental functions. To the extent that energy efficiency avoids the use of such energy, it makes a positive contribution to respecting such biophysical limits. The caveat is that we must consider the life cycle environmental impacts of the energy-efficient technologies – such as the use of energy, toxic materials or non-renewable resources in manufacture – in order to arrive at an accurate assessment of the net environmental benefits of energy efficiency improvements.

Making the polluter pay

The external environmental costs of energy production and use (including the highly uncertain costs of climate change) cannot be precisely quantified. However, it is clear that substantial rises in the price of fossil fuels would be required to meet targets for atmospheric CO_2 concentrations that are consistent with climate stability. In that sense it may be said that current energy prices do not adequately reflect their external environmental costs. Any cost internalisation that made them do so would make energy efficiency considerably more attractive than it is already. Again, the caveat is the extent to which the life-cycle environmental costs of energy-efficient technologies are also internalised

Protecting and enhancing UK competitiveness

If energy efficiency investments have a high rate of return, then capturing efficiency opportunities should improve the competitiveness of both individual businesses and the national economy. The extent to which this is the case is the subject of ongoing debate. Some economists argue that ‘hidden costs’, such as management time or production disruptions, make many efficiency opportunities less attractive than they first seem. However, empirical evidence suggests that substantial ‘no regrets’ opportunities are available, even when hidden costs are taken into account.

Competitiveness should also be considered in the long term. For environmental reasons, there is likely to be increasing pressure to reduce energy demand and carbon emissions. In this context, appropriate energy efficiency investments will enable such pressures to be accommodated at least cost. In addition, there will be increasing export opportunities for manufacturers of energy-efficient equipment, with a corresponding risk of import

dependence if UK companies fail to develop low-carbon technologies. Energy efficiency should be a growth industry in a carbon-constrained world.

Promoting social justice and inclusion:

Energy efficiency can play a central role in improving the life conditions of the 4.5 million UK households that suffer from fuel poverty. In contrast to winter fuel payments, investment in improving the energy efficiency of such households can simultaneously promote social and environmental goals. In a similar manner, investment in improved bus services can reduce social exclusion and accelerate the transition to a low-carbon transport system.

Energy efficiency is an area which is largely under the control of households. At present few households either consider energy efficiency, or are aware of the opportunities for cost-effective energy efficiency measures. Changing this situation should be an important priority for Government, so that households are enabled to gain more control over their energy use and energy costs.

Achieving energy security

It has already been noted that energy efficiency enhances energy security by reducing the need to import or use energy sources of any kind. Energy efficiency should therefore be the first energy security issue to be addressed, before the security of energy supply is even considered.

Conclusion: energy efficiency

In conclusion, increasing energy efficiency seems very attractive from a sustainable development perspective. It reduces the need for energy supply, of whatever kind, and its associated environmental impacts. The widespread availability of cost-effective technologies means that it can enhance competitiveness and provide net savings for households over the long term. Where these savings accrue to low-income people, it can take them out of fuel poverty and otherwise increase their living standards. These are great social, economic and environmental benefits. As discussed in Part 2, for a number of complex reasons realising them in practice is not easy. But where appropriate policies have been implemented, they have made a major contribution to sustainable development.

4.2 RENEWABLES

The Government target for renewables is to have 10% of UK electricity supplied from renewable sources by 2010. Under the DTI Energy Paper 68 (DTI 2000b) medium economic growth scenario, total electricity generation by 2010 is projected to be 371TWh (assuming high energy prices) or 390TWh (assuming low energy prices). This implies that generation from renewables must be at least 37.1TWh by 2010. This compares with just over 10 TWh in 1999, of which over half was large-scale hydro (DTI 2000c, Table 5.1, p.134).

There are a number of renewables technologies that are widely considered as having the potential to make a significant contribution to the 2010 target:

- Energy from waste (combustion of industrial and municipal waste, landfill gas);
- Hydro (small- and large-scale);
- Wind (onshore and off);
- Biofuels (agricultural and forestry waste, energy crops).

In the longer term significant contributions may also be expected from:

- Wave power;
- Tidal power (basin and flow);
- Solar (photovoltaics and thermal).

These are the technologies which will now be briefly evaluated from a sustainable development perspective.

Integrating the economic, social and environmental dimensions of quality of life

Renewables technologies are free of the large-scale, long-lasting pollution problems which make both fossil fuels and nuclear power environmentally problematic. However, they may nevertheless have visual or noise impacts or they may disrupt ecosystems. The impact is specific to the technology: tidal barriers disrupt wetland habitats, for example, and wind farms can disfigure valued landscapes. The latter can be important both for aesthetic reasons and for economic reasons, given the increasing economic contribution made by tourism to the rural economy. Impacts can be minimised through careful siting and appropriate technology choice. Ultimately, any residual, localised environmental impact has to be balanced against the environmental impacts avoided (which may be local, regional or global) by substituting renewables for other sources of energy supply.

Competitive economic activity and social well-being, even after demand-side measures, will continue to require a secure supply of electricity. The basic flow of renewable energy (wind, waves, solar energy) is both indigenous and, over time, can be predicted with relative assurance. However, many renewables only generate electricity intermittently, although some technologies (e.g. energy crops) generate less intermittently than others (e.g. wind power). The future security of supply from renewables, which is important to the social and economic dimensions of sustainable development, very much depends on what efforts are taken now to improve techniques for storing electrical energy and for balancing loads and supply across distributed networks. This is discussed further in Part 2.

Respecting biophysical limits

Renewables, by relying on the flows of energy that are already within the environment, operate intrinsically within biophysical limits. Energy-from-waste technologies, which are not accepted by everyone as renewables technologies, do not necessarily have this characteristic, because the production of the raw material for this technology – waste – may not respect biophysical limits, and the incineration of waste may give rise to pollution. However, even ‘true’ renewables can, as mentioned above, disrupt habitats and disfigure

the countryside through inappropriate siting. Thus policies to promote renewables need to be careful over which technologies they support and where the technologies are situated. Biophysical limits might best be respected through policies that promote a portfolio of technologies that can be deployed sensitively. With respect to the biophysical limit with the greatest political salience at the moment – carbon emissions and their concentrations in the atmosphere – renewables technologies generally, having zero net carbon emissions in use, are not problematic at all.

Making the polluter pay

Not all renewables have negative environmental impacts locally, and in these cases application of the polluter pays principle would greatly favour them compared to other energy-supply technologies which have substantial local, regional and global environmental costs. As already noted, careful siting and choice of renewables technology can in many other cases reduce local environmental impacts to an extent that they are not widely experienced as costs. Generally it may be expected that if renewables are deployed sensitively, they will generate lower environmental costs than other sources of energy supply and would therefore be least affected by this criterion.

Protecting and enhancing UK competitiveness

The impact of renewables on UK competitiveness could be felt in two different ways. The first is through their impact on electricity prices and the knock-on effect on UK competitiveness. The second relates to the benefits to manufacturing from a thriving UK renewables industry able to compete in international markets. In both cases, there are both long and short term effects on competitiveness.

With regard to energy prices, it is how these compare with those of competitors now and into the future that is important. Here the impact will depend upon developments in renewable generating costs and in those of competing technologies. It will also depend upon international policies to control carbon emissions, and any rises in fossil-fuel prices due to falling or insecure output. At present some renewables technologies are close to being competitive with even the cheapest fossil fuels, and are likely to become so in the near future. Other technologies need further development and deployment to realise their potential cost reductions.

There is another cost consideration on which it is very difficult to obtain detailed information. As discussed in Part 2, the large-scale connection of intermittent, decentralised renewables to the grid has significant implications both for electricity distribution systems and for grid stability. Of benefit is the fact that the embedded nature of some renewables technologies (e.g. onshore turbines near communities or small-scale biomass power station) may reduce transmission and distribution losses. On the other hand, the need for stabilising measures for the grid, and the inherent unpredictability of some renewables, is likely to be a source of costs. It is currently far from clear what the scale of these benefits and costs are. This would seem to be a priority for further research.

Some indication of the impact of renewables on electricity prices can be obtained from the figures produced by ETSU for the UK Government (DTI, 1999). These suggest that a renewables programme that went some way beyond the Government's 2010 target would be unlikely to have a negative effect on the competitiveness of UK industry or the economy more widely. In any case, any effect from slightly higher prices for a period might be outweighed by the second competitiveness consideration, which is considered next.

Much energy supply capacity in industrial countries will be replaced, and much will be installed in developing countries, over the coming decades. If reducing carbon emissions intensifies as a global priority, then low-carbon energy technologies will be widely taken up. The companies and countries that develop expertise in these technologies can expect significant export opportunities, as, for example, Denmark is experiencing in relation to wind technology, in which it is a world leader. There would seem to be good prospects of foreign demand for a range of renewables technologies in the future, provided that their costs continue on their current downward trajectory, as is expected. It may be costly for the UK economy to have to import all the low-carbon energy supply (and efficiency) equipment which future restrictions on carbon emissions may require to be installed. Similarly, it is likely to be beneficial for the UK economy to develop the capacity to exploit its substantial renewable resources in such a way as to generate jobs and export revenues from the resulting industries.

Any consideration of the impacts on UK competitiveness from renewables must therefore take a dynamic, prospective, and global perspective. The short-term costs of renewables should be assessed alongside the longer-term export potential and the potential costs of import dependence if the UK is one of the last nations to venture down the low-carbon path.

Promoting social justice and inclusion

It is generally considered that the impacts of climate change will bear most heavily on poor people in poor countries, in this and future generations. Renewable energy technologies do not contribute to climate change, and in this sense they are socially just technologies.

The locally-based nature of many renewables technologies means that they give opportunities to move towards a more decentralised, community-based energy-supply system, in which people can participate in and have more influence over the decisions in this area that affect their lives, which is consistent with this sustainable development criterion. In addition, to the extent that renewables can be located in rural areas or on coastlines, where employment can be scarce, or contribute clean and competitive power based on indigenous resources to communities in poor countries, renewables may be said to promote social development and social inclusion.

Achieving energy security

Renewables are potentially the most secure energy source, with a very large indigenous, widely dispersed potential, which is not really subject at all to external disruption. Their technologies still need to be developed in order to deliver renewable energy in a competitive and socially and economically useful form, but these technologies have made great recent advances, and show much promise for the future. If a grid structure can be developed that allows the dispersed nature of renewables to be experienced as a benefit rather than a cost, and the sources can be developed in a complementary way to remove the disadvantages of the intermittency of some renewables, this set of energy sources offers excellent prospects for energy security.

Conclusion: renewables

In conclusion, renewables are often considered as the archetypal sustainable energy source, and certainly there is no question of depletion of wind, waves or solar power. Moreover, their exploitation leaves no lasting pollution problems for future generations. Providing their siting can be sensitive, so that they are integrated into landscapes rather than disfiguring them, they would seem to offer the best energy supply option for sustainable development as far as the environmental dimension is concerned. In strict financial terms, most renewables technologies are still some way from full competitiveness with fossil fuels, but the gap has narrowed significantly, especially for wind power, over the past decade, and more substantial cost reductions are in prospect. It seems likely that the large-scale deployment of renewables post-2010 will not have a significant negative economic impact, and could be the source of new industrial opportunity, jobs and exports, provided that in the interim judicious public support continues the process of market development and deployment. Socially, renewables offer a decentralised energy supply making use of local resources, which could re-connect communities with their use of energy and, in some places, offer new opportunities for employment and income. Renewables would seem, on this assessment, to perform very favourably against the sustainable development criteria.

4.3 COMBINING POLICIES FOR ENERGY EFFICIENCY AND RENEWABLES

From the foregoing it is clear that both energy efficiency and renewables perform well in terms of sustainable development. However, there remains a question as to whether, on their own, they will sufficiently reduce energy demand or provide enough low-carbon energy to meet the UK's energy needs to 2050 in a way that also meets the RCEP's suggested target of a 60% reduction in carbon emissions by that date.

The Commission cannot take a definitive view on this question, consideration of which is a major task of the Energy Policy Review. However we would draw attention to a recent study which is so far the only one to have addressed this question comprehensively for the UK, and which did come to some conclusions on it.

The study consisted of a modelling exercise, using the MDM-E3 model managed by Cambridge Econometrics, which projected in a 'Total Programme' (TP) the economic and environmental implications of measures reflecting intensified policy support for renewables, CHP and household energy efficiency. The TP also included a doubling of the CCL between 2010 and 2020 and the imposition of an annual 3% increase in road fuel duty (the road fuel duty 'escalator') from 2003-2010. The detail of the modelling is outside the scope of this paper, but is fully described in FFF (2001a,b).

Three aspects of this modelling and its results are of interest in the context of this paper. First, the policy measures modelled include many of those which are discussed in Part 2 as likely to be necessary to secure deep cuts in carbon emissions. Second, the results of the modelling may be evaluated against the criteria of sustainable development which have already been extensively used in this paper. Third, the results may be compared with those in the CCP. Only the sustainable development assessment is included here. Consideration of the other issues is in Part 2.

The relevant Table in Part 2 summarises the results of the modelling. In brief, and as expected, the energy efficiency measures in the TP reduce energy demand in all sectors, and therefore carbon emissions. By increasing the energy efficiency of buildings, especially for low-income households, the TP also makes a contribution to reducing fuel poverty. The TP also greatly increases electricity generation from renewables, substituting for natural gas and coal and reducing both carbon and sulphur emissions. In total, carbon emissions in 2020 are 23% below their level in 1990, whereas in the Base Case they had returned to 1990 levels. Hence, in contrast to the Base Case, the TP may be considered to put the UK on a trajectory which is consistent with a 60% cut in CO_2 emissions by 2050. Economically, the TP results in small *increases* in GDP and employment by 2020.

A brief assessment of the TP against the sustainable development criteria used in previous sections leaves little doubt that such a scenario, were it to be achieved, would represent substantial progress towards sustainable development:

Integrating the economic, social and environmental dimensions of quality of life

The TP clearly addresses and integrates social, economic and environmental concerns. It results suggest positive achievements across all these dimensions.

Respecting biophysical limits

The TP reduces both carbon and sulphur emissions to levels closer to those which may be said to respect physical limits. This is especially the case for carbon emissions. The TP finally breaks the link between carbon emissions and economic growth.

Making the polluter pay

The TP increases the charge for pollution through the higher CCL and road fuel duties. In addition to encouraging energy efficiency, the CCL provides incentives for the development of renewables and the take up of CHP, both of which play a crucial role in reducing carbon

emissions post-2010. Increases in road fuel duty encourage the purchase of smaller and more energy-efficient cars, as well as promoting the shift to alternative modes of transport.

Protecting and enhancing UK competitiveness

The TP makes a positive contribution to UK competitiveness, as shown by its higher GDP compared to the Base Case.

Promoting social justice and inclusion

The TP improves the housing stock, and therefore the living conditions, of low-income households. It also reduces unemployment, which is recognised as probably the single most important means of promoting social inclusion.

Achieving energy security

The TP reduces UK final energy demand by 8% by 2020, and increases the proportion of generation from indigenous renewables to 33%, of which no more than 20% is from intermittent sources, by the same date. This generation substitutes both for the nuclear plants which close before 2020, and, principally, for gas, leaving the UK much less dependent on foreign gas markets. The TP is clearly very beneficial for UK energy security.

Conclusion: combining policies

The modelling in the TP takes full account of the likely closure of nuclear capacity up to 2020. Its results, however, suggest that there is no need to replace old nuclear plant with new nuclear power stations to reduce CO_2 emissions beyond 2010. The issue of nuclear power has emerged as a major issue in the Energy Policy Review, and is considered in more detail, and in a sustainable development context, in the next section. However, these modelling results suggest that it will have to perform strongly across all the dimensions of sustainable development in order to justify public support in preference to the kind of policy package, promoting energy efficiency and renewables, which the modelling considered.

4.4 NUCLEAR POWER

Unlike energy efficiency and renewables, nuclear power over the last fifty years received very substantial support from the public finances, the experience of which is briefly rehearsed in Part 2. In 1995, however, the Government concluded in its Nuclear Review (HMG 1995) that there was no continuing case for such support.

However, in respect of diversity, security of supply, and CO_2 emissions, the Government acknowledged that this conclusion was not necessarily final. At present nuclear power generates about 25% of the UK's electricity, but most nuclear power stations are scheduled for closure before 2020. It is certainly the case that if these stations were to be replaced by gas, the implications for CO_2 emissions and for the enhanced UK dependence on gas, would be profound. This is one of the central issues now being examined by the Energy Policy Review.

The issue before the UK Government at present is *whether* to give policy support to nuclear power, rather than *how* to do so. This is in contrast to energy efficiency and renewables, which are currently in receipt of substantial policy support. As a result, the Commission has not engaged in detailed policy analysis in respect of nuclear power. Instead, the relevant section in Part 2 simply reviews the issues related to nuclear power which are relevant to sustainable development. This allows a sustainable development assessment of nuclear power to be conducted, using the same criteria as before.

The issues related to nuclear power excite much controversy and disagreement. This is reflected, for example, in the very sub-title – Fuel of the Future or Relic of the Past? – of the booklet produced by the Royal Institute of International Affairs (Grimston & Beck, 2000) as an output of its ongoing enquiry into the future of nuclear power. It is not the intention of the Commission here to try to adjudicate between these opposing views. Rather the purpose of its sustainable development assessment is to see how well nuclear power performs against the criteria for the purpose of comparing this performance with that of energy efficiency and renewables.

Integrating the economic, social and environmental dimensions of quality of life

The possibility of a new nuclear programme in the UK is being considered because of the potential of this technology to contribute to the long-term security of UK energy supply and the long-term reduction of UK carbon emissions. These are important economic, social and environmental considerations. Modern economies require a secure supply of electricity, and nuclear power has shown that it can make a substantial contribution over a long period to electricity generation. Electricity is also a fundamental need for households in such societies as the UK. If there were no alternatives to nuclear power for electricity generation, it is likely that the UK public would accept it as essential for economic and social development, despite any environmental concerns.

Respecting biophysical limits

This criterion as used in this paper is based on the need "to ensure that the environment is protected and resources used in such a way that serious or irreversible environmental damage is avoided, potentially dangerous thresholds of environmental impact are not exceeded and important environmental functions are maintained for future generations to enjoy". The nuclear radiation produced by nuclear power stations poses a substantial threat to human health and ecosystems, which persists over thousands of years. As a consequence, nuclear power has been subject to substantial opposition from environmental groups and their supporters. These groups have concerns over the risks from: accidents or deliberate attack; routine low-level radiation releases; the transport, storage, and disposal of low, medium and high-level nuclear waste; the decommissioning of nuclear power stations; and the proliferation of nuclear weapons. It is unlikely that these groups will agree that nuclear power satisfies this sustainable development criterion as phrased. As a result, they will continue to try to persuade policy makers and the public that nuclear power is incompatible with sustainable development on these grounds alone.

The advocates of nuclear power, in contrast, argue that nuclear power in OECD countries (with minimal exceptions) has in the past satisfied this criterion, and in the future it can be guaranteed that it will do so - i.e. the risks can be contained. Those who acknowledge some small residual risk consider that the benefits of the technology across the economic and social dimensions make this environmental risk (and therefore risk to human health) worth taking.

It is unlikely that these two viewpoints will converge sufficiently in the UK in the next few years for a new programme of nuclear power to be possible without large-scale opposition and political conflict.

Making the polluter pay

A major complaint from nuclear supporters is that the Government's CCL is denominated in energy rather than carbon, and that nuclear energy is not exempt from it (like renewables), as it should be because it does not contribute to climate change. In terms of strict neo-classical economics, if the purpose of the CCL is to make energy prices reflect more nearly the costs of climate change, this complaint is justified.

However, if the purpose of the CCL is to reduce energy demand by encouraging energy efficiency, and to promote renewables, then the complaint can be dismissed, especially if it is also considered that nuclear power has uninternalised environmental costs of its own, which make it in its own way as problematic as fossil fuels. To make a sound decision against this criterion of sustainable development, it will be important to ensure that all the costs of nuclear power (as of other energy sources) are fully considered, especially those which, like insurance against accidents (some part of the liability for which for nuclear power is carried by the taxpayer), are often overlooked.

Protecting and enhancing UK competitiveness

It has already been noted that electricity is an essential input into the UK economy. It is sometimes said that 'there is no electricity as expensive as no electricity'. However, as noted earlier, the UK currently has abundant electricity generating capacity, so that there is no comparison between the current UK situation and that, for example, in California. There is time to consider this issue in its full complexity in order to maximise the chances of getting it right.

The consequences for competitiveness of getting it wrong may be serious. One consideration is that a major programme of nuclear power (as for renewables) has the potential to kick-start a substantial UK export industry, but for that to happen there will need to be foreign demand for the technology. This emerged above as a significant prospect for renewables. But it is still highly uncertain whether nuclear power will achieve a world-wide revival and, if so, which of the several technologies being developed will be widely deployed, or whether the UK will have a competitive advantage in these technologies. The UK has got choices wrong in this area before (most notably with the AGR nuclear reactors) and should be especially wary of doing so again.

Another competitiveness consideration is cost. The UK needs a cost-competitive demand/supply mix. There are still considerable cost uncertainties with nuclear power, and a past history of cost underestimates, which should occasion special care to ensure that any new cost estimates are fully transparent and independently assessed, so that they may be judged to be soundly based.

Promoting social justice and inclusion

The implementation of the Fossil Fuel Levy in the early 1990s was not much noticed at the time. It added 10% to electricity bills, with the great majority of the revenues going to the nuclear industry, in principle to pay for eventual decommissioning of its power stations in more than 100 years time. With no compensating measures for those on low incomes, this was a very regressive way to achieve this objective. Furthermore, only a small portion of the Levy receipts were put into a fund for this purpose (MacKerron, 1995).

The energy sector will require large amounts of investment over the coming decades, whatever the energy demand/supply mix chosen. It will be important to ensure that, where the suppliers of this investment are not just private investors, the right balance is struck between resources from consumers and taxpayers, and that regressive effects of the kinds that have occurred in the past are avoided.

Finally there is an important issue of intergenerational justice to be considered with regard to nuclear power, comparable in some ways to the climate change issue. Nuclear power generates very long-lived toxic wastes, which will need to be safely managed or disposed of in such a way as to guarantee their isolation from the natural environment for many thousands of years. Over a shorter time frame, but still in a hundred years' time or more, very considerable resources will also need to be deployed to decommission nuclear power stations. In both cases the costs arising from nuclear power stations will long outlast the benefits of consuming the electricity produced by them.

It is theoretically possible to make provision now to meet these costs in the future (for example, NEA 2000, p.8, says "electricity consumers are paying for nuclear safety and insurance against nuclear accidents, decommissioning of nuclear facilities, and radioactive waste disposal", and the example of the Fossil Fuel Levy was noted above). But the resources being set aside today for these contingencies are very much lower than those that will be required to meet them, because of the assumption that they will grow along with the economy. However, to be adequate to the task they will need to grow over decades or centuries in line with the discount rate that has been applied. Over the occurrence of such growth, and therefore the availability of adequate resources, there is bound to be some uncertainty. There is at least some possibility that future generations will find themselves with the liabilities of decommissioning and nuclear waste management, but not the resources to pay for them (see Thomas et al. 1994 for some discussion of this issue). Some would say that it was incompatible with the intergenerational equity aspect of social justice, and therefore with this sustainable development criterion, to saddle future generations with large and certain costs but uncertain means of meeting them.

Achieving energy security

Nuclear power in the UK depends on imported fuel (uranium). At present uranium supplies are plentiful, and they are located in a wide range of countries, which makes this energy source less problematic in terms of possible disruptions to supply than fossil fuels. However, if there were to be a major expansion of nuclear power worldwide, uranium supplies would become substantially depleted over fifty years so that the sourcing issue could start to give rise to security concerns (unless nuclear technologies depending on different fuels had been developed by then, but there is so much uncertainty over this possibility that it is not further considered here).

Nuclear power stations are currently built in large units, each of which provides a large tranche of base load power when it is operational, but which requires a similarly large back up source when it is out of action due to accidents or maintenance. Accidents at such plants can at least potentially be catastrophic, although some argue that the chances of such accidents are so low in well-managed plants as to be negligible. Nuclear plants also present potentially attractive targets for enemy or terrorist attack, both because of their large electricity supply capacity, and because of the damage which would be caused if their radiation were to be released.

New generations of nuclear power stations currently under development may be smaller and safer than those which have been built. It is, however, not possible to evaluate these against the sustainable development criteria used in this paper while they are still in the design stage and so much uncertainty as to their eventual nature and performance remains.

A final security consideration raised by a world wide expansion of nuclear power is the possibility of nuclear weapons proliferation. While it is certainly possible to seek to design international systems and institutions which limit this risk, the widespread use and availability of civil nuclear materials would certainly increase the probability of their diversion for military use, whatever security arrangements were in place to prevent this. This is a form of insecurity to which other energy sources do not give rise.

Conclusion: Nuclear power

This brief sustainable development assessment leads to the following general conclusions about the option of building new nuclear power stations in the UK.

If new nuclear build were the only way of addressing the security of supply issues identified for the Energy Policy Review, its potential contribution to energy security would be a very strong argument in its favour on both economic and social grounds. At a time when concern about climate change is also high on the political agenda, the fact that this energy source also emits no carbon would be a further powerful justification for maintaining or expanding the UK nuclear electricity capacity.

But, as has been seen in earlier sections, there are other ways of meeting the concerns about security of supply and climate change with which the Energy Policy Review is concerned, most notably the management of demand to reduce the required quantity of supply, and the

deployment of renewable energy sources to meet the demand that is left. The question, therefore, is not whether nuclear power is consistent with sustainable development, but whether it is the *most* consistent of the energy demand/supply combinations that are available.

The combination of energy efficiency and new renewables was seen to perform strongly against all the sustainable development criteria. New nuclear build performs substantially less strongly against these criteria. In terms of sustainable development, therefore, it is not the first choice when it comes to meeting the energy demand and supply challenges of the future.

5. Conclusions and Recommendations

The Energy Policy Review must consider what decisions need to be taken now to meet the kind of energy challenges that seem likely in the first half of this century. The Commission has sought to contribute to this process by taking a rigorous view of the UK's energy options. In particular, it has sought to appraise current energy policy, and assess the main low-carbon options, on the basis of currently available technologies, for the future, against criteria which reflect its understanding of sustainable development. These options will need to be integrated in due course into a wider analysis which also considers the long-term role of fossil fuels, the possible development of carbon sequestration and such technological developments as fuel cells and wider possibilities for a 'hydrogen economy', which were outside the scope of this paper.

The essential question facing the Energy Policy Review is what will be the most economic mix in the medium to long term of demand-side measures, low-carbon energy sources, fossil fuels, carbon sequestration, and other technologies including nuclear fusion, fuel cells and the 'hydrogen economy' more generally, which will meet the challenges of ensuring diversity and security of supply and the mitigation of climate change. It will be apparent from the discussion above of just the immediately available low-carbon options that the answer to this question needs to take account of many complex issues for each of the different possible demand/supply combinations, assessing them for their economic, social and environmental impacts in a transparent, consistent and integrated way. As far as the Commission is aware, no such assessment has yet been made in any country. Our main conclusion is that the Energy Policy Review must at least show the way in this process for the UK.

Table 5.1 sets out a matrix for the assessment of energy technologies in respect of sustainable development. The matrix lists the major categories of demand and supply side technology options down the side, and across the top gives the sustainable development criteria, grouped under the three usual dimensions (economic, social, environmental) of sustainable development, with space left for other impacts not captured by the sustainable development criteria listed here.

Table 5.1: A Matrix for the Assessment of Energy Technologies in Respect of Sustainable Development

ENERGY TECHNOLOGIES	**SUSTAINABLE DEVELOPMENT CRITERIA**										
			ECONOMIC			SOCIAL			ENVIRONMENTAL		
	Integration	Security	Competitiveness			Social exclusion			Respecting biophysical limits Making polluters pay		
			Financial costs (e.g. current costs, cost reductions)	Indus-trial oppor-tunity	Other impacts	Employment	Other impacts	Other impacts	Air emissions (e.g. CO_2, SO_2)	Other wastes (toxicity, length of life, risk of release)	Other impacts (e.g. visual, noise)
ENERGY EFFICIENCY											
CHP											
Households											
Industry											
Commerce, Public Sector											
Transport											
ENERGY SUPPLY											
Fossil fuels											
Renewables											
Nuclear power											
CARBON SEQUESTRATION											

Ideally a full sustainable development assessment of energy options would entail filling in the cells of the matrix with comparable, consistent, quantitative information expressed in money terms so that the optimal decision, taking account of all factors, could be made. However, it should be recognised that, however attractive this may be in principle, there is no way in which such a global cost-benefit analysis of the energy demand/supply options facing the UK, incorporating all the considerations discussed above, could be carried out such as to carry conviction across all those involved in this debate. The most that can, and should, be attempted is to lay out all the costs and benefits of the different options, quantified where possible but otherwise descriptively, in order that a well-informed public debate can take place and ultimately a political decision can be taken which represents the Government's interpretation of what is in the UK's best interests. It is worth repeating that the most important required characteristics of this process are transparency, consistency in the comparisons and widespread participation in the debate.

On its own, much less detailed, sustainable development assessments, the Commission's conclusions may be briefly stated. Current Government policy is striking out on a relatively new course of encouragement of energy efficiency and stimulation of the take up of renewable energy sources. The analysis in this paper suggests that this is entirely in accordance with sustainable development criteria and that the technical and economic potential of this approach is very great. A modelling study reviewed above suggests that a programme of public support for renewables and energy efficiency could result in UK CO_2 emissions being 23% below their 1990 level by 2020, and lead to small economic benefits. Such results suggest that the next ten to fifteen years are critical. If renewables can be developed and energy efficiency measures implemented such that this kind of outcome is achieved over this time frame, then they will have evolved into substantial industries which should be able to move forwards on a commercial or near-commercial basis to make even deeper cuts in carbon emissions thereafter.

However, there are real concerns that the policies adopted will not succeed in achieving the targets for 2010 towards which they are directed, and will therefore also not succeed in putting the UK on an energy trajectory in the longer term which will meet the energy challenges identified in the Energy Policy Review. The danger is that the considerable technical and economic potential of energy efficiency and renewables will not be realised.

Part 2 of the paper has engaged in some detailed analysis as to why this may be the case, and has put forward some policy recommendations, the most important of which are summarised below. The Commission considers that it is extremely important that the necessary action is taken to ensure that the UK is able to reap the full benefits of energy efficiency and renewables technologies over the coming years. This combination is the first choice for sustainable development, and a failure to enable them to realise their full potential will amount to a considerable failure for sustainable development policy as a whole.

Nuclear power does not perform as well against the sustainable development criteria as energy efficiency and renewables. And on the basis of the above analysis, realisation of the full potential of energy efficiency and renewables would render the building of new nuclear capacity unnecessary. The duty of the Government to introduce policies to realise this potential cost-effectively is therefore clear. It is only if these policies fail to deliver this potential that the nuclear option will have to be seriously re-examined. For the moment, however, to revive serious consideration of the nuclear option would be to divert crucial political attention from the first choice for sustainable development – energy efficiency and renewables. The Commission does not believe that such a diversion is in the best interests of the UK or of sustainable development more generally. Rather it puts forward the following recommendations, summarised from those in Part 2 of this paper, for consideration by the PIU Energy Policy Review in the belief that they represent the minimum policy interventions required for energy policy to move the UK adequately towards sustainable development.

RECOMMENDATIONS

5.1 ENERGY EFFICIENCY

- Much more ambitious energy efficiency measures than those in the CCP will be required if the UK is to achieve the annual reductions in carbon intensity of more than 4% pa (up to four times current rates of reduction) which will be needed to meet a 60% reduction in carbon emissions by the middle of this century.

5.1.1 Efficiency Potential and the Rationale for Intervention

- Energy efficiency scores highly against each of the sustainable development criteria and can simultaneously meet economic, environmental and social objectives. The Energy Policy Review should therefore give equal weight to issues of energy demand and energy supply. This will help redress the lack of attention to energy demand issues that has characterised energy policy to date.
- Evidence suggests that energy demand could be reduced by as much as a third through investments that are cost effective at current energy prices. However, investment in energy efficiency is inhibited by a range of market and organisational barriers. Many of these barriers can be cost effectively overcome through government intervention. For instance, the Advisory Committee on Consumer Products and the Environment has recommended a family of graded energy labels, comprising: a co-ordinated energy labelling regime covering cars, homes and domestic equipment; a car rating label for fuel efficiency and CO_2 emissions; home energy rating information for purchasers of all homes; and energy rating and labelling to be extended into other product ranges. (ACCPE, 1999) An effective policy response requires a combination of policies which can act in synergy.
- Internalising the environmental costs of energy use in energy prices will increase the cost effective potential and stimulate technical innovation and will be essential for the achievement of a transition to a low carbon economy. Economic instruments such as carbon/energy taxation and emissions trading therefore have a central role to play.

Concerns over equity and competitiveness have some validity, but suitable measures are available to overcome them.

5.1.2 Policies for Industry

- The CCL and negotiated agreements represent the most important developments in UK energy efficiency policy since the 1970s, but have led to an over-complex policy mix. This could be resolved by making it clear that the negotiated agreements are a transitional measure. Future policy in the industrial sector should be based on a combination of emissions trading (with the progressive introduction of permit auctioning) and an upstream carbon/energy tax.

5.1.3 Policies for the Public and Commercial Sector

- The public and commercial sector is relatively neglected in the CCP, despite strong emissions growth. Measures are particularly required to overcome the landlord-tenant barrier in commercial buildings and to encourage the adoption of energy targets in public buildings.
- A critical issue is the increasing energy intensity of new non-domestic buildings. While building regulations have a role here, the delivery of innovative green buildings will require more far-reaching reforms in the organisation of the construction industry.

5.1.4 Policies for the Domestic Sector

- Energy use in the domestic sector is being driven upwards by a number of powerful trends. In addition, a wide range of barriers prevent households from making cost effective investments in energy efficiency, and the poor quality of the UK housing stock contributes to widespread fuel poverty. The initiatives in the CCP do not address these problems to an adequate extent. Future policy requires a systematic effort to overcome barriers, strict regulations on new construction, the accelerated development of energy service provision, and the introduction of domestic energy taxes with suitable compensation measures to protect low-income groups.

5.1.5 Policies for the Transport Sector

- Transport provides the greatest challenge to the transition to a low carbon economy. The extent of changes needed for a low carbon economy may require more fundamental reforms than are included in the 10 Year Plan. At present, the plan gives insufficient priority to bus services, walking and cycling.
- Long-term policy must simultaneously encourage alternative fuels, reduce energy intensity, promote modal shifts and reduce the need to travel, including through land use planning. Energy considerations need to be integrated into all aspects of transport decision-making.

5.2 RENEWABLES

- A sustainable development assessment of renewables suggests that, provided these technologies can be developed to be broadly competitive, and they are sited and deployed with sensitivity to local concerns, they are the energy supply option most consistent with the sustainable development criteria applied.
- Both the Government's 2010 target of 10% electricity generation from renewables, and the RCEP's renewables scenario to 2050, imply unprecedented rates of growth from these technologies. However, three barriers to the deployment of renewables threaten their short-term deployment and long-term development: planning constraints, which are especially affecting onshore wind projects, the treatment of embeddedness, and the New Electricity Trading Arrangements (NETA). Neither the 2010 target for renewables generation, nor their much greater deployment envisaged by the RCEP thereafter, will be achieved unless these problems are satisfactorily resolved.
- The Renewables Obligation (RO) may not give renewables generators the required signals and incentives to develop technologies that are currently further from market competitiveness, or the confidence to plan for the long term. The introduction of technology banding should be reconsidered for the RO, and higher obligations should be set for the years after 2010.

5.3 POLICY IMPACTS AND INSTITUTIONAL IMPLICATIONS

- Both Government data and economy-environment modelling suggest that the UK can make the transition to a low-carbon economy using a combination of energy efficiency measures and renewables which, over twenty years, will yield net benefits rather than costs to the economy.
- For the necessary policy measures to be forthcoming, however, a fundamental institutional reorganisation of bodies concerned with energy policy is likely to be required. While the Commission does not endorse any particular proposals for institutional change, a number of promising models have been put forward which seem to combine the necessary systems approach, co-ordination and integration. For instance, the RCEP has recommended 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". (RCEP, 2000) This is an area in which the PIU needs to make authoritative recommendations for timely implementation.
- Energy systems generally are now at a potential historical turning point, driven as much by technological changes as by environmental or other considerations, where they could either become consolidated in a centralised form following most of the experience of the last century, or begin a long-term process of decentralisation and dispersion in favour of more locally based forms of power generation, in particular. The UK is currently ill prepared for this latter possibility. The PIU Energy Policy Review should take the opportunity of showing how it could remedy this situation.