

# Section Two

The Low Carbon Economy

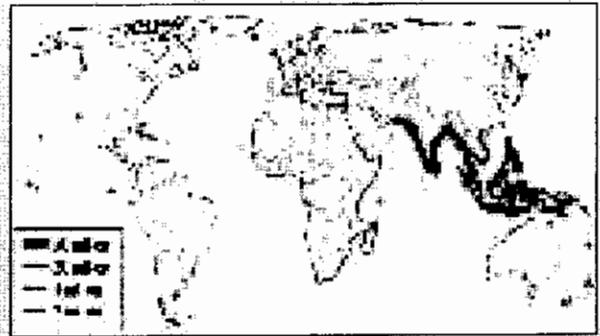
# Chapter 2 The Environment

## Climate change is happening...

- 2.1 There is now strong scientific evidence that climate change is happening and that it is being accelerated by human activity. The world is getting warmer. The earth's temperature rose by 0.6°C during the last century and is forecast to rise by between 1.4 and 5.8°C during this century. Globally the 1990s was the warmest decade and 2002 the second warmest year since records began.
- 2.2 There is increasing evidence that this is the result of an increase in atmospheric concentrations of greenhouse gases - notably carbon dioxide released by burning fossil fuels such as coal, oil and gas. By absorbing heat these gases keep the earth's temperature warmer than it otherwise would be. As greenhouse gas concentrations rise well above their natural levels, the additional warming that will occur could threaten human society.
- 2.3 Climate change research has looked at how far changes in temperature over the past century are due to human activities. Natural effects, such as variations in the sun's output and volcanoes, are insufficient to account for the observed warming, which can only be explained by greenhouse gases from human activities.
- 2.4 The rate at which the climate is changing will affect the world in extreme and unpredictable ways. Its impacts could include:
- many millions more people being exposed to the risks of hunger, water stress, flooding and diseases like malaria. Poor people in developing countries are likely to be most vulnerable;

- low-lying areas, wetlands and small islands will be especially at risk from sea-level rise. Globally, an extra 80 million people could be exposed to flood risk by the 2080s, 60% of whom are likely to be in the poorest parts of South East Asia. In one of the most vulnerable areas, Bangladesh, a 45cm rise in sea level could result in 10% of the total land area being lost and 5½ million people being put at risk;

**Chart 2.1**  
**Number of additional people at risk of flooding each year by the 2080s, assuming no action to cut green house gas emissions<sup>1</sup>**



- irreversible losses of biodiversity could be accelerated. Expected impacts include bleaching of coral reefs, loss of mangrove swamps and impacts on fish populations. Changes in the polar regions are expected to be the largest and most rapid, leading to thawing of permafrost, melting of ice sheets and changes in species distribution; and
- the UK will also be affected. Rising sea levels could threaten our coastal communities and environment. Storms and extreme events could have the most costly impacts - the autumn 2000 floods cost the UK £1bn.

### The costs of climate change

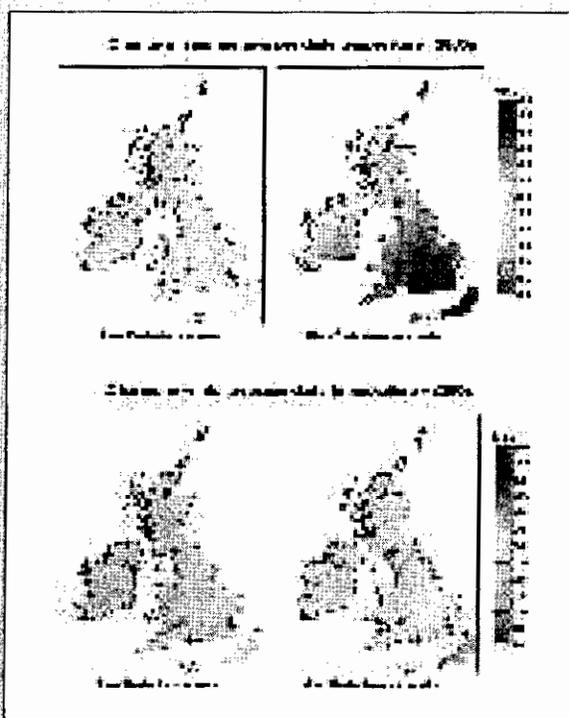
A Government Economic Service working paper<sup>2</sup> has suggested £70/tC (within a range of £35 to £140/tC) as an illustrative estimate for the damage cost of carbon emissions. It also suggested that this figure should be raised in real terms by £1/tC per year as the costs of climate change are likely to increase over time.

These values are under review in light of developments in the academic literature and in the Government's economic appraisal guidance. Currently the estimate only represents a subset of damage costs, and the review will also consider issues of coverage. While the suggested range covers impacts such as effects on agriculture, wildlife and health, sea level rise and some extreme weather effects, it does not include the possible impacts of 'climate catastrophes' (e.g. melting of the West Antarctic ice sheet or

changes to the Gulf Stream), of social impacts such as famine or mass migration, or of impacts after 2100. Nor does it include other benefits of reducing emissions, such as improved air quality. These could increase the social cost of carbon considerably. Impacts will also vary significantly across sectors and regions.

These values do not set a limit on the acceptable costs of reducing emissions. Wider impacts on other energy policy objectives are also relevant. Costs which initially look high may also be reduced by economies of scale and innovation. Nevertheless, in looking at measures to reduce carbon it is important to consider abatement costs. Most of the carbon savings we are looking at pre-2020 can, we believe, be delivered at costs lower than, or in line with, the illustrative range for damage costs.

**Chart 2.2**  
**Changes in summer and winter temperatures<sup>3</sup>**



- 2.5 We will have to adapt to some degree of climate change. Greenhouse gases that have already built up in the atmosphere mean that some temperature rise is inevitable. In the UK, we are already taking steps to adapt the way we manage flood risk, water and other natural resources, but there is still more to do, and there will be challenges for the transport, construction and business sectors too. For developing countries, climate change increases the urgency of finding more sustainable pathways to development.

<sup>2</sup> *Estimating the Social Cost of Carbon Emissions*, Government Economic Service Working Paper 140, [www.hm-treasury.gov.uk](http://www.hm-treasury.gov.uk)

<sup>3</sup> Changes in average summer and winter temperatures (with respect to Hadley Centre model - simulated 1961-1990 baseline climate) for a 30-year period centred on 2080 for high and low greenhouse gas emissions scenarios. UK *Climate Impacts Programme*, 2002.

## Action to limit emissions is under way...

- 2.6 But the worst effects of climate change can be avoided if concentrations of greenhouse gases in the atmosphere are stabilised, rather than increasing as they are now. There is as yet no international consensus on the level at which concentrations of greenhouse gases should be stabilised. But in 1997 the EU member states agreed that we should be aiming for a global average temperature increase of no more than 2°C above the pre-industrial level and therefore a concentration below 550 parts per million (ppm) of carbon dioxide - about twice the pre-industrial concentration - to prevent the most damaging effects of climate change.
- 2.7 Even at this level, there will be negative impacts<sup>4</sup>. The majority of the world's population is likely to experience some consequences. At the upper end of the possible temperature rises there would be severe impacts on natural systems and on all sectors of society, a significant increase in extreme climatic events and a high risk of major geographical changes in ice sheets or in ocean currents. Higher concentrations would be likely to pose even greater and more unpredictable risks.
- 2.8. Against this background we take the view that the potential consequences of climate change are so severe that, within a policy framework that keeps costs to a minimum, we should take steps ourselves and work closely with other countries to reduce our greenhouse gas emissions. If we are to stabilise carbon dioxide concentrations in

the atmosphere at no more than 550ppm, global emissions will need to drop well below current levels.

- 2.9 Already policy-makers around the world have begun to respond to these challenges. The UN Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol are the starting point for international efforts to cut emissions.

### The UN Framework Convention on Climate Change and Kyoto Protocol

The UNFCCC aims to prevent dangerous man-made climate change and commits developed countries to taking the lead in tackling climate change. The Kyoto Protocol set legal targets for them to reduce greenhouse gas emissions by around 5% of 1990 levels in the period 2008-2012. The US and Australia have withdrawn from the Protocol, though Australia has said that it still intends to limit its emissions as if it had decided to ratify. It seems likely that the effect of the Protocol in the period 2008-2012 will be a reduction in projected global emissions of at best 2%. To help meet targets, countries can use international emissions trading or receive credits for reductions achieved by supporting projects in other countries. Discussions on action beyond 2008-12 must begin by 2005. In the long term, developing countries are most at risk from climate change and need to be helped to become a part of the global response to it. Developing countries currently account for around 40% of global CO<sub>2</sub> emissions from fossil fuels, and their emissions may exceed those of developed countries by 2020, although per capita emissions in most developing countries are still relatively low.

<sup>4</sup> Based on conclusions of the *Third Assessment Report of the Intergovernmental Panel on Climate Change, 2001*.

## But more needs to be done...

2.10 Climate change is a global problem. It has to be tackled globally. The UK will continue to show leadership but it cannot solve this problem alone. The UNFCCC and its Kyoto Protocol demonstrate that it is possible to reach global agreement on action, but far more needs to be done. UK emissions of carbon dioxide currently account for only about 2% of the global total. Our own actions will have no impact on climate change unless they are part of a concerted international effort. A wider effort is also necessary, for example in bringing forward technological changes, to keep down costs to the UK and to avoid compromising our competitiveness.

**We will therefore continue to work with other countries to establish both a consensus around the need for change and firm commitments to take action to reduce carbon emissions world-wide within the framework of the UNFCCC.**

2.11 Some countries, including some of our European partners, are already moving in this direction. We need, with them, to lead others internationally. It is clear that substantial cuts are needed in the longer term. Delay will only compound the problem. We therefore believe that the time is now right to reinforce our commitment to the achievement of significant long-term cuts in emissions in the UK.

2.12 Our ambition is for the world's developed economies to cut emissions of greenhouse gases by 60% by around 2050. **We therefore accept the RCEP's recommendation that the UK should put itself on a path to a reduction in carbon dioxide emissions of some 60% from current levels by about 2050<sup>5</sup>.** In this white paper, we therefore set out the first steps to achieving this goal.

And we set as a key objective of the UK's foreign policy securing international commitment to this ambition.

2.13 We can get to a 60% cut in emissions by 2050 in a number of ways. But leaving action until the last minute is not a serious option. If we do not begin now, more dramatic and more disruptive change will be needed later on. We need early, well-planned action to provide a framework within which businesses and the economy generally can adjust to the need for change. This will for example allow business to plan to act in the course of normal capital replacement cycles. It will also encourage new technologies to come forward to meet the challenges we face.

2.14 The UK already has a Kyoto Protocol commitment to reduce greenhouse gas emissions by 12.5% below 1990 levels by 2008-12 and a national goal to move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010. The measures in this white paper keep us on track for both goals<sup>6</sup>, and represent a significant departure from the level that emissions would otherwise be under 'business as usual'.

5 A reduction in carbon dioxide emissions of 60% by 2050 is consistent with the level of reduction likely to be needed by developed countries in order to move towards stabilisation of carbon dioxide concentrations in the atmosphere at no more than 550 ppm, taking account of a realistic assessment of emissions growth in developing countries. This is set out in more detail in the Defra paper *The scientific case for setting a long term emission reduction target*, available at [www.defra.gov.uk/environment/climatechange](http://www.defra.gov.uk/environment/climatechange). RCEP's recommendation of putting the UK on a path to 'reducing carbon dioxide emissions by some 60% from current levels by about 2050' was based on a more detailed calculation of 58% reductions from 1997 levels. This would lead to 2050 emissions of 64 MtC. The Kyoto Protocol, and the UK's current domestic targets, use 1990 as a baseline. A precise reduction of 60% in emissions from 1990 would result in emissions of 65.8 MtC in 2050. As the RCEP recommendation implies, absolute precision five decades before 2050 is not possible. This white paper uses 'around 65 million tonnes' to describe the level of carbon emissions which a 60% cut would deliver by 2050.

6 The UK's carbon dioxide emissions increased for the second year running in 2001 and were some 5.2% below the 1990 level, having been 8.1% below in 1999 and 7.3% below in 2000. This upward trend is expected to have been reversed in 2002 when emissions are likely to have decreased slightly. The measures in this white paper should allow the domestic goal to be achieved. We are also committed to reviewing the Climate Change Programme in 2004. This will provide an opportunity to review progress and to strengthen measures if it is thought necessary to keep us on track towards the domestic goal.

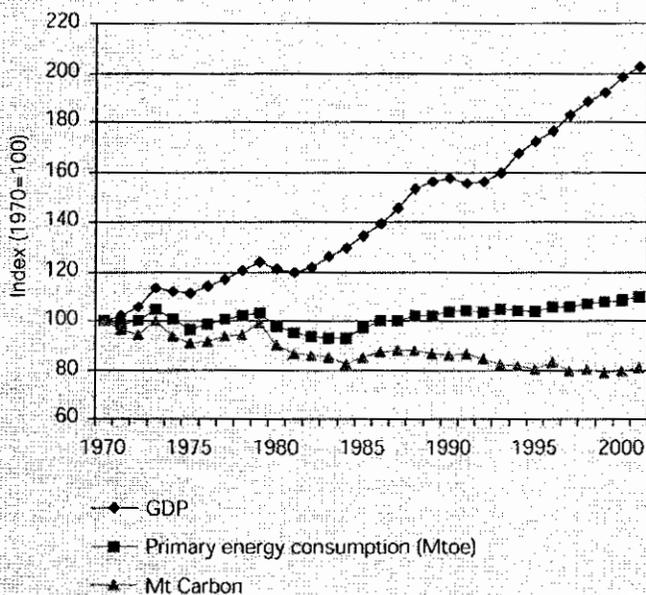
2.15 Discussions under the UNFCCC to tackle climate change beyond 2008-12 will start soon. On the basis of our current policies, including the full impact of the Climate Change Programme, our carbon dioxide emissions might amount to some 135 MtC in 2020<sup>7</sup>. To be consistent with demonstrating leadership in the international process, we will aim for cuts in carbon of 15-25 MtC below that by 2020. This would also put us on course to reduce our carbon dioxide emissions by some 60% by about 2050.

2.16 If we are to cut emissions this much we will need to achieve a fundamental long-term shift in the way energy is supplied and used. Already we have decoupled economic growth from energy use and carbon emissions. Overall energy consumption in the UK has risen by around 15% since 1970, while the economy has doubled.

2.17 In order to achieve our aims we must accelerate this trend. If the UK economy were to grow at an average of 2.25% a year between now and 2050 it would be three times as large then as it is now. Reducing carbon emissions to around 65MtC (see footnote 5) in the same period would require an improvement in the ratio between emissions and economic output of around seven-fold. We will achieve this by raising the resource productivity of our economy - producing more with less pollution.

2.18 The table below illustrates how cuts of 15-25 MtC could be achieved by 2020. The exact target figure will be determined in the light of international negotiations, and the actual mix of measures needed to reach it will be shaped by economic and technological developments. **We will put in hand measures now to ensure we are well placed to deliver on our commitments.**

**Chart 2.1**  
GDP, primary energy consumption and emissions



**Table 2.1**  
How cuts of 15-25MtC could be achieved by 2020

	Estimated MtC reductions
Energy efficiency in households	4.6
Energy efficiency in industry, commerce and the public sector	4.6
Transport: continuing voluntary agreements on vehicles; use of biofuels for road transport	2.4
Increasing renewables	3.5
EU carbon trading scheme	2.4

<sup>7</sup> See material referred to in paragraph 1.49.

<sup>8</sup> The figures represent reductions below the baseline of 135 MtC discussed in paragraph 2.15.

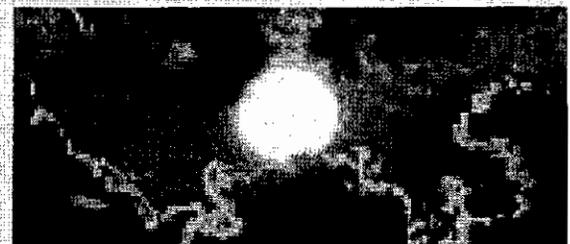
2.19 The Kyoto Protocol's project mechanisms provide for credits from international emissions trading, including from projects under the Clean Development Mechanism and Joint Implementation, to contribute towards emission reduction commitments. They will provide another possible route to savings, although it is not yet possible to judge the scale of any contribution that they may make.

### **Maintaining our competitiveness at the same time...**

2.20 We have analysed carefully the likely impacts on the UK economy of cutting emissions by 60% by 2050. A good deal of caution is needed in looking at economic changes over such a long period and given the sensitivity to the assumptions made. But analysis of data assessed by the Intergovernmental Panel on Climate Change suggests that action aimed at stabilising carbon dioxide atmospheric concentrations at no more than 550ppm would lead to a loss of around 1% in projected GDP<sup>9</sup>. The outcome of our UK analysis is consistent with that review, assuming that the world's leading nations all act together. It suggests that the cost impact of effectively tackling climate change would be very small - equivalent in 2050 to just a small fraction (0.5 - 2%) of the nation's wealth, as measured by GDP, which by then will have tripled as compared to now. And this figure takes no account of the costs avoided by tackling climate change.

2.21 Modelling work shows that higher transition costs would occur if there were very tight reduction targets in too short a time scale, if policies such as emissions trading or other economic instruments were not used or if energy efficiency was not exploited. In the medium term, transition costs would also increase if other countries did not take action to reduce emissions. But the more other countries commit to move in the same direction, the less direct impact there will be on the UK. These impacts need to be monitored and managed, both across the economy and sector by sector. And there will also be some economic benefits, for example through increasing energy efficiency or through enabling UK firms to benefit from new opportunities in manufacturing, servicing and exporting lower-carbon and renewable energy technologies. **We will ensure that we continue to work closely with businesses to develop strategies to enable them to adapt to these changes and exploit them as appropriate.**

<sup>9</sup> Report of Working Group III of Intergovernmental Panel in Climate Change, Mitigation, 2001



## Analysis and modelling work

A wide range of analytical work has supported the white paper. This included work by the Government's interdepartmental analysts group on long-term reductions in greenhouse gas emissions, following which the DTI commissioned Future Energy Solutions to use the MARKAL modelling approach to look at the costs and options for a substantial CO<sub>2</sub> reduction by 2050<sup>10</sup>. MARKAL uses a 'bottom-up' model of the UK energy system, which selects the least cost technologies to meet specified energy demands, subject to constraints imposed on emissions.

The results depend on the assumptions - on technology availability and costs - that are made in the model. However, the assumptions used reflected expert opinion, informed by workshops with industry experts.

The work was not intended to create a single view or forecast. Instead a wide range of sensitivity analyses was carried out to assess which technologies and measures might be crucial to minimising the costs of emissions

reduction and to assess how costs change if assumptions are varied. The analyses covered business as usual cases as well as reductions in CO<sub>2</sub> of 45%, 60% and 70% by 2050.

The analysis suggests that for many of the assumptions tested the cost of reducing CO<sub>2</sub> emissions by 60% by 2050 was in the range £200-300 per tonne of carbon. GDP in 2050 was reduced by 0.5-2.0%, equivalent to an average annual reduction of between 0.01 and 0.02 percentage points from a business as usual GDP growth rate of 2.25% per annum.

Higher costs were indicated if innovation in low-carbon technologies was limited, if energy efficiency improved only in line with past trends, or if both new nuclear build and carbon capture and storage were completely excluded in the longer term.

To be on track for the 15-25 MtC reduction beyond current baselines that we are aiming at, MARKAL indicates costs of reducing carbon in 2020 in the range £10-80 per tonne of carbon.

## A clear long-term policy framework...

2.22 To deliver these outcomes, our aim will be to provide industry and investors with a clear and stable policy framework. In practice, we need a mix of measures in order to shape the market to achieve our goals, including economic instruments and regulation. But we are seeking a framework which, as far as possible, simplifies the mix of measures and takes account of the cost of environmental damage from carbon emissions. We will also

aim to use the price mechanism as far as we can to give clear signals about these costs. This will give the market the flexibility to determine the best way to reduce carbon emissions, and drive action on both the demand and supply sides of the economy. It will also give business a dynamic incentive to find new and innovative ways to reduce emissions. Environmental taxes and tradable permit schemes can both help to achieve these objectives.

2.23 The UK has already made significant progress through the climate change levy and the voluntary UK emissions trading scheme.

<sup>10</sup> Full details of this work are at [www.dti.gov.uk/energy/greenhousegas/index.shtml](http://www.dti.gov.uk/energy/greenhousegas/index.shtml)

The levy is a tax which applies to business and public sector use of gas, coal, electricity and liquefied petroleum gas (LPG). It gives those sectors an incentive to improve energy efficiency and thereby to reduce greenhouse gas emissions. It also involves 80% discounts for energy-intensive sectors which enter into climate change agreements to improve energy efficiency or meet emissions targets. Following the recommendations of Lord Marshall, the levy was designed as a 'downstream' energy tax,<sup>11</sup> which makes it possible to avoid impacting on domestic energy users, and therefore avoid adding to the problem of fuel poverty.

2.24 The first phase of the UK emissions trading scheme has involved a range of organisations from the private and public sectors agreeing to meet emissions caps in return for a share of a financial incentive. Emissions trading has expanded recently through the participation of firms covered by climate change agreements, seeking to deliver their targets.

2.25 The development of emissions trading in the next few years will primarily be dependent on developments at EU level. On 9 December 2002, the European Union Council of Ministers reached initial agreement on a new European carbon emissions trading scheme. This is expected to begin in 2005.<sup>12</sup> Installations which are covered by other equivalent arrangements may not need to join the scheme until 2008. In the scheme, each participant will be set a cap - a target level of emissions. Each will then receive

tradable allowances equal to its cap. To comply with the scheme, each participant must hold allowances at least equal to its emissions. Participants will therefore have three choices:

- meet their cap by reducing their own emissions;
- reduce emissions below their cap and sell or bank the excess allowances; or
- let their emissions remain above their cap and buy allowances from other participants.

2.26 The best strategy for each participant will depend on the price of allowances in the market compared to the costs of reducing their own emissions. In this way, emission reductions from the participating sectors will be achieved at minimum cost across the European Union.

2.27 **We will make the new trading scheme a central plank of our future emissions reduction policies, through which the traded carbon market can set a signal for the value of carbon reductions in the economy. It will be a mechanism for delivering part of the carbon savings we need to make, helping to save around a further 2-4MtC by 2020. We will continue to work proactively with the European Commission, European Parliament and other member states to secure detailed plans for the implementation of the scheme to help deliver this aim. We will also work with them to extend, where appropriate, the coverage of the EU scheme in due course.**

2.28 The inclusion of the electricity industry within the scope of the EU emissions trading scheme will further change the incentives on electricity generators and suppliers, as it will begin to give a direct incentive to electricity

<sup>11</sup> In report *Economic Instruments and the Business Use of Energy*, November 1998 <http://archive.treasury.gov.uk/pub/html/prebudgetNOV98/marshall.pdf>

<sup>12</sup> From the outset, it is proposed that it should cover CO<sub>2</sub> emissions from combustion installations exceeding 20MW, oil refineries, coke ovens, and ferrous metal industries, mineral industries and pulp and paper plants (over certain size thresholds).

generators to reduce emissions. To the extent that the scheme leads to an increase in electricity prices, this will add to costs for electricity users. The scale of such impacts is currently uncertain, but will be driven by the price of carbon in the European market.

2.29 We aim to have a coherent approach to carbon valuation and energy use, so that environmental costs can be internalised as efficiently as possible, irrespective of whether the instruments are international or domestic. The linkages between tax and tradable permit schemes will be carefully considered in the light of the emerging EU emissions trading scheme. As the box below shows, emissions trading is unlikely to cover all emissions from all sectors of business for the foreseeable future, and there will continue to be a role for a tax if a price signal is to be given to other areas of business.

2.30 The issues involved in linking the two mechanisms are not entirely new. The UK has already made links between the sectors covered by the climate change agreements and the voluntary emissions trading scheme. Some changes might be needed, for example, to ensure that the sectors of manufacturing industry which are covered by the EU emissions trading scheme are not subject to unnecessary burdens. The views of manufacturers would be welcome. We will now consider the impact of the proposed EU emissions trading scheme on the climate change levy, while bearing in mind that this will ultimately depend on the precise nature of the future emissions trading scheme which has yet to be agreed. Any tax changes will be a matter for future Budgets.

### **Emissions trading - potential development**

The political agreement on the proposed EU trading scheme outlines its design, together with procedures for expansion. How the scheme will develop in the UK will depend on further work on proposals to manage the transition from the current UK policy mix to the new EU scheme, as well as on decisions by the European Commission and member states. But a possible scenario might be:

**January 2005** - First phase of the EU scheme starts, covering CO<sub>2</sub> from electricity generation, oil refineries and some other sectors of heavy industry. Temporary exclusions allowed for heavy industry during this first phase, with caps on generator emissions adjusted to take account of measures for renewables and energy efficiency.

**January 2007** - Current phase of UK emissions trading scheme for 'direct participants' ends. All of the direct participants in the UK scheme that are covered by the EU scheme transfer their CO<sub>2</sub> emissions to the EU scheme.

**January 2008** - Second phase of EU scheme starts. Scheme covers CO<sub>2</sub> emissions from other sectors of industry as required by the directive and relevant changes made as necessary to the arrangements for the climate change agreements.

Coverage could be extended by unilaterally opting in other activities and greenhouse gases, or by harmonised EU-wide expansion. The EU scheme might expand to include other energy intensive sectors of industry or other industrial and commercial sectors where the size of installation makes this cost-effective.

2.31 The European Union is also close to agreeing a directive on the taxation of energy products. This would require all member states to introduce taxes on the business use of energy to encourage energy efficiency, such as the climate change levy. Once agreement on the emissions trading directive has been reached, the Commission is planning to bring forward proposals to modify the rules on taxation of energy products in the light of the agreement on community-wide emissions trading, to ensure that the two schemes are complementary. We will consider these proposals as part of our own approach to linking the two measures.

2.32 Wherever possible, we will also link the other measures described in this white paper to the carbon emissions trading scheme. This will help enable a common Europe-wide value to emerge for carbon savings, enabling business and consumers to choose themselves how best to achieve their economic and commercial aims against that background. We will now be taking forward work to consider how best to make such linkages and will come forward with appropriate proposals when the relevant policy positions are more firmly established.

### **Considering other environmental impacts too...**

2.33 There are other important environmental issues to be borne in mind as well as climate change. Measures to reduce carbon emissions can also have other benefits, such as improved air quality.<sup>13</sup> For example, the UK

also has binding international commitments to meet targets for emissions of air pollution and for local and regional air quality, including cuts of 50% in sulphur dioxide and 20% in oxides of nitrogen from current levels by 2010. Meeting these will require significant reductions in emissions from electricity generation, in particular current coal fired generation. Energy infrastructure, including renewable energy, has effects on the environment. Future analysis of energy policy choices will continue to bear all these impacts in mind.

<sup>13</sup> Air quality is set out in *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Cm4548, January 2000. [www.defra.gov.uk/environment/airquality](http://www.defra.gov.uk/environment/airquality)

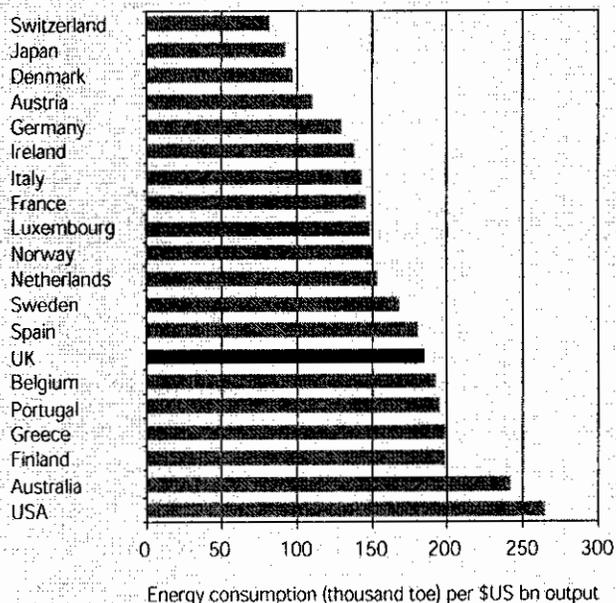
# Chapter 3 Energy Efficiency

3.1 Over the last thirty years, our economy has doubled in size, while energy use has barely increased<sup>1</sup>. Nonetheless, we are still using far more energy than we need, in particular because we are using it inefficiently. Energy is often wasted because of poorly insulated buildings or where heating, ventilation, air conditioning and lighting are poorly controlled. Products are less energy efficient than they could be - for example, the average upright freezer on the market today uses nearly three times as much energy as the most efficient one. Energy saving light bulbs<sup>2</sup> use less than a quarter of the energy of ordinary light bulbs, and also last ten times longer. Businesses and householders may not know how to cut energy use, which is just one of many demands on their time and capital.

3.2 The cheapest, cleanest and safest way of addressing our energy policy objectives is to use less energy. The financial benefits of doing so are clear. Better insulated buildings and more energy efficient workplaces cut energy bills for householders and businesses. Reducing demand puts less pressure on energy supplies.

3.3 Over the last 30 years the economy's energy intensity<sup>3</sup> - the ratio of energy consumption to GDP - has improved by around 1.8% each year. Without this, home heating, for example, would use more than twice the energy it uses today. But simply continuing previous rates of change is not enough. We have to improve energy efficiency far more in the next twenty years than in the last twenty if we are to meet our goals. Many other industrialised countries already do far better than the UK.

**Chart 3.1**  
Energy intensity ratio in "top 20" OECD countries, 2000<sup>4</sup>



3.4 This chapter sets out how we will achieve the necessary step change in energy efficiency across our economy. Our policies have to tackle barriers to the uptake of energy efficiency across all energy users, and provide the framework for continuing, and accelerating, the rate of improvement in the UK's energy intensity. We must also promote innovation to find new ways to save energy in the future.

## The savings we need...

3.5 We expect more than half the emissions reductions in our existing Climate Change Programme - around 10 MtC per annum by 2010 - to come from energy efficiency.

<sup>1</sup> See paragraph 2.16

<sup>2</sup> Compact fluorescent lamps (CFLs)

<sup>3</sup> Energy intensity for the UK as a whole is total energy consumption divided by total GDP. It is normally expressed as Mtoe/\$USbn, to enable international comparison.

<sup>4</sup> Source: IEA

### Energy efficiency savings to 2010<sup>5</sup>

**Households** account for around 5MtC of the expected savings. We have put in place measures to deliver 1.5 MtC, and this white paper sets out key measures which have the potential to deliver the remaining 3.5 MtC. The following are not targets for individual items, but illustrate where savings might be achieved:

- progressively raising efficiency standards to that of the most efficient boiler type, condensing boilers, and installing around 5 million, saving around 0.6MtC;
- insulating around 4.5 million cavity walls from 2005-2010, saving around 1.2 MtC;
- installing an extra 100 million energy saving lights, beyond the 60 million already anticipated by 2005, saving around 0.5MtC;
- faster improvements in the standards of new household appliances and significantly increasing the uptake of A-rated appliances, which could save around 0.4MtC; and
- other insulation measures, improved heating controls, improved standards of new build and refurbishment through revisions to the building regulations, and community heating with CHP, saving around 1MtC.

The Climate Change Programme anticipates savings of around 6MtC by 2010 from **businesses and the public sector**. The climate change levy, the associated climate change agreements, and the UK's own voluntary emissions trading scheme already put us on track to deliver these savings.

3.6 Further ahead, **we believe that energy efficiency can contribute around half of the additional 15-25 MtC savings we are likely to need by 2020** (see chapter 2 table 2.1).

■ **by 2020, a further 4-6MtC of annual savings can come from households.**

This will require further uptake and development of insulation, including in homes that current technologies cannot tackle cost effectively, such as the 7 million homes with solid walls. Building standards, heating systems, lighting and appliances must continue to improve, in some cases through technologies yet to reach the market, such as LED<sup>6</sup> lighting. We will need more innovative developments, which combine energy efficiency with measures such as micro CHP, small-scale renewable heat such as solar water heating, or renewable power such as solar electricity; and

■ **by 2020, a further 4-6 MtC can be delivered annually from the business and public sectors.** The source of savings, and the types of policy to encourage them, would build on those to 2010, with progressively tighter emissions caps under the EU emissions trading scheme being a key measure to stimulate further savings.

3.7 Savings of this magnitude would need roughly a doubling of the rate of energy efficiency improvement seen in the past thirty years.

### Delivering the savings...

3.8 To deliver these savings, we need a mixture of measures, addressing key areas of our economy - including energy used for heating, lighting and powering buildings and appliances in them, which accounts for around half of the UK's total energy consumption. Different policy instruments - emissions trading, the energy efficiency commitment, tax incentives, a greater

<sup>5</sup> These savings are already anticipated in the 135 MtC baseline emissions to 2020 explained in chapter 2.

<sup>6</sup> Light emitting diodes

emphasis on energy services, building and product regulations, advice and information - will be designed to reinforce each other.

3.9 As chapter 2 explains, the new EU emissions trading scheme will play a central role from 2005. By setting strict limits on carbon emissions, it will spur large energy users to find cost-effective ways to reduce emissions. We will press for the scheme to develop so that other sectors can be added or linked to it wherever possible. **The energy efficiency commitment (see paragraph 3.32) will have a major role to play in homes, and we will consider whether to extend it beyond the household sector.** Higher efficiency standards for products and buildings will be required.

3.10 Tax measures will also have a role to play. Lower taxation on lead-free petrol helped to shift consumer demand to the point where leaded petrol was phased out. The Chancellor announced in the 2002 Pre-Budget Report that we would consult further on specific measures to promote greater energy efficiency in households.

### **Through higher building standards...**

3.11 Compared with the 1990 building regulations, the latest revisions introduced last year have reduced the energy needed for heating a new home by half. Similar improvements have been achieved in new commercial and public sector buildings. In the existing stock, which will continue to account for the vast majority of energy consumed in buildings for decades to come, regulations also cover major changes - for instance, higher standards for replacement boilers and windows in England and Wales were

introduced in April 2002. Similarly in Scotland, higher standards were introduced in March 2002, including for replacement windows, and the Building Bill will be enacted in 2003 with the aim of further improving standards.

3.12 But standards elsewhere remain higher, particularly in Northern Europe. A detached house built to the latest standards in England and Wales consumes nearly 20% more energy than an equivalent home in Denmark<sup>7</sup>. **We will raise standards over the next decade, learning lessons from the standards achieved in other comparable European countries.**

3.13 **We will also use the regulations further to raise the standard required for new and replacement boilers to the level of the most efficient boiler types - A and B rated condensing boilers.** Over 1 million boilers, heating and hot water systems are replaced each year, and we believe around 5 million condensing boilers need to be installed by 2010. Currently, our performance falls well short of what has been done elsewhere, as the table below illustrates.



<sup>7</sup> *Putting Climate Change at the Heart of Energy Policy*; EST submission to the energy white paper, 2002 ([www.est.org.uk/est/index.html](http://www.est.org.uk/est/index.html))

## Condensing boilers - a case study<sup>8</sup>

### The Netherlands

**1980-1987:** Subsidies for condensing boilers and a widespread information campaign.

**Mid 1980s:** Demand outstripped supply so manufacturers launched intensive installer training programmes.

**1990:** Subsidies relaunched: government funding matched by funding from energy companies through a customer levy. Housing policy promoted condensing boilers.

**1995:** Building regulations require new build to meet standards of energy efficiency only achievable with condensing boilers.

**1996:** Long term awareness campaign started, plus energy efficiency labelling.

**1996:** Energy tax introduced with hypothecated revenue for energy efficiency.

**2000:** Subsidies (25%) for energy audits introduced.

**2002: Condensing boilers account for ~75% of Dutch market.**

### UK

**1980s:** Development and demonstration of technology under the Government's Energy Efficiency Demonstration Scheme.

**1989-today:** Promotion under the Government's Energy Efficiency Best Practice Programme.

**1993-4:** British Gas-funded cashback scheme.

**1996-9:** Government-funded cashback schemes.

**1997 onwards:** 'Energy Efficiency'<sup>9</sup> awareness-raising campaign with labelling of condensing boilers.

**2000 onwards:** EESoP/EEC<sup>10</sup> and Government fuel poverty programmes installing condensing boilers. Energy Saving Trust working with manufacturing industry.

**2002: Condensing boilers account for ~12% of UK market.**

To achieve much higher levels is likely to require measures such as:

- a communications campaign raising awareness of links between climate change and household energy use;
- training of heating engineers and gas fitters;
- voluntary agreement with industry on condensing boilers; and
- higher boiler standards required by building regulations for existing and new dwellings.

9 [www.saveenergy.co.uk](http://www.saveenergy.co.uk)

10 EESoP - the Energy Efficiency Standards of Performance.  
EEC - the Energy Efficiency Commitment.

3.14 A new EU directive on the energy performance of buildings is now in place<sup>11</sup>. This covers homes alongside business and the public sector. It requires EU member states to set minimum standards for building work on new and existing buildings, to review building standards at least every five years, to introduce energy certificates for all buildings to show how efficient they are, and to test the efficiency of boilers and air conditioning systems in commercial and business premises.

3.15 We already have minimum standards for building work and a building certification system for dwellings and welcome the impetus the directive will give to these. We also welcome the challenge the directive presents to extend certification to all buildings and to introduce boiler and air conditioning inspection systems, or similar, that mean these can be operating more efficiently. The Office of the Deputy Prime Minister will take the lead in responding to the directive, as it has responsibility for most of the legislation that can be used to transpose it into law; however, DTI and Defra will also play a full part.

3.16 **We will start work immediately on the next major revision of the building regulations, which we will aim to bring into effect in 2005.** Tighter building regulations will also encourage developers to use low carbon solutions such as solar water heating and photovoltaics.

3.17 We will also make a start on developing the new provisions that will be needed to implement the directive's certification and inspection requirements, so that public

buildings and those buildings that are sold or tenanted each year can be certified within the timescale required.

3.18 There is also a huge opportunity to deliver improvements through our public investment in schools, hospitals and other public services. In February 2003, we launched *Sustainable Communities: Building for the Future*<sup>12</sup>, a long-term programme to increase housing supply in high demand areas such as the Thames Gateway. This includes a commitment that, from April this year, the Housing Corporation will require that the new homes they fund achieve the Building Research Establishment's EcoHomes<sup>13</sup> standard for sustainable residential development.

3.19 Achieving these bigger and faster changes will require the concerted effort of all parts of the industry - customers (particularly in industry, business and the public sector), architects and designers, the construction industry, manufacturers and other suppliers, the professional bodies, energy companies and government itself. The shift to far greater energy efficiency is also an ideal opportunity to intensify the efforts already being made to improve the productivity of the construction industry. Our sustainable communities action plan is a major opportunity to encourage sustainable construction and maximise the potential that energy efficient technologies can play in the planned new housing developments and refurbishment of existing developments. **We will therefore bring together representatives of housebuilders, the Housing Corporation, the construction industry and others in a new working group to consider how best to improve the**

<sup>11</sup> The EC directive on the energy performance of buildings came into force on 4 January 2003. Member states have three years to implement the directive with an additional three years if needed to implement requirements on building certification and inspection of boilers and air conditioning systems. See [www.europa.eu.int/eur-lex/en/dat/2003/l\\_001/l\\_00120030104en00650071.pdf](http://www.europa.eu.int/eur-lex/en/dat/2003/l_001/l_00120030104en00650071.pdf)

<sup>12</sup> [www.communities.gov.uk](http://www.communities.gov.uk)

<sup>13</sup> [www.products.bre.co.uk/breeam/ecohomes.html](http://www.products.bre.co.uk/breeam/ecohomes.html)

sustainability of all aspects of construction and design, including off-site construction and low carbon technologies (such as photovoltaics or CHP). **We will also bring together representatives of all the key players in a Better Buildings Summit**, which will be jointly convened and chaired by Ministers from ODPM, Defra and DTI.

- 3.20 We will also work with local authorities and their building inspectors to see whether and how enforcement of the regulations can be cost-effectively improved to achieve better correlation between design and built performance.

### **And higher product standards...**

- 3.21 Today's homes contain more household appliances than our grandparents ever dreamt of - cookers, microwaves, washing machines, fridges and freezers, TVs and videos (with multiple sets in many homes), computers and game machines. UK households spend around £5 billion each year on electricity to power lights and appliances, which account for around a quarter of UK electricity consumption. And as these basic products achieve near universal take-up, new, energy-hungry services such as digital TV and broadband communications pose a new challenge.
- 3.22 Not only are these new gadgets energy-hungry, but as users most of us are also energy-lazy. Each year, video recorders and televisions in the UK consume around £150m worth of electricity while on standby, and our homes have increasing numbers of power supplies and chargers permanently plugged in. Consumer education can only have a limited effect in this area. Instead, we need to raise

the standards of the products themselves to give us the best technological answers for cutting energy consumption. Overall, faster improvements in the standards of new household appliances and greater uptake of A- rated appliances can bring about significant carbon savings and could save around 0.4MtC by 2010, relative to the business as usual baseline.

- 3.23 Similar issues arise in industry and commerce, where the speed of information and communications technology leads to new demands. At the same time, smart control systems can significantly cut usage and waste. Again, we need the best possible standards to ensure that equipment is as energy efficient as possible.
- 3.24 Overall, we need to remove the least efficient products from the market, encourage competition to bring forward improved products, and make it easier for people and businesses to choose the best. Ways to do so include minimum standards, voluntary agreements with industry, fiscal measures, procurement policy, and better information on product performance.
- 3.25 Provided manufacturers are given adequate time to change their product specifications, higher standards should not damage our industrial competitiveness. Indeed, properly designed, they can help British and other European manufacturers to anticipate and meet rising consumer expectations in other parts of the world. We will continue to consult closely with UK industry, including manufacturers, dealers and service providers, and with the European Commission and other member states, on how best to deliver low-cost improvements in product standards.

Our Market Transformation Programme<sup>14</sup> already works at national and EU level with Governments, industry, retailers and others.

3.26 We are already encouraged by industry's response to this agenda, especially in its self-commitments to improve efficiency standards and targets for such things as electric motors, televisions, video recorders, digital TV services, power supplies, water heaters and washing machines. The European code of conduct on digital TV services has enabled the UK to avoid additional energy consumption equivalent to around 0.4MtC a year. We will encourage and support such industry self-commitments when these will deliver earlier or higher standards than mandatory measures alone.

3.27 The UK's membership of the single European market means that product standards on tradable goods and equivalent industry voluntary agreements usually have to be set or agreed at the EU level. Mandatory standards to remove inefficient boilers, fridges and fluorescent lamp ballasts<sup>15</sup> from the market are already in force and are very effective. For example, even the least efficient new fridge freezer in the EU now consumes only half as much energy compared to products that were still on the market 5 years ago. The standard for lamp ballasts alone will save nearly 0.25MtC a year in the UK.

3.28 The Commission is now proposing a new framework directive<sup>16</sup>, to set standards for a wider range of products, and to revise the energy labelling regime which currently deals only with household appliances.

It has estimated that such measures could save around 10% of total EU energy consumption by 2020<sup>17</sup>. **We support these proposals and will work proactively to influence and speed their delivery.**

3.29 In particular, our analysis and consultations suggest that we should press for urgent action in the EU to raise standards in air conditioning, boilers and water heaters, power chargers, consumer electronics, office equipment, motors, fans and pumps, washing machines, fridges and other white goods and lighting, including significant reductions in standby power.

3.30 We will also reinforce other measures to promote the sale of products above current EU minimum standards, including fiscal instruments, information tools such as the EU energy label, the Energy Saving Trust's Energy Efficiency Recommended logo and the Energy Star label for IT equipment.

### **In the home...**

3.31 Tougher building regulations will have an impact on new homes, alterations to the existing stock and all replacement windows and boilers. But they will not deal with long-standing problems like the 15 million homes with inadequate wall insulation - either solid walls or unfilled cavities.

3.32 We have already introduced - in April last year - an energy efficiency commitment (EEC) for domestic energy suppliers, which runs until 2005. Each supplier<sup>18</sup> has an energy saving target, which they can meet by encouraging

<sup>14</sup> [www.mtprog.com](http://www.mtprog.com)

<sup>15</sup> A 'lamp ballast' controls the current passing through fluorescent lighting tubes

<sup>16</sup> Proposal for a framework directive on the eco-design of end use equipment

<sup>17</sup> European Commission background and discussion paper on a draft proposal for a framework directive on energy efficiency requirements for end-use equipment, April 2002. (This proposal is now integrated with the proposal in footnote 16).

<sup>18</sup> Applies to licensed energy suppliers with at least 15,000 electricity and/or gas customers.

householders to install energy saving measures, for example by subsidising the cost of installing a condensing boiler, wall or loft insulation, energy efficient lights and appliances either directly or through retailers. At least half the target must be met in households whose occupants are either on a low income or disabled. It is already accelerating the uptake of energy efficiency measures, reducing the cost of measures to the consumer, and encouraging the heating and insulation industries to build up their capacity to meet the increased demand. But by 2005, when the current EEC ends, there will still be around 6-7 million homes where cavity wall insulation would be relatively easy to install. Filling 4.5 million of these by 2010 would save around a further 1.2 MtC.

3.33 Energy suppliers have responded positively, and are working hard to meet their targets. We want their good work to continue, and for it to become an integral part of their long-term business strategies. So, **we will consult on an expansion of the EEC to run from 2005 to at least 2008, at possibly twice its current level of activity.** This will allow energy suppliers and the energy efficiency industries to plan the level of EEC activity over the medium and longer term. It will require energy suppliers to take up a substantial proportion of the potential for higher energy efficiency in homes, and deliver carbon savings of around 1 MtC by 2010, primarily by encouraging better home insulation. As we introduce the new EU emissions trading scheme, we will consider how the EEC can be best dovetailed with it. Looking to the future, a continuation and further expansion of EEC, or some successor mechanism, could deliver a further 3 MtC of savings by 2020.

3.34 While energy suppliers are selling energy saving measures under EEC, few have sought to develop new markets in energy services. Rather than simply selling electricity and gas, energy services focus on the outcome the customer wants - such as warm rooms and hot water - and offer the most cost-efficient way of achieving it. Under an energy services contract a supplier might, for example, install insulation or a more efficient boiler in a customer's home, and recoup the investment through the quarterly bill over, say, 3 to 5 years. The householder uses less energy as a result, and the savings on the energy bill are used to repay the cost of the measures. So, worthwhile home improvements are installed with no upfront cost to the householder, who benefits from a warmer, more comfortable home and lower energy bills for years to come once the initial investment has been repaid. Some have called this approach selling 'negawatts' instead of 'megawatts'.

3.35 Energy services could help to overcome consumers' reluctance to invest in energy efficiency improvements. However, since the energy markets were opened up to competition in the late 1990s, householders can switch supplier by simply giving 28 days' notice. Energy suppliers have little incentive to offer energy service contracts if customers can switch at short notice. **We will therefore establish a working party with OFGEM, energy suppliers and others to explore how to create an effective market in energy services.** This will address, among other issues, the barriers caused by the current 28-day notice period while maintaining adequate freedom of choice and consumer protection for customers. It will report initial conclusions later this year.

3.36 We will also continue to tackle poorly insulated and inefficiently heated homes through our **fuel poverty and social housing programmes** (see chapter 8). Because these focus on helping people heat their homes adequately, in the short term their contribution to carbon savings is relatively small. But they will help to ensure that we have a much more energy efficient housing stock in coming decades.

### At work...

3.37 In businesses and the public sector, there are many ways to reduce energy use. Improving insulation, heating, lighting and equipment are important, particularly in the commercial and public sectors. There are also many other opportunities in day-to-day operations and production processes. Many savings can occur at the time of investment in new or replacement plant. Technologies include more efficient motors, variable speed drives, heating and cooling plant and proper pipe insulation. Savings can also come through making productive use of otherwise 'waste' heat and cooling, and avoiding unnecessary heating and cooling through better design and control.

3.38 As chapter 2 explained, we have already put in place a range of actions to promote energy efficiency in business. The climate change levy (CCL) is a levy on business and public sector energy use. Receipts (around £1 billion a year) are recycled back to business, mainly through reduced National Insurance but also through £50 million for tackling business energy efficiency. Within the CCL, climate change agreements (CCAs) have been negotiated with energy intensive industries. Participants pay only 20% of the CCL in

return for agreeing to meet challenging energy efficiency targets over a 10-year period. The CCAs alone are expected to achieve savings of around 2.5MtC by 2010.

3.39 We launched the world's first economy-wide greenhouse gas emissions trading scheme in April 2002<sup>19</sup>. By December 2002, 34 companies had become members, while a further 6000 companies with CCAs can use the trading scheme either to help meet their target or to sell any over-achievement. The targets set for participants in the scheme should deliver 1.1MtC of carbon equivalent<sup>20</sup> savings by 2006.

3.40 Taken together, the savings generated by these schemes account for most of the 6MtC of savings identified under the Climate Change Programme. Beyond that, three other mechanisms help business improve efficiency:

- building regulations;
- the Carbon Trust (see box below); and
- the Enhanced Capital Allowances Scheme<sup>21</sup> which enables businesses to claim 100% first year capital allowances on investments in energy saving technologies.

3.41 Chapter 2 noted that policies will in future need to be reviewed in the light of the emerging EU emissions trading scheme.<sup>22</sup> **We will also consider whether to extend the EEC beyond the domestic sector, perhaps to businesses that do not pay the**

19 [www.defra.gov.uk/environment/climatechange/trading/](http://www.defra.gov.uk/environment/climatechange/trading/)

20 The UK emissions trading scheme includes all 6 greenhouse gases. All savings are expressed in terms of the estimated global warming potential on an equivalent basis to those from carbon dioxide.

21 [www.eca.gov.uk/](http://www.eca.gov.uk/)

22 In addition, the linkage with the integrated pollution prevention and control (IPPC) directive will need to be clarified.

**CCL, as a means of improving their energy efficiency. We would consult fully on such a proposal if we concluded that it was the right approach.**

### **In the public sector...**

3.42 The public sector accounts directly for only 5% of UK carbon dioxide emissions. But this sector - in particular the Government itself - has a vital role to play in leading by example.

3.43 Government, along with other public sector organisations, is taking action to improve energy efficiency. For example:

- we will be showing leadership in our own performance. The central Government estate has an interim target to reduce carbon emissions by 1% a year from 1999-2000, **with new targets to be set in 2003, including on CHP** (see chapter 4). Our review of government procurement has identified a number of areas where government purchasing could more strongly support sustainable development goals. The review has been considering how to build energy efficiency into government procurement and contract strategies, and identified some specific categories where products are already available which meet high energy efficiency standards. As a result we have made central arrangements for departments to purchase goods with high energy efficiency standards and which provide value for money in areas such as IT equipment, boilers, lights and lighting systems, refrigeration equipment, televisions and washing machines. We will be implementing our conclusions later this year;

- NHS Trusts are already targeted to reduce the level of primary energy consumption by 15% or by 0.15 MtC equivalent from March 2000 to March 2010<sup>23</sup>; and
- since 2002/3 local authorities have been required to benchmark their energy use in operational property and street lighting and will set local improvement targets from 2003/04. Along with Registered Social Landlords, they are also required to bring their own housing stock up to decent standards by 2010.

### **Preparing the market and helping people make choices...**

- 3.44 **With the Devolved Administrations we will continue to support the work of the Energy Saving Trust and the Carbon Trust** which provide free advice to households, businesses and public sector bodies on how to save energy. Raising awareness and providing targeted advice and information is a cost-effective way of overcoming barriers to energy efficiency. Advice also supports EEC by encouraging customers to take up the energy suppliers' offers. The UK-wide network of Energy Efficiency Advice Centres might, over time, evolve to become Local Sustainable Energy Advice Centres, covering energy efficiency, renewables and transport energy use.

### **Encouraging energy efficiency in homes, business and the public sector**

Government and the Devolved Administrations provide funding for the Energy Saving Trust and the Carbon Trust to stimulate the uptake of energy efficiency in homes, business and the public sector.

The **Energy Saving Trust**<sup>24</sup> (EST) works in partnership with manufacturers, retailers, installers, energy suppliers, local authorities, advice providers and others. EST seeks to ensure the most effective delivery of energy efficiency to homes and small businesses for consumers; the 'Energy Efficiency' branding and marketing programme aims to transform attitudes to energy efficiency.

The **Carbon Trust**<sup>25</sup>, launched in April 2001, is developing and implementing programmes to accelerate the take-up of energy efficiency in the non-domestic sector. These include the 'Action Energy' information and advice service; an interest-free loan scheme for small businesses; and stimulating innovation in new low-carbon technologies.

### **Encouraging innovation...**

3.47 We need to develop even smarter ways to satisfy our energy needs, through better building techniques and products. Industry needs to continue to develop more efficient manufacturing processes that improve resource productivity. New types of meters will be needed to enable homes and businesses to make the best use of on-site electricity generation through renewables or CHP. And once products have been developed we need to get them deployed into the market. We agree with the recommendation of the Chief Scientific Adviser's Energy Research Review Group that energy efficiency should be treated as a priority area in which increased investment in research and development is particularly likely to yield major breakthroughs. The research and development to enable these technologies to make a contribution in the years to come needs to start now. The Carbon Trust's Low Carbon Innovation Programme<sup>26</sup>, launched in 2002, provides funding to enable that to happen.

3.45 Our forthcoming Housing Bill will propose a requirement for home sellers to produce a sellers pack. This will be necessary for us to comply with the requirements of the EU buildings directive. The pack will promote energy efficiency by ensuring all homebuyers have access to information on energy performance of the homes they are considering buying.

3.46 We also need to ensure that industry is suitably qualified to deliver the measures we have set out. Our policies to improve training and skills are outlined in chapter 7.

3.48 The new generation of buildings could have both minimum energy requirements and produce their own electricity through new and emerging technologies such as micro CHP<sup>27</sup>, photovoltaics and fuel cells. Some homes that use little or no energy for heating already exist in the UK. In 2002-03 we introduced two new programmes - Community Energy and Clear Skies (a community and household renewables scheme) - worth £60m over three years to support CHP and renewable energy technologies.

24 [www.est.org.uk](http://www.est.org.uk)

25 [www.thecarbontrust.co.uk/thecarbontrust/default.htm](http://www.thecarbontrust.co.uk/thecarbontrust/default.htm)

26 [www.thecarbontrust.co.uk/foundation/](http://www.thecarbontrust.co.uk/foundation/)

27 Micro-CHP enables the simultaneous production of heating and electricity in the home and in small businesses. It is likely to operate in place of a domestic central heating boiler. CHP policies are further discussed in chapter 4.

## Reporting progress...

- 3.49 These strands of policy in different sectors add up to an ambitious strategy for change. Further work is needed to consult on and put in place some of the detailed policies that will deliver it, for example as the scope and operation of the EU emissions trading scheme becomes clearer. But we do not want to lose momentum. **So, within a year, we will publish an implementation plan that sets out in further detail how we will deliver the strategy that we have set out here.** This will update and expand on the measures set out in the Climate Change Programme. **From then on we will report annually, as part of the follow up to this white paper, on progress towards achieving the savings we have set out.**



# Chapter 4 Low carbon generation

4.1 A new energy policy demands new thinking about energy supply. We need a shift towards energy sources and generation technologies that produce much less or no carbon. We can expect to see far more small-scale, distributed heat and electricity generation.

4.2 In particular:

- renewable energy will play a vital part. To date, renewable energy has expanded far less in the UK than in some other European countries. Yet the potential is huge. For example, the UK has over one third<sup>1</sup> of Europe's entire potential for offshore wind energy. And there is great scope for innovative, local developments, bringing together low carbon technologies such as renewable energy and energy efficient buildings<sup>2</sup>; and;
- combined heat and power (CHP), which is an efficient form of providing heating and electricity at the same time, also fits into this wider picture. The UK already has around 5GW of CHP installed, mainly on an industrial scale. In the future, we can also expect to see far more 'micro-CHP' - efficient, small-scale heating and electricity generation systems in homes as well as businesses.

4.3 Although nuclear power produces no carbon dioxide, its current economics make new nuclear build an unattractive option and there are important issues of nuclear waste to be resolved. Against this background, we conclude it is right to concentrate our efforts on energy efficiency and renewables. We do not, therefore, propose to support new nuclear build now. But we will keep the option open.

4.4 This chapter looks at the role that we can expect renewables and CHP to play; examines the obstacles to their greater take-up; reviews the short and longer-term technological opportunities and the role we can play in promoting them; and sets out our conclusions on the role of nuclear power.

## The role of renewables...

### What is renewable energy?

Renewable electricity can be generated from wind power, wave, tidal, solar photovoltaics (PV), hydro generation, geothermal and biomass (energy from forestry or crops). These forms of generation offer an enormous potential resource, particularly in the UK where our coastline provides extensive opportunities to use wind, wave and tidal power. They all produce no carbon at all or, in the case of biomass, produce only the carbon they have already absorbed from the atmosphere when growing. Some forms of waste are also classed as renewable under the Renewables Obligation.

Solar energy can heat water directly, either for hot water or for space heating in buildings. And heat from the ground, river water, sewage and even the air can be put through a heat exchanger for both water and space heating.

4.5 If we are to achieve a 60% reduction in carbon emissions by 2050, we are likely to need renewables by then to be contributing at least 30% to 40% of our electricity generation<sup>3</sup> and possibly more. We therefore need to develop a framework which encourages the development of a wide range of renewable options and to make significant changes to our institutions and systems.

<sup>1</sup> BWEA, 2002 [www.offshorewindfarms.co.uk/info.html](http://www.offshorewindfarms.co.uk/info.html)

<sup>2</sup> Renewable fuels will also be important in transport. This is discussed in chapter 5.

<sup>3</sup> *Options for a low carbon future* (Future Energy Solutions, 2003) [www.dti.gov.uk/energy/whitepaper](http://www.dti.gov.uk/energy/whitepaper)

## We have made a start...

4.6 In January 2000 we announced our aim for renewables to supply 10% of UK electricity in 2010, subject to the costs being acceptable to the consumer<sup>4</sup>. It is clear that achieving the 10% target over the next seven years will be very challenging.

4.7 We have recently put in place a range of new measures to deliver this. We have:

- introduced a Renewables Obligation for England and Wales in April 2002<sup>5</sup>. This will incentivise generators to supply progressively higher levels of renewable energy over time. The cost is met through higher prices to consumers. By 2010, it is estimated that this support and Climate Change Levy (CCL) exemption will be worth around £1 billion a year to the UK renewables industry;
- exempted renewable electricity from the CCL;
- created a renewables support programme worth £250m from 2002-2005;
- drawn up a strategic framework for a major expansion of offshore wind; and
- created a new organisation within Government - Renewables UK - to help our renewables industry grow and compete internationally.

In addition, from 2005 onwards, the EU emissions trading system will provide a further incentive for renewables.

4 *Conclusions in response to the public consultation - New and Renewable Energy: Prospects for the 21st century* (DTI, 2000)  
[www.dti.gov.uk/renew/condoc/policy.pdf](http://www.dti.gov.uk/renew/condoc/policy.pdf)

5 The Scottish Executive launched the Renewables Obligation Scotland on 1 April 2002. We make proposals in paragraph 4.64 on integrating the Renewables Obligation Certificate trading schemes for Great Britain and Northern Ireland.

4.8 We are pushing forward these programmes in consultation with industry. A new Renewables Advisory Board - comprising representatives of the relevant industries, the Government and the Devolved Administrations - has been set up with a remit to provide expert independent advice to DTI on renewables issues.

## But we need to do still more...

4.9 We produce less electricity from renewables than a number of our European partners. In 2000, renewables (excluding large hydro plant and mixed waste incineration) supplied only 1.3%<sup>6</sup> of our electricity, compared with 16.7% in Denmark, 4% in the Netherlands, 3.2% in Germany and 3.4% in Spain. To hit the 10% target we will need to install approximately 10,000MW of renewables capacity by 2010, an annual build rate of over 1250MW. Only 1200MW of renewables capacity has been installed in total so far (excluding large hydro). The measures we have already put in place will make a major difference to the rate at which capacity is installed. But they were only introduced last year and it will take a few years before these measures impact fully.

4.10 Our analysis and consultation has shown that we need to strengthen our policy if we are to ensure that the measures we have put in place have the maximum impact. We describe below a number of steps that we will take to accelerate the take-up of renewables.

4.11 As we have set out, our aim for renewables is that they should supply 10% of UK electricity in 2010, as long as the cost to customers is acceptable. We believe that renewable sources of energy will increasingly

6 *Renewables Information 2002* (IEA, 2002)  
[www.iea.org/stats/files/ren2002.pdf](http://www.iea.org/stats/files/ren2002.pdf)

demonstrate that they can meet our energy needs both economically and in a carbon free way. Technologies such as onshore and offshore wind and biomass are potentially - after energy efficiency and alongside CHP - the most cost-effective ways of limiting carbon emissions in the longer-term. We expect industry to respond to the framework established by the Government and demonstrate they can achieve our goals at an acceptable cost. **On that basis, our aspiration is by 2020 to double renewables' share of electricity from our 2010 target and we will pursue policies to achieve this.**

4.12 We remain firmly committed to the current Renewables Obligation and will maintain the level of support it provides as planned until 2027. **In 2005/06, we will review progress and will elaborate a strategy for the decade to 2020.** This will take account of the experience of carbon prices arising from the emissions trading scheme and of the costs of renewable technologies.

4.13 We have already put in place a substantial renewables support programme worth in total £250m between 2002/03 to 2005/06. But we recognise that further funding is needed to give us the best chance of reaching the 2010 target. **We will therefore increase funding for renewables capital grants by a further £60m within this period. This is additional to the extra funding announced in the 2002 Spending Review, which allocated an additional £38m for energy policy objectives in 2005/06<sup>7</sup>.** This funding will enable us to increase momentum and to take forward a broad strategy for renewables including ramping-up medium-term funding for offshore wind.

4.14 As well as making progress towards our 2010 target, and paving the way for our 2020 strategy, we need to make sure that we are planning for the longer-term up to 2050. We are already reviewing innovation spending, including that for renewable energy, across government. With respect to renewable energy, we will review the barriers to successful innovation across the range of renewables technologies and will set out a programme for developing, with industry, strategies for the successful application of those technologies in the liberalised energy market. We expect this work to cover advanced conversion technologies for biomass, wave and tidal, building-integrated renewables, and hydrogen and fuel cells.

### **Innovation, research and development are crucial...**

4.15 Key to realising the full potential of renewables over time is the generation of innovative ideas which will bring on new technologies as well as improving existing ones. The Chief Scientific Adviser's Energy Research Review Group<sup>8</sup> recommended that more needed to be spent on energy research and development and singled out two renewables technologies (solar PV and wave/tidal power) as areas in which increased investment was particularly likely to lead to step-change breakthroughs. **We accept these recommendations and have already increased funding for basic research into renewables (see paragraphs 4.60 and 4.61).**

<sup>7</sup> Compared with 2002/03

<sup>8</sup> *Report of the Chief Scientific Adviser's Energy Research Review Group*, Office of Science and Technology, 2001.  
[www.ost.gov.uk/policy/issues/csa\\_errg/main\\_rep.pdf](http://www.ost.gov.uk/policy/issues/csa_errg/main_rep.pdf)

## Combined heat and power also has significant potential...

- 4.16 CHP is an efficient form of providing heating and electricity at the same time. CHP's overall fuel efficiency is around 70-90% of the input fuel - much better than most power stations which are only up to around 40-50% efficient. It enables a very wide range of energy users, from heavy industry down to individual homes, to save money and help the environment by reducing overall carbon emissions. It is also the cornerstone of many community energy schemes, providing heating, electricity and in some cases cooling to a wide range of users. But the low prices in the wholesale electricity market and the increases in wholesale gas prices over recent years are adversely affecting new CHP developments. A number of proposed new power stations, which already have planning approval, are awaiting electricity price rises and/or gas price reductions before they go ahead.
- 4.17 We have set a target of achieving 10GWe of Good Quality CHP<sup>9</sup> by 2010. Good progress has been made over the last decade and 4.8GWe is currently installed. Achieving the Government's target could save a further 1.25MtC per year. **We remain committed to a target of 10GWe of Good Quality CHP capacity being installed by 2010.**
- 4.18 **In addition to the measures we have already put in place to support CHP, we will introduce a number of further measures to help address the current market difficulties and support the achievement of our target:**

- **we will undertake a review of the existing guidance on information required to accompany power station consent applications.** Applicants will need to provide significant evidence clearly demonstrating they have considered all economically viable options for CHP and community heating;
- **we will continue to emphasise the benefits of CHP and community heating whenever Planning Policy Guidance, Regional Planning Guidance or Sustainable Development Guidance is introduced or reviewed;**
- **it is vital that NETA does not discriminate against smaller generators, including CHP.** Some changes have already been made. We expect OFGEM to continue to work with smaller generators and ELEXON to ensure that the administrative procedures for the Balancing and Settlement Code under NETA are fully accessible to smaller generators. **We will work with OFGEM to keep these developments under review since the existence of a level playing-field for smaller generators, including CHP and renewables, is essential if our ambitious targets are to be met;**
- **in the draft CHP Strategy we announced that we would consider setting targets for Government Departments to use CHP generated electricity. We will now proceed with this. Over the coming months we will consider the nature and extent of such a target or targets and announce our conclusions in the energy section of the Framework for Sustainable Development on the Government Estate that we hope to publish later this year. We will also encourage other parts of the public sector to consider whether setting CHP targets would be appropriate;**

<sup>9</sup> Good Quality CHP is CHP generation that meets efficiency standards prescribed in the Government's CHP Quality Assurance programme.

- **as we consider and consult on the expansion of the energy efficiency commitment (EEC) for households from 2005 onwards and on whether to extend the EEC beyond the household sector (see chapter 3), we will explore the opportunities for incentivising CHP technologies;**
- **we will support field trials designed to evaluate the benefits of micro-CHP;**
- we recognise that the CHP target will require sustained effort from both the private and public sectors, and can therefore only be achieved with the active collaboration of all the partner organisations which have a contribution to make. **We have invited the Energy Saving Trust and the Carbon Trust to review their current and future programmes to ensure that they reinforce the delivery of the Government's CHP target; and**
- over time the measures outlined in this white paper - in particular emissions trading - will encourage lower-carbon forms of generation and more efficient use of fuels. **Under the UK Emissions Trading Scheme, carbon savings from CHP can already be traded, and we will work on a framework for pilot projects within the Scheme for which CHP projects may be eligible.** This work would take into account the forthcoming EU Directive on emission reduction projects. Furthermore, the EU emissions trading scheme will encourage low-carbon technologies, including CHP. And we expect to see a new approach to electricity generation developing that recognises and encourages local generation opportunities.

- 4.19 These measures will be elaborated in the final version of our CHP Strategy to be published in the course of this year, on which we look forward to a continuing and constructive dialogue with industry.
- 4.20 **We will also monitor and report on developments on CHP as part of the arrangements described in chapter 9.**

### **Structural barriers to renewables and CHP...**

- 4.21 Many renewable and CHP generators, because of their small size and/or location, need to be connected to local distribution networks rather than the national transmission network. To achieve our targets for higher levels of renewable generation and CHP plant, distribution networks will have to be capable of accommodating many more directly connected generators. Very substantial changes will be needed in the way in which our distribution networks are designed, organised and financed - greater than anything we have seen in the last 50 years. Distribution Network Operators (DNOs) will also need to take a more proactive approach to distributed generation.
- 4.22 During the white paper consultation, distributed generators expressed concern that their projects were being unduly delayed because they could not obtain quick and easy connections to the distribution network. Under the present price control rules there is no financial incentive for the DNOs to connect distributed generation to their networks. We therefore believe that the regulatory framework needs to be amended so that the DNOs connect and use higher levels of distributed generation.

4.23 OFGEM has started working with the DNOs to address these issues<sup>10</sup>. **OFGEM is committed to publishing the detail of an incentive framework for connecting and utilising distributed generation later this year, for implementation in April 2005.**

This will help distributed generators to obtain quicker and easier connections to the distribution network in the interim period to the next price control and beyond. DNOs need to work closely with the industry to exploit the existing infrastructure by using innovative engineering solutions when connecting higher levels of distributed generation.

4.24 **We are also working with OFGEM to address the administrative burdens placed on smaller generators and to ensure that they are not unfairly disadvantaged in their relations with local suppliers<sup>11</sup>. Through the Distributed Generation Co-ordinating Group<sup>12</sup>, we are also following up a range of wider changes designed to facilitate distributed generation. We will report progress on this in the follow-up to the white paper (see chapter 9).**

4.25 We need to develop the existing transmission network to exploit our massive onshore and offshore wind resources. Transmission companies must start preparing now to

strengthen the network to enable the UK to increase substantially its deployment of renewables. **The regulatory arrangements are crucial to our ability to deliver infrastructure which will, in turn, permit the development of renewable generation throughout the country - not least in those peripheral areas where natural resources are often greatest. Discussions are currently taking place between OFGEM and the transmission operators on plans to upgrade the transmission network across the whole country. We are also consulting on network issues across Great Britain (GB) in the context of the forthcoming British Electricity Trading and Transmission Arrangements (BETTA) legislation (as discussed in paragraphs 4.28 and 4.29). It is essential to create a network infrastructure capable of supporting our environmental objectives.**

4.26 **We are establishing with OFGEM a joint working group on environmental issues<sup>13</sup> modelled on the successful joint working group on security.** One of the key priorities for the group will be to monitor network operators' progress in modernising the transmission and distribution networks to meet our carbon aims.

**The New Electricity Trading Arrangements (NETA) are evolving to respond to industry concerns...**

4.27 During the first few months of NETA some generators, in particular renewables and CHP, were exposed to very high costs as a result of the mechanism used to balance the

<sup>10</sup> In January 2003 OFGEM published its initial thoughts on both the principles for developing the regulatory framework for the next distribution price control and on interim arrangements for the period to April 2005 when the next price control is implemented. [www.ofgem.gov.uk/docs2003/dnoletter\\_jan.pdf](http://www.ofgem.gov.uk/docs2003/dnoletter_jan.pdf)

<sup>11</sup> OFGEM has recently launched a help facility for smaller generators under NETA [www.ofgem.gov.uk](http://www.ofgem.gov.uk)

<sup>12</sup> The DTI and OFGEM created and jointly chair the Distributed Generation Co-ordinating Group. The Group is concerned with a wide range of issues related to the connection and operation of distributed electricity generation in Great Britain. The Group is also considering recommendations made by an earlier group (Embedded Generation Working Group) on how to encourage DNOs to connect higher levels of distributed generation [www.distributed-generation.org.uk](http://www.distributed-generation.org.uk)

<sup>13</sup> As discussed in chapter 9

electricity system. NETA is evolving to deal with these problems. It is important that the balancing mechanism reflects costs and that the system as a whole provides a realistic route to market for all generators. We have worked with OFGEM to make the balancing mechanism more genuinely reflect costs. A number of amendments have been made since NETA was introduced<sup>14</sup>. This has helped all players but especially smaller generators such as renewables and CHP to operate more effectively in the market. OFGEM has also approved a proposal to introduce in February 2003 a further amendment that should more accurately reflect the costs of being out of balance<sup>15</sup>. OFGEM is also committed to continuing to work with smaller generators to ensure that the Balancing and Settlement Code is fully accessible to smaller generators<sup>16</sup>.

**We will continue to keep the operation of these aspects of NETA under close review.**

We discuss the impact of NETA on the electricity industry as a whole in chapter 7.



### What is NETA?

The New Electricity Trading Arrangements (NETA) were introduced in England and Wales on 27 March 2001. NETA replaced the Electricity Pool whose centralised, inflexible arrangements for setting wholesale electricity prices meant that prices failed to reflect falling costs and increased competition.

NETA put in place market-based trading arrangements, more like those in other commodity markets. The majority of electricity is traded through bilateral contracts where prices are agreed between parties and on power exchanges, the remainder, around 2%, is traded through the NETA balancing mechanism.

The Balancing Mechanism has two functions. As electricity cannot be stored, the transmission system has to be balanced on a second by second basis to ensure system security. The National Grid Company (NGC) operates a balancing mechanism to do this. The 2% of electricity traded through the balancing mechanism is due to generators and suppliers being out of balance with their contracted position: either a generator not producing enough or too much electricity or suppliers not consuming enough or too much electricity. NGC then has to accept offers for more electricity, or bids to produce less. These additional costs to NGC are passed on through imbalance charges.

<sup>14</sup> Modification P12 to the Balancing and Settlement Code (BSC) was implemented on 2 July 2002. This has the effect of reducing gate closure to one hour and has helped all participants (and especially less predictable generators) better manage the risk of being out of balance.

<sup>15</sup> Modification P78 to the Balancing and Settlement Code (BSC).

<sup>16</sup> The Balancing and Settlement Code covers the trading, balancing and subsequent settlement of electricity.

## BETTA...

- 4.28 We have announced that we intend to bring forward legislation to create a wholesale electricity market for GB as soon as Parliamentary time allows. The development of these new arrangements, is being undertaken with OFGEM and with the involvement of industry. For planning purposes, we are working towards the implementation of BETTA in October 2004. We intend to implement BETTA by April 2005 at the very latest.
- 4.29 BETTA will mean that Scottish domestic and business customers will benefit from the same levels of competition that are now established in England and Wales. The single set of trading rules, connection policies and transmission charging arrangements under BETTA will reduce barriers for independent generators across GB to getting their power to market. BETTA will help to create a diverse generating base in GB and encourage new transmission capacity, helping to support renewables development.

### **Planning needs to be streamlined and simplified ...**

- 4.30 Many of those who responded to the white paper consultation saw planning as one of the big obstacles to new renewables. We recognise that this is a serious problem for renewables. **The Office of the Deputy Prime Minister (ODPM) will shortly publish new planning guidance on renewables (PPS22)**

**for England<sup>17</sup>. A separate guide containing advice on best practice will also be published.** These documents will provide guidance to local planning authorities and developers about the best way to promote renewables through the planning system as well as encouraging a strategic approach to the deployment of renewable projects through regional planning guidance and development plans. We will also be consulting on a new regional-level strategic approach to energy issues, including renewables, which we expect will incorporate regional targets, as discussed further in chapter 9. This approach will help to encourage regional bodies as well as local authorities to examine strategically the resources and opportunities for renewable projects within their areas and what they can do to develop them in their region.

- 4.31 **ODPM, in partnership with other government departments, will be examining how to bring consideration of the use of renewables and energy efficiency in developments more within the scope of the planning system, in the context of the review of PPG22 and the Government's wider planning reforms, and in a way that does not impose undue burdens on developers.**
- 4.32 We need better information on what is happening on the ground. **We will therefore work with local planning authorities and others to obtain better statistics on the number of renewable projects that are achieving planning approval and why others are being rejected.**

<sup>17</sup> The Welsh Assembly Government is currently revising its national planning guidance on renewables (TAN8) and has commenced the process of developing a Wales spatial plan. The Scottish Executive updated its national planning guidance (NPPG6) in 2000.

4.33 We have published legislative proposals<sup>18</sup> to streamline the public inquiry process for Major Infrastructure Projects in the planning process in England by allowing lead inspectors to appoint further inspectors to share the work and allowing issues to be considered concurrently in inquiries rather than sequentially. **We will also apply these principles to decision-making for major energy projects in England and Wales, where consents are awarded by the Secretary of State for Trade and Industry.**<sup>19</sup> This should help streamline planning processes for large renewable energy developments and other large generation plant and help major upgrades of the transmission network.

4.34 There is currently no guidance on the implications for land use planning at local level for projects related to energy reliability. **We will prepare a separate guidance note focusing on this for local planning authorities.**

## People make the difference ...

4.35 Increasing the deployment of renewables will depend on people supporting local projects<sup>20</sup>. The public consultation suggests people are keen on renewables, particularly for their contribution to tackling climate change. But they feel that they do not know enough about the impact of renewables in practice.

4.36 The white paper consultation has shown the value of community engagement. This will be crucial for the development of new forms of

distributed generation, in gaining acceptance of new infrastructure and in developing opportunities for local energy delivery. Developers need to continue to engage local planning authorities and work directly with communities. We have recently launched Clear Skies, a three-year capital grant programme worth £10m, for schemes such as solar water heating and biomass heat which have a strong community or household focus. The Scottish Executive has also a similar community and household capital grants scheme in Scotland worth £3.7m over 3 years. Defra's Community Energy scheme, which has a two-year budget of £50m, helps install and refurbish community heating systems. The Countryside Agency launched the Community Renewables Initiative in 2002 to help people to influence and benefit from renewable energy. All of these schemes have a key role to play in helping to breakdown the barriers to public acceptability of renewables by providing local residents with a direct benefit from the renewables development.

### Community action in practice

National Wind Power's practice is to establish community funds at each operating wind farm in consultation with local communities and councillors. These funds benefit the community and typically include student sponsorships, equipment for schools and village halls repairs.

One such example is the provision of IT and other equipment worth up to £60,000 to support 19 schools near the Bears Down Wind Farm in Cornwall. Local schools also received two days energy efficiency training as part of a £30,000 energy efficiency scheme funded by the wind farm and carried out by the Cornwall Energy Advice Centre.

18. *Planning and Compulsory Purchase Bill*  
[www.publications.parliament.uk/pa/cm200203/cmbills/012/2003012.htm](http://www.publications.parliament.uk/pa/cm200203/cmbills/012/2003012.htm)

19. These powers are devolved in Scotland.

20. *Renewable Energy in the UK* (PIU, 2001)  
[www.piu.gov.uk/2001/energy/Renewener.shtml](http://www.piu.gov.uk/2001/energy/Renewener.shtml)

4.37 We see a clear benefit in local communities becoming producers, as well as consumers, of energy, establishing and benefiting from the local ownership of some forms of generation. To help promote ideas and good practice **we will collate and publish examples of projects in which developers have gained added value by taking innovative approaches to engaging and working with communities, in partnership with local government and the renewables industry.**

### **We will simplify the procedures for accommodating our national security needs...**

4.38 The Ministry of Defence (MoD) needs to make sure that windfarm developments do not impair operational needs including training and radar monitoring. MoD has objected to a third of all recent on and offshore wind energy proposals<sup>21</sup>. We need to work with the industry to reduce this.

4.39 To address these issues, MoD:

- has contributed to the issue recently of new guidelines for windfarm developers through the Wind Energy, Defence and Civil Aviation Working Group<sup>22</sup>, designed to increase the transparency of the process for assessing wind proposals;
- will provide more central guidance to those reviewing applications, develop a help line for the industry and shorten proposal turn-around times from the current 6-8 weeks;

- will provide advice to developers on any adjustments that could be made to the location of a wind farm in order to make it acceptable to MoD. If this is not possible, MoD will explain to developers the problem of siting a wind farm in the locality; and
- is supporting research to model the effect of turbines on radar and to identify ways in which adverse impacts could be reduced, including technical adaptations to turbine design.

4.40 MoD is also ready to engage with local authorities and regional bodies as they move towards considering the best sites for wind farms in the longer-term when they begin to develop their regional strategies for energy, as discussed in chapter 9.

### **Learning to handle intermittency...**

4.41 Renewables contribute to certain aspects of security of supply. Supplies will not be disrupted by international crises. But some will create additional system complications, depending on the extent to which they are intermittent (wind energy, wave energy, tidal and solar) and on the types of generation they displace. Intermittency causes additional system costs. And as the proportion of intermittent generation increases, the cost of maintaining stable supplies also increases<sup>23</sup>.

21 Ministry of Defence (2002).

22 Comprising DTI, MoD, the Civil Aviation Authority, the British Wind Energy Association, the Devolved Administrations and others with an interest.

23 The additional system costs - attached to transmission, the distribution network and balancing generation and demand - of 20% and 30% of electricity supplied by intermittent generation is equivalent to a maximum of £0.9/MWh and £2.20/MWh respectively. It is quite possible that technical developments in storage, fuel cells and load management may by 2020 reduce such costs. *Quantifying the system costs of additional renewables in 2020 (Ilex, 2002)* [www.dti.gov.uk/energy/develop/080scar\\_report\\_v2\\_0.pdf](http://www.dti.gov.uk/energy/develop/080scar_report_v2_0.pdf)

4.42 These costs need to be managed and new ways found to minimise them. We are already funding research into this through the DTI's Renewable Energy and the Engineering and Physical Sciences Research Council's (EPSRC)<sup>24</sup> SUPERGEN<sup>25</sup> programmes. As part of our current capital grant programme we allocated in 2002 an additional £4m to facilitate the demonstration of new control, storage and metering technologies.

### **Renewable technologies are at different stages of development...**

4.43 We need to scale up substantially our deployment of renewables in order to secure economies of scale and reduce costs significantly. Some renewable technologies are close to commercial deployment and should be pulled through to market by the range of measures that we have in place. With support from the Renewables Obligation and the Renewables Obligation Scotland, onshore wind is already economic. But we are also strongly committed to supporting the innovation that will be fundamental to bringing forward new and emerging technologies. The remainder of this chapter looks at what more needs to be done for us to fully establish a wide range of renewable options to deliver our carbon aims.

### **Offshore wind - about to take off...**

- 4.44 We have more wind off our coasts than anywhere else in Europe<sup>26</sup>. Given our experience in offshore engineering, we should be able to expect offshore windfarms to make a strong contribution to our carbon aims.
- 4.45 Developers have entered into agreements for leases for windfarm sites around the UK coast with a total capacity of at least 1400MW of renewable energy, sufficient to power a city the size of Greater Manchester. The offshore wind industry considers a further 3000-4000MW can be built by 2010.<sup>27</sup>
- 4.46 Only 250MW<sup>28</sup> of offshore wind capacity has so far been installed world-wide. 4MW of this is in UK waters. Although the long-term potential looks promising, the economics of offshore wind are very uncertain. In the short-term significant fixed costs have to be borne before installation can begin. Our programme of capital grants has started to address this.
- 4.47 Delivering our carbon aims will require the rapid expansion of offshore wind not only within territorial waters but beyond. We published in November 2002 a consultation document<sup>29</sup>, *Future Offshore*, which proposes a strategic planning framework to harness the significant potential of offshore wind. The *Future Offshore* consultation document includes proposals for the provision and regulation of offshore infrastructure for transmitting electricity.
- We will work with OFGEM, developers and the transmission companies, over the**

<sup>24</sup> Government's leading funding agency for research and training in engineering and the physical sciences [www.epsrc.ac.uk](http://www.epsrc.ac.uk)

<sup>25</sup> Sustainable Power Generation and Supply initiative [www.epsrc.ac.uk](http://www.epsrc.ac.uk)

<sup>26</sup> BWEA, 2002 [www.offshorewindfarms.co.uk/info.html](http://www.offshorewindfarms.co.uk/info.html)

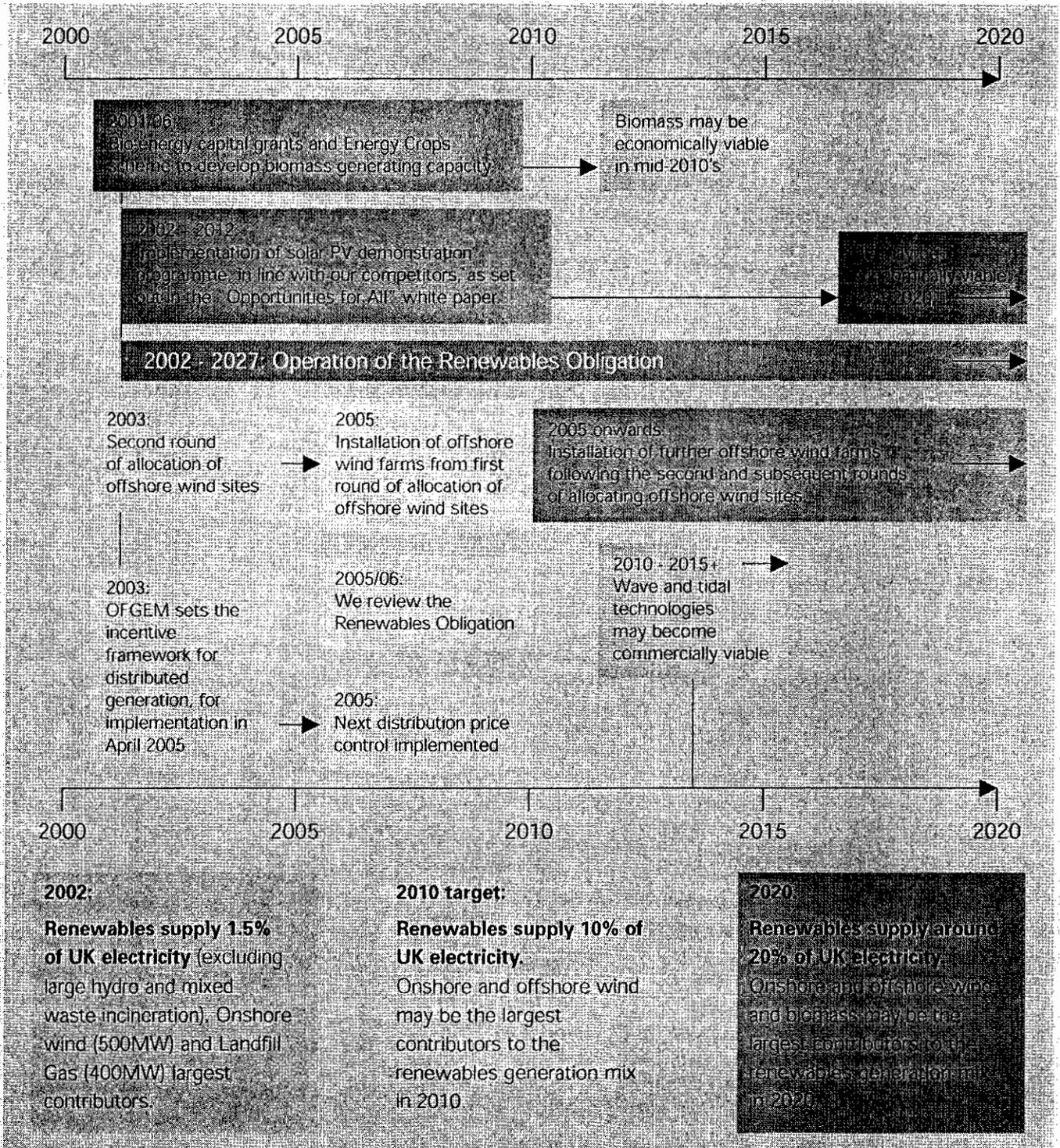
<sup>27</sup> BWEA, 2002

<sup>28</sup> BWEA, 2002

<sup>29</sup> *Future Offshore: A consultation of the future framework for developing offshore wind farms* (DTI, 2002) [www.dti.gov.uk/energy/leg\\_and\\_reg/consents/future\\_offshore/index.shtml](http://www.dti.gov.uk/energy/leg_and_reg/consents/future_offshore/index.shtml)

## A Renewables Timeline

The timeline below shows the key dates on the critical path to help us to achieve our 2010 10% target and to double the renewable's share of electricity generation in the decade after.



**coming months, to take this issue forward.**

A second round of windfarm site allocations is planned for spring 2003, focusing on three strategic areas of the sea within territorial waters, informed by a strategic environmental assessment.

- 4.48 To enable further rounds to extend the opportunity for developers to exploit areas beyond the UK 12-mile zone **we will also bring forward legislation as soon as possible to enable the granting of licences for offshore windfarm developments beyond territorial waters. We will identify and assess the difficulties that might be posed for aviation and other military and civil interests before we offer areas of the sea to the wind industry for development.**

**Biomass and waste technologies need to gain momentum...**

- 4.49 Biomass<sup>30</sup> and waste can be used for electricity, heat and liquid fuels. Unlike wind, biomass and waste generation is flexible - it can be generated at any time. A strong biomass supply chain can also revitalise rural communities, offering diversification opportunities for farmers and foresters as well as job opportunities in growing, supply and electricity plant building. We are supporting biomass projects through our 3-year £66m Bioenergy Capital Grants Scheme and through our £29m Energy Crops Scheme, to help farmers and foresters establish energy crops.

<sup>30</sup> Biomass is anything derived from plant or animal matter and includes agricultural, forestry or wood wastes/residues and energy crops. Energy crops are crops grown for the purpose of energy generation, such as short rotation coppice willow and miscanthus.

- 4.50 To develop a stronger stimulus to provide a biomass supply chain, **we will undertake a statutory consultation in 2003 of the current requirement under the Renewables Obligation that by 1 April 2006 75% of the biomass in co-fired stations should be energy crops<sup>31</sup>.**

**Elean Power Station -  
the UK's first straw-fired power plant**

Elean Power Station at Sutton near Ely, Cambridgeshire, is the UK's first straw-fired power plant. With an electricity output of 36MW, it is the world's largest such facility. The power station will generate enough power to heat and light 80,000 homes.

The 200,000 tonnes/per year of straw needed to fuel the facility is being procured through long-term contracts with farmers and contractors located within a 50-mile radius. Running currently on 100% straw, Elean Power Station also has the capability of using a range of biofuels and up to 10% natural gas. Whatever the exact make-up of its fuel in the course of its life, the plant represents an important first in the development of renewables in the UK and a significant step forward towards the Government's objectives for renewables deployment over the coming years.

<sup>31</sup> Stations that are powered by co-firing may have an important role to help deliver biomass and energy crops and in delivering renewable energy capacity quickly at relatively low cost. Under the current Renewables Obligation arrangements, electricity generated from biomass by co-firing in existing generating stations are eligible for Renewable Obligation Certificates (ROCs) subject to two restrictions: Only electricity generated before 1 April 2011 will be eligible and from 1 April 2006 at least 75% of the biomass must consist of energy crops.

- 4.51 The Government's Strategy Unit published a report in November 2002<sup>32</sup> on its review into the delivery of our Waste Strategy 2000<sup>33</sup>. The report includes the recommendation that we should ensure that there are financial incentives to develop new waste technologies, such as pyrolysis, gasification and anaerobic digestion. **We are now considering the recommendations of the report.**

### **Wave and tidal are further off but potentially very important ...**

- 4.52 Wave and tidal technologies are rather further from commercialisation, with a number of competing designs. The UK is at the forefront of these technologies. On the island of Islay, we have the only commercially operational wave-power station in the world. Yet progress from research and development to more general commercial application has been slow. But, as recognised in the Chief Scientific Adviser's review, the UK has an opportunity here to develop world-leading expertise.
- 4.53 **Recognising this, we are supporting industry to develop prototype wave and tidal technologies in projects off the Western Isles and Devon coasts. We are also supporting, along with the Scottish Executive and others<sup>34</sup>, the establishment of a marine test centre off the coast of the Orkney Islands. This centre, a first in Europe, is expected to open later this year.** We are determined that wave and tidal technologies should be given the opportunity to play the fullest part they can in the

expansion of generation from renewables. This in turn can create another significant opportunity, with world-wide application, for our manufacturing sector.

### **Energy from the Oceans - The Stingray Project**

Funded under the DTI's Renewable Energy Programme, a Northumberland-based company The Engineering Business has successfully developed its ideas for a tidal stream generator system *Stingray* from concept through to demonstration stage. In September 2002, following early design work carried out under Phase 1 of its project, a 150kW full-scale prototype weighing 180 tonnes was built, installed and successfully operated on the seabed in Yell Sound, Shetland.

With early results encouraging, the technology will continue to be developed with further offshore testing planned this year. The company has plans to commence installation of a 5MW *Stingray* power station with connection to the local distribution network in summer 2004.

- 4.54 Large-scale tidal barrages have the potential to make a significant contribution to carbon reductions in 2020 or beyond. But such schemes have a very substantial impact on the local and regional environment and are very expensive, though some of the costs could be offset by other benefits. It is clear that plans for a Severn Barrage would raise strong environmental concerns and we doubt if it would be fruitful to pursue it at this stage. Tidal barrages may be capable of offering major renewable projects which will help us reach our goals and we will continue to explore opportunities.

32 *Waste Not, Want Not* (Strategy Unit, November 2002).  
[www.pi.u.gov.uk/2002/waste/report/index.html](http://www.pi.u.gov.uk/2002/waste/report/index.html)

33 *Waste Strategy 2000 for England and Wales* (Defra, 2000).  
[www.defra.gov.uk/environment/waste/strategy/cm4693/pdf/wastvol1.pdf](http://www.defra.gov.uk/environment/waste/strategy/cm4693/pdf/wastvol1.pdf)

34 The Carbon Trust, Scottish Enterprise, Highlands and Islands Enterprise, Orkney Islands Council.

## Solar PV is a potentially very large market...

- 4.55 The costs of solar PV technology have fallen substantially over the last 25 years and are widely expected to fall further as global markets expand. We committed in the *Opportunities for All* white paper<sup>35</sup> to embarking on a major initiative with industry and others to achieve a UK solar PV demonstration programme in line with those of our main competitors. The current programme, worth £20m over 3 years, is the first stage of this process.
- 4.56 At present solar PV qualifies for the Renewables Obligation. In practice almost all schemes are too small to generate the minimum 0.5MWh a month to qualify for a ROC<sup>36</sup>. **We will explore whether there is scope through the European renewables Directive to help bring smaller sources of generation within the Renewables Obligation. Through the Distributed Generation Co-ordinating Group, we are also exploring the scope for developing simpler metering arrangements to help micro generators (including solar PV) obtain a fair value for the surplus electricity they export to the grid.**
- 4.57 The Chief Scientific Adviser's Energy Research Review Group also identified solar PV as a key research area and specifically recommended that work on novel emerging systems, such as organics and polymers, could offer major decreases in the costs of production.

<sup>35</sup> *Opportunities for all in a World of Change* (DTI, 2001) [www.dti.gov.uk/opportunityforall/pages/contents.html](http://www.dti.gov.uk/opportunityforall/pages/contents.html)

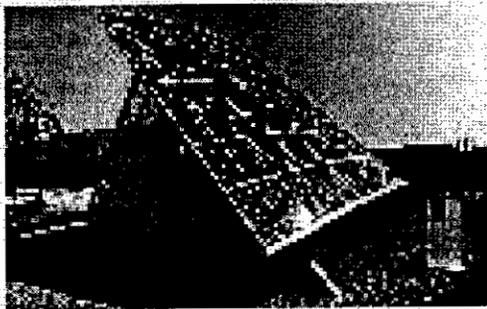
<sup>36</sup> Eligible renewable generators receive ROCs for each MWh of electricity generated. These certificates can then be sold to suppliers. In order to fulfil their obligation, suppliers can either present enough certificates to cover the required percentage of their output, or they can pay a "buyout" price of £30/MWh for any shortfall. All proceeds from buyout payments are recycled to suppliers in proportion to the number of ROCs they present.

## Fuel cells offer a longer-term advantage...

- 4.58 Fuel cells produce electricity from hydrogen and air, with water as the only emission. Potential applications include stationary power generation, transport (replacing the internal combustion engine - as described more fully in chapter 5) and portable power (replacing batteries in mobile phones, laptop computers etc). Fuel cells also have the potential to help renewables produce more stable supplies. Hydrogen can be generated when electricity demand is less than that being generated by the renewable energy source. This can then be converted to electricity via the fuel cell when electricity demand exceeds that being generated by the renewable energy source.
- 4.59 To ensure that the UK is at the cutting-edge of fuel cells technology, **we will:**
- following the Fuel Cells Market Study<sup>37</sup> funded jointly by DTI and the Carbon Trust, work with industry to produce a Fuel Cells Vision for the UK;
  - launch a new industry network, Fuel Cells UK, in May through which the industry can collaborate and work with us in implementing the vision (see Fuel Cells UK box);
  - develop a web-based fuel cells exchange so that global information can be accessed quickly and easily by UK industry;

<sup>37</sup> *Review of Fuel Cells Commercial Potential for DTI and the Carbon Trust* (E4Tech, 2003) [www.dti.gov.uk/energy](http://www.dti.gov.uk/energy)

- **develop a research programme dedicated to fuel cells to be funded jointly by EPSRC, DTI and the Carbon Trust;**
- **review the objectives of the DTI research and development programme;**
- **encourage UK organisations to work with the DTI's International Technology Service to identify potential partners and to participate in European collaborative research and development (R&D) projects including the EUREKA programme and to complement work by National Contact Points<sup>38</sup> to support participation in the EU's 6th Framework Programme;**
- **in collaboration with the EPSRC, review the supply of doctorates and MScs with the requisite skills; and**
- **working with the Carbon Trust, DTI's Small Business Service and Regional Development Agencies, support new start-ups in this sector.**



## Fuel Cells UK

Interest in fuel cells across the world has never been higher as commercialisation draws closer. The UK has a significant number of fuel cell players but there is no established forum to enable the industry to come together and to raise its profile. Fuel Cells UK is being established to foster the development of a UK industry, to raise the profile of fuel cell activity in the UK, and to act as central liaison point for national and international activity.

Fuel Cells UK will become the first point of contact for information on UK fuel cell activities. It will develop and distribute relevant promotional material (including a UK capabilities guide) and will foster partnering by linking potential partners together. Its activities will be guided by a high-level steering group which will ensure that its activities have maximum relevance for industry.

Fuel Cells UK will work closely with existing and new initiatives across the UK to build synergies and optimise the outcomes for both the industry and other stakeholders (including Government). One such DTI initiative will be Fuel Cells Forum, a network for industry, academia, venture capitalists and Government stakeholders in fuel cells to exchange and disseminate information.

Fuel Cells Forum will enable organisations to highlight their activities, and for industry to pose challenges to the research community. The DTI's International Technology Service offers the possibility for stakeholders to identify and engage overseas partners and keep abreast of developments overseas.

<sup>38</sup> National Contact Points provide an information and assistance service for UK organisations seeking R&D support from the EU's Framework Programme for Research and Development.

## **Research is needed to give us new options for the longer term...**

- 4.60 Technology will almost certainly surprise us in the field of renewables as elsewhere. **To expand the knowledge base we have already provided an extra £8 million to the Research Councils specifically for renewables research over the next three years. This is part of a new £28m investment in support of sustainable energy research.** The money will be spent on fundamental research into a range of technologies, consistent with the recommendations of the Chief Scientific Adviser's Energy Research Review Group.
- 4.61 We also need to support industry in taking the new ideas generated in the laboratory to the point where they can enter the market. We have increased the amount available to support industrially-led research and development through the DTI (£19m per year) and the Carbon Trust (£5m per year).

## **Renewables offer big opportunities for UK business...**

- 4.62 The growth in the global renewables market offers considerable opportunities for UK companies to create jobs in manufacturing, services and supplies and to improve their export capabilities. The development of windfarms is already producing new jobs in manufacturing<sup>39</sup>. Renewables UK will help to secure benefit for UK industry in the renewables market.

<sup>39</sup> The world's leading wind turbine manufacturer, Vestas, established a turbine manufacturing base at Campbeltown in the Kintyre peninsular creating 130 jobs. Cambrian Engineering is establishing a wind turbine tower and offshore pile manufacturing and assembly operation at Arnish in the Isle of Lewis, expected to create 65 jobs.

- 4.63 If the UK is to compete globally, projects need to move out of the R&D stage into commercialisation. We have a role to play in facilitating this. **Through Renewables UK we will develop by April 2004 programmes and tools to assist the UK renewables supply chain.**

## **Widening the renewables obligation certificate market...**

- 4.64 The Northern Ireland Executive has recently brought forward an Energy Bill containing provisions to introduce a Northern Ireland Renewables Obligation. **We are considering with the Scottish Executive how we might devise a system allowing mutual recognition of Renewable Energy Certificates under the Renewables Obligation and those in Northern Ireland under their future Obligation.**

## **The international community has a role to play...**

- 4.65 The World Summit on Sustainable Development (WSSD) took place in Johannesburg in August/September 2002. The Summit brought together 180 countries who reaffirmed the international community's commitment to sustainable development through action to provide access to clean water, sanitation and sustainable energy, and to protect biodiversity, the oceans, fish stocks and natural resources. The Summit agreed joint actions urgently and substantially to increase the global share of renewable energy sources.<sup>40</sup> At the Summit the Prime Minister announced that the UK's Export

<sup>40</sup> [www.johannesburgsummit.org/](http://www.johannesburgsummit.org/)

Credit Guarantee Department will make available £50m per year to renewable energy exports to developing countries. The Sustainable Energy Exports Committee will work to deliver this commitment. At WSSD, the UK also launched and is taking forward an international partnership to promote the growth of renewable energy and energy efficiency systems (REEEP).

### **A Renewable Energy and Energy Efficiency Partnership (REEEP)**

REEEP aims to deliver our WSSD commitments on energy and take forward the recommendations of the G8 Renewable Energy Task Force for removing the policy, technical, market and regulatory barriers to renewable energy and energy efficiency.

Interested partners include governments from OECD and non-OECD countries, businesses, non-Governmental organisations and international agencies committed to accelerating the market development of renewable energy and energy efficiency technologies.

The partnership will focus on:

- state-of-the-art policies for power sector reform and building on best regulatory practice to promote distributed energy systems;
- innovative financing and tradable certificates for renewable energy and energy efficiency projects; and
- evaluation and awareness raising of the non-carbon reduction benefits of renewable energy such as energy security, rural development and export opportunities

4.66 **We will integrate the WSSD agreements and relevant follow-up into UK policy and action with a clear focus on the use of technological innovation to deliver sustainable development. We will work with like-minded states to promote the deployment of renewable sources of energy in developing countries, building on the initiatives launched at WSSD as well as encouraging investment in appropriate energy infrastructure.**

### **We do not propose new nuclear build...**

- 4.67 As chapter 1 makes clear, our priority is to strengthen the contribution that energy efficiency and renewable energy sources make to meeting our carbon commitment. We believe that such ambitious progress is achievable, but uncertainties remain.
- 4.68 While nuclear power is currently an important source of carbon free electricity, the current economics of nuclear power make it an unattractive option for new generating capacity and there are also important issues for nuclear waste to be resolved. This white paper does not contain proposals for building new nuclear power stations. However, we do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets. **Before any decision to proceed with the building of new nuclear power stations, there would need to be the fullest public consultation and the publication of a white paper setting out the Government's proposals.**

## But we are not seeking to shut existing stations prematurely...

- 4.69 The financial problems of the private sector nuclear electricity generator, British Energy, are well known. These problems are about a company, not about the future of nuclear power. Our main objectives with regard to British Energy continue to be the safety of its nuclear power stations and the security of electricity supplies to the grid and consumers. British Energy's nuclear power stations will continue to generate electricity. And since the revenue from continuing to run those stations more than covers the avoidable costs of their operations, this revenue can be put towards paying for the nuclear liabilities that are already incurred and cannot now be avoided.
- 4.70 Under the company's restructuring proposal, announced on 28 November 2002, which is subject to the approval of the European Commission, we are taking on financial responsibility for the company's historic spent nuclear fuel liabilities. We are also, to ensure safety and environmental protection, underwriting new and enhanced arrangements by the company to meet decommissioning and other liabilities. On 14 February 2003, British Energy secured the agreement in principle of its financial creditors to its restructuring proposal.

### Managing the Nuclear Legacy

Irrespective of decisions on future nuclear build, the legacy of nuclear waste has to be dealt with safely, securely and cost effectively in ways that protect the environment for current and future generations. We have announced our intention to make radical changes to arrangements for nuclear clean-up funded by the taxpayer. The white paper *Managing the Nuclear Legacy*<sup>41</sup> set out proposals for a new authority, the Nuclear Decommissioning Authority (NDA), to deal initially with the historic liabilities already funded by the taxpayer, which represent 85% of total UK nuclear liabilities. The NDA will set a framework for a clean up programme over the long-term, securing best value for money consistent with high safety, security and environmental standards, and using the best available skills through competitive markets for clean-up contracts. Preparation for the necessary legislation is underway.

#### **For nuclear sites outside the NDA remit, we will seek to ensure there are adequate resources set aside to provide for clean-up.**

In 2001, the Government and the Devolved Administrations for Scotland, Wales and Northern Ireland published *Managing Radioactive Waste Safely*,<sup>42</sup> a proposed programme of action for deciding how best to manage the UK's solid radioactive waste in the long-term. Having considered responses to the proposals, we announced in July 2002 that we would set up a new independent body to oversee a review of different ways of managing the waste, and to recommend a national strategy to Ministers. We hope to receive recommendations and announce the strategy by 2006.

<sup>41</sup> July 2002, CM5552

<sup>42</sup> *Managing Radioactive Waste Safely, 2001*  
[www.defra.gov.uk/environment/consult/radwaste/pdf/radwaste.pdf](http://www.defra.gov.uk/environment/consult/radwaste/pdf/radwaste.pdf)

# Chapter 5 Clean Low Carbon Transport

## Transport will contribute to carbon reductions...

- 5.1 The transport sector, including aviation, produces about one quarter of the UK's total carbon emissions. Road transport contributes 85% of this, with passenger cars accounting for around half of all carbon emitted by the transport sector.
- 5.2 The movement of people and goods will remain essential for economic success. Rising demand for transport reflects the priority which people attach to mobility. Transport is and will continue to be a highly-valued, high demand commodity.
- 5.3 But we can reduce the impact of transport on the environment through better, cleaner vehicles and fuels and by our action to reduce the negative impacts of traffic growth.
- 5.4 Measures for promoting a shift to low-carbon vehicles and fuels are brought together in our *Powering Future Vehicles*<sup>1</sup> strategy, published in July 2002. **That strategy is complementary to this white paper.** In the foreword to the strategy, the Prime Minister spelled out his objective that the UK should lead the global shift to the low-carbon economy, building competitive advantage for the UK's automotive industries as well as providing cleaner and better transport. We have set targets that within the next decade one in ten new cars sold in the UK will be low-carbon vehicles with emissions of 100 grammes per kilometre (g/km) CO<sub>2</sub> or less, and that one in five new buses will also be low-carbon. We have made the UK the first country to set itself targets for shifting its mainstream transport fleet to low-carbon technologies.

## The *Powering Future Vehicles* (PFV) strategy

The PFV strategy provides a framework for decisions and action, aimed at promoting the development, introduction and take-up of low-carbon vehicles and fuels; and at ensuring the full involvement of the UK automotive industries in the new technologies.

The key components of the strategy are:

- to promote research, development and demonstration of new vehicles, fuels and fuelling infrastructure;
- to ensure that environmental, health and safety issues are dealt with;
- to ensure that new technical standards and testing procedures are promptly developed and put in place;
- to work proactively with EU and other partners on international issues and standards;
- to facilitate the quick and smooth development of new fuel distribution infrastructures;
- to ensure the continued development of appropriate taxation of low-carbon transport;
- in this and other ways, to encourage consumers' take-up of low-carbon vehicles and fuels, including financial measures and consumer information and awareness;
- to make maximum use of new vehicles and fuels in the Government and other public sector fleets;
- to work closely with all stakeholders in establishing the Low Carbon Vehicle Partnership; and
- to set challenging targets for making the UK a world leader in the move to low-carbon transport.

<sup>1</sup> *Powering Future Vehicles: The Government Strategy*. DfT, DTI, Defra and HMT, July 2002

5.5 Action at both UK and European level has already promoted significant technical progress and innovation in the automotive industries. We expect this progress to continue. Since 1990, the average carbon efficiency of new cars entering the fleet - the distance travelled for a given amount of carbon emitted - has improved by 10%. Cars have also become safer and cleaner, with air quality emissions down to one twentieth of what they were 20 years ago. These are important achievements. At the same time, strong economic growth and the high priority which people attach to mobility has led to increasing car mileage. The net effect is that total carbon emissions from car transport have been roughly flat.

5.6 The Transport Ten Year Plan<sup>2</sup> sets out a comprehensive programme of investment and innovation. The strategy focuses on addressing the negative impacts of congestion. It promotes increased use of public transport and a shift of goods traffic from road to rail, as well as sustainable patterns of land use. All help to reduce the need to travel and consequent environmental impacts. By 2005, we expect to see progress as a result of schemes to tackle traffic bottlenecks; a growing programme of new bypasses and other major road improvement schemes; better traffic management, helping to limit congestion on both motorways and in towns and cities; and increased use of public transport.

5.7 The Plan will be reviewed in 2004. The review will roll forward the Plan, setting out proposals for transport up to 2015 and will continue to take full account of our objective to reduce the environmental impact of transport.

## **Innovation will continue to improve vehicle efficiencies...**

5.8 The EU voluntary agreements on new car fuel efficiency with the European, Japanese and Korean manufacturers have proved a highly effective mechanism for improving cars' fuel efficiency and reducing carbon emissions. They have provided manufacturers with a stable long term framework within which to plan, research and introduce fuel-saving innovations. This approach, which focuses on the levels of carbon emitted rather than on dictating particular technologies, gives manufacturers the flexibility to develop the best and most cost-effective solutions. The agreements are on course to reduce emissions from the average new car from 190g/km in 1995, the base year for the agreements, to 140 g/km by 2008 - a reduction of around 25%<sup>3</sup>.

5.9 **We strongly support this approach. We will work with the Commission in developing further voluntary agreements to continue the reduction in average new car emissions or other arrangements with the same objective.** We will draw on the expertise of the Low Carbon Vehicle Partnership in doing so.

5.10 In the UK we have backed the voluntary agreements with a supportive fiscal framework. We have moved to graduated Vehicle Excise Duty and Company Car Tax, both now linked to the car's CO<sub>2</sub> performance. This is encouraging car buyers to consider buying the lower-carbon vehicles coming into car showrooms. **We will keep transport taxes under review to ensure that they**

<sup>2</sup> *Transport 2010 - the Ten Year Plan*, Department of the Environment, Transport and the Regions, July 2000.

<sup>3</sup> All figures relating to the voluntary agreements are for 'tank to wheel' emissions.

**continue to provide incentives to encourage the early development and take-up of low carbon vehicles and fuels.**

it has attracted international attention. A further call for projects is in progress, to deal with identified Roadmap priorities.

#### **Vehicle taxation - supporting low-carbon choices**

Before 1999, **Vehicle Excise Duty (VED)** was the same flat rate for all cars. VED for new cars is now graduated, linked to a car's CO<sub>2</sub> emissions. VED now ranges from £60 to £160, with zero duty for electric vehicles.

**Company Car Taxation** (the personal tax on private use of company cars) also shifted to a graduated, CO<sub>2</sub>-linked basis last year. Tax is payable on a proportion of car list price, ranging from 15% to 35% for higher emission cars.

We are monitoring the impact of the shift to CO<sub>2</sub>-related taxation on car buyers' choices. Diesel car registrations in 2002 - with their lower CO<sub>2</sub> emissions - were 38% up on the previous year, taking diesel's share of total new car registrations to 23.5%, compared with less than 5% in 1990<sup>4</sup>.

5.11 We are also supporting strategic automotive research and development through the *Foresight Vehicle* programme. Over 400 companies and organisations are involved in projects valued at £100m. Around one third of these projects relate to low-carbon vehicle technologies, including new powertrains, advanced electronics and advanced materials and structures. The *Foresight Vehicle Technology Roadmap*<sup>5</sup> was developed in collaboration with industry, and identifies priority issues. Published in November 2002,

<sup>4</sup> Society of Motor Manufacturers and Traders Analysis of 2002 car sales.

<sup>5</sup> [www.foresightvehicle.org.uk/initiatives/init01.asp](http://www.foresightvehicle.org.uk/initiatives/init01.asp)

## **Foresight Vehicle Programme - Project Examples**

### **HEART4EV**

This project seeks to increase the efficiency of the gas turbines used to power hybrid vehicles. The current limitation of this technology is a reliable, low cost, highly effective air-to-air heat exchanger (known as a "recuperator"), used to recover energy from the turbine's high temperature exhaust gases and pre-heat the incoming air.

The project will result in the UK having a world leading, low-cost, durable and highly effective recuperator, for marketing worldwide. It will also open the way for future drivetrain programmes aimed at establishing the recuperated microturbine as an alternative to reciprocating internal combustion engines, with significantly lower fuel consumption and carbon emissions.

### **HERO**

This project is investigating the application of parallel hybrid drivetrain technology in an off-road 4x4 vehicle. HERO demonstrates that the application of hybrid technology in the form of a "mild hybrid" can enhance both the performance and functionality of an off-road vehicle and reduce its environmental impact. This could significantly reduce exhaust emissions and allow the use of regenerative braking to make significant gains in efficiency.

### **LAMTRAK**

This project is supporting another innovation - an infinitely variable ratio transmission device for use in vehicles - known as the Torotrak rolling traction variator - to increase fuel efficiency and reduce pollution.

LAMTRAK will assist Torotrak in meeting its target of 80% penetration of the world's automatic transmission market. The project will improve understanding of the elasto-hydrodynamics of friction reduction in thin lubricating films. This in turn will lead to increased application in vehicles, leading to greater fuel efficiency.

### **RHOLAB**

The RHOLAB project aims to develop a novel lead acid battery incorporating thermal management, fault tolerance and safety features as a traction battery for hybrid vehicles. A battery pack must meet a specification that includes sensing, switching and thermal and electrical control devices in a way that does not jeopardise its manufacturability. As part of the project, the consortium will build a prototype pack that will allow the operation to be assessed while powering a hybrid vehicle.

### **CHOICE**

This project will design, build and evaluate a diesel series hybrid city bus incorporating vehicle and passenger information systems.

The vehicle performance will be optimised in terms of exhaust emissions and fuel efficiency based upon a wide range of input information including current and predicted operational duty, actual measured performance and current and immediate route location. The platform for the project is the Dennis Dart SLF single deck 50-passenger bus, with latest access features for disabled passengers. The series hybrid powertrain will employ an engine from the passenger car sector, giving lower cost, better emissions performance and fuel economy, compared to conventional bus powertrain systems.

5.12 The creation of the Low Carbon Vehicle Partnership is an important component in the Powering Future Vehicles Strategy.

### **The Low Carbon Vehicle Partnership - (LowCVP)**

LowCVP - an action and advisory group - will promote the UK's shift to low-carbon transport, help industry, consumers, environmental and other stakeholders to participate in the shift, and maximise the competitive advantage for UK businesses.

Launched in January 2003, the Partnership Board is made up of top-level executives of UK auto manufacturers, transport operators, consumer and environmental groups and the research and technology sectors.

Early projects will include:

- a collaborative programme involving bus manufacturers, operators and users in shifting the UK to low-carbon buses;
- a programme to build the UK component industry's capability in the design and manufacture of key components for new technology vehicles;
- advice to Government on the role and remit of the Centre of Excellence for Low Carbon and Fuel Cell Technologies, an initiative proposed by the Automotive Innovation and Growth Team (AIGT) now being taken forward by the Government;
- advice to Government on the setting of 2020 targets for ultra-low-carbon vehicles, including zero-emission vehicles, and on the priorities for government R&D programmes, and
- helping Government co-ordinate its low-carbon research development and demonstration activities and providing a single portal for potential participants.

5.13 Work<sup>6</sup> commissioned by the Department for Transport and the DTI indicates the scope for further reducing average new vehicle carbon emissions. It suggests that full-specification family cars with carbon emissions of 100g/km (equivalent to about 75 miles per gallon of diesel) or less may be achievable within the next two decades, in particular through hybrid and related vehicle technologies. As the Foresight Vehicle Programme projects show, (see box, page 66) this is an area of technology where the UK has a strong research, development and design presence.

6 *Carbon to Hydrogen Roadmap for Passenger Cars: A Study for DfT and DTI*, Ricardo Consulting Engineering Ltd, November 2002.

## Hybrid vehicles

Hybrid vehicles use internal combustion engines in conjunction with electric battery power, to give increased efficiency, lower fuel consumption and lower CO<sub>2</sub> emissions. Hybrids usually incorporate energy recovery from braking systems, and eliminate engine idling in static traffic. This also reduces noise and urban pollution. Hybrid vehicles will increasingly have the capability to switch to electric-only driving for extended distances, giving zero tailpipe emissions for example when driving through Low Emission Zones.

We support take-up of hybrid cars with £1,000 purchase grants under the *TransportEnergy* programme, administered by the Energy Saving Trust. Hybrids also benefit from lower Vehicle Excise Duty and Company Car Tax.

Two hybrid cars are currently available in the UK - the Toyota Prius, a family saloon with CO<sub>2</sub> emissions of 120g/km<sup>1</sup> and the Honda Insight, a two-seater car at 80g/km. A four-door Honda Civic hybrid will become available in early 2003, at 116g/km.

UK-based Ricardo Engineering Consultants have produced the *i-MoGen* - a demonstration hybrid diesel car, delivering full 1.8 litre diesel

performance with a 1.2 litre diesel engine.

A number of global vehicle manufacturers and component suppliers are now applying *i-MoGen* technology in their future programmes.

We are supporting development and road demonstration trials of hybrid and other innovations through the Government's New Vehicle Technology Fund. Projects include a micro-turbine-engined bus developed by the Wright Group of Northern Ireland, two other hybrid bus projects being carried through by EA Technology and Environmental Transportation Systems, and an LPG-fuelled hybrid urban delivery van being developed by ENECO Ltd. Projects in the pipeline include several demonstration pilot diesel hybrid taxis.

Hybrid technologies provide direct and immediate benefits in reducing cars' fuel consumption, driving costs and carbon emissions. They also provide a stepping stone to the development of mass-market hydrogen powered fuel cell vehicles, since the electric traction and control systems used in hybrid vehicles will also be key components in fuel cell vehicles.



## We can also reduce emissions through lower-carbon fuels...

- 5.14 Better cars will significantly reduce fuel use and carbon emissions. But we can also reduce the carbon intensity of transport by adopting fossil fuels that have a lower-carbon content. We already support the increased use of the well-established road fuel gases - LPG (Liquefied Petroleum Gas) and natural gas.

<sup>1</sup> A car which has a fuel economy of 55mpg will emit 120g/km of CO<sub>2</sub>.

### LPG and Natural Gas

We promote the wider use of these gases through lower rates of fuel duty, and through our *TransportEnergy* Programme, run by the Energy Saving Trust. This provides grants for the purchase and conversion of gas vehicles, and works together with the fuel industry on the fuels' availability on the road, and with vehicle manufacturers.

Starting from scratch in the late 1990s, **LPG** is now available nationwide from over 1,100 filling stations. The positive experience of LPG shows that, with industry and Government working together, major innovations in fuel technologies and distribution can be quickly and successfully carried through.

There are currently (February 2003) around 75,000 LPG cars in the UK. We have particularly encouraged manufacturers to develop off the shelf LPG car models, to make this fuel a mainstream showroom option for car buyers. Models are now available from eight manufacturers.

**Natural gas** is mainly used in heavy vehicles. Apart from lower emissions, the noise from gas fuelled engines is up to two-thirds lower than diesel engines, a useful environmental benefit in busy urban areas. *TransportEnergy* grants support the conversion or purchase of lorries, buses and utility vehicles. A major supermarket chain is in the process of converting its delivery fleet. Work with industry - vehicle manufacturers, users and fuel suppliers - continues with a view to encouraging wider take-up.

Our objectives for natural gas reflects the EU Commission's analysis of the future pattern of transport energy use, which identified natural gas - alongside biofuels and hydrogen - as an important component in widening fuel diversity and energy security in the transport sector.

5.15 And we are promoting the wider use of other alternative fuels - in particular biofuels - which have significantly lower lifetime carbon emissions. With the low duty rates being introduced, we estimate that biodiesel and bioethanol could account for up to 5% of total fuel use by 2020.

### Biofuels for transport

Alongside renewably-produced hydrogen, fuels made from biomass represent an important potential route for achieving the goal of zero-carbon transport, creating new opportunities for agriculture in the UK as well as globally.

We have reduced the duty on **biodiesel** to 20 pence/litre below the standard (ultra low sulphur) diesel rate, and this fuel is now coming on to the retail market in increasing volumes in a 5% blend with conventional diesel. Some lorry fleets are also converting to 100% biodiesel fuelling.

As announced in the Pre-Budget Report in November 2002, we propose to introduce the same 20 pence/litre incentive for **bioethanol**, subject to EU agreement. This can also be used in blends for existing cars, potentially also as an 85% pure biofuel in adapted cars.

Biofuels are currently made from food crops. We are also interested in supporting the development of bioethanol and biodiesel production from biomass such as farm wastes, forestry residues, coppice crops and possibly also domestic waste. These can potentially deliver bigger carbon savings and wider environmental, farming and rural employment benefits.

## **A significant contribution to carbon reductions...**

- 5.16 Taken together, the proposed continuation of voluntary agreements on vehicle carbon dioxide performance, increased use of biofuels and other initiatives could improve the carbon efficiency of transport by up to 10% by 2020. The carbon savings will increase further beyond 2020 as more fuel-efficient cars spread progressively into the fleet.

## **Ultimately taking us beyond fossil fuels, to a very low-carbon transport economy...**

- 5.17 Although vehicle technologies seem capable of becoming twice as fuel-efficient as today's vehicles, deeper carbon reductions will need low-carbon fuels - either hydrogen (generated from non-fossil sources) or biomass-based liquid fuels.
- 5.18 The auto industry generally expects hydrogen powered fuel cell cars to move towards mass-marketing around 2020. This timetable ties in with the findings of a recent investigation<sup>8</sup> carried out for us by environment and energy experts from three leading UK environmental organisations, the Energy Saving Trust, the Institute for European Environmental Policy and the National Society for Clean Air. This study indicates that the greatest carbon savings from early non-carbon electricity will come from its use to displace more carbon intensive electricity generation rather than from its use for transport energy. This suggests that the major environmental benefits from a shift to

the large-scale use of hydrogen-fuelled vehicles will come at the point when surplus low-carbon energy becomes available.

- 5.19 But on a longer-term time scale, hydrogen use in transport has major potential for decoupling transport and carbon, if current technological and cost barriers can be overcome. **We are is therefore supporting research, development and demonstration programmes (including vehicles and fuelling infrastructure) to overcome the initial market barriers to the development of this technology.** The Chief Scientific Adviser's Energy Research Review Group recognised that hydrogen production and storage was a key research area.

8 - *Fuelling Road Transport - Implications for Energy Policy*, by Nick Eyre, Malcolm Fergusson and Richard Mills, November 2002.

## Hydrogen, transport and future energy systems

Hydrogen looks likely to play a key role in future low-carbon energy systems, as an 'energy carrier' through which non-fossil energy can replace fossil fuels in stationary power units such as domestic fuel cell based CHP units and in vehicles. Hence the very wide interest in the prospective shift to a future 'hydrogen energy economy'.

Hydrogen fuelled vehicles have zero tailpipe emissions - they emit only water vapour at the point of use, improving local air quality. They will also be low-noise. Industry experts agree that buses, utility vehicles and similar depot-based fleets are likely to be candidates for the early trialling and introduction of hydrogen fuel cell technology, since larger vehicles can handle hydrogen fuel tanks more easily and need only depot supply of the fuel.

There is considerable international interest in developing hydrogen for transport. In the USA, increased funding for research and development into hydrogen-powered vehicles was announced in the 2003 State of the Union address. The aim is to take hydrogen powered vehicles from the laboratory to the showroom within a generation, and to develop hydrogen production, storage and distribution technology. This is expected to create further opportunities for US-UK collaboration.

Hydrogen can be produced from a wide range of sources, including hydrocarbons, biomass and wastes, or the electrolysis of water. But these sources must themselves be non-fossil for hydrogen vehicles to deliver their full lifecycle carbon benefits.

Hydrogen seems likely to play a key role in future transport technologies. We are supporting the shift by:

- exempting hydrogen from road fuel duty for a period to encourage its early development and take-up;
- granting Enhanced Capital Allowances with a 100% first-year write-down for investment in hydrogen fuel infrastructure;
- supporting fuel cell research (see paragraphs 4.59-4.60);
- giving hydrogen projects a high priority in the Carbon Trust's Low Carbon Innovation Programme;
- funding the trialling of fuel cell buses by Transport for London in 2003 and the supporting hydrogen fuelling station being installed by BP;
- supporting the trialling of fuel cell cars as these come out of car-makers' design laboratories; and
- working with London and other local and regional organisations on a wider network of demonstration trials, including linkages with existing local hydrogen distribution networks such as that on Teesside. We will encourage projects that can demonstrate hydrogen production in combination with other carbon abatement technologies.

## **A low-carbon economy needs to be planned for...**

- 5.20 We expect both hydrogen and biomass fuels to play major roles in a very low-carbon transport economy, with benefits also in terms of improved energy diversity and security. But significant use of hydrogen for transport has profound implications for the long-term demand for non-fossil electricity as well as for future energy infrastructures, including electricity and gas. Equally, significant use of biofuels for transport has major implications for biomass production, fuel production, and fuel distribution - as well as for the rural economy and agriculture.
- 5.21 We need to adopt a strategic approach to both these important new technologies, bringing together the prospective uses of hydrogen and biofuels in transport with other aspects of the energy system. We need to understand more about the options and technologies for hydrogen and biofuel production. And we need a clear vision of the way in which infrastructures can evolve in good time. With industry, we also need to reach a common understanding of the likely trajectory to the availability of affordable hydrogen vehicles. **Drawing on the Low Carbon Vehicle Partnership and other expert knowledge, we will over the next year produce an assessment of the overall energy implications of both a hydrogen economy, and of large-scale use of biomass-based fuels, and develop roadmaps of the possible transition to these new fuels and vehicles.**

## **We need to reduce the emissions from aviation...**

- 5.22 Demand is rising in the aviation sector internationally at about 4% a year. We all benefit from the growth in business, services and our ability to travel. International aviation emissions currently do not count in the national inventories of greenhouse gas emissions. There is no international agreement yet on ways of allocating such emissions. The UK's international emissions currently amount<sup>9</sup> to some 8MtC (9MtC including domestic). They are expected to rise to some 14-16MtC by 2020.
- 5.23 **We are committed to ensuring that the long-term development of aviation is sustainable and that it meets its external environmental costs. We are discussing with stakeholders the most economic instruments for ensuring that the industry is encouraged to take account of, and where appropriate reduce, its contribution to global warming. We will set out our plans in an Air Transport white paper.** Potential instruments to address CO<sub>2</sub> emissions from international aviation being considered internationally include an en route emissions charge and participation in an open emission permit trading system. For domestic flights British Airways has joined the UK emissions trading scheme. These may be opportunities for future participation in this scheme for other carriers who operate UK-based routes.

<sup>9</sup> UK aircraft CO<sub>2</sub> forecasts for 2030 are reported in Annex E of *The Future Development of Air Transport in the United Kingdom: South East* Department for Transport, July 2002 and February 2003.

### **Reduced emissions from the other transport modes, such as shipping...**

- 5.24 Other transport modes account for much smaller amounts of energy and carbon but can contribute useful reductions. Like aviation, shipping is international in nature and in its oversight. The UK supports the work of the International Maritime Organisation (IMO) to put in place a global strategy for reducing greenhouse gas emissions from ships. An IMO Working Group is working on both technical improvements to engines, onboard machinery, hull and propeller design, and also working on operational and market-based measures such as environmental indexing of ships, voluntary agreements, emission standards and emission trading. The Working Group will put forward a draft resolution on the strategy at the IMO Assembly this year.
- 5.25 On the domestic shipping front we are working to reduce carbon emissions from domestic freight transport by encouraging a switch from road to other modes. Freight Facility Grants support freight owners and carriers in switching traffic from road to inland waterways and this programme has now been extended to coastal freight and short sea shipping.

### **And rail...**

- 5.26 Rail transport carbon emissions, accounting for less than 1% of total UK emissions, are typically about half those for road-based modes per passenger or tonne per kilometre. Investment in rail infrastructure will help to reduce overall carbon emissions by supporting the shift in passenger and freight transport from roads and domestic aviation. New rolling stock on the network is also more energy efficient, further helping to improve carbon performance.

