THE BURNING QUESTION

IS THE UK ON COURSE FOR A LOW CARBON ECONOMY?

BY CATHERINE MITCHELL AND BRIDGET WOODMAN

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Executive summary

Introduction

The Government wants to cut carbon dioxide emissions by 60 per cent from 1990 levels by 2050. This aspiration is supported by a number of interim goals, including a cut in carbon dioxide emissions by 20 per cent from 1990 levels by 2010 contained in the Government's Climate Change Programme. Progress in meeting this interim target is essential if the 2050 aspiration is to be achieved.

However, carbon dioxide emissions have tended to rise rather than fall in the last few years, indicating that the Government's programme is already off track, and this may well worsen. The latest energy projections forecast only a 15.2 per cent reduction in carbon dioxide emissions by 2010.

Other targets, including those for renewable energy and combined heat and power (CHP), also look likely to be missed. In addition, the Government has watered down other targets which were part of the strategy for achieving the 20 per cent cut, such as for domestic energy efficiency and in the UK's National Allocation Plan for the EU Emissions Trading Scheme. Each year the Government fails to keep its plans on track makes the task of ultimately achieving its goals more difficult.

The Government set out its energy policy in March 2003. From evidence gathered over a two year consultation process it concluded that the basis of its energy policy should be renewables, energy efficiency and CHP. The current energy system is responsible for 95 per cent of carbon dioxide emissions. Reducing this by 60 per cent will require a new energy system and this will not happen without clear, focused political will to promote investor confidence.

However, while the 2003 White Paper was strong on evidence and vision, it was less strong on substantive policies to ensure delivery. A key recommendation of this report is that Government must tackle the perception of political risk within energy policy. Government has to bring its policies closer together within a strong institutional and political framework, both by increasing support to renewables, energy efficiency and CHP, but also by strong, clear political statements in support of the White Paper's aims.

Progress on the Climate Change Programme is currently being reviewed, and a revised programme is expected in spring 2005. If the Government continues to be serious about its 2010 target and 2050 aspiration, the review should address the slippage already seen in the Programme and take decisive action to put the UK back on track. This report reviews the progress so far in implementing the main components of the Climate Change Programme.

Government targets

Chapter 1 sets out in detail the Government's targets on cutting carbon dioxide emissions, as agreed under the Kyoto Protocol and articulated in the Government's own Climate Change Programme (2000) and Energy White Paper (2003).

Under the Kyoto Protocol, the UK has taken on a binding commitment to reduce its emissions of all greenhouse gases by 12.5 per cent from 1990 levels by 2008–12. The Government has also established its own, more demanding targets for carbon dioxide. The strategy to achieve the reductions emphasises electricity generation from low carbon technologies, improved energy efficiency and lower emissions from transport.

The chapter goes on to look at the various projections about the likelihood of reaching targets based on current trends. Although such projections are fraught with uncertainty, it seems unlikely that the targets will be hit, and even if they are, levels of emissions are predicted to start rising again unless further action is taken.

Energy efficiency measures

Chapters 2–4 look at the specific policy areas in the Climate Change Programme, starting with energy efficiency measures. Overall, energy efficiency measures are responsible for delivering around half of the projected carbon dioxide savings up to 2010 and are the most cost-effective way of achieving reductions in emissions. The Government has frequently stated that a 'step change' in energy efficiency is necessary.

However, the Energy Efficiency Action Plan does not constitute a 'step change'. The target for carbon dioxide reductions in the domestic sector has been reduced, while those for industry are open to negotiation and are plagued by a lack of transparency.

Domestic energy efficiency measures so far seem to be both successful and reasonably cost-effective, with both Warm Front and the Energy Efficiency Commitment (EEC) achieving their targets. However limited monitoring and uncertainty about the extent of 'comfort taking' means that the level of actual savings achieved are themselves uncertain. Monitoring of the programmes should be improved and the Government should consider expanding both schemes. This should include both higher targets and a broader scope – for example to develop and provide measures for insulating properties without cavity walls.

The potential for energy service companies (ESCOs) to contribute to domestic energy savings has not been exploited so far. The trial adjustment to the rules governing changes in supplier are therefore a welcome step forward and should be widely publicised to ensure that households take up the opportunity. Depending on the outcome of the trial ESCO scheme, the Government should consider requiring energy suppliers to provide energy services and penalise them if they do not perform. Meanwhile the four per

cent limit on the proportion of each company's customers allowed to participate in the trials should be lifted.

Current electricity and gas metering arrangements make it impossible for consumers to monitor how they use energy, despite the fact that 'intelligent' meters are available. The Government needs to set a target for the installation of advanced meters as part of ongoing meter replacement programmes.

Business and industry are subject to a range of measures intended to drive increased efficiency or encourage the uptake of low carbon generation. However, it is difficult to estimate the final effect of the programmes on reducing emissions of carbon dioxide.

The Climate Change Programme estimated that the Climate Change Levy (CCL) would lead to reductions in carbon dioxide emissions of 2MtCe (million tonnes of carbon or equivalent) a year by 2010. However, there is little information available on its actual performance. The Government should publish a revised evaluation of the CCL's performance and the use of receipts from it.

In addition, the failure to increase CCL rates since its introduction has made it less effective as an incentive to adopt energy efficiency measures or renewable generation. The Treasury and currently DEFRA (the Department for Environment, Food and Rural Affairs) estimate that the social cost of carbon is £70 per tonne, while the CCL rate values it at only around £37 per tonne. There are therefore good grounds for at least doubling the rate of the Levy if it is to reflect the Government's own thinking on the cost of carbon emissions. Rates should be revised annually with an aim of doubling the rate of the Levy within a specified time period – for example five years. There should be matching cuts in employers' National Insurance contributions and increased funding for energy efficiency programmes.

The CCL has to some extent been overshadowed as a policy measure by the Climate Change Agreements (CCAs) between the Government and industry. The CCAs give an 80 per cent discount on the CCL in return for agreed emissions reductions measured against a baseline. The first period of CCA operation over-achieved on the targets, raising serious questions about the validity of the baselines set. DEFRA is now revising these, and to re-establish confidence in the measure should consider having both the baselines, and subsequent performance, independently assessed.

The National Allocation Plan for the first phase of the European Union Emissions Trading System (EU ETS) is barely consistent with the UK's ambition of reducing carbon dioxide emissions by 15.2 per cent. This is enough to maintain its commitment under the Kyoto Protocol, but will not meet the Government's domestic target. It is deeply disappointing that the government has caved in to pressure from industry by proposing a weaker target. Although the Government states that allocations in the second period will be consistent with 'contributing' to the 20 per cent reduction

target, the failure to set a more demanding target for the first phase will make achieving this extremely difficult. The Government must reaffirm its commitment to achieving its 20 per cent reduction target in order to allow businesses time to plan more than business-as-usual reductions.

There is a huge potential for reducing energy use and loss in buildings. Energy loss can be addressed by improving building standards. However, poor enforcement means a high degree of uncertainty about the savings that will be made. This can be improved by giving local authority building control departments the resources to enforce the regulations. The current proposals for the 2005 building regulations do not require integrated low carbon generation, even in large projects. Given the availability of grants under, for example, the Community Energy Programme, and grants for small-scale renewable technologies, the onus should be on developers to demonstrate that incorporating low carbon generation is not feasible on a particular project.

Alternatively, developers should be required to incorporating a percentage of renewable electricity and heat technologies into new projects consistent with the 2015 Renewables Obligation target. The recent changes to the planning guidance allows local authorities to adopt policies in favour of small scale, building-integrated renewables, and local authorities should be encouraged to make the inclusion of renewables a condition of planning consent for new developments. For the longer term, the Government should commit to a target of zero net emissions from new buildings by 2015.

Low carbon generation

Chapter 3 looks at progress on increasing capacity and takeup of renewable, low carbon technologies. The Government has a target for renewables to supply ten per cent of electricity by 2010 (with a subsequent proposal for supply in 2015). It is unlikely that this target will be met.

The main delivery mechanism, the Renewables Obligation (RO), suffers from problems of design and scope, which have led to a rapid increase in wind power planning applications but neglected other, less developed technologies. This imbalance needs to be addressed by, for example, ensuring that developing technologies can realise an additional, performance-based price for their output. This additional mechanism would be separate from the operation of the Obligation, and could include having a 'feed in' tariff scheme to guarantee a market and price for output from new technologies, or for small scale projects (for example, those below 1MW), attaching an additional value to the renewables certificates for emerging technologies and requiring suppliers to commit to buying a certain proportion of their required power from such sources.

In addition, the scope of the RO is limited. Currently, it only values the electricity sold to suppliers. Electricity generated but not sold to suppliers,

for example from domestic systems, has no extra value, so reducing the incentive for these technologies to be installed. Moreover, heat derived from renewables or from liquids, such as biofuels, is not covered by the electricity obligation. This neglects the contribution that renewables can make to total carbon dioxide reductions or to the wider energy system. The Government should establish a renewable heat obligation in addition to the electricity obligation.

Biomass is particularly undervalued by the RO given that it can provide non-intermittent output and renewable heat when used in CHP plants. Adjustments to the rules to allow increased co-firing in coal plants should increase the biomass contribution to renewables output. However, this should not be at the expense of encouraging the development of new capacity, especially smaller scale plants, or the emergence of a viable energy crop industry in the UK.

The RO will be reviewed in 2005. However, under the current conditions investment will be concentrated on mature technologies (onshore wind) or those technologies which are sufficiently developed to qualify for capital grants (offshore wind and biomass). In the short term, this will lead to an expansion of renewables capacity, but the longer-term consequences for less mature technologies which offer huge economic and employment advantages to the UK could be severe.

CHP is the poor relation of low carbon generation and the Government has so far failed to tackle the problem of low implementation of CHP, despite its many promises to do so. A first step would be to commit to meeting its own target for CHP capacity by 2010, rather than accepting that it is likely to be missed. The Government also needs to recognise that, in many cases, CHP is a 'special case' which will not necessarily be competitive in the short term.

In particular, it is clear that the potential of community CHP projects is not being realised, despite the fact that they deliver both emission reductions and reductions in fuel poverty. The Government is considering extending the Community Energy programme beyond 2005. Given the estimates of cost-effective potential, and the contribution to both the Government's climate change and fuel poverty strategies, the scheme should be extended, with higher levels of funding available and more realistic expenditure deadlines. In theory, developers have to show that they have considered opportunities for CHP in projects. However, this approach clearly has not acted as a driver. The measure should be strengthened in the current DTI revision of power station consents, with a requirement for developers to justify the rejection of CHP as an option.

The imminent review of the RO will consider the treatment of CHP: the Government should include the possibility of an obligation for all CHP output in the scope of the review. However, it is essential that this does not

undermine the support that the Obligation gives to renewable technologies and the Obligation should therefore be increased to take account of newly eligible CHP capacity.

Transport

Chapter 4 looks at measures to reduce emissions from transport. Projections of future emissions show that carbon dioxide emissions from transport are expected to rise dramatically, missing the targets set out in the Climate Change Programme. The Government's approach to increasing efficiency in transport has so far concentrated on fiscal measures, in particular fuel duties and the Vehicle Excise Duty (VED).

Voluntary agreements with car manufacturers and differentiated fuel duties have resulted in improvements in efficiency and reduced emissions. However, biofuels are taxed at a higher rate than liquified petroleum gas (LPG), despite having lower emissions. The structure of fuel duties should be revised to ensure that the duties reflect a fuel's carbon dioxide emissions.

The level of VED differs according to the car's emissions. However, the differentials are not sufficient to drive consumers to pick lower emission cars. The differential should be increased to levels where VED becomes an effective policy mechanism in reducing emissions.

So far, the Government's approach has been inconsistent and short-term. The Alternative Fuels Framework has provided a degree of certainty for new investors over a three year period. However, if more radical change is to be achieved, such as the adoption of renewable fuels, three years is not long enough to ensure a high degree of confidence from investors. A ten year framework would be more appropriate. The Government should also introduce a biofuels obligation consistent with the EU Biofuels Directive target that 5.75 per cent of fuels supplied should be biofuels by 2010.

Emissions from aviation currently threaten to overwhelm the efforts the UK has made to reduce its emissions of carbon dioxide. Emissions from international aviation are not currently included in the UK's climate change commitment and targets. This should be rectified, and the Government should stick to its intention to press for the inclusion of aviation in the EU Emissions Trading Scheme. The impact of aviation should also form part of the review of the performance of the Climate Change Programme so far.

Broader issues

Chapter 5 highlights some of the broader issues in energy systems which the Government must now address in order to achieve its targets. The Government's ultimate ambition is to create a 'low carbon economy'. However, changing the course of energy systems is not a simple or a short-term task, and the policies in place so far have met with, at best, limited success.

The Government seems to believe that if enough policies are in place, it will be able to meet its goals. This paper argues that individual policy measures will not necessarily provide enough support to overcome the barriers in the broader energy system, and that as a result the Government should adopt a more comprehensive approach to changing technology. This includes setting out a clear framework for energy policy which makes clear that environmental issues, in particular climate change, should tend to take precedence over economic objectives when the two areas come into direct conflict.

An example of this is the design of electricity trading rules. The New Electricity Trading Arrangements (NETA) were devised to deliver short-term, low cost power, which they have so far succeeded in doing. The emphasis on economic performance has penalised small and renewable generators, and as a result has hindered the longer-term move to a low carbon economy. It would have been far better had the rules been created to support the Government's aim of developing a sustainable energy system rather than undermining it. NETA supports the status quo of electricity production and use, rather than enabling change.

In addition, there is considerable uncertainty about the level of government commitment to achieving a low carbon economy. Statements from Ministers talk about aspirations, targets and, latterly, 'moving towards goals'. This ambiguity does nothing to encourage investor confidence. If the Government continues to be committed to reducing carbon dioxide emissions, and encouraging low carbon generation, it needs to make this unequivocally clear. This clarity will need to be backed up by putting resources into the policies and establishing a strong framework for action.

This problem is exacerbated by the fact that there is no clearly responsible body to ensure delivery of carbon cuts through the successful implementation of the Government's policy. The Sustainable Energy Policy Network could take over this role, but is currently hampered by a lack of accountability as well as by the large number of different organisations ultimately responsible for delivery. A more effective approach would be to establish a body whose remit is to report annually on the movement towards targets and to identify policies or departments which are not playing their part. This should be a body that has the influence to ensure that targets are met, such as a small delivery unit in the Cabinet Office reporting directly to the Prime Minister.

Introduction

The UK Government has made many bold statements on the need to tackle the threat of climate change. At the end of April 2004, the Prime Minister stated that climate change is 'the single most important long-term issue that we face as a global community', and that 'the cost of not acting in this case is so overwhelmingly greater than any short-term cost of action, that we have to act and we have to act now' (Blair 2004a). More recently, he stressed the need for effective action in the UK in order to position the country as a global leader on climate change (Blair 2004b). The Government has repeatedly committed itself to action to reduce emissions of greenhouse gases. However, the most recent data on emissions of the most important greenhouse gas, carbon dioxide, shows that the downward trend in emissions has levelled out, and emissions of carbon dioxide in 2003 were broadly the same as in 1997 (DTI 2004d). Clearly, something is not working.

The UK's overall strategy to reduce emissions of greenhouse gases is contained in the Climate Change Programme (CCP), published in 2000. The measures in the Programme are largely directed at the energy sector: fossil fuels are the largest single source of carbon dioxide emissions. The CCP is primarily designed to meet the UK's commitment under the Kyoto Protocol to reduce its emissions of greenhouse gas emissions by 12 per cent from 1990 levels by 2008–12. However, it also contains further statements extending action beyond the Kyoto requirements by reducing total greenhouse gas emissions by 23 per cent from 1990 levels by 2010, and emissions of carbon dioxide by 20 per cent by 2010.

The CCP targets have been elaborated in later documents: the Energy White Paper, for example, announces the intention of achieving the equivalent of 27 to 33 per cent cuts in carbon dioxide from 1990 levels by 2020, and 60 per cent cuts in carbon dioxide by 2050 (DTI 2003). This will require increases in both the UK's energy intensity and carbon intensity – in other words, steps to ensure that energy is used more efficiently, and that as far as possible energy is produced from low carbon sources. Developed countries may ultimately have to reduce their carbon dioxide emissions by more than 90 per cent to avoid dangerous climate change (DETR 2000) – so even a 60 per cent cut must be viewed as merely an intermediate step.

In comparison with many other countries, the UK's targets are ambitious and wide ranging. However, shifting to a low carbon economy is not a simple or a short-term goal. Achieving the targets will require innovation from Government and industry to allow the development and implementation of new technologies and new practices to displace the conventional methods of

producing or using energy. This is not just a question of substituting one set of technologies with another, because existing conventional means of producing and consuming energy are supported by an entire infrastructure of other technologies and practices. Achieving a low carbon economy will ultimately involve both technological innovation and widespread changes to the broader social, institutional, economic and technical system that currently supports the existing energy infrastructure, and which tends to exclude technologies or practices that do not conform to its dominant characteristics.

However, while the Government states that innovation is central to its ambition of a low carbon economy (DTI 2003), it continues to demand that innovation occurs through market mechanisms and in situations where costs are predetermined – in both cases, these conditions tend to constrain innovation. The Government relies heavily on market-based measures to achieve the shift and the associated reduction in emissions. These include, in particular, the Renewables Obligation (RO), the Climate Change Levy (CCL) and the Emissions Trading Schemes (ETS).

The success of the measures relies on the willingness and ability of actors in the market to react to them and also on the removal of barriers in the broader system which may undermine or contradict them. These barriers can be summarised as institutional (for example, confused or overlapping departmental responsibilities), economic (lack of competitiveness in the established system), technical (performance of the new technologies does not conform to established rules), regulatory (the electricity regulator's overriding duty to protect the interests of consumers, which it interprets as a requirement to ensure low cost power) and a lack of information about the benefits or advantages of adopting the new technology or practice. The success of a market-based approach therefore relies on the Government's ability to remove or negate a wide range of barriers which impede the implementation of the measures in its climate change strategy.

The success of the Government's plans does not only depend on whether the new technologies work or the new practices are effective, but also how best they can be integrated within existing 'dirty' energy infrastructures in the short term to enable a gradual shift to a low carbon economy in the longer term. This in turn will require a clear and ambitious vision of what the Government intends to achieve both in terms of specific measures and how they relate to the broader energy system. While mechanisms can be put in place to encourage innovation or deployment of new technologies through subsidies or protected markets, a broader view of the interaction between technologies and the market is necessary to ensure that technologies are ultimately implemented more widely. In other words, support mechanisms such as the RO are necessary, but they are only part of the picture if the Government wants to create a thriving low carbon economy. Support mechanisms will need to be backed up with strong, clear, wide-ranging policy.

In the longer term, further developments and innovations will be necessary to augment the technologies already in existence and to develop new ones. Any policy geared towards shifting to a low carbon economy has to ensure that there are sufficient measures and incentives in place to enable that this innovation takes place. In addition, the progress or otherwise of the various measures must be regularly assessed and measures adjusted if necessary.

Furthermore, the development and implementation of new technologies in established and liberalised energy systems brings with it a high degree of risk for investors: their investments are often high-cost, long-term and irreversible, yet the technologies are often too new and untested to guarantee a return on investment. That return is almost entirely dependent on government policy – but at the moment, the Government seems reluctant to provide sufficient guarantees that its policies will ensure that investors benefit from their actions in the longer term. Without this sort of certainty, investors will be reluctant and the policies will fail.

At present, the Government's energy policy is based around four 'pillars' – environmental, social, security and economic. There is a clear recognition that the four pillars are not necessarily mutually exclusive, but rather that there will often be trade offs between the different elements as different demands and political priorities emerge. However, the Government has explicitly ruled out creating a hierarchy for the different elements, although *de facto* hierarchies in fact exist in the roles and duties of various actors in energy systems. This is especially clear, for example, in the role of the energy regulator Ofgem, which is required to put competition issues before environmental concerns in its decisions. It is important that the relative priority of environmental measures within government policy is clear to all stakeholders in the energy sector before any consistency in policy implementation, or certainty in investment, can be achieved.

Energy production and use cannot be addressed in isolation. The policies put in place to reduce emissions need to be strong and effective not just because they will have to change norms of behaviour or challenge the existing energy infrastructures, but also because they will be subject to the influence of other policies and initiatives directed at other parts of the economy. Setting a clear target is a first step, but it is not enough in itself, given that the policies intended to achieve the target must operate in a hierarchy of other policies within the broader economy. What is needed is an unambiguous demonstration of a commitment to meet the target and an unequivocal statement of the level of priority that should be given to this commitment.

The Prime Minister's recognition of the threat posed by climate change seems to be a clear statement of personal commitment to the issue. However, this report argues that the Government as a whole has so far failed to address the issue with sufficient clarity and force to produce the beginnings of a shift to a low carbon economy. There are already indications, for

example, that the Government is reconsidering the nuclear option, which would reinforce the characteristics of the current 'dirty' infrastructure. Leaving the nuclear option open is at best a dangerous distraction from the need to enable increased deployment of renewables and energy efficiency.

The UK has already missed some of the interim targets it had set itself – both renewables and CHP generation are below the levels that the Government aspired to in the 1990s. The most recent energy projections present a best case scenario of only a 15.2 per cent reduction in carbon dioxide emissions by 2010. The lessons from these early failures need to be learnt quickly in order to address the potential shortfall and achieve the first significant steps on a path to a low carbon economy. The forthcoming review of the Climate Change Programme must address the areas where measures are not working – failing to do this now will mean that the goal of moving towards a low carbon economy will become progressively harder to achieve.

This report looks first at the targets the Government has set and the current projections for emissions in 2010. It then examines the three main areas in which the UK intends to reduce emissions: an increase in energy intensity through increasing energy efficiency, a shift in electricity production from fossil fuelled to low carbon generation, and limiting increases in emissions from the transport sector. The final chapter is a brief overview of the broader issues which could act as barriers to the emergence of a low carbon economy.

1. Government targets

The first stage in an assessment of the UK's Climate Change Programme (CCP) is to define what the UK's targets for a low carbon economy actually are. On the face of it, this should be a simple task. Following the Kyoto Protocol, the UK is committed as a member of the European Union to reducing its emissions of greenhouse gases (excluding international aviation emissions) by 12.5 per cent from the 'baseline' 1990 level by 2008–12 (Table 1.1). This should reduce the UK's emissions of greenhouse gases from 209MtCe (million tonnes of carbon or equivalent) to around 183MtCe.

Table 1.1 **UK baseline emissions**

	Baseline year[1]	Emissions (MtCe)[2]	Emissions in CCP (MtCe)[2]
Carbon dioxide	**1990**	**164.6**	**168.0**
Methane	**1990**	**21.0**	**21.1**
Nitrous oxide	**1990**	**18.5**	**17.9**
Hydrofluorocarbons	**1995**	**4.22**	**4.1**
Perfluorocarbons	**1995**	**0.12**	**0.3**
Sulphur hexafluoride	**1995**	**0.35**	**0.3**
1990 baseline		**209**	**211.7**

Sources: DETR 2000, DEFRA 2004e

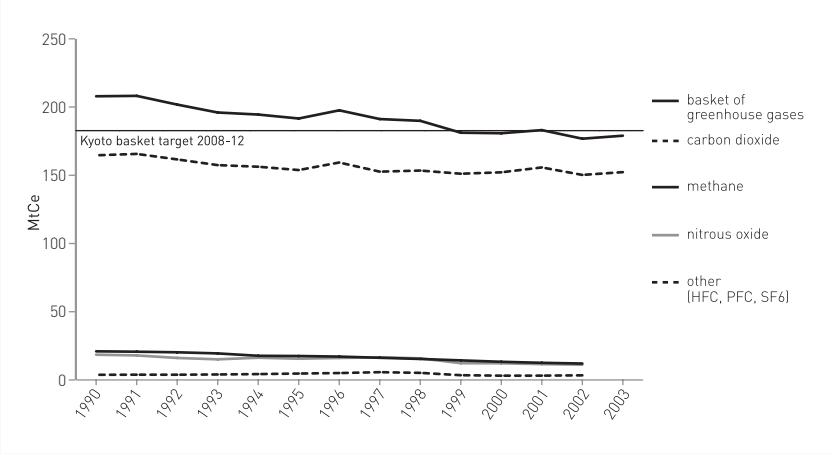
Notes: 1 The 1990 baseline, used for comparison with the Kyoto target, is the sum of 1990 totals for CO_2, CH_4 and N_2O and 1995 totals for HFC, PFC and SF_6.

2 The calculations of emissions in 1990 in the CCP (211.7MtCe) have been updated several times by DEFRA. The most recent figures, published in March 2004, are used here (209MtCe total greenhouse gas emissions in 1990) 12MtCe is roughly equivalent to 44MtCO_2.

The Kyoto/EU target was achieved by the end of 1999, when total greenhouse gas emissions amounted to 181MtCe, a reduction of 13.2 per cent from the 1990 baseline (DEFRA 2004e). However, as can be seen in Figure 1.1, the rate of decline in emissions of all greenhouse gases has slowed since the late 1990s, and in the case of carbon dioxide, emissions are rising again.

Much of the reduction in emissions since 1990 came from the shift from coal to gas generation in the electricity sector and the resulting lower emissions of carbon dioxide (Table 1.2) (DTI 2004d). This led to a decrease of around 15 per cent in emissions. These savings are one-off and, in the context of climate policy, fortuitous, as the reductions were largely achieved independently of any

Figure 1.1 **Emissions of greenhouse gases 1990–2003**



Source: DTI 2004c, E12.1

substantive government action to reduce emissions (Helm 2004). There is potential for recent reduction trends to reverse, as with recent rises in carbon dioxide emissions, mainly as a result of increased use of coal power stations in response to changes in the electricity market (DTI 2004d).

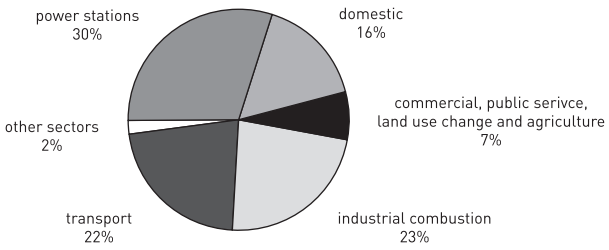
This report concentrates on policy measures to reduce carbon dioxide emissions rather than all greenhouse gas emissions. Not only does carbon dioxide dominate the UK's greenhouse gas emissions, it is also the main focus of policy activity across all sectors of the economy. Energy consumption accounts for around 95 per cent of all carbon dioxide emissions in the UK (DTI 2004d). The recent rises in carbon dioxide emissions show the

Table 1.2 **Carbon dioxide emissions by fuel (MtCe)**

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003p
Gas	**30.4**	**42.2**	**48.9**	**49.9**	**52.2**	**55.6**	**57.2**	**57.0**	**56.5**	**56.9**
Oil	**56.4**	**54.2**	**55.6**	**53.2**	**51.9**	**50.6**	**49.5**	**50.3**	**49.3**	**49.1**
Coal and other solid fuels	**66.6**	**47.8**	**44.9**	**39.7**	**39.6**	**35.5**	**36.6**	**39.7**	**36.2**	**37.6**
Non-fuel	**11.1**	**9.6**	**9.9**	**9.7**	**9.8**	**9.5**	**8.9**	**8.7**	**8.2**	**8.7**
Total	**164.6**	**153.8**	**159.3**	**152.6**	**153.5**	**151.1**	**152.2**	**155.8**	**150.3**	**152.3**
% change since 1990	–	**-6.6**	**-3.2**	**-7.3**	**-6.8**	**-8.2**	**-7.6**	**-5.4**	**-8.7**	**-7.5**

Source: DTI 2004d, Tables 2 and 3

Figure 1.2 **Carbon dioxide emissions by source 2003**



Note: 'Other sectors' includes waste and fugitive emissions from fuels.
Source: DTI 2004d, Table 1

fragility of UK performance in reducing its overall greenhouse gas emissions. The Kyoto commitment, once ratified, will be the only binding commitment for reducing greenhouse gas emissions. However, the Government has announced its intentions beyond Kyoto in two key strategic documents – the Climate Change Programme and the Energy White Paper – and elsewhere. These documents are outlined in more detail below.

The Climate Change Programme

Climate Change – the UK Programme (CCP) was published in November 2000. Its purpose was to 'lay the foundation for the more fundamental changes that will be needed in the years to come. It puts in place policies which give clear signals about the changes that will be needed over the coming decades, and which offer incentives and help to adapt to this changing environment' (DETR 2000).

The CCP drew together measures already in place in 2000, such as the Climate Change Levy, and announced a number of new measures to create strategy to reduce emissions (Table 1.3). If successful, the programme would take the UK well beyond its Kyoto commitment and result in a reduction of the UK's greenhouse gas emissions overall by 23 per cent from 1990 levels by 2010. In addition, the Government announced an intention to cut the UK's emissions of carbon dioxide by 20 per cent below 1990 levels by 2010 (from 164.6 to 131.7MtCe). The strategy to achieve this covers all the major sectors in the economy. In terms of delivery, however, the emphasis is on electricity generation, improvements in energy efficiency and reductions in emissions from transport.

Table 1.3 Summary of the Climate Change Programme

Baseline emissions

All greenhouse gases	**209 MtCe/yr**
Carbon dioxide	**164.6 MtCe/yr**

	Saving (MtCe/yr)	% change from 1990
Pre-CCP measures		
Ongoing impact of measures (eg fuel switching) introduced before 1997 as well as:	**24.3-25.8**	
– Climate Change Levy	**2**	
– fuel duty escalator to 1999	**1-2.5**	
– delivery of 10% renewable energy target	**2.5**	
All greenhouse gases	**177.7**	**–15%**
Carbon dioxide	**150.6**	**–8.5%**
Additional CCP measures		
Domestic:		
Energy efficiency (including the Energy Efficiency Commitment to 2005)	**2.6-3.7**	
Replacement of community heating systems	**0.9**	
New Home Energy Efficiency Scheme	**0.2**	
Appliance standards and labelling	**0.2-0.4**	
Business:		
Climate Change Agreements and implementation of Integrated Pollution Prevention and Control policies	**2.5**	
Climate change levy package/Carbon Trust	0.5	
UK Emissions trading scheme	At least 2	
Business/Domestic:		
Reform of building regulations (England and Wales)	**1.3**	
Transport:		
EU-level voluntary agreements on CO_2 from cars, company car taxation and vehicle excise duty	**4**	
Ten Year Plan	**1.6**	
Sustainable distribution in Scotland and Wales	**0.1**	
Agriculture, Forestry, Land Use change:		
Afforestation	**0.6**	

	Saving (MtCe/yr)	% change from 1990
Public sector:		
New central government schools and NHS targets	**0.5**	
Scottish Executive:		
Changes to the building regulations, new central estate target, and NHSiS target	**0.1**	
Reduction from CCP additional measures (MtCe)	**17.75**	
Additional action not quantified in the CCP: For example, action by devolved administrations and local authorities, improved management of traffic speed, voluntary carbon offset schemes, public awareness campaigns	additional carbon savings	
All greenhouse gases	**160.9**	**–23%**
Carbon dioxide	**133.5 (131.8)**	**–19% (20% with unquantified measures)**

Source: DETR 2000

The Energy White Paper

In June 2000 the Royal Commission for Environmental Pollution published its report *Energy – The Changing Climate* (RCEP 2000). This stressed the 'radical challenge' facing the UK needed to balance access to energy with the environmental problems caused by energy production and use. The report called on the Government to 'adopt a strategy which puts the UK on a path to reducing carbon dioxide emissions by some 60 per cent from current levels by about 2050'.

Following the publication of the RCEP report, the Prime Minister announced that the Performance and Innovation Unit (PIU) (now the Strategy Unit) would review the strategic issues surrounding energy policy. The findings of the PIU study would inform the Government's response to the RCEP report as well as setting out a strategy and objectives for a longer term energy policy. The PIU reported in February 2002 (Performance and Innovation Unit 2002).

In February 2003, the Government published its Energy White Paper, responding to the RCEP report and addressing the broader questions of energy reliability and the need for a new energy infrastructure. The headline from the launch of the White Paper was the Government's acceptance of the RCEP's recommendation that the UK should 'put itself on a path towards'

reducing carbon dioxide emissions by 60 per cent by 2050 (DTI 2003). In order to achieve such significant cuts in the future, the Government recognised the importance of achieving incremental changes. So it reiterated the objectives behind the existing Climate Change Programme and stated in addition that 'we expect to aim for' cuts in carbon of 15–25MtCe below predicted levels in 2020 (DTI 2003).

The envisaged savings from different sectors are outlined in Table 1.4. Little further detail on how this might be achieved was presented in the White Paper.

Table 1.4 **EWP suggested reductions by 2020**

	Saving (MtCe)
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
Total	15-25

Source DTI 2003, Table 2.1

Defining the targets

Beyond the clear binding commitment under the Kyoto Protocol, the range of additional targets and ambitions set out in the CCP, the Energy White Paper and elsewhere can be confusing. As far as possible, they are summarised in Table 1.5. The extent of the challenge being faced up to 2050 is illustrated in Figure 1.3, that shows past emission reductions and the levels that would be required if the targets are to be met.

Energy and emissions projections

Projections of future energy production and demand across the economy are one of the foundations of developing present day energy policy. Energy Paper 68 (EP68), published in 2000, was the starting point for the CCP and contains a set of projections of possible future levels and compositions of energy demand up to 2020. The paper forecast that the UK would reduce its greenhouse gas emissions by 15 per cent by 2010, and so meet its Kyoto commitment. However, emissions were forecast to start rising because of continuing

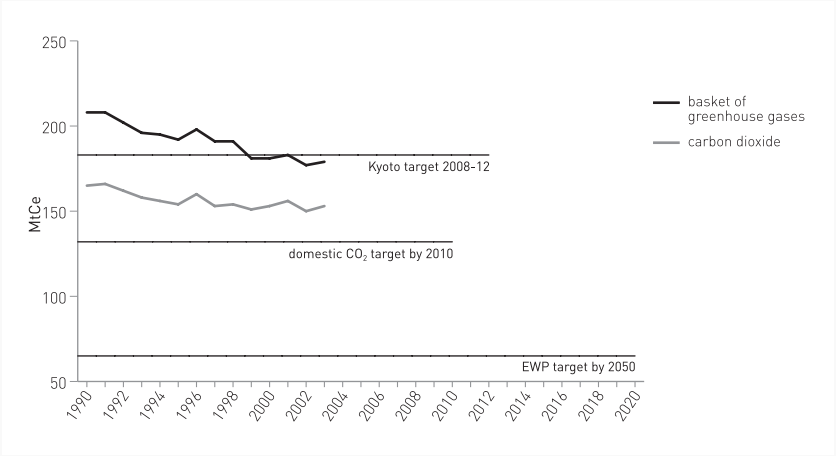
Table 1.5 Milestones in emissions reduction

	Greenhouse gases (MtCe)	CO_2 (MtCe)	Renewables	CHP
1990 (baseline emissions)	**209**	**164.6**		
2000				5GW of CHP
2003			5% of electricity generation	
2010	Kyoto commitment: 12.5% below 1990 levels by 2008–12 (~183MtCe)	20% reduction on 1990 levels (around 132MtCe)	10% UK electricity sales	10GWe of 'good quality' CHP
2015			15% of UK electricity sales	
2020		Reduction to ~110 –120MtCe (ie 27-33% cut from 1990 levels)[1]	20% of UK electricity sales	
2050		60% reduction from current levels (~65MtCe)	30-40% of generation	

Sources: DETR 2000, DEFRA 2002, DTI 2003, DTI 2003e

Note: 1 These figures depend on what levels are predicted in 2020 (DTI 2003).

Figure 1.3 UK targets and emissions (1990–2003)



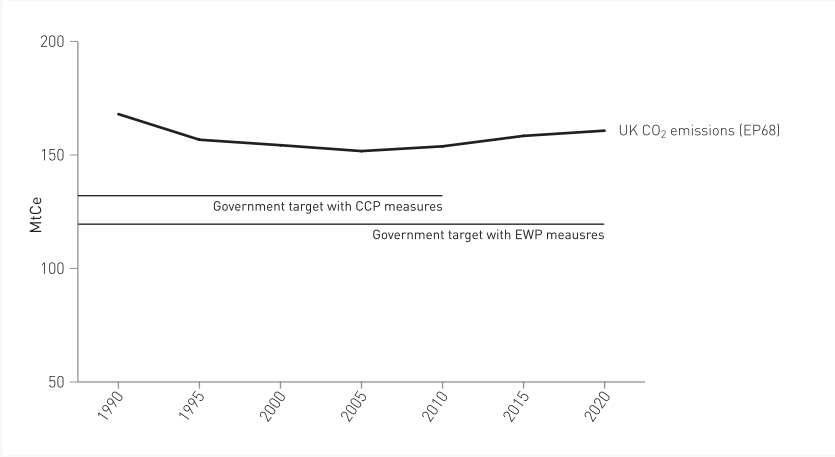
Source: DEFRA 2004e

economic growth and the closure of some nuclear power stations. The additional measures put forward in the CCP were designed to counter this trend and ensure that the UK could also meet its domestic target of a 20 per cent reduction in carbon dioxide emissions by 2010 (DTI 2000).

EP68 recognised that most savings in carbon dioxide emissions between 2005 and 2010 would come from one-off reductions in emissions from the power generation sector, mainly as a result of increased gas generation at the expense of coal-fired generation. Other sectors, such as transport, were expected to increase emissions. The one-off fuel switches are therefore expected to deliver the bulk of reductions in the short term; if the trend is to continue, broader action across a range of sectors will be needed.

Beyond 2010, emissions were expected to continue to rise, meaning that by 2020 emissions were projected to be four to seven per cent above the 2010 level (DTI 2000). Figure 1.4 shows the projected emissions of carbon dioxide in EP68 without the application of the measures in the CCP, together with the levels which the Government hopes to attain through the CCP and policies in the Energy White Paper.

Figure 1.4 CO_2 emissions with and without the CCP and EWP



Source: DTI 2000, DETR 2000, DTI 2003

EP68 is currently being updated by the DTI. The Updated Energy Projections (UEP) were originally meant to be finalised in March 2004, but have been delayed to the autumn. The new projections are intended to be used as the basis for the forthcoming review of the progress of the CCP as well as for legislative measures such as the allocation of emission allowances under the EU's Emissions Trading Scheme.

Energy projections are always fraught with uncertainties relating to future economic performance, technical improvements, new policies and unforeseen

events. The new projections being prepared by the DTI have an additional dimension which may have been implicit in past forecasting exercises, but which has now become explicit: the use of the updated projections as the basis of the UK's National Allocation Plan for the EU Emissions Trading Scheme means that industry has a direct economic interest in future emissions projections. This is discussed in more detail in the following section on the development of the National Allocation Plan.

The May 2004 version of the UEP forecasts that if the measures currently in place from the CCP perform as modelled, the UK will achieve an 11.8 per cent reduction in carbon dioxide emissions by 2010 – far short of the Government's 20 per cent target (Table 1.6). More information on the progress of the UEP was released in October 2004 but contains little detail on the performance of individual sectors or new information on the impact of the EU Emissions Trading Scheme. For that reason, we use the detail contained in the May 2004 UEP.

The May UEP assumes that firm policies, notably the renewables and CHP targets, are met. Even if measures which are as yet proposals – such as the introduction of new building regulations in 2005 or the effective implementation of the EU Emissions Trading Scheme – are included in the models, the projected emissions still fall by only 15.2 per cent by 2010

Table 1.6 **May 2004 UEP projected emissions reduction with current CCP measures (MtC)**

	1990 baseline	2010 with CCP measures	% change
Power stations	**54.14**	**37.91**	
Refineries	**4.80**	**5.30**	
Residential	**21.52**	**21.55**	
Services	**8.50**	**7.28**	
Industry	**35.50**	**30.68**	
Road transport	**29.78**	**35.11**	
Off-road	**1.75**	**1.61**	
Other transport	**3.20**	**2.89**	
Agriculture	**0.40**	**0.19**	
Afforestation[1]	**0.0**	**-0.70**	
Land use change[2]	**5.3**	**3.6**	
Total UEP	**164.9**	**145.4**	**-11.8**

Notes: 1 Previously afforestration was included in Agriculture; Agriculture has variously been combined with Services or Industry.

2 Land use change figures are modelled separately from the DTI's energy model.

Source: DTI 2004b, Tables 6 and 10

Table 1.7 UEP projected emissions reduction with all measures (MtC)

	Actual 1990 emissions (MtCe)	UEP projected emissions in 2010 (MtCe)	% change on 1990
Actual 1990 CO_2 emissions	**159.6**		
May 2004 UEP with CCP measures		**141.8**	
Land use change	**5.3**	**3.6**	
Additional firm measures[1]		**-4.05**	
Total with CCP	**164.9**	**141.4**	**-14.3%**
with EU Emissions Trading Scheme (ETS)		**1.5**	
Total with EU ETS		**139.8**	**-15.2%**

Source: DTI 2004b, Table 10

Note: These are the extension of existing Climate Change Agreements (CCAs), the negotiation of new CCAs, new building regulations in 2005, the extension of the Energy Efficiency Commitment and Warm Front programmes and 'other measures' including appliance standards.

(Table 1.7). These additional measures are considered sufficiently firm to be included in the projections, but they may still be subject to ministerial approval and negotiation with target sectors, so their net contribution to emissions reductions is still uncertain.

These 'best case' projections highlight the fact that there is a 'carbon gap' in the UK's programmes for which no policies exist. If carbon dioxide emissions are reduced by only 15.2 per cent, this carbon gap amounts to around 8MtCe.

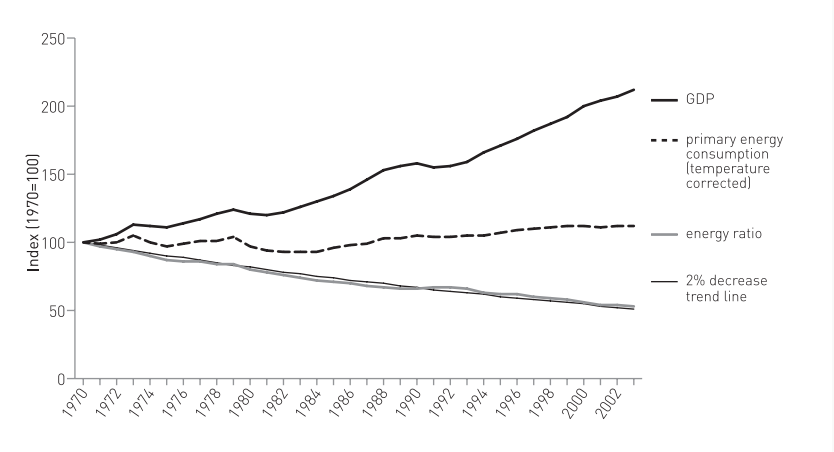
Recent modelling by Cambridge Econometrics confirms that the UK is seriously off track in meeting its targets. UK Energy and the Environment estimates that carbon dioxide emissions will be 12.25 per cent below 1990 levels by 2010 because of increases in emissions from the commercial, transport and household sectors, meaning that the 20 per cent target for 2010 is missed by 7.75 per cent (Cambridge Econometrics 2004). Like the UEP, the report assumes that the renewables and CHP targets, the Climate Change Levy and other policy measures are successful, which, as discussed later, is increasingly open to question.

Whether or not the forecasts ultimately prove to be exactly right, it is clear that the measures set out in the CCP are not delivering as expected. Concerted action is needed now to put the UK back on track.

Energy intensity and carbon intensity

The success of the CCP and Energy White Paper programmes in reducing emissions of carbon dioxide depends on the UK improving its carbon

Figure 1.5 **The energy ratio 1970–2003**



Source: DTI 2004c Chart E11.1

intensity – in other words, reducing the level of carbon emissions per unit of GDP. This can be achieved through reducing its energy intensity (the energy consumed per unit of GDP) and reducing the amount of carbon used in energy production by switching from fossil fuels.

The received wisdom is that increased economic production is closely linked to increased energy consumption. However, as Figure 1.5 shows, increased GDP does not necessarily entail a commensurate increase in energy consumption: since 1970, this 'energy ratio' has fallen at around two per cent a year in the UK. This is because of a range of factors, including efficiency improvements, fuel switching from coal to gas and a decline in energy intensive industry.

However, this rate of decrease has to be radically improved if the UK's targets for carbon dioxide emissions are to be met. Table 1.8 shows the average rate of reduction in carbon dioxide emissions in the 1970s and 1980s using DEFRA's emissions data. Unlike International Panel on Climate Change (IPCC) data, these figures do not include reductions from land use change but the overall trend in reductions should be broadly consistent with that shown by IPCC data. The highest rate of reduction in carbon dioxide emissions occurred in the 1970s – despite the dash for gas in the 1990s, the rate of reduction in carbon dioxide emissions from 1990 to 2001 is only just over half that from 1970 to 1980. In part, this is because emissions actually rose in 2000 and 2001.

The average rate of carbon dioxide emission reduction between 1990 and 2000 was 0.7 per cent a year, in large part due to the one-off impact of switching from coal to gas in electricity generation. Between 1990 and

Table 1.8 **Average reductions in CO_2 emissions 1970-2002**

	CO_2 emitted at start of period	CO_2 emitted at end of period	Average reduction/ year (%)
1970-1980	185.3	164.3	1.1
1980-1990	164.3	159.3	0.3
1990-2000	159.3	147.7	0.7
1990-2002	159.3	146.3	0.68

Source: DEFRA 2004e

2002, the average rate of reduction was just over 0.68 per cent a year. If maintained, this is more than enough to meet the UK's 12.5 per cent Kyoto commitment for total greenhouse gas reductions on current projections. However, if the rate of reduction is not improved, the UK will not meet its target of a 20 per cent reduction in carbon dioxide emissions by 2010 – at 0.68 per cent a year, the UK will only achieve a 13.5 per cent reduction.

Each year that the UK does not achieve the required rate of reduction in emissions, the rate for subsequent years will increase. The issue of the rate of reduction is becoming increasingly important to the long-term achievement of the Government's targets, as the rate has slowed over the last few years and emissions have at best stabilised, and may be showing an upward trend.

There has obviously been some improvement in the carbon intensity of the UK economy since the early 1990s (2.8 per cent a year) because of improvements in efficiency, fuel switching and improvements in the performance of nuclear power stations – although this is less than the historic trend between 1970 and 2000, when carbon intensity improved by three per cent a year. If the one-off impact of fuel switching is ignored, the rate of reduction between 1990 and 2000 is only two per cent a year (DTI 2003d).

Assuming that all the measures in the CCP are successful, carbon intensity between 2000 and 2010 will improve by 2.8 per cent a year. After 2010 carbon dioxide emissions are expected to start rising (DTI 2000, DTI 2004b). If this is to be avoided, there will need to be a significant improvement in carbon intensity compared with historic levels: the DTI estimates that this will have to be in the order of 4.3 per cent a year after 2010 if the 2050 target is to be met (DTI 2003d). In comparison with past improvements, this is an unprecedented rate of improvement, and will require a step change in policy implementation to improve energy intensity and bring more low carbon technologies online.

Clearly, the ambition of the CCP on its publication in 2000 is not being fully realised, with emissions in 2010 projected to be around 139.8MtCe, a reduction of 15.2 per cent on 1990 levels. In addition, the required rate of improvement in carbon intensity far outstrips past performance. The next section looks in detail at the design and implementation of some of the specific measures in the Climate Change Programme (CCP) and attempts to highlight where performance problems may lie.

2. Energy efficiency

Energy efficiency measures are central to the strategy to reduce energy intensity set out in the Climate Change Programme (CCP) and the Energy White Paper. The CCP relies on energy efficiency to deliver more than half its emissions reductions to 2010 (around 10MtCe a year), while the White Paper also envisages around half the expected reductions (about 8–12MtCe) coming from improved energy efficiency up to 2020.

The White Paper called for a 'step change' in energy efficiency, and recognised that 'the cheapest, cleanest and safest way of addressing our energy policy objectives is to use less energy' (DTI 2003). However, the detail of this 'step change' was left until the publication of the Energy Efficiency Action Plan (EEAP) in April 2004 (DEFRA 2004). The EEAP restates the aim of delivering a 'step change in energy efficiency on a scale not achieved before in the UK' (DEFRA 2004) but in fact it does not extend the reduction targets far beyond those contained in the original CCP and will not result in a dramatic improvement in the UK's energy intensity.

Neither the White Paper nor the Action Plan define what might constitute a 'step change' in energy efficiency. There is no dramatic shift in the treatment of energy efficiency beyond business-as-usual or order of magnitude shift in the efforts that Government and industry make to improve efficiency. Instead, the Plan sets out a framework for 12.1MtCe savings by 2010 – a slight increase in the best case scenario announced in the CCP in 2000 (Table 2.1). The potential savings from the domestic sector have fallen from a maximum of 5.2MtCe to 4.2MtCe, despite the extension of the main measures – the Energy Efficiency Commitment – from 2005 to 2011.

Table 2.1 **Projected savings to 2010**

	Projected carbon savings (MtCe pa)		
	CCP	EWP	EEAP
Households:			
Domestic energy efficiency, incl. Energy Efficiency Commitment (EEC)	**2.6-3.7**	**–**	**–**
Measures already in the CCP, including EEC to 2005	–	–	**1.5**
EEC from 2005, Decent Homes[1]	–	–	**1.4**

	Projected Carbon savings (MtCe pa)		
	CCP	EWP	EEAP
HEES/Warm Front	0.2	–	0.2
Community Energy	0.9	–	0.1-0.2
Appliance standards and labelling	0.2-0.4	–	–
Other measures	–	–	0.2
Subtotal (households)	3.9-5.2	5	4.2
Business and public sector:			
CCA	2.5	–	2.4
Revision of CCA targets	–	–	0.9[2]
Extension to new sectors	–	–	0.5[2]
UK and EU ETS	at least 2	–	2.0
Carbon Trust (incl ECAs)	0.5	–	1.0
Public sector	0.5	–	0.5
Subtotal (business and public sector)	5.5	~6	7.9
Business and domestic:			
Building regulations	1.3	–	1.4
Total	10.7-12	–	12.1

Notes: 1 And equivalent programmes in the devolved administrations.
2 Estimated delivery, to be finalised later this year.

Source: DETR 2000, DTI 2003, DEFRA 2004, Tables 1, A3 and A4

The shortfall created by the reduced domestic target is made up by an increase in potential savings from Climate Change Agreements. This makes the performance of this programme an increasingly important element in the Government's strategy, and it is discussed in more detail below.

Domestic energy efficiency

The extent to which efficiency measures will actually contribute to reducing demand from the domestic sector is difficult to predict, given the prioritisation of fuel poverty measures within the various energy efficiency programmes. For example, the benefits of better insulation may be taken in the form of more warmth rather than lower energy consumption (this is known as 'comfort taking'). Aside from the desirable social consequences of increasing people's level of comfort, the interaction between the social and environmental aspects of the Government's policy emphasises the need for careful balance.

The Energy Efficiency Commitment and Warm Front

The key component of the Government's strategy for reducing energy consumption from the domestic sector is the Energy Efficiency Commitment (EEC), which was introduced in April 2002. (Prior to that, suppliers ran the smaller Energy Efficiency Standards of Performance scheme.) Its first phase runs until March 2005, with two proposed subsequent phases running to 2008 and 2011 respectively. The EEC applies to larger domestic energy suppliers, who each have an energy saving target which can be met by encouraging customers to install energy saving measures. At least half of the target must be met with measures for those in fuel poverty or who are disabled.

Ofgem estimates that around 57 per cent of priority households and 34 per cent of non-priority households could benefit from at least one measure under the EEC (Ofgem 2004c). The rest, constituting a sizeable proportion of the housing stock, are excluded for a number of reasons including a lack of cavity walls or because they are off the gas grid.

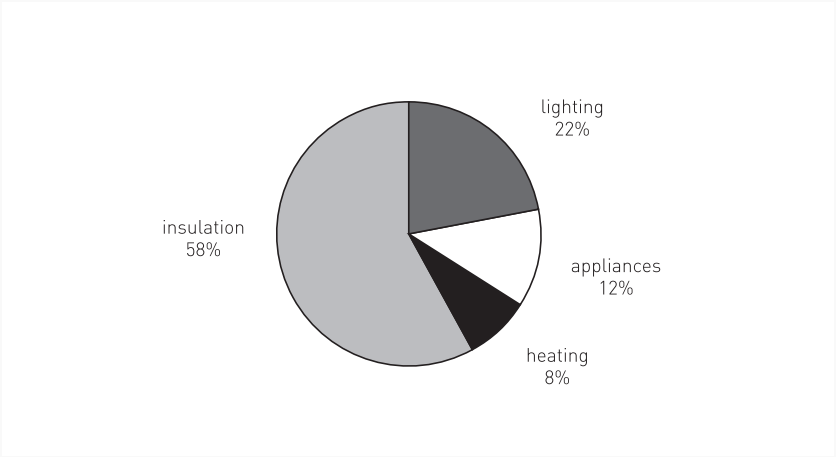
The first EEC runs from 2002 to 2005, and is projected to save 0.4MtCe a year – equivalent to 62 TWh of energy savings over the three years of the scheme, or a one per cent a year fall in carbon dioxide emissions from households (Ofgem and EST 2003). The second phase is expected to save around 0.7MtCe (DEFRA 2004g).

The cost of the first phase of the EEC is estimated to be around £3.60 per customer per fuel a year (Ofgem and EST 2003). This figure is based on DEFRA modelling, and the actual cost depends on both the assumptions used and the extent to which suppliers chose to pass on the costs. In addition, suppliers have tended to find the most cost-effective ways of meeting their obligation. For example, many suppliers have chosen to take bulk measures in association with social housing groups such as local authorities, which can reduce overall costs (National Audit Office 2004a). The annual cost of £3.60 per customer per fuel could therefor be an over-estimate. If agreed, the second phase would operate at around twice the level of the first EEC, with an estimated cost of about £5 per customer per year (DEFRA 2004g).

Ofgem and the Energy Savings Trust (EST)'s review of the first year of the EEC (2002–3) showed that suppliers had underperformed slightly, achieved only 17.2 TWh of savings rather than a third of the 62 TWh overall target (20.7 TWh) (Ofgem and EST 2003). The second year review shows a dramatic improvement, with suppliers meeting 77 per cent of the overall target (Ofgem 2004c).

The most significant savings were achieved by insulating properties (loft and cavity wall insulation), followed by lighting (Figure 2.1). Insulation is effectively a one-off activity, with benefits spread over several decades, and it is likely that the level of activity in this area will decline over time as more properties are insulated, meaning that other areas may become proportionately more important.

Figure 2.1 **Energy savings by measure type (% total savings)**



Source: Ofgem 2004c, Figure 2.5

The costs of energy efficiency measures are largely known, especially in the domestic sector, as the technologies and practices are well-established. This in turn means that the costs of an energy efficiency programme are well understood, although the calculations of the benefits arising may be less reliable. Table 2.2 weighs the total annual benefits against the total annual costs of the programme and shows that the EEC is reasonably cost-effective

Table 2.2 **Energy Efficiency Commitment costs and benefits**

EEC	2002-05	2005–08	2008–11	Total
Annual carbon savings in 2010MtC/y	0.4	0.7	0.7	1.8
Annual benefits in 2010				
Energy savings value to consumers £M/y	150	250	250	
Social value of carbon savings £M/y	30	50	50	
Comfort benefits value to consumers £M/y	40	80	80	
Total annual benefits	**220**	**380**	**380**	**1538**
Annual costs during programme				
Capital investment £M/y	160	390	420	
Additional programme implementation £M/y	30	70	70	
Exchequer costs £M/y	–	–	–	
Programme lifetime	3	3	3	
Total annual costs	**193**	**463**	**493**	**1681**

Source: DEFRA 2004, Annex 6 Table 1

up to 2010. It is important to remember when comparing the costs and benefits that the consumer and social benefits of the EEC will extend far beyond the end of the programme, so truncating the comparison at 2010 is in effect underestimating the total long-term benefits of the scheme.

The Warm Front programme is primarily designed to reduce fuel poverty, but the CCP also envisages 0.2MtCe savings from the scheme. Although Warm Front is run in England, there are similar programmes in place in Scotland and Wales. The programme is currently allocated £150 million a year, and the most recent public spending review promised an increase in its annual budget to £245 million by 2007–8.

Although Warm Front is separate from the EEC, there seems to be a significant degree of overlap, with energy suppliers choosing to buy measures implemented under Warm Front to contribute to their EEC targets; the money received is used to carry out further Warm Front programmes. This overlap raises the issue of possibly double counting the savings from the schemes, but there seems to be no information on whether this is occurring.

Scheme managers calculate theoretical carbon savings from the measures they implement under Warm Front. The National Audit Office, which has been critical of the limited penetration and scope of the scheme, calculates on this basis that the measures implemented in 2001–2 will save 0.1MtCe by 2010 (National Audit Office 2003). However, this calculation does not appear to take into account a degree of comfort taking from those participating in the scheme. The impact of the programme on carbon dioxide emissions is therefore unclear.

Both the EEC and Warm Front have clear targets for carbon dioxide reductions. However, the actual impact of the schemes is difficult to evaluate. For example, calculations of carbon savings from the measures implemented are theoretical, and may not incorporate the full extent of comfort taking, leading the National Audit Office to conclude that the estimated savings had not been achieved in practice (National Audit Office 2004a). Similarly, Ofgem and the EST have highlighted the behaviour of suppliers in promoting the use of energy efficient lighting. Suppliers have tended to promote 100W-equivalent bulbs as the most cost-effective means of achieving savings on lighting but if the new bulbs are replacing lower wattage bulbs, the savings achieved could be over-estimated (Ofgem and EST 2003).

DEFRA is improving the models it uses to estimate savings. Monitoring of the reliability of the models could be enhanced, to include more houses, as without this the real contribution made by the programmes is uncertain. Given that both the EEC and Warm Front have a value in their own right (enhanced living conditions) and that even the later stages of the EEC are predicted to be reasonably cost effective, the Government should consider expanding the schemes. This should include both higher targets and a broader scope – for example to provide measures for insulating properties without cavity walls.

The Community Energy programme

Community energy, or district heating, is the supply of heat to groups of buildings from a centralised heat production facility. Combining CHP plants with community energy projects can result in economies of scale for the plant as well as reduced emissions and increased comfort for participants through improved heat supply.

The Community Energy programme has two aims: to provide for up to 130MW of new CHP capacity, and to contribute to measures to alleviate fuel poverty (DEFRA 2004a). It is intended to provide waste heat from CHP generation to networks of buildings. The programme provides up to £2 million as development grant support and £48 million capital support. It aims to bring in around £200 million from other sources.

So far, 50MW of CHP capacity has been allocated grant support, with ten schemes using renewable sources of energy (DEFRA 2004). The CHP strategy puts the capacity awarded support at 45MW (DEFRA 2004a). This will save around 33,000tC a year and help 35,000 people on low incomes.

To put this level of support into context, a report for the Carbon Trust estimated that the cost-effective potential for CHP in community heating was around 2300MW by 2010 (Table 2.3) (Building Research Establishment 2003). The 130MW aim of the programme therefore represents just 5.6 per cent of the potential cost-effective capacity. In addition, the BRE report used a public private partnership discount rate of nine per cent, based on a private sector discount rate of 12 per cent and a public sector discount rate of six per cent. Since the study, the Government has lowered the public sector discount rate from six per cent down to 3.5 per cent, giving an overall discount rate of 7.25 per cent. This increases the cost-effective potential for public private partnerships to almost 10,000MW (DEFRA 2004a) making the aim of the programme even more derisory.

Table 2.3 Summary of UK potential for community heating/CHP (9% discount rate)

Total net community heating/CHP potential for UK	2,289MWe
Number of postcode sectors	450
Total heat sold	19,380GWhpa
Total capital cost	£2746m
Total net present value of all sectors	£405m
Total customer savings on heating bills	£435m pa
Carbon emissions saving (fossil fuel basket excluding nuclear and renewables)	1.67MtCpa
Carbon emissions saving (average grid mix basis)	0.68MtCpa

Source: Building Research Establishment 2003, Table 4.1

The success of the scheme seems also to be hindered by its relatively short duration – it is due to end in March 2005, with all receipts for expenditure to be submitted by February 2007. Long lead times on some projects make meeting these deadlines impossible, so constraining the level of development.

It is clear that the potential of community CHP projects is not being realised, despite the fact that they deliver both emission reductions and improvements in fuel poverty. The Government is considering extended the scheme beyond 2005, depending on the outcome of the next spending review. Given the estimates of cost-effective potential, and the contribution to both the Government's climate change and fuel poverty strategies, the Community Energy scheme should be extended beyond 2005, with higher levels of funding available and more realistic expenditure deadlines.

Promoting energy services

Energy services are the provision of the services derived from the use of energy – heat and light – rather than the traditional approach of selling units of electricity or heating fuel. Shifting the focus from energy units to services can have advantages for both suppliers – in terms of product differentiation and brand loyalty – and consumers – through the provision of cost-effective energy efficiency measures (Energy Services Working Group 2004).

Encouraging the development of energy services would impact on a number of the specific measures in the CCP, in particular the EEC and Warm Front, while also potentially contributing to the social agenda of removing people from fuel poverty.

Increasing the profile and availability of energy services will also serve to improve consumers' awareness of how much energy they use and the ways in which they use it. Energy services will make choices about energy use explicit; while some energy users may decide to maintain their level of use, others will be able to assess the cost of doing so and, for example, decide instead to dress more warmly. Increased awareness and choice of action amongst end users will play a vital part in the success or failure of the Government's policies to limit demand and improve efficiency.

Electricity meters make it impossible for customers to link knowledge of their demand with the possibility of new services from suppliers, and for suppliers to monitor patterns of consumer demand with any detail. However, using advanced metering technologies would allow consumers to know the price and even the environmental impact of the power they are using. Such 'intelligent' meters are rapidly becoming the norm in Italy, where users can chose to consume power at a time when overall demand, and therefore the price, is lower. The meters also allow suppliers to monitor usage, meaning that they can develop effective demand reduction and energy service programmes. A final argument for driving the installation of intelligent meters is

that they would allow customers to export, and be paid for, any power that they produce from domestic renewable systems.

However, energy service companies (ESCOs) have been slow to emerge in the UK's energy system, in particular because energy markets allow customers to switch between suppliers after giving 28 days' notice. The relative ease with which customers can switch has meant that suppliers are unwilling to invest in efficiency measures that would allow them to provide a service to a customer who could switch supplier a couple of months later.

The Government is seeking to address this with a two year trial ending in April 2006 to promote the development of energy services. Up to one million households can sign long-term contracts with suppliers who will help them to reduce energy use. This removes a degree of uncertainty for suppliers who can sign energy service contracts with up to four per cent of their customers, lasting up to five years. It is too early in the trial to evaluate its progress, although Ofgem will publish a review in early 2005 (Ofgem 2004b).

In the meantime, the Government should encourage Ofgem and the suppliers to publicise the new service as widely as possible. Depending on the outcome of the trial, the Government should consider requiring energy suppliers to develop a range of energy services as part of their business, and consider penalties if they do not comply. The four per cent limit on the number of customers seems arbitrary and should be increased or removed altogether to encourage the greatest possible adoption of energy services. In addition, the Government needs to set targets for the installation of intelligent metering technologies as part of ongoing meter replacement programmes.

Energy efficiency in business

The CCP projected that carbon dioxide emissions from business would be reduced by at least 5MtCe by 2010. The Energy Efficiency Action Plan raised this to 7.9MtCe.

The main mechanisms in the UK approach to reducing emissions from industry are complex and interacting (and also interact with obligations under the Integrated Pollution Prevention and Control legislation). The first element – the Climate Change Levy – is designed to increase efficiency and/or increase the use of low carbon energy through the imposition of a levy on fuel use. The second element – Climate Change Agreements – allows individual industrial sectors to avoid 80 per cent of the levy payments if they agree targets for reducing emissions from their installations. The third element – the Emissions Trading Scheme – allows companies with Climate Change Agreements and other energy users to trade emissions allowances in order to meet their reduction targets. A final element – the EU Emissions Trading Scheme – has not yet begun operating but has been built into the Action Plan.

The success of market mechanisms, in particular trading schemes, as a means of reducing emissions from industry will depend on the value that is established for carbon and other greenhouse gases. The higher the cost of carbon emissions, the greater the economic incentive for the polluter to reduce them.

A Treasury review of literature on the social costs of carbon emissions suggests that a pragmatic figure of £70 per tonne of carbon is appropriate as an estimate of the marginal costs of damage from carbon emissions (Clarkson and Deyes 2002). The markets designed by the Government as drivers for reducing carbon emissions should reflect this estimated cost of emissions.

This section looks at these schemes, together with the activities of the Carbon Trust to stimulate more energy efficiency in business.

The Climate Change Levy

The Climate Change Levy (CCL) was introduced on 1 April 2001 and forms a key part of the Government's overall Climate Change Programme. It is a tax on the use of energy in industry, commerce and the public sector – the costs of the tax are offset through cuts in employers' National Insurance contributions.

The rates for the CCL were set in 2001 and have not increased with inflation, so reducing the level of incentive to shift to low carbon or efficient options over time. The rate for electricity is 0.43p/KWh which is broadly equivalent to a carbon tax of £37 per tonne of carbon. Ofgem administers the accreditation and certification of exempt types of energy, and issues levy exemption certificates (LECs) to quantify the sales of exempt power. One LEC is equivalent to one megawatt of power. The CCL raises about £800 million a year, matched by a 0.3 per cent cut in the rate of employers' National Insurance contributions and funding for business energy efficiency programmes, for example, through the Carbon Trust.

The CCP estimated that the levy package would lead to reductions in carbon dioxide emissions of 2MtCe a year by 2010. There are no firm estimates of expected reductions given in either the Energy White Paper or the Energy Efficiency Action Plan, so the impact of the programme is difficult to evaluate. The Government should publish a revised evaluation of the performance of the measure and the use of the receipts. In addition, the failure to increase the rates since the levy's introduction has reduced its power as a driver of efficiency and the adoption of renewables. The rates should be increased – along the lines of the Landfill Tax – to ensure that it continues to encourage takeup of low carbon measures.

The Treasury figure of £70 per tonne of carbon emitted gives strong grounds for doubling the level of the CCL (from around £37 to £70 per tonne). This would both ensure that Government assessments of the costs of carbon are consistent, and increase the power of the CCL as a driver to reduce emissions. We suggest doubling over a period of about five years to

give a clear long-term signal to industry. Increases in CCL should be matched by a combination of reduced rates of employers' National Insurance Contributions and increased funding for energy efficiency programmes, as when CCL was introduced.

Climate Change Agreements

Climate Change Agreements (CCAs) were introduced with the CCL in 2001. More energy intensive sectors are eligible for an 80 per cent discount from the CCL provided that they agree targets for improving their energy efficiency or reducing carbon emissions. This reflects the Government's belief that energy intensive industries need special consideration given their energy usage, the requirements of the Integrated Pollution Prevention and Control regime and their exposure to international competition. In practice, the effect of this approach has been to insulate the most energy intensive industries from the price signals given by the levy.

There are currently 44 sectors with CCAs, constituting over 12,000 facilities owned by 5,000 companies, including ten major energy intensive sectors (aluminium, cement, ceramics, chemicals, food and drink, foundries, glass, non-ferrous metals, paper and steel). DEFRA agreed the CCAs with the relevant trade associations on behalf of the companies within the sectors concerned. Each agreement is essentially unique, and may differ from others in, for example, the baseline adopted (ranging from 1990 to 1999) and whether the targets are absolute or relative to output (ENDS 339, Future Energy Solutions 2003). The 2004 Budget announced the Government's intention to extend eligibility for the CCA scheme to other businesses that meet an energy intensity threshold.

Under the CCP, CCAs were expected to save 2.5MtCe by 2010. The Energy Efficiency Action Plan revised this to 2.4MtCe, but raises the possibility of a further 0.9MtCe from existing agreements, plus another 0.5MtCe reduction through extending CCAs to other sectors (DEFRA 2004). In total, then, CCAs are ultimately expected to deliver savings of 3.8MtCe by 2010.

CCAs were agreed for ten years with performance assessed every two years. The first performance period ended in 2002 and results published in April 2003 showed that 24 out of the 44 sectors had met their targets, with a resulting reduction in emissions of 3.7MtCe (13.5MtCO_2) against an estimated 2000 baseline (DEFRA 2003).

On the face of it, this appears to be an impressive result over two years, and certainly DEFRA was keen to stress that the savings achieved exceeded the original target of 2.5MtCe by 2010 (around 9.2MtCO_2). However, DEFRA also acknowledges that the major savings came from the steel industry, where emissions of carbon dioxide fell by 9.5MtCO_2 (2.6MtCe) – more than the target for all the sectors put together. Furthermore, 93 per cent of the reduction in emissions from the steel sector were delivered by CORUS, in part because of increased efficiency, but overwhelmingly because of plant closures and

reduced output (ENDS 339, DEFRA 2003). (The 2002 targets for the steel sector were adjusted as a result and CORUS will have to gain the approval of the Secretary of State before it can sell any of its surplus allowances.)

Even without the 'overachievement' of the steel sector, other sectors exceeded their targets by nearly one million tonnes of carbon dioxide (around 0.27MtCe), and many have already achieved the targets set for 2010 (DEFRA 2004). The level of savings raises questions about the extent to which industry brought forward efficiency measures which were already planned in the longer term – and whether the potential for cost-effective savings was underestimated, resulting in soft targets and few savings beyond business-as-usual (ENDS 339). DEFRA is currently reviewing the original target levels in the light of the results, suggesting that the targets were indeed too undemanding.

As with the CCL, there is a lack of transparency about the operation of the CCAs. This is particularly apparent in the agreements on the baselines used and what might constitute business-as-usual savings. Without improved transparency, there can be very little confidence in the savings claimed. Extending the eligibility of the CCAs to new sectors is questionable without a clear evaluation of the success of the measure so far. The revision of the baselines is welcome, and DEFRA must ensure that they are sufficiently realistic to result in genuine savings. To re-establish confidence in the measure, DEFRA should consider having the final agreements, and subsequent results, independently audited.

The UK Emissions Trading Scheme

Emissions trading has become a key part of the overall strategy to address greenhouse gas emissions on a basis of economic efficiency. The Government has promoted it as 'a central plank of our future emissions reduction policies' (DTI 2003). The UK scheme was launched in April 2002 and operates in conjunction with the CCAs. Emissions trading will be the key tool for establishing the value of carbon, which in theory means that it should be a driver for low carbon technologies if the price of carbon in the market reflects the environmental costs associated with it. The UK scheme will run until 2006, and is expected to deliver a reduction of 0.5MtCe.

In theory, the trading schemes go some way to addressing the market failure of not attaching a value to the environmental damage caused by greenhouse gas emissions. Operators of installations have the choice of: reducing the installation's emissions below the level required and selling allowances; keeping emissions at the level required; or allowing emissions to exceed the required level and buying allowances to bridge the gap. Strategies will vary from operator to operator depending on the marginal abatement cost and the trading price for allowances at any particular time. If the cost of carbon is high enough in the trading schemes this will create a driver for low carbon technologies. If it is low – as now – there will be

little incentive for operators to invest in low carbon or energy efficiency options beyond business-as-usual.

The trading scheme itself is voluntary and has attracted 34 'direct' participants, encouraged by a £215 million financial incentive from the Treasury, in addition to 'indirect' participation from CCA companies. Indirect participants had to demonstrate that the credits traded were in addition to the savings they would make under the CCAs. Incentive payments are made to direct participants in return for reductions against their emission levels of a range of greenhouse gases in 1998–2000.

The voluntary nature of the scheme clearly reduces its effectiveness. Companies that expected emissions to fall through plant closures – such as British Sugar – joined the scheme, while others with expected increases in emissions, such as refineries, did not participate. British Airways joined the scheme, but the company's participation should be viewed in the context of declining UK flights in the face of competition from low-cost airlines. Easyjet and Ryan Air – who are leading the increase in domestic no-frills flights – did not join (ENDS 326).

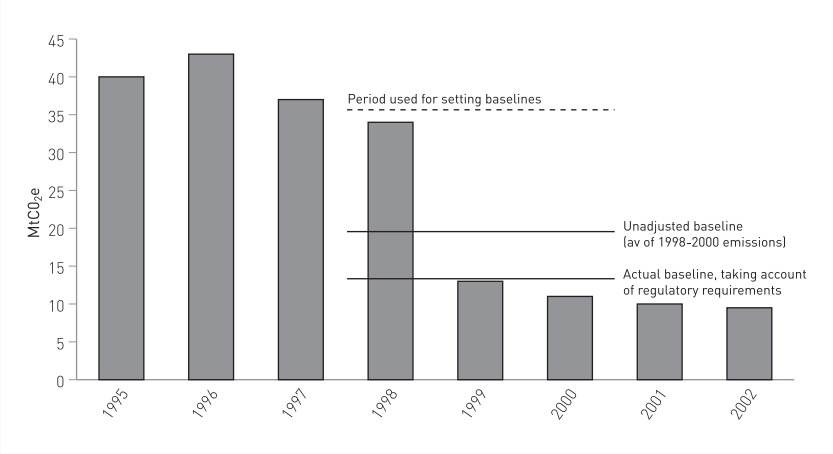
As with the CCA scheme, there is also a significant doubt as to whether truly additional reductions have been made. Given the soft targets in the CCAs, companies with CCAs who chose to participate in the Emissions Trading Scheme (ETS) may have traded 'hot air' as a result of savings which were in fact business-as-usual – only leading to additional emissions from those who bought their allowances.

In addition, the baselines used for the UK ETS were undemanding, particularly for the largest four participants (Ineos Fluor, Invista, Rhodia and BP), whose level of emissions were actually below their targets at the beginning of the scheme as a result of steep declines in emissions between 1998 and 1999 (Figure 2.2). Not only would this allow them to trade hot air, it could also mean that they could receive incentive payments for reducing emissions without actually having to do anything. A report on the first year of the scheme by the National Audit Office pointed out that the reported reductions for all participants in the first year (4.64MtCO_2e) exceeded the target set for total reductions in 2006 (3.96MtCO_2e) (National Audit Office 2004).

The results from the second year also significantly exceeded the targets, with the 11 main direct participants achieving reductions of over 3.5MtCO_2 (around 0.95MtCe) over their 2003 target (Table 2.4).

The idea behind emissions trading is that the market decides. However, the state of the market is decided by the limits that government decides to impose on it. If the required reductions are not demanding enough, the value of carbon falls as hot air is traded at low cost. Conversely, if the reductions are too onerous, the value of carbon will rocket – although there is no evidence from the UK scheme that the targets set by DEFRA required anything more than business-as-usual reductions in emissions.

Figure 2.2 **Ineos Fluor, Invista, Rhodia and BP emissions 1995–2002**



Source: National Audit Office 2004, Figure 4

Table 2.4 **Emissions from UK ETS main participants 2003 ($MtCO_2e$)**

	Baseline emissions	2003 target emissions	2003 actual emissions	2003 surplus
BP	**4.67**	**4.57**	**4.22**	**0.35**
British Airways	**1.01**	**0.96**	**0.84**	**0.12**
British Sugar	**0.58**	**0.54**	**0.51**	**0.02**
First Hydro	**1.37**	**1.26**	**1.16**	**0.10**
Ineos Fluor	**1.86**	**1.54**	**0.60**	**0.09**
Invista	**2.57**	**2.37**	**1.10**	**1.26**
Lafarge	**3.22**	**3.12**	**2.94**	**0.18**
Rhodia	**2.10**	**1.93**	**1.43**	**0.50**
Shell UK	**3.62**	**3.45**	**3.48**	**-0.02**
UK cCoal mining	**4.20**	**4.06**	**3.96**	**0.10**
Total		**23.80**	**20.24**	**3.56**

Sources: ENDS 353, DEFRA 2004f

Note: Figures have been rounded.

The key requirement of the trading scheme should be that the target reduction is realistic, and capable of delivering real reductions over and above any business-as-usual improvements in efficiency or renewables implementation. The UK ETS can be viewed as a learning exercise, allowing

companies and brokers to acquire experience before the introduction of international trading schemes (National Audit Office 2004). It is vital that the UK's participation in the EU trading scheme seeks to address some of the fundamental flaws identified and makes a positive contribution to moving towards a low carbon economy.

European Union Emissions Trading Scheme

The EU's Emissions Trading Scheme (EU ETS) is due to begin on 1 January 2005. The first phase will run until 2007, and the second phase from 2008 to 2012 (the Kyoto Protocol compliance period). After that, it will run for periods of five years. The first phase will only cover emissions of carbon dioxide, although other greenhouse gases may be included subsequently.

Member States set their own caps for installations covered by the scheme in National Allocation Plans (NAPs), which are subject to approval by the European Commission. Individual companies can trade the permits across all Member States. Unlike the UK scheme, the first phase will be mandatory for a number of sectors: electricity generators, oil refineries, iron and steel production, cement clinker and lime production, glass manufacturing, brick and tile manufacturing and pulp and paper as well as all combustion installations above 20MW. The penalty for non-compliance in the first phase is €40/tCO_2, rising in the second period to €100/tCO_2. The second phase may be widened to include other sectors, including the chemical sector and aluminium production.

NAPs have to be consistent with Member States' commitments under Kyoto. The UK's revised plan for the first phase may be consistent with an overall reduction of only 15.2 per cent in carbon dioxide emissions by 2010 – beyond the Kyoto commitment, but well under the Government's 20 per cent target for carbon dioxide emissions by 2010. The previous plan required a three per cent reduction in emissions from 2002 levels in 2005-7. Under the revised plans, the baseline and business-as-usual projections have both been revised, so that the real emission reduction is unclear but is likely to be less.

Allocating allowances on the basis of projected emissions has put the projections centre stage. As already discussed, the UK is updating Energy Paper 68 and has produced Updated Energy Projections (UEP) which form the basis of the allocation of allowances in the NAP. Emissions for most non-electricity sectors are projected to rise from a 1998–2002 baseline, despite the Government's commitment to improving the efficiency of the industrial sector. In addition, the projected emissions for some sectors shifted significantly between the first draft NAP (January 2004) and the second, supposed final version, produced in April 2004 (DEFRA 2004c, DEFRA 2004b). Projected emissions will have changed again in the new plan.

It is clearly in industries' best economic interest to seek to secure as many allowances as possible, permitting them to trade if they wish or to

bank against future unforeseen increases in emissions. Certainly the production of the UEP has led some industries, in particular oil refineries, the iron and steel sector and the electricity sector, to engage in the process. The May 2004 UEP states that 'with the advent of the NAP, many industries have shown interest in presenting data for analysis that was not previously available' (DTI 2004b).

The Association of Electricity Producers and the CBI have engaged in some vigorous lobbying to increase the projected level of emissions in the UEP and so the level of available allocations. This appears to have paid off, with the Government announcing in late October 2004 that emissions factors for coal and gas fuels had been amended, and that the UEP projections for 2005–07 had therefore risen. As a result, the Government increased the annual allocations for emissions by around three per cent to about 252.7 $MtCO_2$ a year (DTI 2004i).

As with the CCAs and the UK ETS, the ultimate success of the EU ETS will depend on the level of allowances given to industry and whether the resulting price of carbon in trading is high enough to drive efficiency measures and the implementation of low carbon technologies. Although there is limited data available, prices in the emerging allowances market can provide an indication of the extent to which the EU ETS will act as a driver in this way. Early forward trading was at about €12–13 per tonne of carbon dioxide (€3.2–3.5 per tonne of carbon). However, once the NAPs were published by national governments, this slumped to between €7 and €9 a tonne (€1.9–2.4 per tonne of carbon), dramatically below the Treasury estimate of £70 per tonne cost of carbon (Carbon Trust 2004a). Not only does this indicate the degree to which industry sees the NAPs as undemanding, it also reduces the incentives to invest in efficiency or abatement.

However, a major challenge in the UK's reliance on emissions trading to provide many of its reductions is the international nature of the EU scheme. While the UK may see itself as setting a challenging target (if it continues to push for 20 per cent in the second period), other countries could be much less demanding, resulting in low carbon prices across Europe and little incentive to invest in low carbon technologies. Alternatively, if other countries set demanding targets, the UK (or any other country) could find that companies trade it out of compliance, with little or no opportunity to prevent it. By shifting much of the responsibility for meeting the emissions targets on to the market, the UK will find itself in a position where it has no say in how companies decide to treat the targets.

Although the Government states that allocations in the second period will be consistent with contributing to the 20 per cent reduction target, the failure to set a more demanding target for the first phase will make achieving this more difficult. The forthcoming review of the CCP presents an opportunity to make a firm commitment that achieving the

target will be the foundation of the second phase allocations. This certainty will allow businesses the time to plan their activities in the knowledge that emissions trading will require more than business-as-usual reductions.

Carbon Trust programmes

The Carbon Trust was launched in April 2001 with the aim of improving the uptake of energy efficiency measures in the non-domestic sector. Its activities fall into two categories: Action Energy, intended to encourage the deployment of existing energy efficiency and low carbon technologies in the business and public sectors, and the Low Carbon Innovation Programme, aimed at facilitating the development of new low carbon technologies. It is also responsible for promoting the Government's Enhanced Capital Allowances (ECAs) scheme for energy efficiency.

The CCP estimated that activities of the Carbon Trust would lead to a 0.5MtCe reduction in carbon dioxide emissions by 2010; the Energy Efficiency Action Plan doubled this to 1MtCe, and the 2004 spending review allocated the Trust an additional £40 million (DETR 2000, DEFRA 2004).

The Action Energy programme (formerly the Energy Efficiency Best Practice Programme) focuses on the short-term deployment of existing energy efficiency, CHP or renewable technologies in business and the public sector. Its activities are supported by two financial incentive schemes: energy efficiency ECAs, offering 100 per cent first year tax allowances for the purchase of approved efficient equipment, and Action Energy loans, which provide SMEs with interest free loans for eligible energy efficiency projects. In its first year, the Carbon Trust estimated that the Action Energy programme had led to a saving of 0.6–2.9Mt$C0_2$ (0.16–0.78MtCe).

The Low Carbon Innovation Programme (LCIP) has a much longer-term focus. It is designed to provide funding and investment to accelerate the development of new and emerging low carbon technologies – from funding for research and development to investment in early implementation projects. The first phase of the programme (2002–5) has a budget of £75 million. Because of its long-term nature, it is difficult to predict what the impact of the programme will be, although the Carbon Trust has estimated that the projects funded in 2002–3 would save 0.3–0.9MtCO_2 (0.08–0.24MtCe) in 2010 and that this total would increase over time (Table 2.5).

The range of uncertainty in the projections of emissions reduction reflects the difficulties in assessing Action Energy's influence on actual funding, the difficulty of tracking the uptake of ECAs, and the difficulty in making long-term predictions about technology development in the LCIP. It is in turn difficult to assess the possible performance of the Carbon Trust's programmes and the likelihood that it will be able to meet its revised emissions reduction target of 1MtCe. However, it is possible to say that the

longer-term strategic opportunity offered by the LCIP for technology development is exactly the sort of approach that should encourage low carbon innovation in the energy system.

Table 2.5 **Carbon Trust activities 2002-03**

	Focus	Actual/potential CO_2 emissions saved ($MtCO_2$)	Cost effectiveness (£/t CO_2)
Action Energy	**Short term**	**0.6–2.9**[1]	**8–39**
Low Carbon Innovation Programme	**Medium to long term**		
To 2010		**0.3–0.9**[2]	**15–47**
To 2020		**0.7–1.9**	**7–19**
To 2050		**1.8–5.2**	**3–7**

Source: Carbon Trust 2003

Notes: 1 Range reflects how savings are attributed to Energy Action's influence.
2 Range reflects different assumptions regarding LCIP's materiality.

Energy efficient buildings

Building regulations

Buildings account for about half of the UK's carbon dioxide emissions; of this, about 30 per cent come from the domestic sector, and about 20 per cent from other buildings (ODPM 2004a). The emissions result from space heating, providing hot water, ventilation, air conditioning, lighting and so on. Some aspects of the energy performance of houses are addressed in the EEC programme, which targets domestic energy consumers, while commercial buildings can participate in the Carbon Trust's Action Energy programme. However, improvements in building regulations can address energy consumption in the design of new buildings or alterations to existing ones. Buildings and their services clearly offer a huge potential for emissions reduction, both through increased efficiency and through the use of renewable energy technologies integrated into the fabric of the buildings.

The CCP estimated that new building regulations in the domestic and business sectors would save emissions by 1.3MtCe (DETR 2000). New building regulations for England and Wales came into effect in April 2002 and are estimated to have reduced the energy needed for heating new homes by about 50 per cent in comparison with the 1990 standards (DTI 2003). The 2002 building regulations are currently being revised and are the new regulations are due to be introduced in 2005.

The Energy Efficiency Action Plan revised the expected savings from the 2002 regulations down slightly, but estimated that the 2005 measures could

result in further savings of 1MtCe, split between the domestic and business/public sectors (0.8 and 0.2MtCe respectively) (DTI 2003, DEFRA 2004).

The consultation on the implementation of the 2005 building regulations estimates that they will improve the efficiency of new buildings by a further 25 per cent (ODPM 2004). The proposed changes include compulsory pressure testing to ensure that new buildings meet design specifications, and improvements in window placement and ventilation to reduce solar overheating as well as improved boiler standards. The new regulations would apply to new-build domestic and non-domestic buildings, and to major alterations to existing buildings. These proposals would lead to a considerable improvement in the performance of new buildings, although it must be remembered that building performance is only one aspect of the picture, and action to reduce energy consumption by end users is also needed.

The performance of UK buildings compares notoriously badly with that of other countries in Northern Europe. For example, a detached house built to the 2002 standards in England and Wales consumes 20 per cent more energy than an equivalent home in Denmark, while existing stock consumes around 30 per cent more (Energy Savings Trust 2002). Even assuming the improvements in the draft 2005 regulations are actually implemented, standards in England and Wales will barely meet those which have existed in Denmark since the mid-1990s.

The draft 2005 regulations set out an aspirational target for 2010 standards, which would bring the UK into line with the standards currently in place in Denmark and, in the case of windows, improve on them (Table 2.6).

Table 2.6 **Requirements for new build houses in England and Wales and Denmark**

	U-values W/m2K[1]			
	Wall	Roof	Floor	Window
Part L 2005 indicative standard	0.27	0.13	0.22	1.8
Part L 2005 worst acceptable element average[2]	0.35	0.25	0.25	3.3
Aspirational 2010 indicative	0.2	0.1	0.2	1.4
Denmark 1995/98 (to be revised 2005)	0.2-0.3	0.15-0.20	0.2	1.8

Source: ODPM 2004a, Section 6, Tables 2 and 3

Notes: 1 U-value is a measure of how well heat flows through an object. The lower the U-value, the better the insulation of the material.

2 The draft 2005 regulations set standards for the whole building rather than individual elements in order to allow flexibility for designers and builders. However, within the whole building standard, individual aspects of the design should perform no worse than the minimum standards set out here.

However, the Danish standards will be revised in 2005, and are likely to leave the UK behind again.

While improved efficiency measures would be compulsory in the 2005 regulations, the consultation does not envisage making the integration of renewable technologies, or even micro-CHP plants, into buildings mandatory. Instead it states that they should be used 'where technically, environmentally and economically feasible' (ODPM 2004a). This means that as they stand the regulations are unlikely to act as a significant driver for the deployment of low carbon generation. Given the availability of grants under, for example, the Community Energy scheme, and grants for small-scale renewable technologies, the onus should be on developers to demonstrate that incorporating low carbon generation is not feasible in a particular project.

The potential for reducing emissions from buildings is huge and there are several examples of net zero emission housing projects (for example, the Hockerton Housing Project in Nottinghamshire) where high efficiency levels are complemented by the use of renewable technologies. While these projects are exceptional at the moment, the design of building regulations can in the short term move the general market towards these examples of best practice. In the longer term, the Government should commit itself to achieving a target of net zero emission construction of new buildings by 2015. Announcing a target now would allow the construction industry to develop or adopt the skills and technologies necessary to achieve it.

Improved building regulations can improve both the energy performance of buildings, and the level of comfort they afford. The efficiency improvements proposed for the 2005 regulations can therefore serve a dual purpose. However, the Building Research Establishment (BRE) has highlighted major problems with developers' awareness of the requirements, and with the enforcement of the regulations to verify that the buildings are actually constructed to the required standards (BRE 2004). The EEAP acknowledges this, rating the likelihood of building regulations not delivering the expected savings as 'high' because of poor enforcement (DEFRA 2004). Despite this, there is no firm commitment on specific action to improve enforcement, meaning that the use of the building regulations as a significant driver of improved standards is extremely limited.

The poor enforcement of the regulations also means that there must be a high degree of uncertainty about the savings which will be made from improved building standards (BRE 2004). This can be improved by ensuring, for example, that local authority building control departments have the training and resources to ensure that the regulations are met.

Finally, the 2005 regulations are at the consultation stage, and therefore open to lobbying and negotiation from the construction industry. The BRE has expressed concern that the proposed changes could be watered down

by various stakeholders (BRE 2004). The current regulations do not compare favourably with existing standards in other Northern European countries, but they are a step in the right direction. The Government should therefore resist any pressure to reduce the standards proposed.

Public sector buildings

Public sector buildings are responsible around five per cent of total UK carbon emissions, mostly from space heating and lighting. The Climate Change Programme forecast carbon dioxide emission reductions of 0.5MtCe by 2010, and the Energy Efficiency Action Plan did not increase this target.

The public sector is also responsible for around 30 per cent of expenditure on new buildings, and can therefore exercise considerable influence in driving more efficient standards in construction (DEFRA 2004). The Energy Efficiency Action Plan announced that in future the central government estate would only buy buildings in the top quartile of energy performance. This announcement followed an earlier decision to set targets for government departments to reduce carbon dioxide emission by 12.5 per cent by 2010–11 relative to their 1999–2000 levels, and to increase their energy efficiency by 15 per cent by 2010–11.

The CCP focused on energy efficiency measures as the route for reducing emissions. Later targets have also aimed to drive renewables and CHP deployment (Table 2.7). Targets for both in the public sector exceed those in the CCP and elsewhere. Given that government action sends a clear message of intent, as well as driving the market, this is welcome. However, performance will need to be closely monitored, as past experience has shown that some departments perform much better than others (House of Commons Environmental Audit Committee 2003).

Table 2.7 **Public sector targets**

	Baseline	Target date
12.5% reduction in carbon intensity[1]	1999-2000	2010-11
15% increase in energy efficiency	1999-2000	2010-11
Buying 10% renewable power		31 March 2008
Source 15% good quality CHP		2010
Develop strategy for sourcing renewables up to 2020		March 2006
Contractual clauses with suppliers to encourage emission reductions and the supply of energy data		August 2004

Source: Sustainable Development Unit 2004

Note: This is in addition to the 19% reduction achieved in the 1990s. If successful it would mean that the government estate should achieve a 29.5% reduction in carbon intensity relative to a 1990 baseline.

Key conclusions and recommendations

- Overall, energy efficiency measures are responsible for delivering around half of the projected carbon dioxide savings up to 2010. The Government recognises that improved energy efficiency is the most cost-effective way of achieving reductions in carbon dioxide emissions and has frequently stated that a 'step change' in energy efficiency is necessary.
- The Energy Efficiency Action Plan does not constitute a 'step change' in improving energy efficiency. The target for carbon dioxide reductions in the domestic sector has been reduced, while those for industry are open to negotiation and are plagued by a lack of transparency.

Domestic energy efficiency

- Domestic energy efficiency measures so far seem to be both successful and reasonably cost-effective, with both Warm Front and the Energy Efficiency Commitment on course for achieving their targets. However, limited monitoring and uncertainty about the extent of 'comfort taking' means that the level of actual savings is uncertain.
- Monitoring of the programmes should be improved. Both the EEC and Warm Front have a value in their own right in terms of the Government's fuel poverty agenda. The Government should consider expanding the schemes. This should include both higher targets and a broader scope – for example to provide measures for insulating properties without cavity walls.
- The potential for energy service companies to contribute to domestic energy savings has not been exploited so far. The trial adjustment to the rules governing changes in supplier are therefore a welcome step forward. The possibility for householders to sign up for ESCOs needs to be widely publicised. Depending on the outcome of the trial ESCO scheme, the Government should consider requiring energy suppliers to provide energy services and to penalise them if they do not perform.

Energy efficiency in business

- Business and industry are subject to a range of measures intended to drive increased efficiency and/or encourage the uptake of low carbon generation. However, it is difficult to estimate the final effect of the programmes on reducing emissions of carbon dioxide.
- The Climate Change Programme estimated that the Climate Change Levy would lead to reductions in carbon dioxide emissions of 2MtCe a year by 2010. However, there is little information available on its actual

performance. The scheme seems to have faded from the climate change agenda. The Government should publish a revised evaluation of the performance of the measure and the use of the receipts from the levy.

- In addition, the failure to increase the rates of the levy since its introduction has reduced its power as a driver of efficiency and the adoption of renewables. The rates should be increased annually to ensure that it continues to encourage take-up of low carbon measures. The aim should be to double its level, so ensuring that it reflects the Treasury's estimate of the social cost of carbon emissions, offset by cuts in employers' National Insurance contributions and extra funding for energy efficiency programmes.
- The CCL has to an extent been overtaken by the Climate Change Agreements between the Government and industry. The first period of CCA operation over-achieved on the targets, raising serious questions about the validity of the baselines set. DEFRA is now revising these, and to re-establish confidence in the measure should consider having both the baselines and subsequent performance independently assessed.
- The National Allocation Plan for the first phase of the EU ETS is consistent with the UK reducing carbon dioxide emissions by 15.2 per cent. This is enough to meet its commitment under the Kyoto Protocol, but will not meet the Government's domestic target.
- Although the Government states that allocations in the second period will be consistent with 'contributing' to the 20 per cent reduction target, the failure to set a more demanding target for the first phase will make achieving this more difficult. The Government needs to make a firm commitment that achieving the 20 per cent reduction target by 2010 will be the foundation of the second phase allocations. This certainty will allow business the time to plan their activities in the knowledge that emissions trading will require more than business-as-usual reductions.

Energy efficient buildings

- There is a huge potential for reducing energy use and loss in buildings. Energy loss can be addressed by improving building standards. However, possible poor enforcement means that there must be a high degree of uncertainty about the savings that will be made from improved building standards. This can be improved by ensuring that local authority building control departments have the training and resources to ensure that the regulations are met.
- The current proposals for the 2005 building regulations do not require integrated low carbon generation, even in large projects. Given the

availability of grants under, for example, the Community Energy programme, and grants for small-scale renewable technologies, the onus should be on developers to demonstrate that incorporating low carbon generation is not feasible in a particular project.

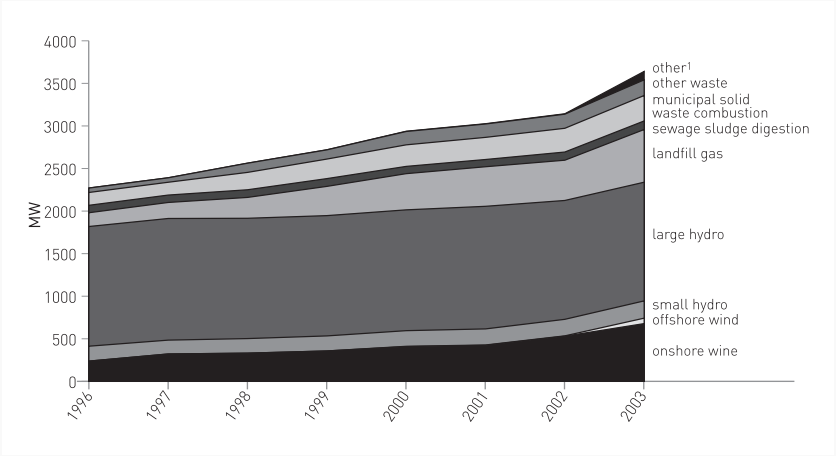
3. Low carbon generation

The Government's main focus in its strategy to reduce carbon intensity is the promotion of renewable fuels, either for electricity generation or transport, and, to a lesser extent, the promotion of combined heat and power (CHP) generation, using either fossil or renewable fuels. This chapter considers the structure and performance of the main policy instruments in the Climate Change Programme (CCP).

Increasing renewables generation

The CCP projected savings of 2.5MtCe of carbon dioxide emissions through the delivery of a ten per cent target for renewable electricity sales by 2010. In the 1990s, the main instrument to encourage renewables generation in England and Wales was the Non-Fossil Fuel Obligation (NFFO), with similar schemes operating in Scotland and Northern Ireland. Although the scheme resulted in some use of renewables, the structure of the various orders, their unpredictability, and external problems such as planning issues meant that take-up was limited and fell far short of the predicted 1,500MW of installed capacity by 2000. At the end of 2000, NFFO-contracted renewable capacity still only totalled 907MW (Figure 3.1) (DTI 2001a). The last NFFO order took

Figure 3.1 **Renewable installed capacity 1996-2003**



Note: 1 Includes photovoltaics, wave and, for 2003, co-firing of biomass fuels. Capacity in 2003 was 6MW for pv, 0.5 for wave and 92.4 for co-firing.

Source: DTI 2003b, DTI 2004g, Table 7.4

place in 1998 and the Government's replacement support mechanism for renewables, the Renewables Obligation (RO) and the Scottish Renewables Obligation, was introduced in April 2002.

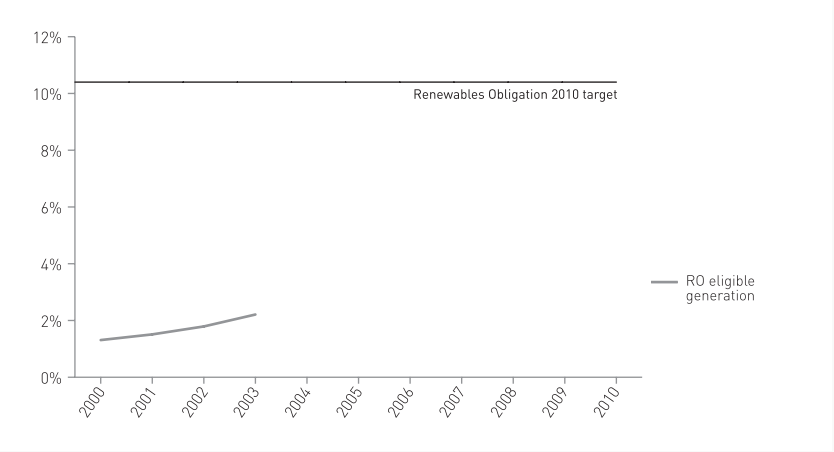
The RO is an obligation on electricity suppliers to buy a specific proportion of their electricity from eligible renewable resources. Suppliers provide Ofgem with evidence of how much renewable electricity they have bought by presenting the requisite amount of Renewable Obligation Certificates (ROCs), each representing 1MWh of output. If suppliers do not wish to buy the renewable output directly, they also have the choice of buying ROCs from elsewhere. In addition, if they do not want to meet the Obligation, they can 'buy out' from it by paying a penalty (currently £31.39 per MWh, adjusted annually in line with the RPI) to Ofgem. The fund of penalty payments from suppliers are then redistributed to suppliers in proportion to the amount of the Obligation they have met. For example, if they have bought five per cent of the total RO for the year they will receive five per cent of the recycled buyout revenues. In 2002–3, suppliers in England and Wales received £72.2 million in redistributed funds, while suppliers in Scotland received £11.3 million (Ofgem 2004). Recycling buyout penalties in this way adds value to ROCs although this added value will decrease incrementally as renewables generation approaches the target level.

The proportion of renewables electricity to be bought by suppliers increases over time from three per cent in 2002–3, to 10.4 per cent in 2010–11. Not all 'renewable' technologies are eligible for the RO – hydro plants over 20MW, non-biodegradable wastes and overseas generation are all excluded. The updated energy projections estimate that total electricity generation will be 353TWh (billion kilowatt hours) in 2010 (DTI 2004b), implying that 10.4 per cent of electricity sales will be around 36TWh in 2010. Figure 3.2 shows the scale of the challenge in securing enough eligible renewables generation to meet the 2010 target. Given the ineligibility of some technologies for the RO, the 10.4 per cent target is more demanding than the CCP's ten per cent target from all renewable sources by 2010.

It was originally intended that the Obligation would remain at 10.4 per cent of electricity sales after 2010 until at least 2027. The effective deadline on expansion of capacity beyond 10.4 per cent of supply meant that there was a finite market for ROCs – once the target is met, ROCs lose the additional buyout value. The DTI's Renewables Advisory Board found that investors would increasingly then view renewable projects as unattractive as the period of adequate subsidised returns would be too short beyond the end of 2004 (DTI 2003c). This in turn would limit or halt the development of new renewables projects.

Despite the fact that the Government was adamant in November 2003 that the operation of the RO would not be reviewed until 2005 or 2006, the implications of this finding brought a rapid about face, with the DTI announcing in December that it intended to extend the RO to 15.4 per cent

Figure 3.2 **RO eligible renewables generation and 2010 target** (%)

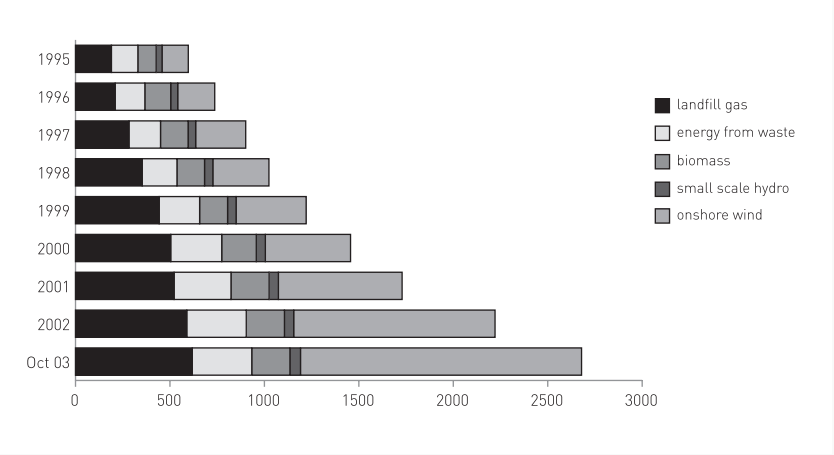


Source: DTI 2004e, Table 2

of electricity sales by 2015 (DTI 2003a). The extension of the RO will require secondary legislation, and is subject to consultation with various industry stakeholders (Ofgem 2004a).

The introduction of the RO, coupled with the announcement of the first phase of offshore wind development, led to a huge increase in applications for renewables projects. Wind power has benefited the most, with an exponential growth in applications for onshore wind, while those for other technologies have increased much less dramatically (Figure 3.3).

Figure 3.3 **Cumulative MW granted planning consent**



Source: Data from the Renewable Power Association

The Government has conducted two rounds of bidding for offshore wind sites. The first has so far led to 1.2GW being granted consent, with the possibility of a further 0.5GW. The second round of bidding, announced in late 2003, could result in a further 5.4–7.2GW of offshore wind capacity by 2010. It is worth bearing in mind that not all will ultimately be built (Renewable Energy Planning Panel 2003), but the British Wind Energy Association states that over 2GW of wind capacity has been granted planning permission or consent for construction in the future, and that 474MW of new capacity is expected on line in 2004 (www.bwea.com).

The Government has also introduced other measures to ease renewables deployment – notably changes to the planning regime, capital grants and the establishment of regional targets.

The planning changes are particularly significant, as planning issues have in the past proved to be a major barrier to increased renewables development, particularly in the case of onshore wind. The new statement calls for local policies which 'promote and encourage' renewables development rather than restrict it, and for regional plans that define criteria against which projects will be assessed (ODPM 2004). PPS22 is the first real attempt by Government to find a balance between local concerns about the impacts of renewables projects and the broader national and international benefits of increased renewables output. It might prove particularly significant for the deployment of small-scale, building-integrated renewables projects such as photovoltaic, as local authorities can now adopt policies in favour of them as long as the projects are viable. Local authorities should be encouraged to adopt such policies, and to make the inclusion of renewable electricity and heat technologies in projects a condition of planning consent for new developments. The level required should be consistent with the 2015 RO target.

Emerging problems with the Renewables Obligation

Achieving the target will require an unprecedented expansion of capacity. The three per cent RO target for 2002–3 was missed, with only about 1.8 per cent of RO-eligible output being supplied (Ofgem 2004). This is not surprising given the relative failure of the NFFO in bringing renewables capacity online, which means that eligible generation started from a low base. More seriously however, the recent Renewables Innovation Review estimated that this underperformance would continue, and that RO-eligible renewables will supply only eight per cent of the UK's electricity by 2010, missing the RO target by 2.4 per cent (DTI and Carbon Trust 2004). The House of Lords Science and Technology Committee is even more pessimistic, predicting that renewables will supply only six to seven per cent by 2010 (House of Lords Science and Technology Committee 2004).

There is already evidence that there are problems with both the design and scope of the RO. This section highlights two in particular, which have wide-ranging implications. A failure to address problems such as these in

the upcoming review of the RO would also affect the shape of the UK's future electricity system.

The need to encourage diverse technologies

The RO was designed to meet the target as economically as possible. The blanket value of ROCs means that in order to maximise their returns, developers concentrate on the lowest risk, least cost technologies. Suppliers in turn offer contracts to developers offering the lowest cost generation. This excludes technologies that are in an earlier stage of development, and which are therefore more expensive and more risky. At the moment, onshore wind is economic under the current competitive RO regime, but neither offshore wind nor biomass are (DTI 2003c). However, the Energy White Paper predicts that offshore wind will be the biggest renewables generator by 2020.

In order to encourage the deployment of offshore wind and biomass, the Government has made capital grants available for projects in addition to the support offered by the RO. These have gone some way towards addressing the financing problems of offshore wind developers in particular, but leave other developing technologies more or less in the cold. This 'system failure' takes two forms: firstly, research and development funding does not provide sufficient funds to allow prototypes to be scaled up to demonstration plants, and the RO does not provide a sufficient level of security for developers to do so without significant risk. Secondly, there is not sufficient support from the RO to allow developers to move from a demonstration plant to the beginnings of a commercial implementation programme meaning that new technologies are prevented from moving from the demonstration to the commercial stages.

One problem then, is that the RO is not banded to provide different levels of support for technologies at different levels of development. Technologies caught in this innovation gap include wave and tidal stream technologies, where the UK has enormous resources, and the potential to make itself a global leader in generating technologies (ICCEPT 2003, DTI and Carbon Trust 2004). The Government's recent award of £50 million over three years for development and demonstration of wave and tidal technologies will go some way towards addressing the innovation gap, but given its short-term nature is unlikely to result in moves towards commercial programmes in the technologies which benefit. A commitment to a more predictable and constant programme of funding would provide more certainty for developers.

The Government excluded the banding option when designing the RO on the grounds that it would be 'picking winners'. However, this is a short-term option, given the intention to develop a low carbon economy that includes a diverse set of renewable generating technologies. By not picking winners, the Government is in effect picking losers, and this will have

implications both for the shape of the future electricity system and for the UK's potential position as a leader in renewable technology development.

In addition, the scope of the RO is limited. Currently, it only values the electricity generation sold to suppliers, meaning that any electricity generated but not sold to suppliers, such as domestic photovoltaics or wind energy, has no extra value. This reduces the incentives to install these technologies. Given the growing recognition of low carbon generation in the 2005 building regulations, the Government should make domestic generation eligible for the RO, requiring suppliers to pass on the ROC benefits of any power exported by their customers.

Creating a biomass supply chain

The Energy White Paper envisages that much of the new generation up to 2010 will be provided by wind power (both on and offshore) and biomass. The use of biomass is not expanding as rapidly as wind, despite the availability of capital grants. As can be seen in Figure 3.3 (p43) few biomass projects have been granted planning permission since the introduction of the RO.

The rapid expansion of wind power is not a problem at the moment, given the low overall penetration of any renewables technologies, but it may well have implications in the future, both in terms of the economics of the system and its diversity. Relying on an intermittent technology such as wind leads to higher system management costs because of the need to compensate for varying output. On the other hand, developing a mixture of renewable technologies, in particular biomass, can offer firmer generation and therefore lower system management costs (Ilex and Strbac 2002). In a low carbon system, then, biomass can be seen as having a greater value than just the electricity it produces.

The emergence of a successful UK biomass industry depends on two main factors: establishing an energy crop growing industry and developing generating plants. In an effort to drive increased use of biomass in generation, the Government proposed a relaxation of the co-firing rules for biomass use in existing coal plants, extending the eligibility of co-firing for the Obligation from 2011 to 2016. As well as increasing total renewable generation, this may allow time for a domestic energy crop industry (for example, willow coppicing) to emerge. So far, much of the material used in co-firing has been imported (for example, pine kernels), reducing the level of emissions benefits that could be derived from biomass use because of the emissions involved in transporting the fuels. However, as the Royal Commission on Environmental Protection (RCEP) points out, encouraging the planting of energy crops will rely on the growers having confidence in the contracts they have with generators. As with other renewable technologies, a lack of confidence in long-term conditions acts as a barrier to the development of the supply chain (RCEP 2004).

Increased co-firing can potentially raise problems for developers of other renewable sources of power: an increase in output from co-firing would lead to a fall in the value of ROCs, thereby removing an incentive for investment in new renewables plant (Ilex 2003) while maintaining centralised generating stations. In addition, the Renewables Innovation Review expressed reservations about the strategy of large-scale co-firing at centralised coal stations rather than efforts to encourage the development of smaller biomass stations sited on distribution lines as a way of stimulating a healthy energy crops industry (DTI and Carbon Trust 2004).

The eligibility of co-firing in existing fossil fuel plants therefore has to balance a number of concerns. The Renewables Obligation was intended to develop new renewables capacity, rather than just driving renewables output. Encouraging new projects to come on line will put the UK in a better position to expand the industry up to and beyond 2010, while using existing fossil capacity to boost output risks discouraging developers and limiting the potential for new projects. Having said that, developing a domestic biomass crop supply chain needs to begin in earnest now, if there is any chance of biomass being a major contributor to renewables output after 2010.

Given the importance of biomass to complement other renewable technologies, and the need to create a domestic energy crop business, the use of co-firing seems justified, as long as an energy crop supply chain can be shown to be emerging. In addition, the Government needs to encourage the development of smaller-scale, dedicated biomass plants, perhaps through encouraging greater use of biomass in CHP projects.

The review of the Renewables Obligation

The RO will be reviewed in 2005. The impending review has already caused some concern amongst investors, because of the lack of clarity on its scope. The uncertainty about the future of the RO led to concerns about future investments and so in turn to the proposed extension to the RO to 2015. The Government has also issued proposals on the terms of reference for the review in a further effort to reassure investors.

The terms of reference rule out replacing the RO with an alternative mechanism, or amending its basic operating principles. This makes sense given that reform of the RO now to include technology bands would send the wrong message to markets about the willingness to change its terms.

However, under the current RO conditions, investment will be concentrated on mature technologies (onshore wind) or those technologies which are sufficiently developed to qualify for capital grants (offshore wind and biomass). In the short term, this will lead to an expansion of renewables capacity, but the longer-term consequences for less mature technologies which offer huge potential advantages to the UK could be severe.

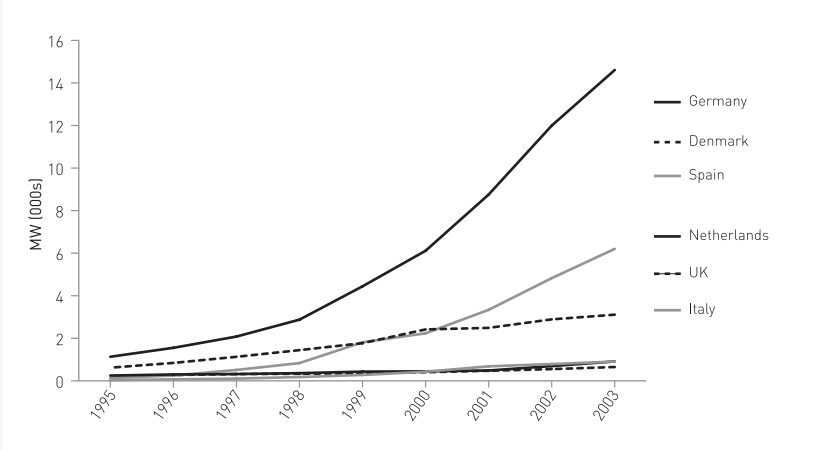
The Government therefore needs to consider measures beyond the capital grants scheme to ensure that emerging technologies can receive higher prices for their output in the short term.

The most effective and least damaging option would be to set up an enhancement of the RO to encourage innovation in renewable technologies. As an example, the British Wind Energy Association (BWEA) has recommended an enhanced set of financing mechanisms for emerging offshore technologies which would provide support for R&D efforts, and also provide additional value to ROCs from wave and tidal projects (BWEA and Climate Change Capital 2004).

Alternatively, a structure of 'feed in' tariffs could be established for emerging renewable technologies on top of the RO to provide a guaranteed market at a guaranteed price for projects. The value of feed in tariffs and the certainty they give to investors has been demonstrated by the rapid increases in wind generation in Germany and Spain, both of which offer developers tariffs. In contrast, the competitive UK system has performed relatively badly (Figure 3.4). Similarly, the Renewable Power Association suggests that the certainty ensured by long-term contracts for output from developing technology would both improve the bankability of projects and reward performance (Renewable Power Association 2004).

The strengths of these proposals are that they do not interfere with the current structure of the RO, but provide additional, performance-related funds for technologies that currently fall into the innovation gap. In addition, they provide developers with increased certainty about income, allowing technologies to bridge the innovation gap. The Government must therefore use the review of the RO to consider additional support measures and

Figure 3.4 **Onshore wind cumulative installed capacities (MW)**



Source: European Wind Energy Association 2004

give priority to those which would provide some long-term certainty for developers.

The terms of reference for the review of the RO also explicitly rule out considering proposals for supporting renewable heat, on the grounds that it will be considered separately. Setting up a renewable heat obligation would act as an additional driver for the use of biomass, which can be used in CHP plants, and the RCEP has recommended a 'green heat credit', set up along the lines of the RO, with an obligation on heat suppliers to supply a specified proportion of renewables heat by a certain date (RCEP 2004). Administratively, it would seem to make sense to consider a heat obligation at the same time as the review of the RO. In addition, as the Government is proposing allowing CHP output to count towards a supplier's obligation, excluding the heat aspect seems irrational.

Combined heat and power

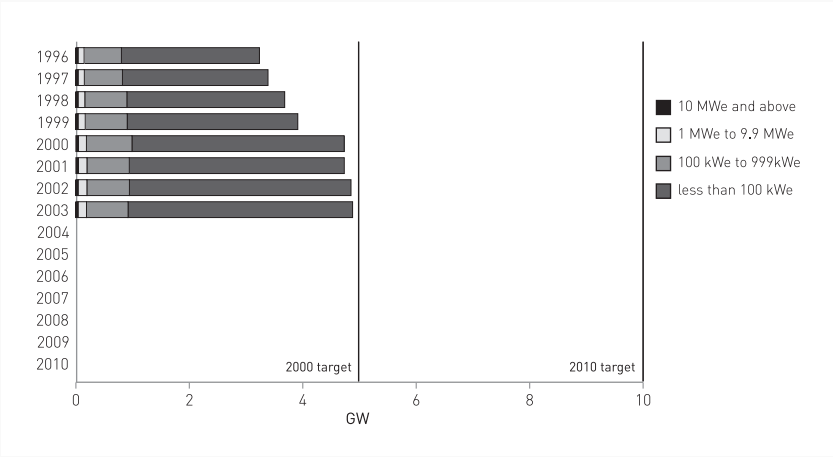
So far, two targets have been set for CHP capacity in the Climate Change Programme: 5GW by 2000 and 10GW by 2010. A draft strategy for achieving the 10GW target was finally published by DEFRA in a consultation document in May 2002, 18 months after the publication of the Programme. Despite recognising that 'CHP [is] the most cost-effective single non-transport measure in the Climate Change Programme' (DEFRA 2002), the Government took until April 2004 to publish its final CHP strategy.

The Government commissioned Cambridge Econometrics to produce projections of CHP capacity in 2010 to support its work in developing the strategy (Cambridge Econometrics 2003). Despite the estimate in the Cambridge Econometrics analysis that only 8.1GW of capacity would be installed by then – a 20 per cent shortfall on the Government target – the CHP strategy put forward no significant new measures to stimulate more installations. Instead, the strategy seems to contain a watered down commitment to the 10GW target, which is now expressed as 'we must *continue to aim* at our target of 10GWe of "good quality" CHP capacity in the UK by 2010' (DEFRA 2004a). In effect, the Government has accepted the failure to meet its target six years ahead of its delivery date.

The delay in producing a strategy has left CHP in limbo, with a firm target for capacity by 2010 but a less than enthusiastic approach to achieving it. Whether this ambiguous attitude to CHP has had an impact on the operation or construction of plants is difficult to evaluate, but what is certain is that the 5GW target was missed (installed capacity totalled 4.7GW in 2000), and that CHP capacity has stagnated since then, leaving 2.7GW of Government-consented capacity on hold or scrapped (CHPA 2004) (Figure 3.5).

In 2003, 46 schemes ceased operation, and only 11 new ones came online (Table 3.1). These were mostly smaller schemes of less than one

Figure 3.5 CHP capacity and targets



Source: DTI 2004g, 6.1

Table 3.1 CHP capacity

	1998	1999	2000	2001	2002	2003
Number of schemes	1,357	1,383	1,522	1,552	1,541	1,506
Net number of schemes added during year	14	27	139	30	-11	-35
Electrical capacity (MWe)	3,680	3,912	4,730	4,732	4,849	4,879
Net capacity added during year	292	232	818	2	117	30
Heat capacity (MWh)	15,262	14,800	11,888	11,898	11,560	11,168
Electricity generation (output) (GWh)	18,684	20,256	26,539	22,444	24,485	24,244
Heat generation (output) (GWh)	62,227	60,439	62,121	60,584	59,902	59,284
Overall efficiency (%)[1]	71.5	71.4	75.5	69.3	68.1	69.1
Load factor (%)	58	59.1	64.1	54.1	57.6	56.7

Source: DTI 2004g

Note: 1 These are calculated using gross calorific values; overall net efficiencies are some 5 percentage points higher.

megawatt used in the commercial and residential sectors or in hospitals. In addition, 64 operators have mothballed their plants, although their capacity (31MW) is still included in the official figures on CHP capacity. Despite

all this, it is estimated that CHP saved 3.3–4.6MtCe in 2002 compared with equivalent electricity-only and heat-only generation (DTI 2003b).

Most CHP plants are fuelled by gas, meaning that their economic performance is subject to fluctuations in gas prices. Over the last few years, electricity prices have fallen, while gas prices have risen, meaning that many CHP plants have become uneconomic, and operators have chosen to close or mothball their schemes. In addition, CHP is often an intermittent generator, leaving it open to penalties under the current electricity trading arrangements.

The support available through Climate Change Levy (CCL) exemptions for 'good quality' CHP has clearly not been sufficient to encourage new construction, or in some cases to keep existing capacity operating. CHP schemes can also benefit from a number of other government measures designed to encourage energy efficiency or low carbon generation. These include the Enhanced Capital Allowances scheme, the Community Energy Programme, the Energy Efficiency Commitment and ring-fenced allowances for new entrants under the EU Emissions Trading Scheme. However, the short-term nature of some of these mechanisms limits their value. For example, the lack of clarity about the CCL after 2010 and the extent to which operators can continue to rely on the exemption for good quality CHP as a driver may deter investors in projects that can take up to five years to build (Combined Heat and Power Association 2004).

The current revision of power station consents is similarly ambivalent towards CHP. While endorsing the value of Good Quality CHP, the consultation on the guidance only envisages requiring developers to show that they have assessed the opportunities for CHP (DTI and DEFRA 2004). They will not be required to justify why they have rejected CHP as an option. The balance in the guidance should be shifted from requiring developers to show evidence that CHP has been considered to requiring them to demonstrate that CHP is not a viable option.

Other measures are also being put in place to try and encourage more CHP. For example, the Sustainable Energy Act required the Government to set a target for sourcing at least 15 per cent of the electricity used by Government from good quality CHP. However, this will be reviewed at the end of 2005 to 'ensure it reflects the market's ability to deliver the level of capacity at the right price'. The short timescale before the review and the emphasis on cost are likely to do little to encourage risk-averse investors, or indeed allow for the construction of much new CHP capacity.

The Government's current proposal to consider counting CHP power bought by suppliers towards their RO may act as an additional driver if it is adopted. This has the advantage of being a long-term support mechanism (DTI 2004h). On the other hand, replacing renewables output with gas-fired rather than biomass-fired CHP generation would undermine both the confidence of renewables developers and the credibility of the

RO programme overall. If CHP generation is to be given additional support under the RO, the Government must increase the levels of the Obligation to compensate.

The Government already recognises that CHP is a cost-effective way of reducing emissions and increasing efficiency. However, it is yet to back up this conviction with any firm plan of action. Given the stagnation and decline of CHP since 2000, it is clear that existing measures are not sufficient to maintain existing capacity, let alone move towards the 10GW target in 2010.

Key conclusions and recommendations

Increasing renewables generation

- The Government has a target for renewables to supply 10.4 per cent of electricity sales by 2010 (with a subsequent proposal for 15.4 per cent in 2015). It is increasingly unlikely that this target will be met.
- The main delivery mechanism, the RO, suffers from problems of design and scope, which has led to a rapid expansion of wind power but neglected other, less developed technologies. This imbalance needs to be addressed by, for example, ensuring that developing technologies can realise an additional, performance-based price for their output.
- This additional mechanism would be separate from the operation of the RO, and could include a 'feed in' tariff scheme to guarantee a market and price for output from new technologies, or attaching an additional value to the renewables certificates for emerging technologies for a specified period and requiring suppliers to commit to buying a certain proportion of their required power from such sources.
- The scope of the RO is limited. Currently, it only values the electricity sold to suppliers. Electricity generated but not sold to suppliers, for example from domestic systems, has no extra value, so reducing the incentive for these technologies to be installed. Moreover, heat derived from renewables or from liquids such as biofuels is not covered by the Obligation. The concentration solely on electricity supply in the support mechanism therefore neglects the contribution that renewables can make to total carbon dioxide reductions. The Government should commit to establishing a renewable heat obligation on heat suppliers.
- Biomass is particularly undervalued by the RO, given that it can provide non-intermittent output and renewable heat when used in CHP plants. Adjustments to the rules to allow increased co-firing in coal plants should increase the biomass contribution to renewables output. However, this should not be at the expense of encouraging the development of smaller scale plants, or the emergence of a viable energy crop industry.

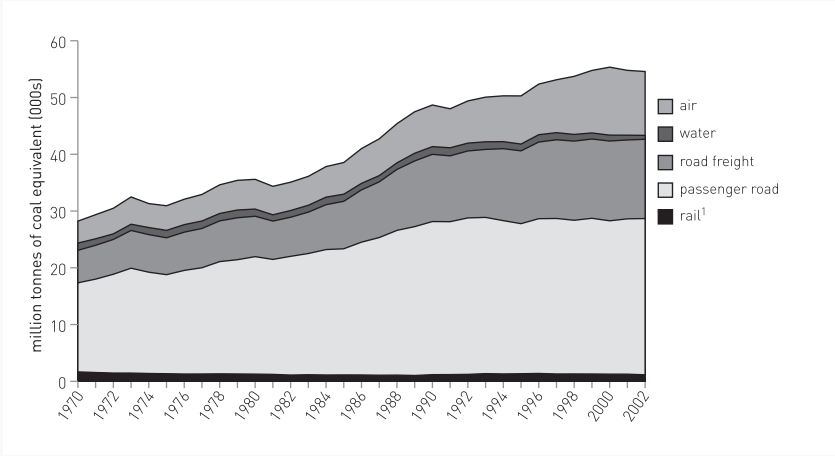
Combined heat and power

- CHP is the poor relation of low carbon generation and the Government has so far failed to tackle the problem of low implementation of CHP, despite its many promises to do so. A first step would be to commit to meeting its own target of capacity by 2010, rather than accepting that it is likely to be missed.
- The forthcoming review of the RO will consider the treatment of CHP. The Government should include the possibility of an obligation for all CHP output in the scope of the review. However, this should not be at the expense of expanding renewables generation. If CHP is to be included, the level of the RO should be increased proportionately.
- In theory, developers have to show that they have considered opportunities for CHP in projects. However, this approach clearly has not acted as a driver. The requirement should be strengthened in the revision of power station consents, with a requirement for developers to demonstrate why CHP has been rejected.
- In particular, it is clear that the potential of community CHP projects is not being realised, despite the fact that they deliver both emission reductions and improvements in fuel poverty. Given the estimates of cost-effective potential, and the contribution to both the Government's climate change and fuel poverty strategies, the Community Energy programme should be extended beyond 2005, with higher levels of funding available and more realistic expenditure deadlines.

4. Transport

The transport sector contributes roughly 22 per cent (33.2MtCe) of the UK's carbon dioxide emissions, of which road transport (freight and passenger) makes up roughly 85 per cent (DTI 2003). Energy consumption has risen rapidly since the 1970s. Since the late 1990s, consumption from road transport has levelled off but consumption from air travel is growing dramatically (Figure 4.1).

Figure 4.1 **Transport energy consumption 1970–2002**



Note: 1 Includes electricity consumed at transport premises from 1990.
Source: DTI 2004c, E11.8

The transport ten year plan (TYP), published in July 2000, largely focused on reducing congestion through the increased use of public transport and a shift from road to rail for freight (DETR 2000a). The Future of Transport White Paper, published in July 2004, extends the TYP to 2014–15, and sets a strategic framework for the next 30 years (DfT 2004a).

The Climate Change Programme (CCP) brought together the existing measures contained in the TYP, and the impact of the fuel duty escalator to 1999. In addition, it included the effect of the EU voluntary agreement scheme for car manufacturers to reduce carbon dioxide emissions from cars, which is backed up by the UK's strategy of encouraging change through differential taxing on cars and fuels. In total, these initiatives are expected to deliver savings of 6.7–8.2MtCe by 2010 (DETR 2000). Despite this, the most recent transport statistics show that the underlying rate of

growth in road traffic has remained between one and two per cent since 1999 (DfT 2004b).

The Government has subsequently also produced a strategy on the use of low carbon fuels – Powering Future Vehicles – which proposed a target that, by 2012, ten per cent of new cars sold in the UK should emit 100g/km or less carbon dioxide as well as other measures designed to remove market barriers and promote new low carbon fuels and technologies through market measures (DfT *et al* 2002).

The Energy White Paper added little that was new to the CCP and the future vehicles strategy. It does however estimate that a further reduction in road transport emissions of 2–4MtCe could be achieved by 2020 through an increase of up to ten per cent in efficiency. This depends on the successful introduction of around five per cent biofuels as a blend for petrol and diesel, and the tightening and extension of the EU voluntary agreement scheme for improving the efficiency of cars. The Energy White Paper did not forecast any reductions in emissions from other forms of transport.

Between 1990 and 2002, emissions of all greenhouse gases from road transport in the UK rose by 12.7 per cent, from 111.2MtCe to 125.3MtCe (Office for National Statistics 2004). The most recent Department for Transport forecasts estimate that carbon dioxide emissions from road transport in 2010 will be between 29.3 and 30.2MtCe. This is a reduction of only 3.1–4MtCe from 1990 levels – far below the 6.7–8.2MtCe set out in the CCP (Table 4.1). On current projections then, the CCP target will be missed.

Table 4.1 **Forecast 2010 road CO_2 emissions in England (end user, MtCe)**

	Road traffic CO_2 emissions	Saving compared with 2010 baseline
1990	**33.3**	–
2000	**30.1**	–
2010 without TYP	**31 to 31.6**	–
2010 with TYP	**29.3 to 30.2**	**1.1 to 1.4**

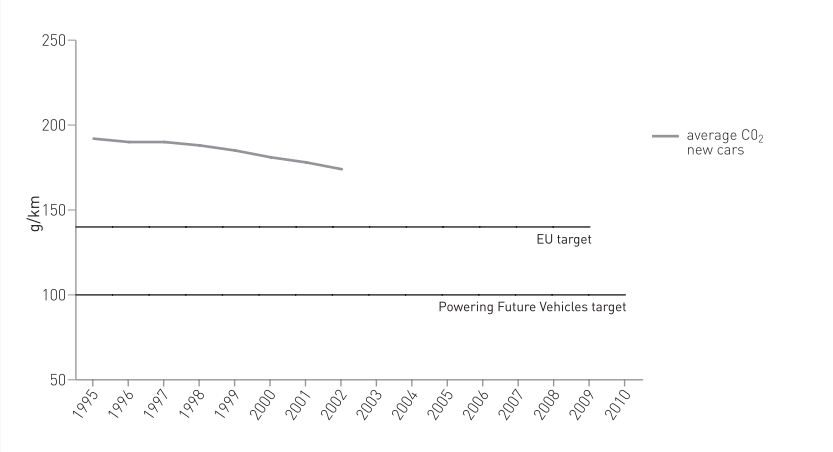
Source: DfT 2003a, Table 4

The issue of transport emissions encapsulates the Government's problem of balancing economic and environmental concerns. It does not want to discourage the movement of people or goods, and so its policies are directed towards increasing efficiency of cars and the use of new fuels. This section looks at the Government's initiatives to reduce the impact of car use, which is the main contributor to carbon dioxide emissions, and also its attitude to the rapidly growing aviation sector.

Increasing the efficiency of transport

The key aspect of the Government's approach to reducing road transport emissions is the fiscal measures designed to encourage efficiency and the adoption of lower emissions fuels. This is meant to deliver savings of 4MtCe. The approach is designed to complement the European Commission's voluntary agreements with car manufacturers to reduce emissions of carbon dioxide to an average of 140 grams per kilometre (g/km) by 2008 or 2009. This is a reduction of around 52 g/km from the 1995 level of 192 g/km (DTI 2004c) (Figure 4.2). However, the UK is performing relatively badly in comparison with other EU countries: the UK's average emissions in 2002 were 174g/km, while the EU average was 166g/km (Environmental Audit Committee 2004a).

Figure 4.2 **Average new car CO_2 emissions (g/km) and targets**



Source: DTI 2004c, Chart E11.11

Most of the reductions delivered so far appear to have come from a one-off switch to diesel, driven by fiscal incentives at the national level rather than by action from the manufacturers (ENDS 349). In the UK, these incentives include varying rates of tax on company cars with different levels of emissions. This appears in particular to have influenced the purchasing decisions of large companies, with an overwhelming majority of companies stating that the system had affected employees' choice of car (Foley 2003). In other words, the strategy of voluntary agreements and emphasising increases in efficiency will not necessarily stimulate innovation in the development and use of new fuels, at least in the short term. The increased use of diesel will reduce emissions of carbon dioxide, but will result in higher local pollution levels of particulates and NOx emissions.

Another plank of the UK's strategy to improve the efficiency of cars and support the EU scheme is the varying rate of Vehicle Excise Duty (VED). Introduced in 2001, the level of duty varies according to the level of a car's emissions. Research for the DfT concluded that a relatively narrow spread of charges meant that the scheme did not currently provide much of an incentive for consumers to choose lower emission vehicles. However, a larger differential between bands would encourage most people to consider buying a lower emission car (MORI 2003).

The other major fiscal measure to encourage lower emissions is the differentials in fuel duties. So far, much of the effort on this has been directed at liquefied petroleum gas (LPG). The level of duty on LPG was frozen in 1996, and the Government gave a commitment that the level of duty would not be increased until the 2004 Budget. This gave manufacturers a degree of certainty about the policy framework into which they would introduce LPG pumps. The approach was supported by an Energy Savings Trust programme to provide grants for the necessary equipment in vehicles. The introduction of LPG started from scratch in the late 1990s, and is now available in 1,400 filling stations in the UK.

However, technical and environmental improvements in conventional petrol and diesel cars as a result of the voluntary agreements will undermine the environmental case for LPG over time as the emissions performance of different fuels converge. By 2005, European standards for exhaust emissions of regulated substances will mean that LPG no longer has any air quality benefit over petrol cars and no carbon dioxide benefit over diesel cars (Foley 2003).

This has left the Government policy on fuel duty on LPG uncertain. If it is based on emissions, then the argument for continuing a lower duty level for LPG will soon cease to be valid. However, if the Government chose to remove LPG's fuel duty advantage over petrol and diesel, this might lead to the collapse of the market after suppliers had invested in creating the infrastructure to distribute and sell the fuel on the basis of the Government's tax approach. In terms of driving a reduction in emissions from road transport, Government's policy on LPG duty has in effect created a dead end market. However, if nothing else, it is a useful example of how effective some market measures and clear price signals can be in promoting the adoption of a particular type of fuel.

There are signs that the Government is addressing these concerns about new fuel take-up and industry confidence in investment in new plant and equipment. The 2003 pre-budget report introduced an alternative fuels strategy which sets out the rationale behind different fuel levels and outlines the approach to fuel duties on a rolling three year basis. The 2004 Budget raised the duty on LPG by 2.4p a litre to 7.82p a litre and there will be further annual decreases in the duty differential until 2006–7.

However, as the Environmental Audit Committee has pointed out, three years is not a long-term strategy, and it may prove too short to encourage

the development and adoption of more radical fuels (Environmental Audit Committee 2004a). This could prove particularly significant for the use of renewable fuels, which are discussed below.

Encouraging the use of renewable fuels

There is a certain inconsistency in how the Government has approached fuel duty for other new fuels, with biofuels taxed at a higher rate than LPG or natural gas, despite the fact that carbon dioxide emissions from biofuels such as biodiesel and bioethanol are around 40–57 per cent lower than fossil fuels. If five per cent of the road transport fuels currently used were biofuels, emissions could be reduced by as much as 1MtCe (DfT 2004). In addition, there is no differentiation between different biofuels on the grounds of their emissions, despite the fact that emissions from ethanol from woody biomass are lower than from ethanol from sugar beet (Foley 2003).

The impression of inconsistency is reinforced by the lack of agreement between different departments on the purpose of the fuel duty mechanism. DEFRA does not consider the current level of reduction (20p a litre) to be sufficient to encourage the development of a national woody biomass industry, or to meet the EU Directive on biofuels of non-binding targets of two per cent of market share by 2005 and 5.75 per cent by 2010 (ENDS 344). However, DEFRA's desire to encourage the adoption of biomass is not shared by the Treasury. In evidence to the Environmental Audit Committee, the Treasury Minister John Healey stated that meeting the terms of the Directive was not a major concern, and that taxpayers should not have to pay over the odds to encourage the environmental gains from biofuels (ENDS 345).

The Treasury's position seems to be shared by the DfT, which is currently developing its approach on the implementation of the Biofuels Directive. The DfT's proposals are, by its own admission, unambitious: the 2005 target 'should be based on our best projections of biofuels sales by the end of 2005' – in other words, should not progress from the measures announced in the 2004 budget (DfT 2004). This would lead to around 12 million litres a month being sold – only 0.3 per cent of total fuel sales (ENDS 352). Even so, this would lead to a six-fold increase on the levels of biofuels currently used. The consultation also proposes deferring setting a 2010 target until 2017.

Differentiating fuel duties can drive the adoption of certain fuel types, as has been demonstrated by the LPG experience. The rolling three year programme in the alternative fuels framework can go some way to addressing market uncertainty. However, the level of fuel duties can only be guaranteed over short timescales (the duration of a Parliament), so a longer-term approach will also be needed to ensure that new, less damaging fuels which require more fundamental changes are adopted. In the case of biofuels, these changes will need a biomass industry to be established and new facilities built to produce the fuels. It is unlikely that this will be accomplished on any

significant scale unless the Government acts to encourage both the use of biofuels and investment in biomass growing and refining facilities.

The current approach to biofuels in transport will not meet the albeit non-binding targets for 2005 or 2010. The level of commitment to reducing carbon dioxide emissions from the transport sector is not comparable to that seen in the electricity sector. However, the increasingly certain failure to meet the CCP target means that the Government has to adopt a more imaginative approach to transport emissions. In the case of biofuels, this must be based on the development of a viable UK supply chain for energy crops and so must enhance confidence amongst growers and refiners as well as developers.

Diesel cars can use five per cent biofuel in the mix without any adverse effect on performance. An obligation on suppliers to supply an increasing amount of UK grown biofuels could therefore be put in place with relatively little short term disruption to their infrastructure, while at the same time providing a more certain market for crop growers and refiners. This should be consistent with the indicative target in the EU Biofuels Directive that by 2010 5.75 per cent of fuel supplied is biofuels.

The problem is doubly complex for the development of hydrogen. If the technology is really to address the problem of climate change, the hydrogen will have to be produced from renewable sources. This in turn means that the longer-term development of transport policy will depend on the extent to which the Government succeeds in enabling new forms of low carbon generation. The strategy and commitment for hydrogen therefore requires the same long-term approach to be extended to low carbon generation.

Emissions from aviation

The conflict between the Government's aspirations on climate change emissions and its policies towards aviation is already well documented (see, for example, Royal Commission on Environmental Pollution (RCEP) 2000, Bishop and Grayling 2003, Environmental Audit Committee 2004). However, the implications of this conflict are worth considering briefly here because of the extent to which they highlight the failure to ensure a sufficient balance in trade-offs between different policy objectives. This failure may well threaten the UK's climate change performance as aircraft emissions increase to levels which could cancel out any other reduction in carbon dioxide emissions.

The issue of aviation emissions is complex because emissions from international flights are not allocated to countries under the Kyoto Protocol. In addition, aircraft emit nitrogen oxides and create condensation trails, which can also lead to magnified global warming effects when emitted at altitude. The International Panel on Climate Change (IPCC) estimates that the impact of carbon dioxide emissions from aircraft might

have between two to four times the impact of carbon dioxide alone (DfT 2003, RCEP 2002).

UK emissions from aviation were estimated at 9MtCe in 2002. Of this, 1MtCe came from domestic flights, with the other 8MtCe from international flights. Emissions are expected to rise to 14–16MtCe by 2020, and to 16–18MtCe by 2030, of which 95 per cent would come from international flights (DfT 2003). This means that aviation will have doubled its emissions by 2030 at a time when other sectors are reducing theirs to meet government targets. Table 4.2 shows the projected increase in emissions and greater impact of carbon dioxide emissions from flights in comparison with ground-level emissions. At the predicted level of growth, aviation emissions in 2030 could account for two-thirds of the UK's intended 2050 target.

Table 4.2 Forecast growth in aviation emissions including radiative forcing (RF) (MtCe)

	1990	2000	2030	2050
Aviation (including RF)	**11.5**	**22**	**44.3**	**43.5**
UK domestic emissions	**164.8**	**147**	**98.7**	**65.8**
Total UK emissions, including aviation and RF	**176.3**	**169**	**143**	**109.3**
Aviation (including RF) as a percentage of UK domestic emissions	**7%**	**15%**	**45%**	**66%**
Aviation (including RF) as a percentage of total UK emissions	**7%**	**13%**	**31%**	**40%**

Notes: 1 Estimates for the radiative forcing of CO_2 at altitude ranges from two to four times that of carbon dioxide emitted on the ground. The Treasury uses a factor of 2.5, which is also used here.

2 These figures were challenged by the Government, but the Committee provided a detailed justification of the figures used, and pointed out that the data presented in the government response contradicted the DfT White Paper.

Source: House of Commons Environmental Audit Committee 2004

Neither the CCP nor the Energy White Paper envisages any measures leading to reductions of emissions from aircraft, either in terms of increased efficiency or reduced demand. The Aviation White Paper, published in December 2003, also fails to quantify any possible savings from limiting growth in air traffic or by encouraging greater efficiency to reduce emissions. It does, however, raise the possibility that a reduction in carbon dioxide emissions of up to 50 per cent could be achieved by 2020 through technical improvements, and restates its intention to encourage the industry to move towards greater efficiency through inclusion in the EU Emissions Trading Scheme. On the other hand, it does not address the problem of nitrogen oxides or condensation trails at all.

At the moment, aviation does not internalise any of the external costs arising from its emissions. Including aviation in a trading scheme, either on the European or eventually the international level, would be a first step to rectifying this failure. But, as with any other sector in the trading scheme, the power of this to encourage greater efficiency will depend on the limits set and the price of carbon in the scheme. Given the uncertainties evident in the EU Trading Scheme, it does not seem sensible to rely on this as the sole means of addressing aviation emissions.

Part of the Government's reluctance to tackle the growth in air transport is the recognition that measures which increase the price of flights would be politically unpopular. It also seems to believe that demand cannot be constrained – an assumption no longer seen in other energy sectors (ENDS 349). At best this is inconsistent. At worst it is an abrogation of responsibility which risks undermining efforts in other sectors to address the issue of climate change.

Key conclusions and recommendations

Increasing the efficiency of transport

- Projections of future emissions show that carbon dioxide emissions from transport are expected to rise dramatically, missing the targets set out in the CCP.
- The Government's approach to increasing efficiency in transport has so far been to concentrate on fiscal measures, in particular fuel duties and the VED.
- Voluntary agreements with car manufacturers and differentiated fuel duties have resulted in improvements in efficiency and reduced emissions. However, biofuels are taxed at a higher rate than LPG, despite having lower emissions. The structure of fuel duties should be revised to ensure that the duties are set to reflect a fuel's carbon dioxide emissions.
- The level of VED differs according to the car's emissions. However, the differentials are not sufficient to drive consumers to pick lower emission cars. The differential should be increased to levels where VED becomes an effective policy mechanism in reducing emissions.

Encouraging renewable fuel use

- So far, the Government's approach on renewable fuels has been inconsistent and short-term. The alternative fuels framework has provided a degree of certainty for new investors over a three year period. If more radical change is to be achieved, such as the adoption of renewable fuels, three years is an inadequate timeframe to ensure a high degree of confidence from investors. A ten year framework would give more

certainty to investors, as was shown by the need to extend the time-frame of the Renewables Obligation.

Emissions from aviation

- Emissions from aviation currently threaten to overwhelm the efforts the UK has made to reduce its emissions of carbon dioxide. Emissions from international aviation are not currently included in the UK's climate change commitment and targets. This should be rectified, and the Government should stick to its intention to press for the inclusion of aviation in the EU Emissions Trading Scheme. The impact of aviation should also form part of the review of the performance of the CCP so far.

5. Broader issues

To an extent, the problems experienced so far with achieving significant moves towards the Climate Change Programme (CCP) targets can be blamed on the design of individual measures. However, given the complexity of energy systems, this would be an overly simplistic conclusion. Other factors beyond the specifics of measures put in place to encourage new technologies and practices can also play a role in hindering the implementation of the CCP – some of the more significant are outlined below.

The previous chapter outlined the major measures in the CCP. It is clear that the Government has in place plans to address carbon dioxide emissions from all sectors of the economy. However, while these plans are delivering some savings, they are not on the scale envisaged, and are increasingly unlikely to achieve the Government's target of a 20 per cent reduction in carbon dioxide by 2010.

This chapter considers some factors in the broader environment of energy systems that have an impact on the success or otherwise of the Government's policies. These factors constitute barriers to the implementation of carbon reduction plans; it is argued that the measures currently in place are insufficient to overcome these barriers.

The beginning of this report highlighted the importance of the broader social and political environment in achieving technical change in energy systems. In the case of electricity systems, for example, the development of transformers and high voltage transmission lines allowed plant operators to exploit economies of scale and incremental technical improvements by developing large-scale generating plants and transporting their power to centres of use. Transmission lines also allowed individual local networks to be connected, ultimately creating a national grid. These technological developments were supported by technical, political, institutional, economic and legal conditions in the broader 'selection' environment, such as the social policy aim of ensuring universal supply, or the increasing economies of scale afforded by improvements in generating technologies.

As operators became more skilled at balancing output across the country to create the most economic mix, shifting power generated at large-scale, centralised plants over long distances became the norm. The development of large-scale plants, their integration with transmission networks and ever-increasing demand for power have become defining factors of developed electricity systems. The self perpetuating logic of technical systems has been likened to 'momentum', driving development and technical choices along a particular course, whether or not it is optimal. While

possibly not as acute, transport systems also demonstrate the characteristics of momentum. For example, increased road construction and more car ownership have encouraged the development of longer distance destinations such as out-of-town shopping centres. This in turn has encouraged more car ownership, greater use and increased road construction.

The importance of the concept of momentum is that the dominant technologies in the established system set the standards – whether in establishing market rules or defining the standards against which the performance of technologies are assessed. For example, local power distribution networks have gradually become 'passive' transporters of power from transmission lines to the final user, rather than 'active' participants in matching demand and supply. The passivity of distribution networks is an important factor in the development of many renewables projects, which are often connected to distribution lines.

One of the outcomes of the centralised energy systems in the UK has been long-term environmental problems, whether as a result of carbon dioxide emissions from vehicles and fossil fuel plants or radioactive waste from nuclear stations. Trying to address the environmental impacts of energy production and use by moving towards a low carbon system will inevitably challenge the momentum of the existing system. A low carbon and non-nuclear electricity system implies a high degree of decentralised generation and increased energy efficiency. This challenges the logic of the established electricity system in the UK.

If conditions are set by dominant technologies, the selection environment is almost certainly hostile for new ones. Just as the development of the current energy systems needed a supportive selection environment, innovation in energy systems will also require conditions in the selection environment to be favourable. The Government recognises that just 'pushing' technologies will not result in technical change – in order to be effective policies promoting new technologies 'must be balanced by complementary policies to ensure that technologies with the potential for strong economic, social and environmental benefits are "pulled" through by business' (DTI 2004f).

Policies designed to promote new technologies – such as those in the CCP – may go some way towards mitigating the power of the dominant technologies in the system. However, if the problems in the selection environment are not addressed, these technologies will always find themselves operating outside the current system rather than becoming the norm.

Experience in other countries shows that the rapid, widespread deployment of low carbon technologies can be achieved if problems in the selection environment are addressed. For example, Germany and Spain have 'feed in' tariffs which have created a regulatory environment where the risks of investment in new technologies is reduced or effectively eliminated. This in turn has encouraged the rapid deployment of wind power. Similarly, effi-

cient condensing boilers are now the standard in the Netherlands, and constitute around 75 per cent of the market. This was achieved through a combination of regulatory requirements such as building regulations, improved public information and energy taxes with hypothecated revenue for energy efficiency. By contrast, condensing boilers made up around 12 per cent of the UK market over the same period.

The issue of momentum and conditions in the selection environment are particularly acute at the moment as the nuclear industry gears up to argue for its resurrection in the context of the review of the CCP. The Government continues to remain ambiguous about new nuclear development, most tellingly with Tony Blair insisting to the House of Commons Liaison Committee that 'you could not close the door' on the possibility of new nuclear construction (House of Commons Liaison Committee 2004).

Nuclear power stations show most of the characteristics of the established system – they are large-scale, centralised and have long-term environmental problems. The major difference between nuclear power plants and other dominant technologies is their cost and lack of flexibility. While gas and coal produce relatively cheap power and can adjust their output to respond to varying levels of demand, nuclear power is costly and cannot respond to demand. The lack of flexibility has contributed to nuclear power's inability to operate economically in the market. The impact of this can be seen in the ongoing financial crisis at British Energy, where the UK is being asked to subsidise the nuclear waste costs of the company to the tune of between £3 billion and £12 billion, depending on the discount rate used (European Commission 2003).

The force of the nuclear industry's argument will rely on ignoring the problems of radioactive waste, safety and security inherent in the technology. It will also rely on believing the industry's estimates of the costs, which historically have not been reliable. Long construction times and their reputation for cost overruns make new nuclear power stations very unattractive for investors in liberalised markets, so new nuclear construction will require government subsidy. This will presumably remove, or at the very least reduce, the support mechanisms available for other energy projects, including renewable and energy efficiency technologies.

The failure to rule out new nuclear construction will therefore have a direct impact on the deployment of low carbon technologies as investors see a long-term risk that the support environment in which they are developing their projects will be undermined by spending on a nuclear programme. Given that new nuclear stations would perpetuate the characteristics of the existing system, lending support to a new construction programme would be a clear signal that the Government was not willing to create a selection environment in which renewables or energy efficiency could ultimately become the new dominant technologies.

The following sections outline some of the specific issues in the selection environment which must be addressed if the Government is serious about creating a low carbon economy. It is not exhaustive but it does indicate that the Government should act to improve conditions at the broader system level if it is to achieve the innovation in energy systems that it desires.

Balancing energy policy

The Government has four goals in its energy policy:

- To put the UK on a path to cut carbon dioxide emissions by 60 per cent by about 2050
- To maintain the reliability of energy supplies
- To promote competitive markets in the UK and beyond
- To ensure that every home is adequately and affordably heated

The Government believes that these four aims can be achieved together. Tensions between the different aims will, however, inevitably arise, and there are already examples of the environmental goal losing out, such as the Department for Transport's aim to expand air travel and refusal to consider constraining demand. Other examples may be more subtle – for example, the emphasis on the lowest cost renewable technologies within the Renewables Obligation (RO).

Despite the Government's confidence that the four goals can be balanced and the Prime Minister's statement that the costs of inaction far outweigh the short-term costs of action, the longer-term shift towards a low carbon economy is often demoted to a secondary position when energy policy decisions are made. The impact of this will be to delay or even prevent the emergence of a low carbon economy – the clues are already there in the failure to meet early targets for renewables and combined heat and power (CHP), and predictions that the 2010 targets will be missed too.

In some cases, the imbalance between policy objectives is institutionalised. For example, Ofgem has a principal objective of promoting competition, while it has only a secondary duty to take environmental and social issues into account. As a consequence, Ofgem has taken decisions driven primarily by competition interests, rather than by consideration of the broader implications of this approach for the emergence of a low carbon system. The Government has given guidance on social and environmental issues, but it has not changed Ofgem's statutory duties, giving the guidance only limited weight (DTI 2004a). The new Energy Act may go some way towards rectifying this by giving Ofgem a principal duty to 'contribute to the achievement of sustainable development', although much will depend on Ofgem's interpretation of 'contribute to' (HMSO 2004).

Similarly, the DfT has consistently taken decisions on the basis that increased transport is inevitable. The recent Aviation White Paper went further and almost completely ignored climate issues in its pursuit of expanding airport capacity. The most recent public service agreement (PSA) with the DfT has given it an objective of meeting the Kyoto commitment and the Government's 2010 carbon dioxide target. The objective is shared with the DTI and DEFRA and should succeed in ensuring that climate issues play a greater role in the DfT's decision making. However, these PSAs do not come into force until 2005, by which time the policies set out in the Aviation and the Future of Transport White Papers will already have been set in motion. The impact of the objective is therefore uncertain, at least in the short term.

The Policy and Innovation Unit (PIU) report in support of the Energy White Paper recommended that, particularly in matters of climate change, 'where energy policy decisions involve trade-offs between environmental and other objectives, then environmental objectives will tend to take preference over economic and social objectives' (PIU 2002). Such an approach should enhance the chances of environmental objectives being achieved backed up by explicit guidance or legislation.

Market problems

The Government's basic premis is that markets and competition operate to produce the most efficient outcome. If any policy outcomes are not enabled by the market, they are dealt with through separate policy mechanisms such as the RO, rather than adjustments to the market itself. The design of the market is therefore fundamental in influencing technology choices and the extent to which the Government's targets will be met. However, the market tends to be defined by the characteristics of the dominant technologies in the system, and can therefore exclude new or developing technologies.

The New Electricity Trading Arrangements (NETA) are a prime example of this. NETA was introduced in 2001 to make the market more competitive and so drive down prices. NETA rewards predictable or flexible output from generators, and penalises those generators that are 'out of balance' on their predicted levels of output. Renewables and CHP plant often operate intermittently or unpredictably, meaning that the generators themselves, or the company to which they are selling their output, are more open to penalty payments. However, the level of the payment may well be disproportionate to the cost incurred by the system operator in correcting the imbalance, so providing a disincentive to invest in renewable projects.

In addition, the risk that companies will incur imbalance charges as a result of intermittent generation has led suppliers to offer low prices for output from smaller generators. Suppliers are often in a monopoly situation in distribution networks, so generators have to take the price offered. The extent

of the penalties incurred by smaller independent generators, either directly or indirectly, led Ilex to conclude in a report prepared for the DTI that there 'is clear evidence to demonstrate that smaller generators are unduly penalised by features of the electricity trading arrangements' (Ilex 2002). NETA therefore tends to restrict new entrants, and over-penalise intermittent generation.

Renewable generation in the UK is given no support within the primary electricity market, NETA, where it has to exist on the same terms as any other generation. This is unique in Europe. NETA was developed to be 'technology and fuel blind'. In other words, its rules and incentives are never fuel or technology specific. In the meantime, the Government is compensating for the flaws in the market design through bolt-on policy measures such as the RO and the Climate Change Levy. A more productive way forward in terms of a low carbon economy would be to ensure that the market did not penalise renewables and CHP in the first place, as is the norm in other European electricity systems. While this would not remove the need for some level of subsidy for developing technologies, it would reduce it.

In the absence of significant energy service programmes from energy suppliers, customers have little incentive to reduce demand, and no ability to monitor their patterns of usage. Installing intelligent meters would improve this situation for individual consumers, and should allow suppliers to develop and implement demand reduction measures. However, even if this happens, the design of NETA largely mirrors the established system paradigm of ever-increasing demand.

NETA does allow for offers to reduce demand, which in theory should allow suppliers or the large industrial operators that participate in the market to profit from reducing their demand. However, the mechanism appears not to have been widely used, not least because there is little incentive to reduce demand at times when electricity prices are generally low.

The advantage of increased demand-side participation in the market would be to encourage increased efficiency in network investment by reducing the peak levels of demand and therefore reducing the need for upgrading or expansion, while contributing to the achievement of the Government's targets. Increased use of the demand reduction in NETA could develop alongside the emergence of energy service companies, and this should be encouraged.

NETA was developed to deliver low cost power to consumers in the short term, and it has been largely successful. This short-term aim, however, has hampered the longer-term aim of moving towards a low carbon economy. In that sense, NETA has failed as a mechanism to deliver low carbon generation.

The development of new initiatives such as NETA should be explicitly assessed for their consequences for climate-related policies. If they risk adverse consequences for these policies, steps should be taken to ensure that environmental issues take precedence. This would go some way towards addressing the problem of balancing policy priorities in the energy sector.

The need for clear targets

The language used by the Government in its various statements on its targets has often shifted, presumably reflecting an evolving attitude to the desirability or achievability of the goals set. The terms applied to the Government's intentions range from 'commitment' (this relates solely to Kyoto) to 'ambition', 'goal', 'target' and 'aspiration'. Some statements are even further away from a commitment. For example, the Energy White Paper talks about an expectation of aiming for cuts in carbon dioxide emissions in 2020 (DTI 2003), and an aspiration to achieve 20 per cent renewables by 2020. The recent Energy Efficiency Action Plan states that the goal is 'moving towards a 20 per cent reduction in carbon dioxide by 2010' (DEFRA 2004).

Each of these terms implies a different level of expectation and commitment. This may be a reflection of the fact that the Government has limited ability to influence or dictate the operation of the various energy networks in a liberalised market, or it may reflect an evolution in the Government's own position on the desirability of setting defined targets against which it can be judged.

An ambition is not the same as a commitment. Not only does it imply a different level of accountability from the Government, especially if the UK falls short, but proclaiming an ambition sends a very different message to the stakeholders in the energy sector than making a commitment. This is particularly important in emerging areas such as renewables deployment, where investment is risky for developers, and they are being asked to take action on the basis of a Government hope. If a 'commitment' to a certain level of renewables generation were given, the companies involved could take investment decisions on the basis that the Government would do all it could to ensure that the required level of deployment took place. The problem of certainty for the developers of new technologies is exacerbated by the ambiguity on future nuclear development.

The nuances in the Government's attitude to developing a low carbon economy also have implications for the broader development of energy policy. If there is a defined commitment within a particular timescale, the relative weights given to the Government's four policy pillars should be clearer than if there is merely an ambition, which leaves room for more negotiation. If there is only an ambition to develop a low carbon system, renewables and energy efficiency will lose out when there are policy trade-offs with other energy policy issues, especially if it is perceived that support for a low carbon economy could raise political difficulties in the short term.

While it is understandable that any government would be wary of making commitments up to 2050, the current ambiguity relating to shorter-term targets needs urgent clarification. Any strategy needs a clear goal which it is designed to achieve: without this, the strategy is little more than

a series of related activities which could easily be diverted off course by other demands or interests. The development of the UK's National Allocation Plan shows clearly the extent to which a target can be derailed by apparently more immediate economic interests.

Monitoring delivery

The Energy White Paper (EWP) has been rightly praised for the commitment it signalled to developing a broad energy strategy over the long term. On the other hand, it was also criticised for the lack of detail about how its goals will actually be achieved. In particular, there is no detailed plan for renewables, in spite of the complexity of the various measures which are in place to encourage their deployment. The lack of detail on implementation is a serious omission for investors seeking certainty about the Government's plans for renewables, especially given the reliance on market-based measures to deliver.

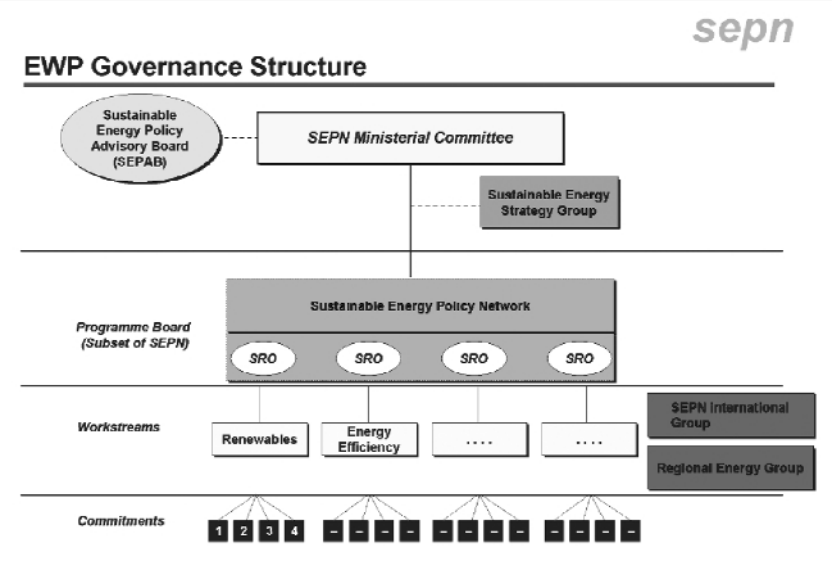
The responsibility for delivering the EWP plans ultimately falls to an *ad hoc* cross-departmental Ministerial group chaired jointly by the Secretaries of State for Trade and Industry and for Environment, Food and Rural Affairs, advised by the Sustainable Energy Policy advisory board. On a day-to-day level, however, implementation has been delegated to the Sustainable Energy Policy Network (SEPN), officially launched in June 2003.

The SEPN consists of policy units from across government departments, the devolved administrations, regulators and other 'delivery' organisations. Its role is to monitor and co-ordinate activities rather than to develop policy to deliver the Government's targets, so it can only address implementation problems as they arise. The 130 'commitments' in the EWP have been allocated to officials from departments across Government, with overall responsibility in the various themed workstreams given to one named official, who reports to the ministerial committee (Figure 5.1).

The creation of the SEPN was presented as 'a new way of working for government...about ensuring the right communications and links are made across and beyond Government' (DTI 2003b). It recognises the complexity of energy policy and the need for all the different implications of energy issues across Government to be addressed. The question is whether this new approach is working, or whether the creation of a sustainable energy agency, as advocated by the PIU study, or some other organisational change, would provide a more certain means of ensuring that the CCP and EWP's intentions are met.

The establishment of the SEPN has certainly added a layer of bureaucracy to energy policy issues, and its structure – in particular the composition of the ministerial committee – allows plenty of scope for conflict and negotiation between the multitude of interests. In this situation, the more powerful departments – the Treasury, DfT, the DTI – are likely to prevail and, given the overall emphasis on costs, difficult or expensive choices are unlikely to be made.

Figure 5.1 The structure of the SEPN



Source: SEPN website

Separating the implementation of the CCP and EWP programmes from the day-to-day negotiation between government departments by creating a sustainable energy agency with executive powers would make the achievement of the overall targets for a low carbon economy more likely. However, a dedicated agency would run the risk of capture by the more powerful interests in the sustainable energy debate, as in the nuclear industry and the DTI in the past. An alternative, which is proving effective in health and education, would be to set up a small delivery unit within the Cabinet Office to oversee the implementation of policies and hold any failing departments to account.

Key conclusions and recommendations

- The Government's ultimate ambition is to create a 'low carbon economy'. However, changing the course of energy systems is not a simple or a short-term task, and the policies in place so far have met with, at best, limited success.

Balancing energy policy

- This chapter argues that individual policy measures will not necessarily provide enough support to overcome the barriers in the broader energy system, and that as a result the Government should adopt a more comprehensive approach to changing technology.

- This includes the need to set out a clear framework for energy policy which makes clear that environmental objectives should tend to take precedence over economic objectives on the relatively rare occasions when the two areas come into direct conflict.

Market problems

- A clear example of the conflict between economic and environmental objectives is the design of NETA, which was devised to deliver low cost power in the short term. The emphasis on economic performance has penalised small and renewable generators, and as a result has hindered the longer term move to a low carbon economy.

The need for clear targets

- There is considerable uncertainty about the level of government commitment to achieving a low carbon economy. Statements from Ministers talk about aspirations, targets and, latterly, moving towards goals. This ambiguity does nothing to encourage confidence from investors. If the Government continues to be committed to reducing carbon dioxide emissions and encouraging low carbon generation, it needs to make this unequivocally clear.

Monitoring delivery

- There is no clearly responsible body to ensure delivery of carbon cuts through the successful implementation of the Government's policy. The SEPN could take over this role, but is currently hampered by a lack of accountability in the event of any failure as well as by the large number of different organisations ultimately responsible for delivery. A more effective approach would be to establish an alternative body, such as a delivery unit in the Cabinet Office, with the influence to ensure that the targets are achieved.

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Appendix 1
Summary of the implementation of the Climate Change Programme

Measure	CCP target (2010) MtCe	Subsequent target MtCe	
EEC		1.8	Savings reported to date may be overestimates as a result of comfort taking and other uncertainties.
Community Energy	0.9	0.1	The scheme is short term (2002-05) meaning that there is little opportunity for developers to realise complex infrastructure projects.
Climate Change Levy	2		The Levy has not increased since it was introduced, reducing the price signal it is meant to give.
Climate Change Agreements	2.5MtCe	3.8	First period over-achieved. The extent of beyond business-as-usual reductions is dependent on the baseline set – there is evidence that the first period baselines were generous. DEFRA is now reconsidering the way that targets were set.
Emissions Trading UK Schemes (UK and EU)	at least 2	2	The overachievement of the CCAs allowed a lot of hot air to enter the trading scheme. The UK's participation in the EU trading scheme is only designed to deliver a 15.2% reduction in CO_2 emissions by 2010. Only the electricity sector is expected to go beyond business-as-usual reductions.
Carbon Trust	0.5	1	Difficult to evaluate the impact of the programmes, and therefore to calculate their contribution.
Building regulations	1.3	1.4	Difficult to monitor compliance. Revised target includes forecast for savings from the 2005 building regulations.
Public sector targets	0.5	0.5	

Renewables Obligation	(2.5MtCe)	10% of sales by 2010 (proposal for 15% by 2015)	Targets missed so far, and it seems likely that only around 8% of sales will be achieved by 2010. The structure of the RO is geared towards the cheapest technologies. R&D funding and support from capital grants may not be sufficient to enable a diverse mix of renewables in the future. The mechanism is limited to electricity production, rather than including heat, which could also encourage the biomass industry. Some arrangements in NETA and BETTA are hostile to renewable technologies. The Government intends to extend the RO to 2015, which has gone some way to reassuring investors.
Combined Heat and Power Capacity	10 GW by 2010		The CHP industry has stalled, and capacity is falling. The 2000 target was missed, and only around 8GW are likely to be installed by 2010. The new CHP strategy proposed no significant new measures to address this shortfall. As with renewables, CHP is penalised by NETA.
Voluntary agreements on car emissions, changes to company car taxation and vehicle excise duty	4		Improvements in efficiency are slowing, and so far have mainly encouraged switching to diesel rather than lower carbon fuels Fuel duties currently favour LPG over biofuels. The Department for Transport's attitude to encouraging increased use of biofuels is extremely unambitious.
Ten Year Plan	1.6		Traffic is growing faster than forecast. The target for reduced emissions is likely to be missed.
Aviation			No targets have been established. Significant rises are expected in the next few years, which are exacerbated by the addition impacts of carbon dioxide emitted in flight.