

EA SUSTAIN. DEVELOP.

A FRAMEWORK FOR CHANGE

# Limiting and adapting to climate change

JULY 2001



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# Limiting and adapting to climate change

“Climate change is not some trendy intellectual scenario for the distant future.

It is with us now”

MICHAEL MEACHER, ENVIRONMENT MINISTER, OCTOBER 2000

## 1. Why a Framework for Change?

### **The Environment Agency's vision**

In June 2000 the Agency consulted widely on its long-term objectives and goals. After taking into account the responses that we received, in January 2001 we published *An Environmental Vision: The Environment Agency's Contribution to Sustainable Development (the Vision)*<sup>1</sup>.

This sets out our long term, aspirational objectives for the environment, grouped under nine environmental themes. In preparing it, we were very conscious that it would be the process by which those objectives are met - the route by which the Agency plans, in partnership with others, to make progress towards the long term destination - that would be of particular interest. This was reinforced by the comments we received during the consultation on the *Vision*.

### **Frameworks for Change**

To show the route we propose to take, we have prepared a series of *Frameworks for Change*, one for each of the *Vision's* nine environmental themes. This document is one of these thematic *Frameworks* which are intended mainly for internal planning purposes though they are publicly available. They set out our proposals for the medium term to make progress towards the long-term objectives described in the *Vision*. These *Frameworks* - and the associated dialogue and business development that will flow from them - are not only intended to make progress towards the environmental outcomes in the *Vision*, but also to improve the Agency's service delivery to Government<sup>2</sup>, industry, and the public. They are also intended to improve our own internal efficiency and effectiveness. Overall, we regard them as being beneficial to both our stakeholders, and society in general. They are frameworks with a menu of possible actions, rather than final plans, because we still have to agree the final proposals. We have to balance the competing priorities within them, take into account their specific implications for others, and match them to the resources we have available. This balancing and prioritisation has to be agreed with Government, and will be done through our corporate planning process, with our firmed-up work programmes appearing in our formal Corporate Plans. The Government's current revision of its statutory guidance in respect of our sustainable development remit will also help us clarify the routes and options available to us.

<sup>1</sup> The Environmental Vision, and Frameworks for Change is available on the Agency's website <http://www.environment-agency.gov.uk>

<sup>2</sup> References to Government include the UK Government and, where appropriate, the National Assembly for Wales.

We will be discussing these proposals with our stakeholders. The main vehicle for this external dialogue and discussion will be a separate series of sector based *Frameworks* starting late in 2001. These will draw from the nine themes the issues and outcomes relevant to the sector concerned.

### **Working with partners**

We recognise that we cannot on our own deliver the outcomes and goals we have set out. We already work in close partnership with a wide range of organisations and groups, and we are keen to explore how we can strengthen existing partnerships and develop new ones. This does not just involve seeking partners for Agency led projects, but also supporting the work of others. We will need to work with a wide range of bodies with an interest in land issues, including those we regulate. Below we list areas where we will want to work in partnership with others, but have not sought fully to specify who these others might be.

## **2. Limiting and adapting to climate change**

Climate change is likely to have a major effect both on the natural world and human society. At the same time, policies that address climate change will deliver homes that are better insulated, industry that is more fuel efficient and competitive, better public transport and business opportunities in the important global market for environmental technology. Climate change is, therefore, both a challenge and an opportunity.

If we do not act to limit emissions of greenhouse gases, the world's temperature could rise by between 1.4 °C and 5.8 °C by the end of this century. This would be the fastest rate of warming since the end of the last ice age 10,000 years ago<sup>3</sup>.

The pattern of the world's weather is also predicted to change, with an increase in the intensity and frequency of some extremes becoming evident. This could increase the frequency and intensity of heat waves, floods, drought and storms. Combined with rising sea levels, these effects would have significant impacts on water resources, agriculture, wildlife and human health.

### **Possible scenarios**

Research has produced a range of climate change scenarios that allow us to begin to understand the possible impacts on the environment of different concentrations of carbon dioxide (CO<sub>2</sub>) in the atmosphere. These stabilisation scenarios suggest that if we do not act to reduce CO<sub>2</sub> emissions global temperatures could rise by 2 °C by the 2050s.

The climate change scenarios show that we could delay this increase by more than a century if we stabilise CO<sub>2</sub> concentrations at 550 parts per million (ppm). Stabilising CO<sub>2</sub> concentrations in the atmosphere at this level would similarly delay by about 40 years the 40cm rise in sea level expected by the 2080s under a "business as usual" scenario<sup>4</sup>. To stabilise CO<sub>2</sub> concentrations at 550 ppm would require a 60% reduction in emissions from 1990 levels and perhaps even more than this for developed countries if they recognise the need to allow for real growth in the emissions from developing countries.

<sup>3</sup> Intergovernmental Panel on Climate Change 2001: *Third assessment report on climate change*.

<sup>4</sup> The Meteorological Office, (1999) *Climate Change and its Impacts: Stabilisation of CO<sub>2</sub> in the atmosphere*.

### Greenhouse gases

Carbon dioxide and methane are the two principal greenhouse gases (Figure 1). They contribute 84% and 8% respectively to the UK's emissions when measured on a scale that takes account of their total global warming effect (global warming potential). The biggest source of greenhouse gases is combustion of fossil fuels whilst agriculture and waste are major sources of methane (Figure 2).

Growth in private transport, domestic energy use and the number of households are amongst a number of societal trends which threaten to dwarf emissions reductions made by industries regulated by the Agency and other bodies.

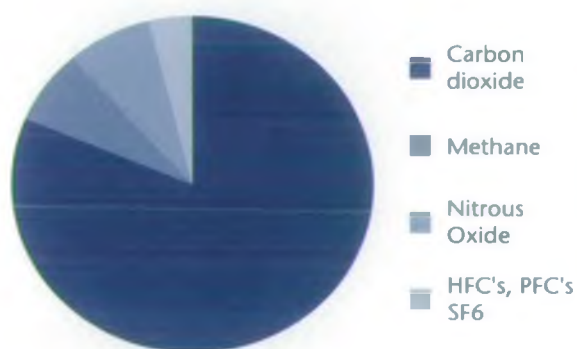


Figure 1: UK emissions of greenhouse gases, measured in global warming potential.

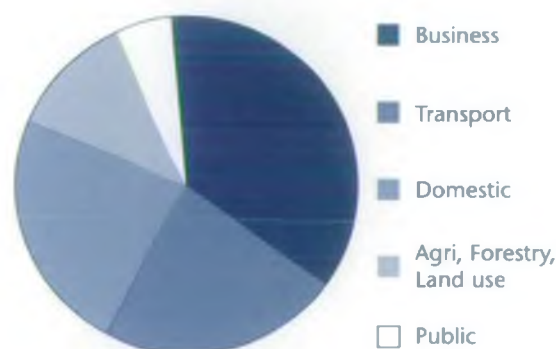


Figure 2: UK sources of emissions of greenhouse gases

The international response to concern about climate change was the United Nations Framework Convention on Climate Change, agreed at the 1992 Earth Summit in Rio de Janeiro. This Framework was further strengthened by the adoption of the Kyoto Protocol in 1997 in which developed countries have agreed to reduce their overall emissions of greenhouse gases by 5.2% over the period 2008–2012 (using 1990 as a baseline). These targets are legally binding and were also differentiated between parties: the member states of the European Union agreed to an 8% cut, for example. In addition EU member states decided to meet their commitments jointly under the 'bubble' arrangement, under which the UK has agreed to reduce its emissions by 12.5%.

The Government published its Climate Change Programme in November 2000<sup>5</sup>. This showed that the UK's greenhouse gas emissions were projected to reach 13.5% below 1990 levels by the end of the year 2000. This exceeds the UK's Kyoto Protocol target to be achieved by 2008–2012.

Where the impacts of the policies it puts forward can be quantified, the Government's Programme could cut CO<sub>2</sub> emissions to about 19% below 1990 levels by 2010. However, the UK's reductions in emissions between 1990 and 2000 were achieved in part through a substantial contribution made by fuel switching in energy production from coal to natural gas. This was a once only benefit and further reductions in emissions will be more difficult to achieve. Sustaining progress to 2050 and beyond – moving toward a low-carbon economy – will require fundamental policy shifts. The Agency believes that it will require a whole economy transition, including a significant increase in support for renewable energy technologies, to facilitate this.

<sup>5</sup> The Stationery Office, (November 2000) *Climate change: The UK Programme*.

### Regional differences

Climate change will have profound effects on society and the natural environment. In the UK, scenarios for climate change predict lower summer rainfall in the South East and higher winter rainfall, rising sea levels, more frequent extreme weather events and greater regional variability in climate. The predictions show warming generally being faster in the south east of the UK compared with north west England<sup>6</sup>. Table 1 indicates current regional activity on climate change and the vulnerability of regions to some important climate change impacts.

Table 2 (page 20) indicates the key impacts and trends that climate change will have on the environment.

### 3. The Environment Agency's role

The Agency is in the front line in tackling climate change, both as regulator of processes that give rise to about half of the current emissions of greenhouse gases, and as the body responsible for many functions that will be affected by a changing climate, such as flood defence. The Agency regards climate change as the most significant environmental challenge that it faces. We respond regularly to Government consultations and play an active role in policy development.

To encourage a reduction in CO<sub>2</sub> emissions, the Agency participated in the process that led to energy intensive industries being offered the incentive of lower climate change levies in return for voluntary agreements to reduce energy consumption.

We are keen to ensure complementarity between these agreements and the energy efficiency component of the EU Directive on Integrated Pollution Prevention and Control (IPPC). These measures, together with the domestic carbon-trading scheme, will yield significant energy savings.

### National framework

The Agency's efforts in adapting to the impacts of a changing climate are set in the context of the framework provided by the Department for Environment, Food & Rural Affairs (DEFRA) and the UK Climate Impacts Programme (UKCIP), which includes the Agency on its steering committee.

The Agency has contributed to a series of studies of the likely regional impacts of climate change. These studies allowed us to pool our knowledge with other affected parties and decision-makers.

The four basic scenarios of climate change published by the UKCIP made it possible to ensure a common basis to the regional studies. The scenarios also assisted the Agency in developing its response to climate change in the UK. They were developed by the Hadley Centre at the Meteorological Office and the Climatic Research Unit at the University of East Anglia and are based on the UK Global Climate Model<sup>7</sup>. These scenarios represent some of the most up-to-date simulations of the UK's climate to the end of this century. They are currently being updated to provide greater resolution and to reflect the latest Inter-governmental Panel on Climate Change thinking on emissions.

<sup>6</sup> UKCIP, Hadley Centre and University of East Anglia (1998) *Climate change scenarios for the UK*.

<sup>7</sup> UKCIP, Hadley Centre and University of East Anglia (1998). *Op cit*.

Our role will, of course, change over the lifetime of this *Framework*. For example, a shift to control of greenhouse gases based on carbon trading may result in the Agency playing a verification and/or policing role. In any case, there will clearly be a need to verify, with some precision, the levels of emissions of greenhouse gases.

### **Future initiatives**

The Agency will review the environmental implications of the various options that could contribute to a long term energy strategy for the UK and make an informed contribution to the public debate.

We will improve our understanding of the direct effects of climate change, particularly in terms of changes to sea level and the impacts of an expected increase in storms and rainfall intensity.

Our work on adapting to climate change will include evaluating the protection afforded by existing flood defences against a range of scenarios for climate change. We will also initiate a forum to generate practical guidance for future design standards. If necessary, we will substantially increase our investment in flood defences to maintain the level of protection.

In addition, we will not only lead by example but will also place more emphasis on promoting and sharing our approaches with other public bodies.

### **Policy drivers**

Among the key national and international drivers that will influence our actions over the period of this *Framework* are:

- **International drivers:** United Nations Framework Convention on Climate Change, Kyoto Protocol.
- **European drivers:** The proposed Sixth Environment Action Programme of the European Community 2001–2010. Directives on Integrated Pollution Prevention and Control, Landfill, and Habitats; EU Kyoto agreements on burden sharing and EU voluntary agreements on CO<sub>2</sub> from cars.
- **National and regional drivers:** Climate Change: The UK Programme; UK Sustainable Development Strategy; Utilities Bill; Renewables Obligation; Energy Efficiency Standards of Performance; Climate Change Levy; UK Climate Impacts Programme; Planning Policy Guidance 22 on Renewable Energy.

## **4. Working in partnership**

The Agency works closely on policy development with the Department for Environment, Food & Rural Affairs (DEFRA), the Department of Trade and Industry (DTI), and the National Assembly for Wales (NAW). Our activities are framed by, and help to implement, a range of Government policies and commitments, including its Sustainable Development Strategy (and the supporting strategies and schemes of the DTI and NAW), its Urban and Rural White papers, and Modernising Government and Better Regulation policies. Of specific relevance to this Framework is the Governments' UK Climate Change Programme.



Wherever possible, the Agency will identify partners to further sustainable development through tackling climate change. We already work with a wide range of organisations to make best use of our resources and to help to spread best practice. In particular, under the umbrella of the UK Climate Impacts Programme the Agency is a key player in promoting prudent adaptation to the impacts of climate change through a number of collaborative regional studies. We have played, and will continue to play, an active role in the following regional partnerships and studies:

- *Climate Change Impacts in North West England*
- *Climate Change Impacts in East Midlands*
- *Climate Change Impacts in West Midlands*
- *Climate Change Impacts in the South East of England*
- *The Climatic Challenge: Climate Change Impacts in South West England*
- *Regional Integrated Assessment of Climate Change Impacts in the NW/East Anglia (REGIS)*
- *Scoping Study on Climate Change Impacts in Wales*
- *The impacts of climate change on natural resources – for example the impact on water quality, water resources and conservation*
- *The risks and uncertainties in decision making in the light of climate change*
- *Socio-economic scenarios for assessing the impact of climate change.*

Moreover, the Agency has particularly good links with DEFRA in this area, and we collaborate on policy development and the identification of research needs (see section 7).

The Agency also works closely with a wide range of other public bodies, such as English Nature and the Countryside Agency and the Countryside Council for Wales. We also co-operate with non-governmental organisations (NGOs), such as the National Trust.

Partnerships will, of course, change over time. Regulation of greenhouse emissions will evolve. Changes to the climate change levy and the carbon trading scheme are both possibilities over the lifetime of this *Framework*. In particular, discussions between the Agency and DEFRA could mean that we will play a key role in the scheme for carbon trading.

New partnerships with NGOs are also likely to develop out of the Agency's commitment to support Government in its view that there is a wide range of other groups, organisations and individuals whose contributions will be critical to the success of the UK climate change programme. The Agency will expand its role in influencing public policy to help this process.

## **5. The Environment Agency's objectives**

In *An Environmental Vision*, our overall long-term objective with respect to climate change is that:

*Drastic cuts will have been made in the emission of 'greenhouse gases' such as carbon dioxide; and society as a whole will take account of and be prepared for the probable changes to our climate.*

This *Framework* clearly does not stand in isolation from the others and the need for the Agency to lead by example is a common theme in them all. Consideration of economic instruments and negotiated agreements link this *Framework* to *A 'greener' business world* and *Wiser, sustainable use of natural resources*. Similarly, issues relating to risk and inventories of emissions are a common

link between this report and the *Framework* documents covering *Restored and protected land and healthier soils*; *Wiser, sustainable use of natural resources*, and *A 'greener' business world*.

The *Vision* and long-term objectives will help achieve these outcomes:

- Energy efficiency programmes will be an integral part of all industrial sectors, transport and domestic life.
- 'Greenhouse gas' emissions from all sources will have been quantified and greatly reduced, with an evident trend showing continuous enhancement.
- Energy and transport policies will take full account of their environmental impacts.
- The basis for positive attempts to remove carbon from the atmosphere will be better understood.
- Society will have accepted the reality of climate change, and will be prepared to take the appropriate actions and bear the necessary costs of limitation and adaptation.
- Uncertainty over future impacts of climate change will have been incorporated into long-term decision making, and reflected in environmental standards and targets.
- Environmental needs for water and the continuity of public supply will be in balance as the climate changes.
- Environmental monitoring programmes will provide accurate information on the direct effects of climate change.

We have identified a number of goals we intend to achieve between now and 2008. We will seek to meet these goals in the most efficient and effective manner, taking into account the costs and benefits of the options available to do so.

## 6. Goals and actions

For each outcome we have identified below a number of goals we intend to achieve in the short to medium term in order to move towards the *Vision*. We have also outlined the activities that will help achieve these goals, together with the tests to assess progress in their delivery. In practice, activities may contribute to the achievement of more than one goal and outcome.

### Tests for progress

The Government's set of sustainable development indicators<sup>8</sup> help show, at a high level, whether we are on a sustainable track. The Agency has also developed its own set of environmental indicators<sup>9</sup> that will be used to show progress towards the vision. In addition to these, we have included some key tests for progress for each outcome.

### Role of the Environment Agency

To clarify the role of the Agency in achieving each of these goals, we have allocated the activities to one of three categories:

Environment Agency's role is central
Environment Agency as a substantial partner
Environment Agency's involvement to build understanding

<sup>8</sup> DETR (1999) *Quality of life counts. Indicators for a strategy for sustainable development for the UK: a baseline assessment*.

<sup>9</sup> Environment Agency (July 2000) *Environmental Indicators*. A set of Environmental Indicators for Agency use. (also available on the Agency's website at <http://www.environment-agency.gov.uk>)

**Energy efficiency**

**Outcome 1 – Energy efficiency programmes will be an integral part of all industrial sectors, transport and domestic life.**

**Tests for progress:**

- Proportion of industry with energy management programmes.
- Fuel efficiency of vehicles in the UK.
- Numbers of houses with unsatisfactory energy efficiency.
- The heating requirement of the average UK building.
- Use of combined heat and power.

GOAL	ACTIVITY
<p>Goal 1.1 The focus is maintained on improving the efficiency of energy use and distribution as a key means of reducing fossil-fuel emissions and reducing energy demand.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Ensure that energy efficiency is actively reviewed and improved at all regulated sites, including the productive use of excess heat</li> <li>• Support partnerships to promote domestic energy efficiency; highlight the need for improved energy ratings for new houses.</li> <li>• In partnership with the Energy Saving Trust, strengthen energy efficiency education with industry and the public.</li> </ul>

**Environment Agency's role is central**

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**Reduce emissions**

**Outcome 2 –Greenhouse gas emissions from all sources will have been quantified and greatly reduced, with an evident trend showing continuous enhancement.**

(see also Framework document A 'greener' business world)

**Tests for progress:**

- Reduction in the emissions of the comprehensive inventory of greenhouse gases.

GOAL	ACTIVITY
<p>Goal 2.1 Those industries we regulate under national and European law meet all legal requirements, to ensure a level playing field.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Finalise arrangements for satisfying IPPC requirements within the climate change levy agreements and the greenhouse gas emissions trading scheme.</li> </ul> <p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Introduce IPPC (phased to 2007).</li> <li>• Fully implement IPPC: energy efficiency and named greenhouse gas emissions for Agency-regulated sites being reduced to contribute to meeting Government climate change targets.</li> </ul>
<p>Goal 2.2 Lists produced of the most relevant industrial sites and report on their performance, to build environmental performance as a key issue for industrial competitiveness.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Agree with stakeholders the procedure for classification of industrial site priorities.</li> <li>• Publish details of the performance of the most relevant industrial sites.</li> </ul>
<p>Goal 2.3 The emissions of other greenhouse gases reduced as part of the regulatory process, so that all stakeholders play their part.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Reduce greenhouse gas emissions from Agency-regulated sites.</li> <li>• Build requirement for estimation of greenhouse gas emissions into regulatory reviews of permits.</li> </ul>
<p>Goal 2.4 The relative role of different greenhouse-gas emissions from all sources continually reviewed, to ensure fair play and that everyone plays their part, and to give industry benchmarks to strive for in improving their environmental performance.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Use the Agency Pollution Inventory to provide an estimate of the releases of greenhouse gases from Agency-regulated processes, with an understanding of the uncertainty attached to such estimates.</li> <li>• Assess the options for controlling industrial releases of greenhouse gases other than CO<sub>2</sub>.</li> </ul>
<p>Goal 2.5 The spreading of best practice assisted – by measuring the success of our regulatory role – including regulation of methane emissions from landfill sites. These estimates compared with those made by others for other sources.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Review the programme to monitor reduction of methane emissions.</li> <li>• Compare internal estimates of Agency-regulated emissions with estimates made by others.</li> <li>• Contribute to a programme to monitor methane and N<sub>2</sub>O from agriculture, forestry and land use.</li> <li>• Use regional partnerships to encourage the public to reduce the amount of domestic waste.</li> </ul>

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**Reduce emissions** *continued*

<p>Goal 2.6 League tables of greenhouse gas emissions from regulated sources produced and placed on the internet, so that best practice can be identified and promoted.</p>	<p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Produce league tables of named greenhouse gas emissions and place them on the internet.</li> <li>• Update the internet site on a regular basis in consultation with industry.</li> </ul>
<p>Goal 2.7 Estimates of methane emissions improved. Operators of landfill sites required to reduce emissions, by better management of the gases emitted and through reducing the amounts of biological waste deposited in them, so that landfill operators can improve their environmental performance.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Promote improvements in methodology for estimating methane emissions with landfill site operators; continue to push for reduction in methane emissions.</li> </ul> <p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Implement the Landfill Directive to timetable; publicise improvements in the reduction of biodegradable materials going to landfill as a result (see <i>Framework</i> document <i>Wiser, sustainable use of natural resources</i>).</li> </ul>
<p>Goal 2.8 Emissions from landfill sites compared across the country, so that operators can benchmark and improve environmental performance, by spreading best practice.</p>	<p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Initiate site benchmarking after agreeing the methodology with operators.</li> </ul>
<p>Goal 2.9 Waste reduction and management practices will have targets set in relation to emissions of greenhouse gases and energy use so that the waste sector plays its full part. Attention will be focussed on the roles of different forms of waste management.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Examine, in each region, the role of the waste sector, outlining how the region intends to move forward and giving clear details of its relationship and links within the Agency and with other regional partners.</li> <li>• Encourage the waste sector to set targets for the reduction of greenhouse gas emissions and energy use in the context of a long-term vision (see <i>Framework</i> document <i>Wiser, sustainable use of natural resources</i>).</li> </ul>
<p>Goal 2.10 More attention will be paid to diffuse sources of emissions, so that all sectors of the economy play their part.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Encourage better monitoring and source identification.</li> <li>• Build partnerships with stakeholders to help to take forward the Agency's long-term vision.</li> </ul>
<p>Goal 2.11 The Agency will lead by example. Emissions of greenhouse gases from our own activities assessed and published, showing to what extent we have succeeded in reducing them per unit of our own activity.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Publicise and have a programme of improvement for the emissions inventory from the Agency's activities.</li> <li>• Reduce the Agency's business mileage (by seven per cent in 2001/02 using a 1996/7 baseline); pioneer the use of a total emissions to air model; ensure that three per cent of the vehicle fleet use alternative fuels; and ensure that 1.2 million kWh of electricity used by the Agency is generated from renewable sources.</li> </ul>

Environment Agency's role is central

Environment Agency as a substantial partner

Environment Agency's involvement to build understanding

**Energy and transport**

**Outcome 3 – Energy and transport policies will take full account of their environmental emissions.**

**Tests for progress:**

- Percentage of electricity generated from renewable sources.
- Clear Government strategy to work towards a long-term energy vision for the UK, in which emissions of greenhouse gases arising from different energy sources are fully taken into account, both in energy pricing and in wider policy developments.

GOAL	ACTIVITY
<p>Goal 3.1 The most effective mixture of economic measures, negotiated agreements and direct regulation to reduce industry's emissions of greenhouse gases determined.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Explore these issues with DETR, DTI, HM Treasury, HM Customs and Excise and industry sectors. Identify data and data validation needs (see <i>Framework</i> document <i>A greener business world</i>).</li> </ul>
<p>Goal 3.2 Options that can be applied to different industrial sectors produced and related to other efficiencies that could be derived in the overall efficient use of energy. Fair but firm regulation thereby developed.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Provide guidance, promote best options, and seek to influence others, and build these into reviews of sectors.</li> <li>• With Government and industry support the implementation of the carbon trading scheme.</li> </ul> <p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Promote, with industry, the adoption of Combined Heat and Power schemes.</li> </ul>
<p>Goal 3.3 The development of renewable energy encouraged and developed, in particular the achievement of the target of 10% of electricity from renewable sources by 2010.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Support the development of renewable energy through our own purchase of renewable electricity (1.2 million kWh in 2001/ 2002).</li> <li>• Participate in the development of regional renewable energy targets.</li> </ul> <p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Contribute to environmentally sensitive development of small-scale hydropower projects.</li> <li>• Ensure recognition and minimisation of the environmental impact of renewable energy developments.</li> </ul>
<p>Goal 3.4 Greater debate on the lifetime impact of different energy sources, the use of non-renewable resources, and the environmental impact as seen from all points of view promoted, with natural and social science at the heart of the debate on energy policy.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Run active campaigns for change, including educational activity.</li> <li>• Carry out research with stakeholders on environmental impacts of different energy sources, within a strategy to reduce greenhouse gases.</li> <li>• Promote an Agency view on the environmental impact of long-term energy supply, consistent with findings of study.</li> </ul> <p><b>Medium term:</b></p> <ul style="list-style-type: none"> <li>• Liase with stakeholders on the best way to promote a "sustainable energy future" in the UK.</li> </ul>

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**Removing CO<sub>2</sub>**

**Outcome 4 – The basis for positive attempts to remove carbon from the atmosphere will be better understood.**

**Tests for progress:**

- Consensus reached on the value of options for carbon sequestration.

GOAL	ACTIVITY
Goal 4.1 The focus on the environmental integrity of carbon sequestration options maintained, to avoid taking unacceptable risks.	<b>Short to medium term:</b> <ul style="list-style-type: none"> <li>• Support and provide careful comment on research and development into the science and technology of carbon sequestration.</li> </ul>

**Environment Agency's role is central**

Environment Agency as a substantial partner

Environment Agency's involvement to build understanding

**Social acceptance and action**

**Outcome 5 – Society will have accepted the reality of climate change, and will be prepared to take the appropriate actions and bear the necessary costs of limitation and adaptation. (See also Outcome 7 on meeting needs for water)**

Tests for progress:

- A comprehensive programme in place throughout England and Wales for adapting to climate change.
- The Agency will have in place a comprehensive programme for adapting to climate change for all of its functions.

GOAL	ACTIVITY
<p>Goal 5.1 The future protection afforded by existing flood defences evaluated against a range of predictions of climate change, so that the desired level of protection can be negotiated with a full range of stakeholders.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Produce an action plan for the Agency for flood defence, addressing the implications of climate change.</li> <li>• Promote understanding of the impact of climate change within flood awareness campaigns.</li> <li>• Evaluate the future protection afforded by existing flood defences against a range of climate change scenarios. Initiate forum to generate practical guidance for new design standards.</li> <li>• Review investment necessary to maintain level of protection (see <i>Framework document Reducing flood risk</i>).</li> </ul>
<p>Goal 5.2 A list of areas around the coast where we consider that it is unlikely to be appropriate to maintain publicly funded defences produced for discussion, so that informed debate can take place.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Evaluate areas around the coast where the maintenance of publicly funded flood defences is unlikely to be appropriate.</li> <li>• Promote, in our regions, the sustainable options they have adopted for flood defence – including managed retreat.</li> <li>• Begin to implement adaptation programme (see <i>Framework document Reducing flood risk</i>).</li> </ul>
<p>Goal 5.3 An improved understanding of the impacts of climate change.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• A detailed analysis of the vulnerability of each of the Agency’s functions to climate change that identifies priorities for action and options for adaptation.</li> <li>• An analysis of current and potential flood risks that reflect the implications of climate change and which would inform a 3-year review of PPG25.</li> <li>• Build partnerships with stakeholders, and provide environmental expertise to regional evaluations of the impact of climate change.</li> </ul>
<p>Goal 5.4 Systems more resilient to climate change through better land management.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Promote conservation objectives within the wider countryside; promote best management practices.</li> <li>• Link conservation sites through wildlife corridors to improve resilience (see <i>Framework document An enhanced environment for wildlife</i>).</li> </ul>

- Environment Agency’s role is central
- Environment Agency as a substantial partner
- Environment Agency’s involvement to build understanding



**Dealing with risk and uncertainty**

**Outcome 6 – Uncertainty over future impacts of climate change will have been incorporated into long-term decision making, and reflected in environmental standards and targets. (See also Outcome 7 on meeting needs for water).**

Tests for progress:

- Transparent process for setting environmental standards and targets, which takes account of risks and uncertainties.
- Policy and political debates over long-term decision making includes discussion of risk and uncertainty.

GOAL	ACTIVITY
Goal 6.1 Identification of key priorities for adaptation at a regional level.	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Make an assessment of the sensitivity of the Agency regional operations to climate change and identifying adaptation priorities in association with other regional partners.</li> <li>• Demonstrate integration of guidance on decision making which takes into account the risk of climate change and the uncertainty inherent in forecasting medium- and long-term impacts of climate change.</li> <li>• Promote and contribute to regional "Partnerships for Change".</li> <li>• Promote and implement locally derived plans.</li> </ul>

**Meeting needs for water**

**Outcome 7 – Environmental needs for water and the continuity of public supply will be in balance as the climate changes.**

Tests for progress:

- Maintenance of public supply.
- River flows.
- River water quality.

GOAL	ACTIVITY
Goal 7.1 Water companies' and other major water users' resource plans tested and made robust against a range of predictions of climate change, thereby demonstrating ability to maintain water supply without unacceptable environmental and social impacts. This will assist water companies in carrying out environmental benchmarking.	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• <b>Complete the second stage analysis of the impacts of climate change for water resources. Utilise the thinking of the National Centre for Risk Analysis and Options Appraisal. Consult water companies and other major water users.</b></li> <li>• Evaluate robustness of each water company's water resources plan and drought plan, and resource plans of other major water users, against a range of scenarios for climate change.</li> <li>• Increase promotion of measures that reduce demand to address potential water shortfalls.</li> <li>• Promote improvements by water companies and other major water users. Take forward with respect to OFWAT/AMP4 process (see Framework document <i>Improved and protected inland and coastal waters</i>).</li> </ul>

**Environment Agency's role is central**

Environment Agency as a substantial partner

Environment Agency's involvement to build understanding

**Monitoring the environment**

<p><b>Outcome 8 – Environmental monitoring programmes will provide accurate information on the direct effects of climate change.</b></p> <p><b>Tests for progress:</b></p> <ul style="list-style-type: none"> <li>• Peer review demonstrates that the Agency’s methodologies for environmental monitoring are consistent with best practice.</li> <li>• Opinion surveys of stakeholders demonstrate that the Agency’s environmental monitoring is valued and is seen to be accurate.</li> </ul>	
GOAL	ACTIVITY
<p>Goal 8.1 Predictive models improved and a greater sense of urgency achieved.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Report on the Agency’s work plan for monitoring climate change. Explore with others opportunities for appropriate monitoring partnerships.</li> <li>• Develop and promote better techniques, for example through remote-sensing of land use, landform and algal/nutrient status of coastal waters. Take forward new monitoring partnerships.</li> <li>• Promote key aspects of the Agency’s environmental information – and its accuracy/robustness – with the general public and media as part of strategy for education and influencing opinion.</li> <li>• Review environmental monitoring programme with stakeholders.</li> </ul>
<p>Goal 8.2 The likely effects on those wildlife and natural habitats for which we have direct responsibilities, assessed, particularly in the aquatic environment.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Maintain and refine the water quality and quantity monitoring arrangements necessary to inform targeting and achievement of this goal.</li> <li>• Examine the implications of climate change on water quantity and quality. Build findings into all forthcoming consent and licence reviews.</li> <li>• Ensure that water resources strategies are robust against the range of possible climate change scenarios.</li> <li>• Define ecologically acceptable river flows to protect fish stocks and fisheries.</li> <li>• Develop and disseminate best practice for fishery managers to provide options for a sustainable response to projected climate change.</li> <li>• Assess indirect impacts on habitats from increased recreation and navigation (see <i>Framework document An enhanced environment for wildlife</i>).</li> <li>• Assess with English Nature and the Countryside Council for Wales the likely effects on those wildlife and natural habitats for which the Agency has direct responsibilities, particularly in the aquatic environment. Develop a joint policy statement on climate change on terrestrial riverine and coastal Natura 2000 sites.</li> <li>• Work with DEFRA to develop policies to promote the migration of species and their re-establishment in more suitable areas.</li> </ul>

**Monitoring the environment** *continued*

<p>Goal 8.3 Baseline information at key environmental sites obtained to a high level of accuracy and precision – to record the effects of climate change.</p>	<p><b>Short to medium term:</b></p> <ul style="list-style-type: none"> <li>• Publish the Agency's baseline information at key environmental sites.</li> <li>• Assess the impact of climate change on water-based recreation and navigation.</li> </ul>
<p><b>Environment Agency's role is central</b></p> <p>Environment Agency as a substantial partner</p> <p>Environment Agency's involvement to build understanding</p>	

**7. Research and development**

The Agency's R&D programme will make a clear contribution to delivering this *Framework*.

Climate change R&D includes:

- An *Uptake Study* will build on *The Implications of Climate Change for the Agency* (R&D publication number 22) to determine the extent of business risk posed by climate change at a functional level (E2A(00)01).
- Improve our understanding of the releases of greenhouse gases to the atmosphere from processes that we regulate. This will yield important data on the cost of abatement options that will allow us to target regulatory effort where it has the greatest impact (P4A(99)05).
- *Integrated regional assessment of climate change impacts*. Collaborative work on adapting to the regional impacts of a changing climate – set in the context of DETR's UK Climate Impacts Programme (UKCIP), on whose steering committee we are represented (E2A(00)09).
- *Future climate change impacts and uncertainty – risk based methodologies and tools to aid decision making*. Develop approaches to dealing with the risks and uncertainties – for example, of changing flood zones or intense rainfall events – that are inherent in climate change science (E2B(99)05).
- *Long-term reference sites for monitoring climate change and other key monitoring programmes* (E1A(99)01) and a *Study of the impact of sea-level rise on coastal processes* which create our important inter-tidal wildlife habitats.
- *Climate change and the demand for water* (DEFRA-sponsored research): the Agency is represented on the steering group of this project, which is looking at demands from public water supply, agriculture, industry and recreation.

**8. Implications for the Environment Agency**

It will take partnership at varying levels to achieve our environmental outcomes for climate change. None of the outcomes are entirely within our power. Some, such as outcome 2 on quantification and reduction of emissions of greenhouse gases from all sources, depend in part on persuading the Government to introduce legislative changes.

Most outcomes, for example, numbers 1 and 3 on energy and transport, require working with or influencing others. Successful delivery will therefore require the Agency to:

**Expertise and awareness**

- Increase awareness internally of the relevance of climate change.
- Increase technical understanding of risks and uncertainties in climate science.

- Increase awareness in the Agency of international impacts of climate change and how they may influence the UK.
- Develop skills in communicating to the media the issues surrounding climate change.

### **Policies and strategies**

- Develop and implement a strategy for responding to environmental stresses such as rising sea levels, greater intensity and duration of storms, water stress and the protection of habitats.
- Develop a policy for taking practical decisions on appropriate design criteria for new and refurbished flood defence structures, despite the inherent uncertainty of future conditions.
- Develop and implement a strategy for climate change R&D, with more support for work focussed on implementing the results or on regional collaboration.
- Develop and implement an Agency policy to ensure greater co-ordination at head office level on climate change.
- Develop a long-term vision of the environmental issues in a sustainable energy system for the UK.
- Develop a policy on risks and uncertainties in decision making in the light of climate change.

### **Monitoring and reporting**

- Reporting on releases to air from Agency controlled processes, in relation to releases from other sources, through the National Atmospheric Emissions Inventory.
- Co-ordinate a programme of monitoring, measuring and reporting on changes to the natural environment.

### **Knowledge**

- Develop a clear ownership, across the Agency, of responsibilities for climate change and share this with partners.
- Improve understanding of the technological options for controlling industrial releases of greenhouse gases other than carbon dioxide (nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) and how they might be controlled under the IPC/IPPC Directive.
- Improve understanding of technologies for methane capture and the potential for reducing emissions from landfills by methane oxidation.
- Improve understanding of technologies for carbon sequestration.

### **Influencing and education**

- Liaison with others to communicate a consistent message.
- Play a role in educating the public, so that society accepts the reality of climate change, and is prepared to bear the necessary costs of limitation and adaptation.
- Play a role in influencing public policy, with a focus on ensuring that all sectors of the UK play their part in addressing climate change.
- Raise public awareness about the link between climate change and events such as an increased incidence of flooding or greater restriction on summers water usage.
- Make an informed contribution to public debate on the environmental implications of long-term energy policy for the UK.
- Influence industry, the public sector and other partners to promote energy efficiency.

### New and revised regulations

- Focus more on energy efficiency, through the shift from regulation from Integrated Pollution Control (IPC) to Integrated Pollution Prevention and Control (IPPC).
- Interact more with other regulators to ensure our roles are complementary.
- Work with Government to ensure the environmental credibility of the carbon trading scheme.
- Work with Government to encourage the development of energy and transport policies where prices take better account of climate change.

### The Planning System

- Work in partnership with DEFRA on R&D to examine the role of the planning system in adapting to climate change and reducing emissions of greenhouse gases.
- Contribute to guidance on good practice for planning for the impacts of climate change.

### The bottom line

Climate change will affect us all. The Agency will play a key role in helping the UK prepare for climate change. We have set down our proposals in a series of ambitious goals. It is up to all of us to take action to limit climate change and adapt to its impacts.

**TABLE 1: Regional analysis**

Issue	Anglian East	Midland West	North	North West	Southern	South	Thames	Wales
Produce regional inventory of greenhouse gas emissions	X	X	X	✓	X	X	X	✓
Produce study into regional impacts of climate change	✓	✓	X	✓	✓	✓	✓	✓
Flood risk	M	M	H	M	M	L	H	L
Public water supply demands and availability	M	H	L	M	M	M	H	L
Sea level rise	H	N/A	M	L	H	M	H	M
Emissions of CO <sub>2</sub> from major industry	M	H	H	M	M	L	L	M
Emissions from transport	M	H	M	M	L	L	H	L

#### KEY

Regions with the greatest risks are denoted H (high) and the Regions with relatively low stress, L (low). The other Regions are designated M (medium). X means no progress and progress made.

Source: Environment Agency (2000). *Environment 2000 and Beyond*.

**TABLE 2: The state of the environment – key impacts and trends**

Viewpoint	State and trends
<p><b>Land use and resources</b></p>	<p><b>Changes to temperature and precipitation:</b> Air temperatures in the UK are increasing by between 0.1°C and 0.3°C per decade. In all scenarios, there is a SE-NW gradient for both precipitation and temperature change – the greatest precipitation and temperature increases being in the NW and SE respectively. This will result in a change in the types of crops grown, which may require different amounts of water. Changes are also likely in species composition. Salmon for example may become scarcer in southern England with species of coarse fish, such as chub and barbel, becoming more prominent.</p> <p><b>Impacts on water resources:</b> Climate change will affect the availability of water stocks, particularly in summer, and groundwater recharge. Water demand for crops will increase due to the need to irrigate in drier and warmer areas, although changes in the types of crops will change the amount of irrigation required. Protected fish species, such as bullheads, may suffer because of lower summer flows in smaller streams. Trout populations are likely to suffer further declines in the south. There is also more likelihood of summer kills – due to algal blooms or low oxygen levels – affecting both game and coarse fish.</p> <p><b>Sea level rise:</b> Climate change is predicted to bring rises in sea levels. The level is rising relative to the land at a rate of 4mm/year in the north west and north east (north of Flamborough Head), 5mm/year in the south west and 6mm/year in Anglian, Thames, Southern and North East regions (south of Flamborough Head).</p> <p><b>Clay soil shrinkage:</b> Clay soils could shrink in dry summers as a result of climate change, causing building subsidence, while an increase in severe storms would mean more property damage.</p>
<p><b>Key biological populations</b></p>	<p><b>Impacts on wildlife:</b> Warming of the UK’s climate has been linked to, among other things, earlier spring leafing of oak trees, earlier emergence of insects and earlier egg laying by 20 out of 65 species of birds.</p> <p>Increased air temperatures may result in a northward shift of natural habitats by 50km to 80km per decade, which could affect species abundance including soil organisms. Further climate change is likely to put some rare habitats and species at risk, as many of the areas to which they would migrate have now been developed. It is very likely that over the medium and long terms, the special interest features at Natura 2000 sites may well decline to a point where the site is no longer outstanding for that feature.</p> <p><b>Impacts on coastal habitats:</b> Both terrestrial and marine coastal habitats could be threatened by a northward shift. The potential effects of climate change on ocean circulation, fish populations, spawning and growth could also cause fundamental shifts in the distribution and abundance of different fish stocks. Increased water demand due to climate change may result in further abstraction from rivers, which could have important consequences for estuarine ecosystems.</p> <p><b>Impacts on wetlands and soils:</b> Climate change may result in wetland habitats drying out, but other “Mediterranean-type” habitats may be created over a long period.</p> <p><b>Impact of sea level rise:</b> A rise of 200mm without appropriate sea defences would cause losses of freshwater habitats in the Somerset levels, Fens and Broads, and may lead to saline intrusion into coastal aquifers reducing groundwater abstraction yield. Such a rise is exceeded in the UK Climate Impacts Programme 1998 medium–low scenario for the 2050’s.</p> <p>Fish stocks are likely to change in coastal waters with new species moving further north. Rising sea level, particularly in the south east is likely to cause significant reductions in inter-tidal habitats such as saltmarshes with effects on flora and fauna.</p>

**TABLE 2: The state of the environment – key impacts and trends** *continued*

<b>Compliance with standards, targets and classification schemes</b>	<p><b>Atmospheric concentrations of greenhouse gases:</b> By 2100 carbon cycle models project atmospheric CO<sub>2</sub> concentrations of between 540 and 970 ppm depending on the scenario. These levels would be 90 to 250% above the pre-industrial (1750) CO<sub>2</sub> concentration of 280 ppm. The same scenarios project an increase of between 1.4 and 5.8°C in globally averaged surface temperature over the period 1990 to 2100.</p> <p><b>Compliance with Kyoto target:</b> The UK is on course to more than meet its target under the Kyoto agreement to reduce emissions of greenhouse gases by 12.5 per cent from the 1990 baseline by 2008–2012.</p> <p><b>Soil releases:</b> The release of greenhouse gases from soil threatens the UK's ability to meet its targets for reduced emissions. Higher levels of carbon dioxide in the atmosphere and climate change could increase breakdown rates of organic matter and the release of carbon dioxide to the atmosphere.</p>
<b>Human and environmental health</b>	<p><b>Pests and diseases:</b> Higher air temperatures in the UK may result in an increase in exotic pests and diseases, such as mosquitoes and malaria. In addition, lower river flows mean less dilution of pollutants, although higher temperatures should make sewage treatment processes more effective.</p> <p><b>Ozone episodes:</b> Higher temperatures could increase emissions of volatile organic compounds and photochemical reaction rates, so increasing the frequency or severity of episodes of raised ozone concentrations.</p> <p>More periods of high pressure in the UK and Europe could also increase summer ozone episodes fed by pollutants from the continent and winter episodes from the build-up of nitrogen oxides and particles.</p> <p>Changes in atmospheric conditions could also alter the impacts of industrial plumes.</p> <p><b>Acidification:</b> Acidification could be increased by higher or more intense rainfall, increasing the annual or short-term deposition of pollutants. A higher frequency of droughts could increase oxidation of organic sulphur and nitrogen in the soil, increasing the flow of strong acids into surface waters.</p> <p><b>Sewer overflows:</b> Increased flooding caused by storms could increase their frequency.</p> <p><b>Soil erosion:</b> More frequent extremes of rainfall or drought could increase soil erosion.</p>
<b>Long-term reference sites</b>	<p><b>Environmental monitoring:</b> Long-term reference sites are necessary for monitoring climate change and its impacts.</p>
<b>Aesthetic quality</b>	<p><b>Tourism and recreation:</b> Predicted changes in the UK's climate will enhance the potential for tourism and recreation, especially in the south, which is set to become warmer and where a large proportion of the population lives. This may increase the demand for access to the countryside and increased environmental stress on the coast.</p>

Sources: Environment Agency (1998, 1999, and 2000)

*The State of the Environment of England and Wales: Fresh Waters, Coasts, the Land and the Atmosphere.*









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