

LIVING IN THE GREENHOUSE

- *How is the climate likely to change?*
- *How significant will these changes be?*
- *What adaptations can be made?*

Much attention has been focussed on how emissions of greenhouse gases can be reduced, to avoid 'dangerous' interference with the climate. However, at least some degree of climate change is inevitable, and little has been done to address this. Current scenarios of climate change in the UK suggest that its effects could be widespread, but to date, there has not been much attention given to what may need to be done to adapt to these changes.

This note is a summary of a longer report prepared by POST, which reviews the likely effects of climate change in the UK, and considers ways in which adaptations to change could be developed.

THINGS TO COME?

In 1996, the Government's Climate Change Impacts Review Group (CCIRG) published its review of the likely effects of climate change in the UK. This suggested that there would be noticeable changes. Key responses to these could include:

- coping with extreme weather-related events (such as storms, floods and landslides);
- managing agriculture to respond to changing conditions;
- safeguarding public health against disease, heatstroke, food poisoning, etc.;
- conserving water resources, especially in the south of England;
- innovating in construction and urban design to minimise the effects of increased temperatures, higher wind speeds, flooding, etc..

More recent scenarios indicate that perhaps the most serious changes are likely to result from an increase in the frequency and magnitude of extreme weather-related events, rather than smaller changes in average conditions. Because the predictions of climate change rely on computer models, combined with scenarios of possible future emissions of greenhouse gases, the scale, timing and location of these changes is uncertain. Also, the expected changes are not likely to be uniform across the country. Indeed, temperatures by the 2050s across southern England may increase by 0.9-2.6 degrees Celsius (deg C), while those in northern



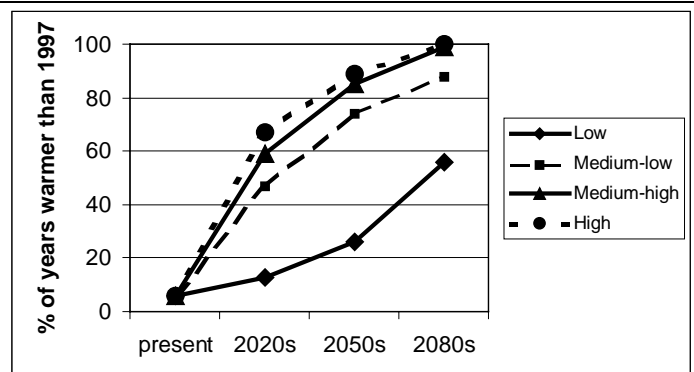
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Report Summary

December 1998

Scotland would rise by between 0.7 and 1.9 deg C. Similarly, precipitation in the south will decrease, and increase in the north. An example of the effects expected under the most recent scenarios prepared for the Government-sponsored UK Climate Impacts Programme (UKCIP) is shown in **Figure 1**.

FIGURE 1 THE FREQUENCY OF HOT YEARS IN THE UK



Source: Hadley Centre and Climatic Research Unit

1997 was the third warmest year on record over the UK, (1.1 deg C above the average between 1961 and 1990).. On current records, a '1997 year' would be expected once every 17 years. Under the UKCIP scenarios (Low to High), by the 2080s, such years would occur with increased frequency. For instance, even under the Low scenario, these would occur every 2 years, and nearly every year for the other scenarios – **so exceptional conditions are likely to become normal.**

RESPONDING TO CHANGE

There are three ways in which humans can respond to climate change:

- **Prevention (mitigation)** to reduce or off-set emissions of greenhouse gases to prevent or delay the changes taking place, or to minimise them if they are to occur;
- **Protection (adaptation)** of human and natural systems to protect against the adverse effects and enhance the benefits of change;
- **Acceptance** of change and taking no action.

If the worst forecast effects of climate change actually occur, no society is likely to allow such impacts without some response, either by mitigation or adaptation.

Uncertainties in climate modelling, impact assessment, cost-benefit analysis and the effectiveness of international efforts to curb emissions are so large that

opting solely for the mitigation approach is not guaranteed to achieve success. Thus, the Intergovernmental Panel on Climate Change (IPCC) regards it as **prudent to develop responses to climate change based on both mitigation and adaptation.**

IPCC has set out a 7- step guidance to adaptation:

- define the objectives
- specify important impacts
- identify adaptation options
- examine constraints
- quantify measures and formulate alternative strategies
- weigh objectives and evaluate tradeoffs
- recommend adaptation options.

Again, because of the large uncertainties surrounding the possible scale, timing and extent of climate change, it is not currently possible to identify precisely what adaptations are necessary. However, as a starting point, the work of the UKCIP aims to provide integrated assessments of the effects of climate change, bringing together individual studies focussed on individual sectors into a more holistic view. However, before deciding what adaptations are necessary and how to implement them, decisions are needed on whether adaptation is warranted in the first place. This will require **a set of criteria against which the significance of the impacts can be judged.** Only those exceeding the criteria will merit a response.

Possible ways of adapting to the 6 key effect areas listed above, are summarised in **Box 1.**

THE OVERALL EFFECTS OF CHANGE

Assessments of the effects of climate change can take one of two forms:

- **sectoral** – where only the impacts on individual sectors (e.g. conservation, water resources, industry, insurance, forestry and agriculture) are assessed
- **integrated** – where the cross-links between sectors are taken into account (e.g. the interactions between agriculture, water resources, biodiversity and flood and coastal defence).

In a sectoral assessment, the outcome will be a series of stand-alone statements of the effects, their significance, and any necessary adaptations. An integrated assessment, as well as statements of sectoral impacts, can consider the effects on the UK as a whole (or at least regionally). However, while this sounds like an ideal outcome, it is not practicable to define an overall level of impact across so many diverse sectors – especially where there are likely to be both ‘winners’ and ‘losers’.

BOX 1 THEMES IN ADAPTATION TO CLIMATE CHANGE

Coping with Extremes

The most important impacts may result from increased magnitude and frequency of extreme events (such as high winds, heavy rainfall, flooding, and landslides). However, there has been no comprehensive assessment of changes in the likelihood of these events occurring in the UK. This is a very difficult and somewhat speculative area, because the large uncertainties in climate models mean that it is not possible currently to link any one event to climate change. Nevertheless, the insurance and construction industries have started to undertake research into aspects such as the postulated additional risks from flooding and subsidence.

Protecting Natural Areas

Climatic zones are likely to shift northwestwards by 50-80km per decade, so many species of plants and animals would have to migrate to remain in the conditions to which they are suited. Adaptive responses could include providing stepping stones and corridors of appropriate habitat along which mobile species could move. One difficulty is that the current nature conservation framework is based on maintaining specified sites as they are. Under the rapidly altering conditions that climate change might bring, a new approach to conservation would be needed.

Managing Agriculture

Agriculture would also be affected by a northwestwards shift of climatic zones. Additionally, crop yields may be affected by ‘fertilisation’ by CO₂, longer-lived pests and diseases, and wetter winter conditions. Agriculture has been adapting to changes resulting from many factors other than climate change for many thousands of years. Changes in market conditions (particularly related to the Common Agricultural Policy) are the most important drivers, and larger impacts on this sector might result from such changes., rather than from climate change itself.

Safeguarding Public Health

Direct effects could include more heat-stroke and increases in vector and water-borne diseases, and in food poisoning. However, winter mortality due to cold is likely to decrease. There might also be indirect effects, such as stress resulting from flooding, or loss of life and property. Possible UK adaptations may involve managing sewage during extreme rainfall, managing wetlands to control mosquitoes that may carry malaria, improving ventilation in buildings and improving public education (e.g. relating to behaviour during heat-waves and food hygiene).

Conserving Water Resources

As rainfall patterns across the country change, the south is expected to become more deficient in water, but the effects on actual yields (the amount of water available for supply) are uncertain. Water resources are already under pressure (in the absence of noticeable climate change), due to demographic and lifestyle changes. Adaptations could include improving predictions of yields, controlling leaks, providing new supplies, and encouraging demand management (e.g. through the use of water-efficient appliances).

Innovating in Construction and Urban Design

Effects here include those on people inside buildings, on the buildings and other constructions, and on the construction process. Adaptations include ensuring adequate ventilation and internal environmental conditions (e.g. more air-conditioning); strengthening buildings against higher winds and rain penetration; improving foundations against soil shrinkage and swelling; and managing construction during periods of high winds and rainfall. Fewer working days are likely to be lost as the result of extreme cold. Some adaptations are already being made, particularly in relation to Building Regulations dealing with foundations, ventilation and energy efficiency.

This is a debate that has featured prominently for many years in developing methods for environmental assessment. Early attempts to define overall impacts were fraught with difficulty. These often involved spuriously precise and subjective judgements by analysts to quantify the magnitude and significance of impacts. These resulting scores were then combined to derive an overall impact 'grand' score - the plan or policy with the lowest 'grand' score being the one recommended for adoption. Such approaches soon lost credibility, so that methods became more descriptive, rather than numerical, with the overall assessment left very much to the political negotiations involved in making planning decisions.

The quest for a single measure of impacts has not faded, however, and a body of research into environmental economics has built up. Here, attempts are made to identify the monetary 'value' of many environmental and social 'assets', and then to combine these into traditional assessments of costs versus benefits. While progress has been made in some areas, many (including DETR) consider the approach as still in its infancy, and that the 'Holy Grail' of a fully operational environmental economics remains elusive. Similarly, many would prefer an approach based on quantitative risk assessments for assessing the significance of change. However, in its 21st report, the Royal Commission on Environmental Pollution (RCEP) that *"no satisfactory way has been devised of measuring risk to the environment, even in principle, let alone defining what scale of risk should be regarded as tolerable."*

This view is reflected by the IPCC, which considers that a risk-based approach to dealing with climate change, involving attempts to place probabilities on the likelihood of different scenarios being realised, is flawed, and should not be pursued. Therefore, the lack of comprehensive rigour involved in environmental economics and risk assessment, taken together with the very large uncertainties surrounding the possible effects of climate change, suggest that **making a simple statement of the overall significance of the impacts of climate change is not practicable at this time.**

STRATEGIES FOR ADAPTATION

Developing a Framework

- Where adaptation is warranted, various issues arise:
- **drivers of adaptation** - the direction, extent or rate of change; and the relative importance of climate change compared with other social, economic and technological changes

- **the aims of adaptation** - e.g. re-establishing circumstances to how they were before climate change; minimising harm; reducing vulnerability; enhancing resilience; or making changes that contribute to wider objectives such as 'sustainable development'
- **location of the adaptation** - e.g. global, regional, national, sub-national, local, or at the level of the individual enterprise
- **extent of the adaptation** - e.g. although an effect may be large, it may not be significant, and only a minor 'tweaking' of current systems may be required
- **timing of adaptation** - e.g. if the nature, scale and significance of impacts can be predicted reliably, it may be possible to anticipate the impacts and plan accordingly. Alternatively, adaptations may be possible as the changes occur
- **adaptation methods** - e.g. whether adaptations to climate change will need to be planned, or will take place unconsciously (so-called 'autonomous' adaptation).

Climate change will not happen overnight, and will not result in a simple switch from current conditions to a new stable set of conditions. Climate change is anticipated to be a gradual and continual process that may last throughout the next century (and beyond). Consequently, **adaptation will itself need to be continuous.**

There are 6 **strategies** for coping with the negative effects of climate change:

- prevention of loss
- tolerance of loss
- spreading or sharing of loss
- changing activities
- changing location
- restoration

Similarly, there are a number of **mechanisms** for achieving these strategies (e.g. institutional, legal, regulatory, financial, structural, technological, research and education). A framework can be developed to examine each of the themes relating to climate change by examining systematically each of the strategies and how it could be effected, using each of the mechanisms.

Research Needs

To develop effective strategies, analysts, decision-makers and stakeholders would need a considerable amount of information about the likely changes to the climate, their effects, their significance, the

capacity to respond, and the cost-effectiveness of those responses. To date, however, this information is not available in most of the areas of concern, and so DETR is presently developing its ideas on how to address this research agenda. Studies are continuing into improving impact scenarios both locally and globally, to reduce uncertainties. Similarly, DETR is considering sponsoring a research project to review possible strategies for adaptation to the potential effects of climate change based on the UKCIP98 scenarios.

This project would provide an early overview of the key UK issues, were there to be a need to prepare for the effects of climate change. A further aim of the study could be to identify key gaps in information and deficiencies in methodologies. If this project goes ahead, one option might be for **DETR to collaborate with other Government departments, agencies and the Research Councils to develop a coordinated programme of research into the objectives and methods of adaptation to climate change in the UK.**

Furthermore, research is needed on broader areas of the climate change issue, including:

- international dimensions, such as how the UK would be affected by climate change elsewhere
- improving understanding of natural processes (e.g. coastal and riverine processes)
- developing more 'holistic' assessment and management tools such as river catchment management and coastal zone management.

Implementing Adaptation

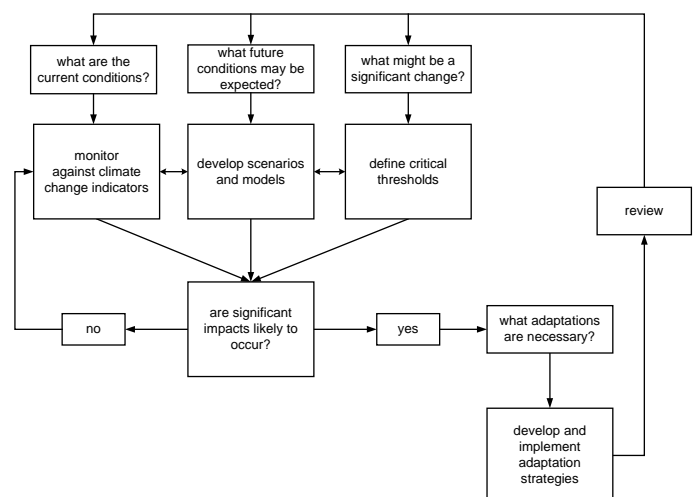
As adaptation will need to be a continual process, a critical factor in ensuring that strategies are effective, will be to build flexibility into decision-making. However, it is also necessary to recognise the many uncertainties involved. One way of approaching this could be to introduce a series of measures that would achieve more than one objective at once. These could correct existing 'anomalies' in economic systems or improve current systems and methods for tackling existing environmental or other problems, while at the same providing some capacity for adaptation within the current limits of uncertainty. Such measures might include:

- improving extreme weather predictions, warnings and emergency response systems
- accommodating change on sites of nature conservation value
- making agriculture more responsive to environmental pressures

- improving the energy efficiency of buildings (e.g. using passive heating and ventilation)
- controlling land use to reduce or avoid risks (e.g. restricting flood-plain development).

The science of climate change continues to develop, but at present it is not advanced sufficiently to enable accurate predictions of the likely effects in the UK, so it is not currently possible to define detailed strategies for adaptation. One approach would be to develop a series of measures, that help to correct current inefficiencies unrelated to climate change but which simultaneously introduce some capacity to adapt to it at a later stage. This could be complemented by improved climate change predictions, integrated assessments of the effects, and the development of a **'route map for adaptation'** based on continuous monitoring of climate change indicators, compared against criteria to assess the significance of impacts (Figure 2).

FIGURE 2 CLIMATE CHANGE ADAPTATION 'ROUTE MAP'



Source: POST

IN CONCLUSION

Although little work has been carried out in the UK on adaptation, the Government is beginning to address the issues. A number of areas for debate remain:

- whether the overall change will be good or bad
- identification of 'significant' changes
- whether there is an actual need for adaptation
- if so, the effects that the adaptation seeks to address, and its aims, timing and methods
- any necessary research requirements.

This is a summary of a 59-page report free to Parliamentarians (ext 2840); External sales (£12) from The Parliamentary Bookshop (tel: 0171 219 3890). Parliamentary Copyright 1998. Parliamentary Office of Science and Technology, House of Commons, 7 Millbank, London SW1P 3JA. This summary is also available on the internet at <http://www.parliament.uk/post/home.htm>