To request a copy of the Overview Report (available in hard copy or CD) or the Implementation Report (CD only) for 'Costing the impacts of climate change in the UK', contact UKCIP at Union House, 12-16 St Michael's Street, Oxford, OX1 2DU, telephone 01865 432076, fax 01865 432077, email enquiries@ukcip.org.uk or see our website **www.ukcip.org.uk.**

UK Climate Impacts Programme
The UK Climate Impacts Programme (UKCIP) helps organisations assess how they might be affected by climate change, so they can prepare for its impacts. Based at the University of Oxford, UKCIP was set up by the Government in 1997 and is funded by the Department for Environment, Food and Rural Affairs (Defra).

We can help you manage research into how your sector or region may be affected by climate change and help you develop an adaptation strategy.

We offer a range of tools and data to help with climate change risk assessments and developing adaptation strategies. As well as this leaflet and the accompanying reports, there are climate change scenarios, socio-economic scenarios and a decision-making framework for taking account of climate risks and uncertainties.

defra
Department for Environment Food and Rural Affairs

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June 2004

UK Climate Impacts Programme

Metroeconomica
Economic and Environmental Consultants

Costing the impacts of climate change in the UK

An introduction

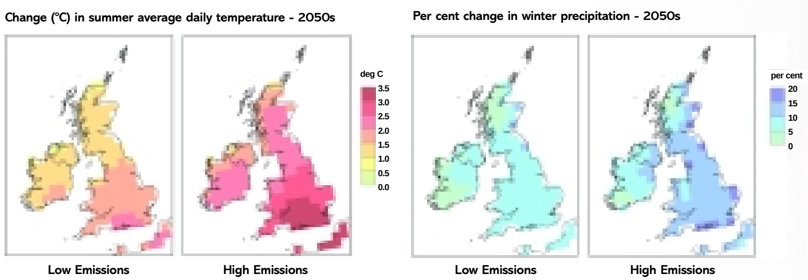
'Our use of fossil fuels is changing our climate, with potentially dramatic and potentially disastrous results. Climate change is not by any means just an issue about the environment. It is a business issue.'

Rt Hon Margaret Beckett MP, Secretary of State for Environment, Food and Rural Affairs, 26 November 2003

We now have convincing evidence that our climate is changing and that these changes are not part of a natural cycle. Over the coming decades, climate change will affect many aspects of our lives, our environment, businesses, and the economy. Recent extreme events, such as the flooding in the autumn and winter of 2000, and the hot summer of 2003 have shown how significant the impacts can be.

In the future, we expect hotter, drier summers, rising sea levels and greater risks that winter flooding will affect our buildings and infrastructure. As well as seasonal changes, there will be more extreme climatic conditions, such as heavy downpours of rain and very hot days.

We need to adapt to these changes in a timely manner, so that we are prepared for the negative impacts, and ready to capitalise on any business opportunities. If we don't plan ahead, we risk being caught out by a sudden, costly event or mounting maintenance costs.



Changes in average summer temperature and winter precipitation for the 2050s. Based on the UKCIP02 Low Emissions and High Emissions climate change scenarios, relative to the baseline period 1961-1990.

The UK Climate Impacts Programme and Metroeconomica have produced a method for costing climate impacts, to help you work out what resources you'll need for adaptation to climate change.

You are most likely to need to adapt to climate risks if you are responsible for:

- business areas that are currently affected, directly or indirectly, by weather or climate;
- making decisions with long-term consequences (decades or longer) for land-use, built assets or population groups;
- infrastructure and business areas that are sensitive to changes in climate;
- contingency planning; or
- if you want to gain an 'early-mover' advantage on a climate change business opportunity.

Adaptation will help you to minimise any negative climate impacts and maximise the benefits. But what resources should you allocate to adaptation, compared to the other demands on your funds?

The UKCIP reports 'Costing the impacts of climate change in the UK' give you a method for calculating the costs of climate impacts. The method also explains how to compare these to the costs of adaptation measures, so you can work out how much you'll need to spend on adaptation.

The method is flexible enough to be applied across a wide range of sectors, and at a local, regional and national scale in the UK. It can be used in the public and private sectors, but public sector decision-makers should first refer to the Treasury Green Book, and to specialist guidelines from government departments where these exist.

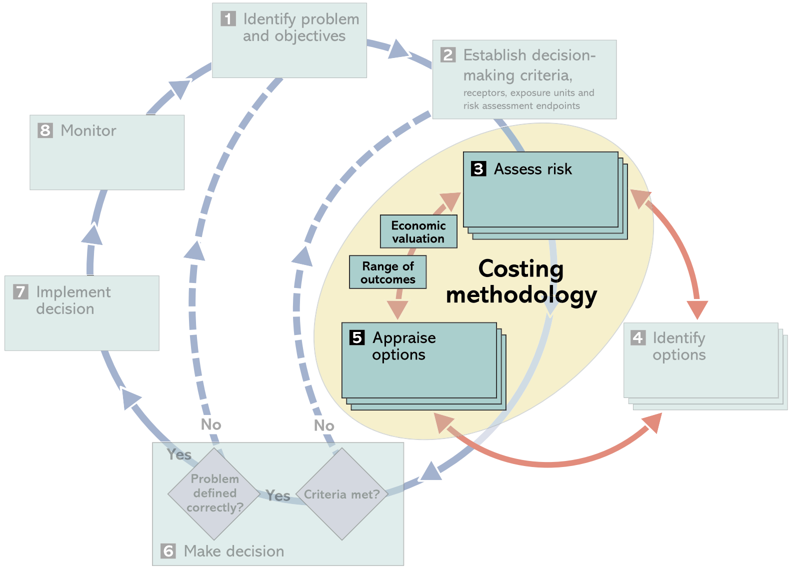
There are two reports – an Overview Report including case examples, to help non-economists who need to commission and interpret costing studies, and a detailed Implementation Report for economists who need to undertake these studies.

There are some specific issues to consider when costing climate impacts and adaptation measures.

- Climate change is already happening, but its effects will intensify over time, and the worst impacts will probably not be felt for several decades. But individuals attach less weight to benefits or costs in the future than to benefits or costs now, so you need to apply discounting to costs of future impacts.
- Climate impacts on one sector or region may well have knock-on effects elsewhere, and these may affect your choice of adaptation option. You can use the impact matrices in the reports to help identify the full range of impacts.
- In some cases, climate impacts could be big enough to cause changes in the prices of goods or services. For instance, wheat prices across Europe jumped in the summer of 2003, when the hot, dry weather caused harvests to fail in several countries. These are called non-marginal impacts and you should incorporate them into your valuations.
- There is uncertainty about climate change and how to value its impacts. Yet uncertainty is something that all organisations have to deal with on a daily basis. To help you understand and manage climate change uncertainty, you can use a range of climate change scenarios. You can also use special criteria devised to help select options when you're uncertain.

WHAT'S DIFFERENT ABOUT COSTING CLIMATE IMPACTS?

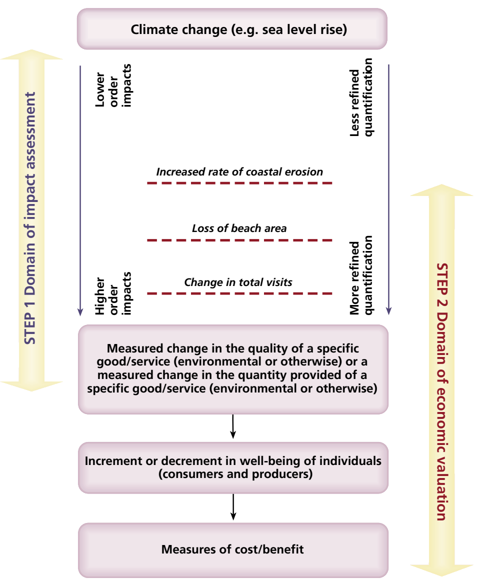
To help you address climate risks and uncertainties, you can use the costing method together with another UKCIP report that provides a risk management framework, 'Climate adaptation: Risk, uncertainty and decision-making'.



The costing method in the context of the UKCIP risk management framework

The costing method involves:

1 identifying and measuring (quantifying) your climate impacts in physical units
2 converting these physical impacts into monetary values
3 calculating the resource costs of your adaptation options
4 weighing up the costs and benefits of the adaptation options, and choosing the preferred option, taking account of risks and uncertainties.



To help you identify your climate impacts, the method includes impact matrices, showing a wide range of impacts including:

- coastal zones
- water resources
- agriculture
- buildings and infrastructure.

The matrices show the direct ('lower-order') impacts of climate change, such as increased coastal erosion caused by sea level rise – as well as the knock-on ('higher-order') effects, such as reduced visitor numbers to the affected coastline.

Having identified an impact, you'll need to quantify it in physical terms, before you can cost it in terms of money. To do this you may need to do a climate impact study.

You can then convert the physical impact into monetary values. The matrices show you which valuation techniques to use for the different kinds of impacts.

The valuation guidelines are grouped into two categories – conventional market-based techniques and individual guidelines tailored to specific issues.

If the climate impact affects an asset or a marketed good or service then you should use conventional market-based costing techniques.

- You can use cost-based methods, such as the 'replacement cost' technique, for valuing impacts on man-made assets. This technique calculates the amount it would cost to replace something that has been lost or damaged by climate change.
- You can value impacts on marketed goods and services from the changes in inputs or outputs due to climate. For instance, the agriculture case example (page 8) works out the value of crops lost (i.e. the change in the output of the farm) during a dry summer.

Impacts on non-marketed goods or services are more difficult to value, and so the reports include individual guidelines for valuing impacts on:

- habitats and biodiversity
- human health
- recreation and amenity
- cultural objects
- leisure and working time
- non-use benefits.

If you want to value these impacts accurately, you'll need to do your own primary valuation study, but this will often be expensive.

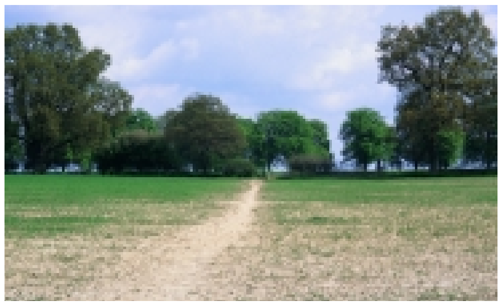
In many cases you won't need this level of accuracy – for instance, to pass a cost-benefit test, you may only need to work out whether an option's benefits exceed its costs. So instead, you can use 'benefit transfer', to transfer values from existing studies to your situation. You will need to weigh up the accuracy that you require, against the time and money needed for doing a primary valuation study.

Having valued your climate impacts, you then need to calculate the resource costs of your adaptation options. Finally, you'll need to bring all the information together, to identify the 'best' course of action.

If economic cost is the only issue that matters, you can use cost – benefit analysis (CBA), which will show whether the total benefits of an adaptation option are greater than its costs.

But economic cost will seldom be the only criterion that matters – other objectives are likely to be important too. In these cases, you can use CBA within the context of other decision-support tools, such as multi-criteria analysis, to account for these wider considerations.

You will want to know how sensitive your calculations are to the input data and models used in your analysis. You will also need to understand any key assumptions. Here, techniques like sensitivity analysis, simulation and interval analysis can help.



Picture: Defra Crown Copyright.

CASE EXAMPLE

Agriculture and the cost of not meeting irrigation needs

Irrigation accounts for 1%-2% of total water use in England and Wales at present. In the drier and more arable areas this can represent a very significant amount of water during dry periods. This case example is intended to illustrate the costing method – it does not give actual cost estimates.

The times when water resources are scarce are also those when water for irrigation is most needed. During an extreme, dry summer's day in one English arable region, irrigation demand can exceed demand from water utilities. In the future, climate change is expected to worsen the situation by causing hotter, drier summers. Yet irrigation demand is forecast to increase dramatically, perhaps by up to 50% by 2021.

This may leave the Environment Agency – as a hypothetical regulator in this illustrative example context – in the position of having to make a tough decision: balancing the competing needs of users of the water supply. Should the water in the river or aquifer be left to provide its many environmental functions, should priority be given to public or industrial water supply, or should the increased irrigation needs be met? A costing study can allocate a monetary value to these different options and can help the regulator make an informed decision.

This case example looks at an English region with extensive arable agriculture and includes an estimate of the range of costs to the industry of an irrigation ban. After examining crop losses, land values and a very broad range of wider costs to the industry, the example estimated that at 1996/7 price levels, the costs of a total ban on irrigation could range from less than £1 million up to £160 million, depending on the climatic conditions and the length and severity of the ban. These figures demonstrate some of the possible future economic impacts of climate change on agriculture.

CASE EXAMPLE

Transport disruption and the cost of time lost

An increased frequency of flooding could have a major impact on transport systems. The damage to road, sea, rail and air networks could lead to a loss of productivity as work time is reduced, and to loss of time available for leisure activities. The costing method can help you estimate a monetary value for this lost time. This case example is intended to illustrate the costing method – it does not give actual cost estimates.

The example centres around data supplied by a UK train operating company on the disruption caused by flooding from heavy rain during a storm, at one key junction in November 1999. The disruption is measured by the number of minutes that trains are delayed. The case example uses cost-benefit analysis and economic assessment tools, and also places a value on the lost leisure and working time.

The train operating company reported that, due to the flooding from the storm, trains arrived at their destination on average 20 minutes late. Some 3,600 passengers were delayed, and the split between working time rail users and leisure time rail users was 55% and 45% respectively.

Using time values for leisure and work from the Department for Transport, the cost of this 20 minute delay to the 3,600 affected passengers was £22,000. The total cost of rail travel delays across Scotland caused by this single storm – which led to flooding, land slips and high winds – are calculated at £71,000. For the whole of 1999, the cost of these time delays is then estimated at £600,000 – referred to in this case example as the 'baseline expected disruption'.

Using the benefit transfer approach to transfer values from the 1999 case, a range of estimates can be sketched out to show how much an increased risk of storms would cost.

Looking to the future, the case example assumes that the incidence of flooding, land-slips and high winds could be 30%, 50% or 70% higher by 2025. These costs are compared to the 1999 'baseline' cost of disruption from flooding – £600,000.

Taking 2025 as our target year, we need to apply discounting at 3.5% per year, since people attach less weight to costs in the future than to costs now.

After discounting, the costs of the increase in delays above the 1999 baseline – which are assumed to be caused by climate change – run at £85,000, £127,000 and £169,000 for the 30%, 50% and 70% assumptions respectively.

These costs estimates could be used to judge whether, for example, it was worthwhile investing in new drainage systems that would reduce the future flood risk on the rail network.

Picture: Courtesy of Network Rail.