Helpu Cymru i leihau
ei Hôl Troed Carbon

Help Wales reduce
its Carbon Footprint

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Climate Change: its impacts for Wales

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About this booklet

Unchecked climate change is one of the most serious global threats the world faces. It threatens the basic elements of life for people and environments around the world – for example access to water, food production, health and the use of land.

In this booklet, you can find out more about how Wales will be affected by the impacts of climate change and what we will need to do to adapt to them. It also explains where you can go to get further information and advice to start planning for these impacts.

About Climate Change

The Earth's climate has always undergone episodes of great change usually over long periods of time. Previously these changes have been driven by natural processes, such as solar activity, volcanic eruptions or the cycle of the Earth's orbit around the Sun.

The problem today is that the climate is changing very quickly and the scale of the increase in global average temperatures cannot be explained by the effects of natural processes. In fact the change in temperature mirrors the increase in the concentration of greenhouses gases in the atmosphere as a result of human activity.

Carbon dioxide and other gases, collectively known as 'greenhouse gases', act as a partial blanket that increases the amount of heat from the sun that is trapped by the atmosphere. Since the industrial revolution, concentrations of greenhouse gases in the atmosphere have increased as we have burnt more and more fossil fuels. This has led to reduced heat loss from the Earth, and resulting in warming of the Earth's surface and lower atmosphere.

Urgent and sustained action to cut greenhouse gas emissions is needed to avoid the worst impacts of climate change in the future, but we also need to respond to the impacts of changes in climate that will occur as a result of past emissions.

The rest of this booklet explores some of these expected impacts and how we can adapt to them.

What impacts is Wales likely to experience as a result of climate change?

Climate change is a complex process which affects some of the Earth's most fundamental natural processes. This makes predicting exactly what will happen, where, and when, challenging.

In response, scientists have developed powerful computer models that help answer these questions.

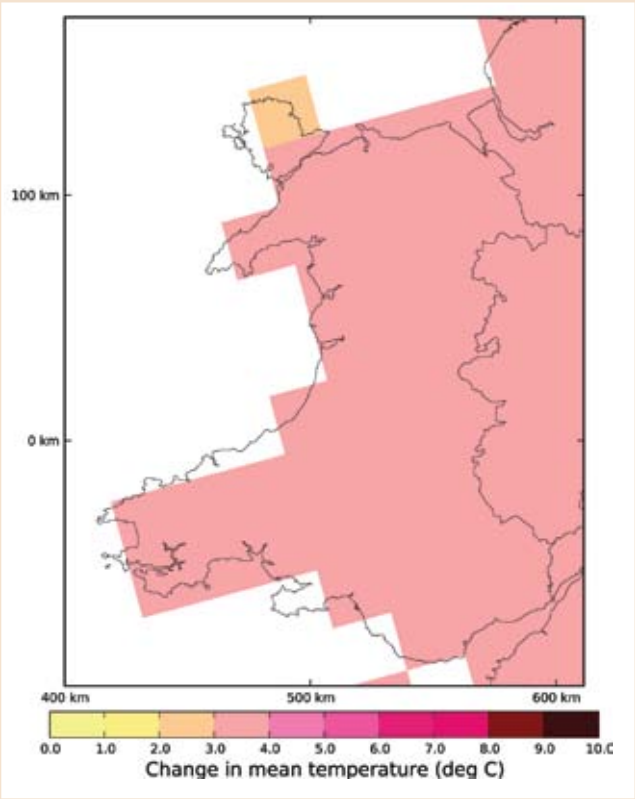
Over the next few pages we use information under the central estimate of the medium emission scenario from the most recent UK Climate Projections, published in June 2009, to show how the climate in Wales will be affected by climate change in the future. (You can find out more about the Projections and the different emission scenarios later on in this booklet.)

Annual average temperatures

Projections show annual average temperatures in Wales get consistently warmer over time.

The overall projected increases in the annual average temperatures in Wales are 1.3˚C by the 2020s, 2.0˚C by the 2040s and 3.3˚C by the 2080s, against the 1961 to 1990 baseline.

Across different parts of Wales the annual average temperatures are projected to rise between 2 and 4˚C by the 2080s.



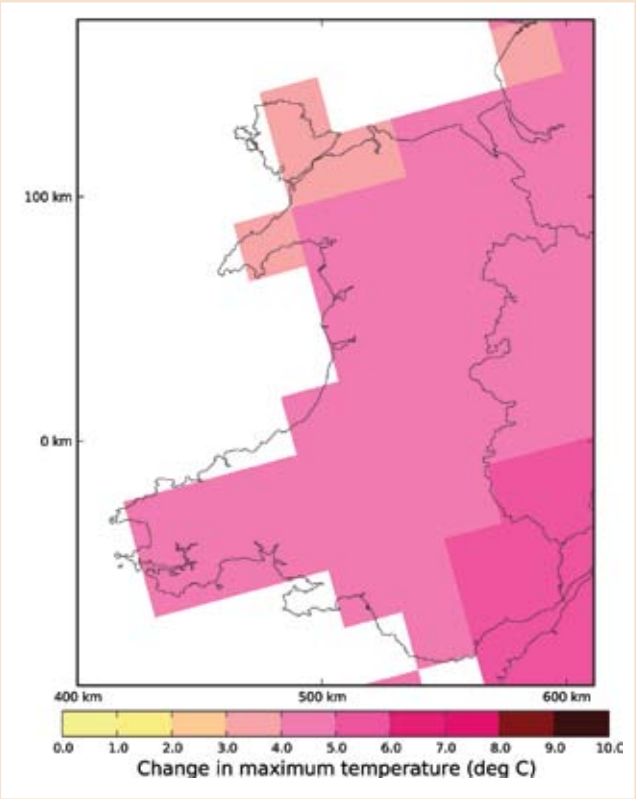
The change in annual average temperatures in ˚C from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Summer maximum temperatures

Projected changes in summer daily maximum temperatures in Wales get larger over time.

The projected increases in the summer averaged daily maximum temperatures for Wales are 1.9°C by the 2020s, 2.8°C by the 2040s 4.8°C by the 2080s.

Across different parts of Wales the daily maximum temperatures averaged over the summer (June, July, August) are projected to rise between 3 and 6°C by the 2080s.



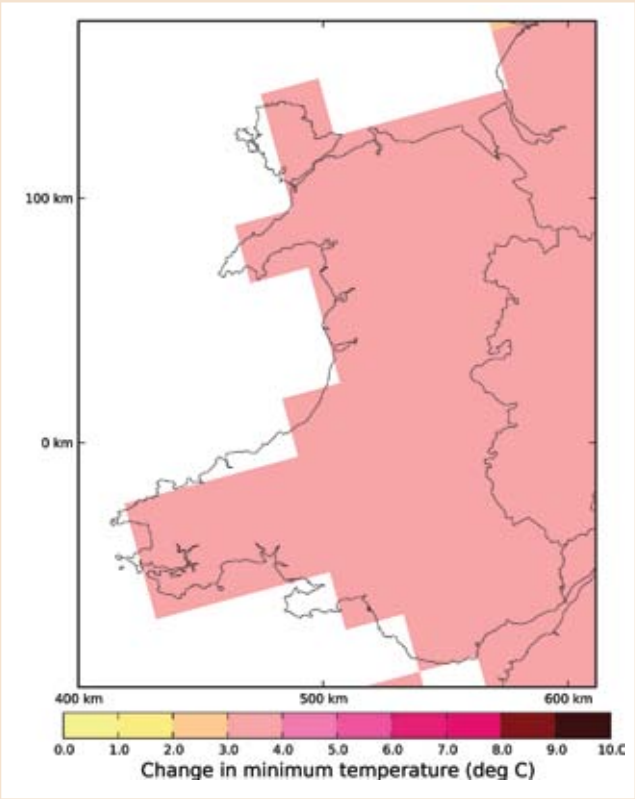
The change in summer averaged daily maximum temperatures in summer in °C from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Winter minimum temperatures

Projections of the warming of winter daily minimum temperatures in Wales get larger over time.

The projected increases in the winter daily minimum temperatures for Wales are 1.5°C by the 2020s, 2.1°C by the 2040s and 3.5°C by the 2080s.

Across Wales the daily minimum temperatures averaged over the winter (November, December, January) are projected to rise between 3 and 4°C by the 2080s.



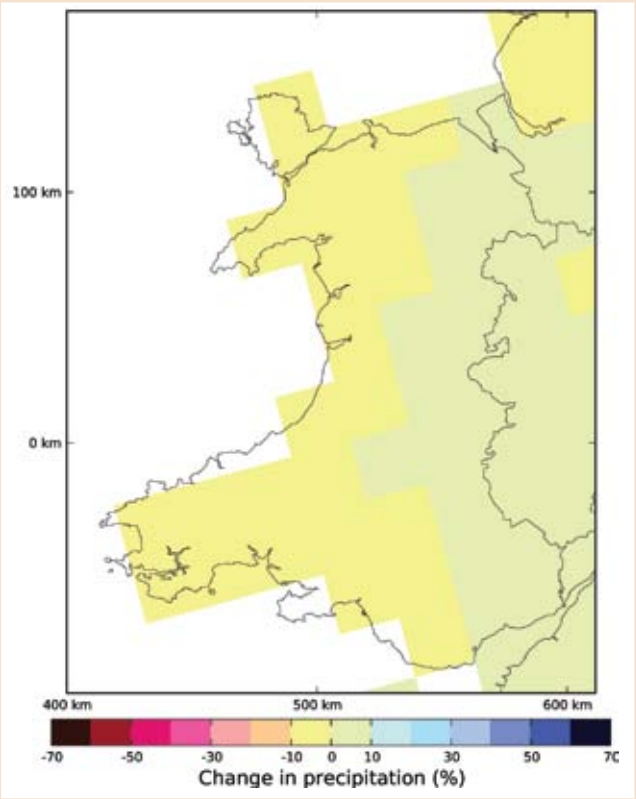
The change in winter averaged daily minimum temperatures in summer in °C from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Annual rainfall

Projections of the annual average rainfall in Wales show only very limited changes over time, most of the changes occurring in the wet and dry extremes which to some extent balance each other out over the year.

There are no overall projected changes in the annual average rainfall for the 2020s, the 2040s or the 2080s for Wales, from the 1961 to 1990 baseline.

Across Wales the annual average rainfall is projected to remain roughly the same as now, with changes of between -10 and +10 % by 2080, with a broad pattern of increases in the west and decreases in the east of Wales



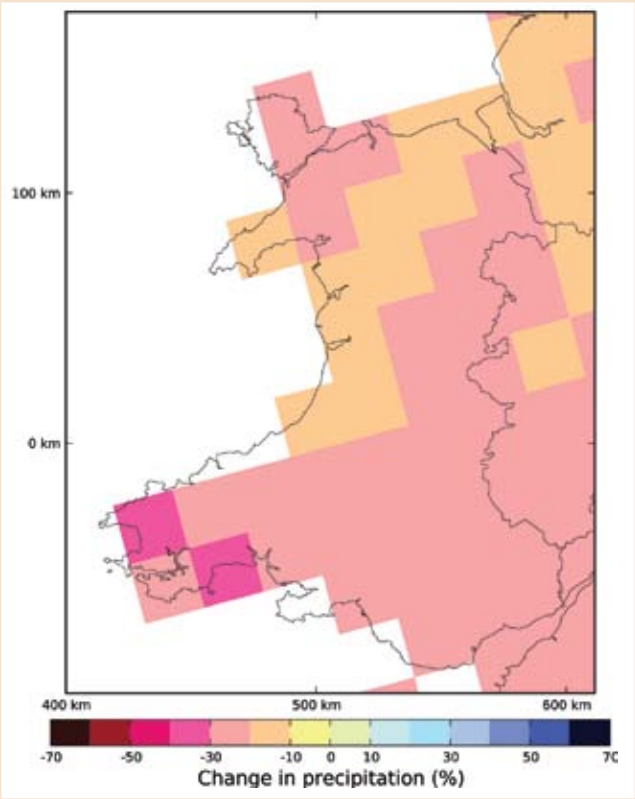
The % change in annual average rainfall from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Summer rainfall

Projections of the summer rainfall in Wales show significant decreases over time.

The projected decreases in the summer average rainfalls in Wales are 7% by the 2020s, 12% by the 2040s and 20% by the 2080s.

Across different parts of Wales the summer average rainfall is projected to decrease between 10 and 40% by the 2080s, with the greatest decreases in South-West Wales.



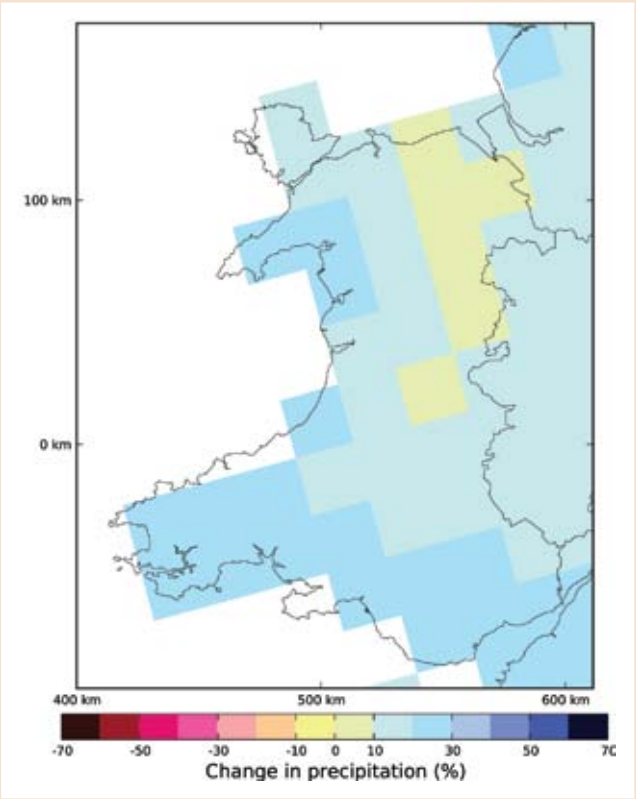
The % change in summer average rainfall from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Winter rainfall

Projections of the winter rainfall in Wales show significant increases in winter rainfall over time. It is expected that these increases will be as a result of increased storminess leading to intense, but short-lived, rainfall events.

The projected increases in the winter average rainfalls in Wales are 7 % by the 2020s, 11 % by the 2040s and 19 % by the 2080s for Wales

Across Wales the winter average rainfall is predicted to increase between 0 and 30 % by the 2080s, with the greatest increases in South-West Wales.



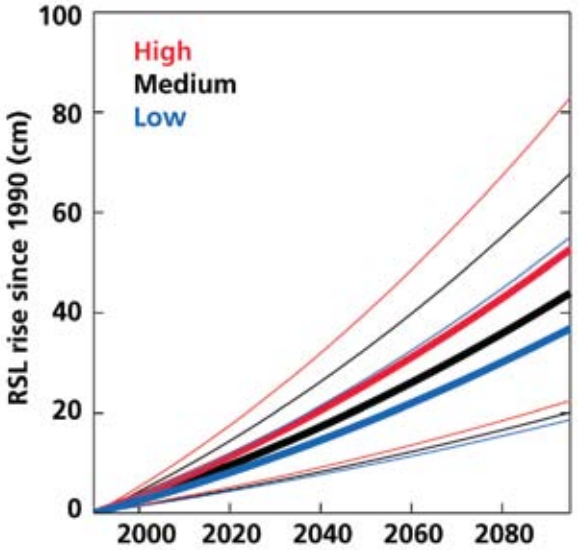
The % change in winter average rainfall from the 1961-1990 baseline for the 2080s (for 25km grid squares for the central estimate of the medium emissions scenario).

Sea level

The relative sea level rise around Wales (taking into account land level changes) is predicted to be 36cm by the 2080s.

Whilst the forecast of relative sea-level rise is for Cardiff, the geographic variations in sea level around Wales are small.

By 2040, the estimated rise for all emissions scenarios is around 15cm. However by 2080 the scenarios diverge significantly with potential increases in mean sea level of between 31cm for the low emissions scenarios and 43cm for the high emissions scenarios.



This graph shows estimates of relative sea level rise for Cardiff, combining absolute sea level rise estimates, from global models, and land movement estimates
These projections show the central estimate (in bold) along with the 5th to 95th percentile range (thin lines) for the 3 emission scenarios.

What does this mean for Wales?

The Climate Projections provide useful information about how the Welsh climate will change over time, but we need to understand how these changes will affect people and the natural environment.

The Projections tell us how the climate is likely to change in Wales, and the rest of the UK, but climate change impacts will be felt globally and we will find ourselves also needing to respond to the consequences of climate change impacts as they affect other parts of the world.

Over the next few pages we explore some of the impacts that these changes could have on society, the economy and the natural environment and what we should be doing in response.

What could these changes in climate mean for society, if we don't start to adapt

- Higher summer temperatures and increased rainfall could cause health problems both directly (e.g. adverse health associated with heatwaves and flooding events) and indirectly (via increased psychological impacts, UV exposure, air pollution and infectious diseases). As a result, the burden on NHS services is likely to increase.
- Emergency services and social care services may be affected due to the reduced reliability of transport infrastructure during more frequent and severe flood events
- Extreme weather events – both heavy rainfall and extremely hot days – may cause disruption for travel on rail and road and increase the vulnerability of road and rail infrastructure services due to wear and tear.
- Less rainfall in the summer could lead to pressure on water resources at certain points in the year.
- Working conditions may become more uncomfortable by hotter summers especially for outside workers.

- During periods of extreme heat it may be difficult to maintain comfortable working conditions in existing buildings. This will affect many parts of the economy. Similar issues arise for people's homes and services such as schools and hospitals.
- The increase in flooding will lead to associated impacts such as social disruption, homelessness and, during an incident, limited access to food and water. The effect of economic and personal loss is likely to lead to significant stress to individuals.
- Increased pressure on sewer systems with associated impacts on diffuse pollution and sewer flooding incidents

Some examples of actions to enable society to adapt

- Improve the design of buildings to cope with hotter temperatures through the use of external shading, natural ventilation or low energy technologies.
- Review how and when we use buildings, for example changing opening hours or term times to avoid very hot periods.
- Increase awareness of water efficiency and improve water saving devices in buildings such as spray taps.
- Improve health awareness in heat waves for vulnerable people.

What could these changes in climate mean for the economy sector, if we don't start to adapt.

- Extreme rainfall events will lead to increased flooding from rivers and surface water and, in turn, to the disruption of businesses, economic losses and an increase in flooding related insurance claims.
- Summer demand for water is likely to increase from current levels for use in irrigation and cooling. Changing patterns of rainfall (more in winter, less in summer) will mean that an assured supply in summer may depend on increased storage of rain from winter.

- Coastal erosion may be more severe, and inundation events will be more likely in low-lying coastal areas as the sea level rises.
- More extreme weather events, such as heavy rainfall events, are likely to have an impact on sectors such as agriculture and the construction industry, where it might lead to waterlogged construction sites and fields.
- Pests and diseases (such as blue tongue) that are usually associated with warmer climates will become an increasing problem affecting agriculture, forestry and livestock.
- There may be a reduced energy demand for winter heating, however this could be offset by an increased demand for summer cooling.
- Increased summer temperatures may lead to an increase in the tourist economy, partly as a result of a warmer climate.

Some examples of actions to enable the economy to adapt

- For organisations, climate change may provide a mix of threats and opportunities. A simple exercise could help to identify some of the threats and opportunities (e.g. disruption to service delivery or availability of raw materials) as well as many opportunities (e.g. more day trippers during the summer).
- Complete a risk assessment to identify potential routes that may be affected by transport disruption and develop contingency plans.
- Incorporate cost contingencies into budgets to account for potential losses in revenue due to disruption in services.
- Locate electrical equipment above flood risk level.
- Separate storage areas that require high energy cooling from those that do not require as much.
- Invest in low energy temperature control solutions for animals and livestock in farming for improved ventilation and cooling.

What could these changes in climate mean for the natural environment, if we don't start to adapt

- Non-native species of plants and animals are likely to become more widespread as the Welsh climate becomes more favourable to them.
- Hotter, drier summers will result in low river flows and higher water temperatures which may have an adverse impact on freshwater ecosystems.
- Changes in temperature and rainfall profiles will impact on ecosystems and is likely to be associated with the loss or migration of climate-sensitive species. Arctic alpines such as the Snowdon lily may be lost whilst the dormouse and nightingale may increase their Welsh range northwards; and other species like char and the northern footman moth may decrease.
- The coastal and lowland zones, estuaries (Dee, Severn), saltmarshes and sand dunes (Morfa Harlech) may be impacted by storms and sea level rise.
- The internationally important raised bogs at Cors Erddrreiniog and Cors Tregaron may dry out unless their water tables are artificially maintained.

Examples of actions to enable the natural environment to adapt

- Plant hedges and trees to help with drainage, to increase ecological networks for species to respond to climate change and to protect areas from both storm related damage and solar radiation.
- Reduce sources of harm not linked to climate change such as pollution from air, agriculture and sewage discharge to reduce the natural environment's vulnerability to climate change.

- Targeted restoration of habitats of conservation importance to improve connectivity between habitat patches. This will help increase the capacity of species to disperse as the climatic conditions in a particular area change;
- Planting a mixture of locally derived native tree stock with a small proportion of native trees but from continental European stock to insure against climatic changes and improve the resilience of woodlands.
- Developing an adaptive approach to managing conservation sites involving monitoring climatic impacts so that management can be adjusted in future.

Adapting to the impacts of climate change

The previous sections outlined the potential impacts of climate change in Wales; what some of the consequences of those impacts might be for society, the economy and the natural environment and some examples of actions that could be taken in response.

Those actions are what we mean by 'adaptation'. Adaptation is, in the context of climate change, making changes to limit harm, or exploit beneficial opportunities, arising from the impacts of a changing climate.

Why is it important for Wales to adapt?

The messages from the UK Climate Projections are stark. Across each of the scenarios we see significant changes in Wales' climate over the course of the century. These changes will have consequences and we need to start building these consequences into how we think, plan for the future and manage projects, businesses and organisations.

There are also some specific features about Wales that mean that we need to be pro-active in thinking about adapting to the impacts of climate change:

- Our population, major towns, industrial development and tourism are concentrated in coastal areas.

- Outdoor tourism is particularly important to our economy.
- The importance in Wales to support sustainable rural communities and economies such as farming and the high amount of livestock and forestry industry.
- A large proportion of Wales has been designated for its biodiversity or landscape value for example as a European Special Area of Conservation, a Special Protection Area, a National Park or Area of Outstanding Natural Beauty.
- Vital travel routes such as some parts of the M4, rail routes and critical national infrastructure are located in flood plains or near the coast.

Why is it important for me to adapt?

Government leadership on adapting to the impacts of climate change is important and the Climate Change Strategy for Wales will set out the Assembly Government's proposals for a framework within which adaptation action can take place. However people, communities and organisations will all need to take responsibility for adapting too.

For example, if you live in an area that is at risk of flood you can take simple steps to help yourself be more prepared for a flood event. You can register for Floodline, the flood warning service from the Environment Agency so that you will get a warning if a flood event is likely to happen. You can also make you home more resilient to flooding, for example by changing the flooring or moving plug sockets higher up the wall.

Often it will be the most vulnerable individuals and communities that will suffer the worst impacts of climate change and it will widen existing inequalities unless we take adaptation action to protect those vulnerable communities.

Businesses and other organisations will find that climate change affects every aspect of their business. This includes changes in demand for goods and services, changes in supply chains, direct impacts on production processes and impacts on staff and

customers among other things. These need to be considered and planned for.

It is not just people that will be affected by climate change. It will have a significant impact on the natural environment as habitats and species respond to changes in temperatures, weather and the pattern of the seasons. Therefore we will need to build resilience in the natural environment.

How do we adapt?

To adapt, we need to assess the potential impact of climate change and its consequences for us.

Having made that assessment we might then need to build this into plans or management processes, or start work to raise awareness of impacts and the action needed in response, or get to work on projects to build resilience.

The first step of the process is to assess the potential risk posed by climate change.

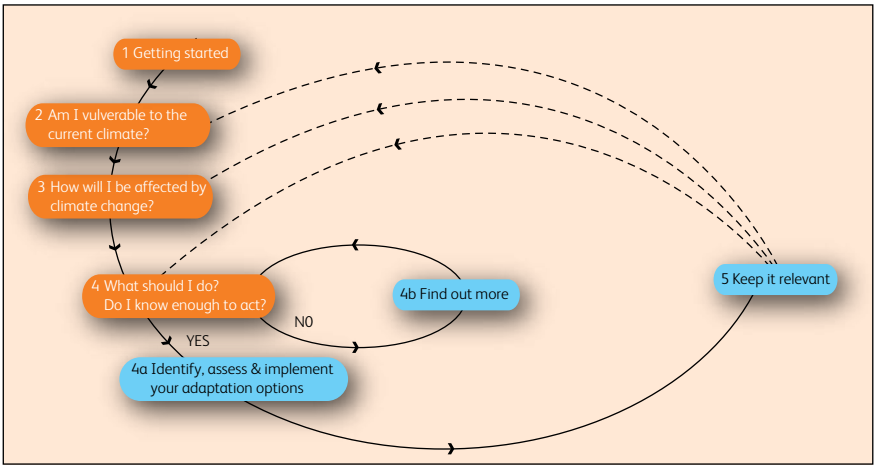
By using a 'risk framework' we can recognise and evaluate the risks with the uncertainties and consequently make appropriate decisions. Information from this process allows the impacts to be reduced and managed and opportunities to be exploited.

Most organisations have some kind of risk framework for assessing threats to their business. These existing processes can be used to look at risks posed by climate change or organisations can develop one specifically looking at the long term impacts of climate change.

The risk framework helps decision makers to answer questions such as:

- What are the climate change risks that could affect my decision?
- What measures are required and by when? and
- What are the most appropriate measures?

A risk framework does not have to be complicated and can be a simple process like the UK Climate Impacts Programme (UKCIP) Adaptation Wizard. The wizard is an online tool that takes you through a 5 step process to assess your risk.



About the UKCIP Adaptation Wizard

1. Getting started – objectives for your organisation, are they preserving status quo or being more flexible
2. Am I vulnerable to current climate change – is your organisation already susceptible to weather events
3. How may I be affected – look at climate models such as UKCP09 and other impact studies
4. What do I do – what are the next steps? Need to assess different options for adaptation.
5. Keep it relevant – it is not likely to be one decision with a final end point. Adaptation is a like a journey which will need to be continually reassessed

Or for a more detailed assessment a more comprehensive risk framework might be needed.

How can we use the UK Climate Projections 2009 (UKCP09)?

Part of the risk framework is looking at how an organisation may be affected by future climate change. The UK Climate Projections can help by showing what the UK climate is likely to look like from now until the end of the century.

The UK Climate Projections can be useful for:

- Emergency planning for heat waves, flooding or droughts,
- Adapting existing and designing new building for a changing climate
- Managing habitats for conservation
- Creating new products and services and also making existing products and services better to deal with climate change

The UK climate projections come in a number of formats such as key findings, pre-prepared maps and graphs and a customisable user interface where data can be extrapolated for individual users with various parameters. All are available from the UK climate projections 09 website.

http://ukclimateprojections.defra.gov.uk/

The site also has links to other UKCP09 products such as science reports (including the weather generator report on how to use the tool, the maritime and coastal report, probabilistic projections report and briefing report) and technical guidance on all of their products, including online user guidance on how to use the projections. Users should read and fully understand the guidance and information on the projections before using them.

UK Climate Projections 2009

We have presented some of the results of the Projections in earlier in this document. The following section gives some technical information about the Projections.

About the Projections

The UK Climate Projections (UKCP09) are the fifth generation of UK climate change scenarios, describing how the climate of the UK might change during the 21st Century. The climate model impacts have been developed by the Met Office Hadley Centre with a partnership of organisations (including UKCIP and the Welsh Assembly Government) involved in developing tools and guidance to support the use of the projections.

The projections show a probabilistic view of what will happen based on high, medium and low greenhouse gas emissions scenarios for the future, taken from those developed by the Intergovernmental Panel on Climate Change.

Current research suggests that we are currently tracking towards the "medium "emissions scenario. The findings for this scenario are worrying and will lead to challenges in terms of the way all of us live our lives. High emissions scenarios would result in a much bleaker picture if we allow emissions to grow at a much higher rate, with global temperatures rising by around 6°C by 2100. Whilst low emissions scenarios, with emissions peaking around 2040, avoid the worst of the predicted consequences. However due to historical emissions we are still locked into scenarios with average summer temperature increases of around 3°C.

To address climate change, we need to reduce our emissions to prevent the severest changes, and adapt to the changes that we know are already unavoidable.

UKCP09 are probabilistic projections which aids with risk based decision making. The projections show a range of possible outcomes and the probability of each outcome which is consistent with the relative strength of evidence that support it. (For more information on the methodology used to formulate the projections please see the UKCIP Probabilistic Projections Report on their site).

The central estimate is the 50% probability level. It represents an outcome for which the evidence suggests that it is equally likely will be more or less than that amount. The 10% estimate represents an outcome for which the evidence suggest that it is very unlikely to be less than the figures stated, whilst the 90% estimate represents an outcome that is very likely to be less than the figure shown.

UKCP09 covers England, Wales, Northern Ireland, Scotland, the Isle of Man, Jersey, and Guernsey. It will also cover an area of sea around the UK. The Projections over land are given for 25 x 25 km grid squares.

Further Information

Welsh Assembly Government

You can find information about Assembly Government policies and programmes on climate change on the Assembly Government website at:

http://www.wales.gov.uk/climatechange

Environment Agency Floodline

http://www.environment-agency.gov.uk

0845 988 1188 and Typetalk 0845 602 6340

UKCIP

The UKCIP website contains further tools to aid businesses and organisations through the risk framework and ultimately adapt to the impacts of climate change. Please see the UKCIP website for further information on the following tools.

http://www.ukcip.org.uk

BACLIAT (Business Areas Climate Impacts Assessment Tool)

This is a tool for businesses and organisations that looks at how climate change will potentially impact on an organisations area. This is done by a simple check list by looking at the impacts on the following 6 areas:

- Markets,
- Logistics
- Processes
- Finances
- People
- Premises

CLARA (Climate Adaptation Resource for Advisor)

This is a web based database of adaptation issues for Small and Medium Enterprises (SMEs). It makes it relevant for business advisors and is a rich source of information providing advice on making the business case for adaptation.

LCLIP (Local Climate Impact Profiles)

This is a 4 stage process that is usually undertaken by Local Authorities but can also be done by organisations to assess previous impacts of the weather and climate on their area. This is usually done by a desk based study looking into previous extreme weather events and the impacts they had. This then aids with highlighting where potential impacts will likely be and therefore the organisation can look into how to adapt to it.

The BRAIN

This is a database of research on adaptation. It shows examples of impacts of climate change and research done in the area on adaptation (this is known as the climate digest and is a collection of up to date reports on adaptation).

Contacts

For more information, contact the Assembly Government's Climate Change Team at:

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