



WALES CHANGING CLIMATE CHALLENGING CHOICES

The impacts of climate change in Wales from now to 2080

Summary Report - February 2000



Cynulliad Cenedlaethol Cymru
The National Assembly for Wales

Scoping study of Climate Change Impacts in Wales

The study which has informed and produced this report was initiated by the National Assembly for Wales. It was conducted by a team co-ordinated by the Institute of Environmental Science, University of Wales Bangor, and including the Institute of Terrestrial Ecology, Bangor, ECOTEC Research and Consulting, and the Climatic Research Unit, University of East Anglia, in collaboration with the UK Climate Impacts Programme. A steering group representing many institutions and interest groups within Wales advised the team. Designed by ECOTEC Research and Consulting.

Further information

A bilingual, 80 page, technical report is available from UKCIP, Union House, 12-16 St Michael's St, Oxford OX1 2DU. It can be consulted at and downloaded from <http://www.bangor.ac.uk/ies/ies.html>.

Information on the United Kingdom Climate Impacts Programme (UKCIP) can be found at <http://www.ukcip.org.uk> (phone + 44 (0) 1865 432076)

The Climatic Research Unit, University of East Anglia, is at <http://www.cru.uea.ac.uk> (phone +44(0)1603 592722)

The Met Office Hadley Centre for climate change prediction and research is at www.met-office.gov.uk/sec5/sec5pgl.html (phone +44(0)1344 856653)

Starting a debate

We hope that the summary and technical reports stimulate debate within Wales. We are happy to host a virtual debate. On the University of Wales Bangor website listed below you will find an email box. If you wish to comment on any aspect of the report, please send in your message using this box and we will mount an edited version of your message in a 'commentary' section at the end of the technical report.

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Cover: Cwm Dyli, Snowdon.

The challenge

The climate is changing as a result of man's activities, and the rate of change is unprecedented. This is the view of the overwhelming majority of scientists with expertise in climate, environment and ecology. The weather patterns which Wales will experience as the 21st century progresses will impact many areas of our lives, and of our economy. The change may be faster than our institutions and economy can cope with. The challenge is to adapt to these changes so that lives are fulfilling, the environment is managed sustainably, and the economy is buoyant.

The challenge will best be met by the concerted action of stakeholders, an informed public, and centres of expertise. The National Assembly is committed to sustainable development, which will only be achieved if the impacts of climate change are fully integrated into its thinking. This report is a first step. It summarises a scoping study which combined climatological modelling of Wales with expert review of 11 key sectors and interviews of nearly 70 stakeholders drawn from a wide range of institutions and interest groups within Wales.

Welsh climate in the 21st century

How will the Welsh climate change? A detailed and sophisticated model run for the UK Climate Impacts Programme predicts that by 2080 Wales will experience

- greater warmth all year round by 1.1-2.9 °C
- more precipitation in winter by 7-24 %
- less precipitation in summer by 7-14 %
- greater annual precipitation by 2-9 %
- a rise of sea level of 18-79 cm
- a higher mean windspeed by 1-4 %
- more evapotranspiration by 13-27 %
- more variability from year to year the number of extreme years will increase
- more frequent and more violent storms more rain in intense storms
- more drought years by 10 %
- more very severe gales by 10 %

.....and how certainly we can predict it

The size of these changes is not certain, due to the nature of climate modelling. Greenhouse gases drive the change in climate, and the rate at which humanity will add them to the atmosphere in future is not known; therefore the models which predict the climate are run with different rates of greenhouse gas emission, called scenarios, and the variation in climate predicted above for Wales is due to the difference between scenarios. The models that produce the predictions are large and sophisticated and their assumptions are agreed on by nearly all climatologists. They are tested in a number of ways, including asking them to 'predict' the climate of

the recent past. However, the climate is determined by the complex interactions of many processes, and we cannot be absolutely sure that all the right processes are included and properly modelled. It is a characteristic of many complex models that small differences in the values they start with can lead to significant differences in their predictions. The outcome is some uncertainty: we will never be able to predict the climate with absolute assurance and precision. Does uncertainty in the predictions mean that we should ignore them? Certainly not. There is consensus that the climate is changing, and changing quickly. We need to act to reduce the degree of change and to be prepared for the consequences of climate change. As models improve, so more precise predictions will mean that planning can be better targeted. But the key point is this: an awareness of climate change should permeate our decision-making now.

Will the change be the same everywhere?

The climate of Wales is enormously varied: the beaches of the south are much warmer and drier than the mountains of the north. Will climate change be the same over the full range of habitats and localities in Wales? We do not know for certain, but currently we believe that there may be a small gradient of change in temperature, with the smallest rise in the west and the largest in the more continental east, but more research is needed to find out if this and other regional effects will occur. Until more work has been done, we must assume that to a first approximation, the temperature will rise just as much on the Gower as on Snowdon, so you can look at a current map of Welsh climate and simply add or subtract the same change in temperature or rain to picture what the climate at any particular place will be like. But remember that the average conditions shown on a climate map will not show the extremes of weather which will occur.

It's already happening

The impacts of climate change are already detectable in the UK. Biological indicators such as oak coming into leaf earlier in spring, and increasing abundance of the common footman moth, show that as the mean annual temperature in the UK has been rising, so there are detectable responses in the environment. The UK has established the Environmental Change Network (ECN) to monitor trends; it has just one site in Wales, on Snowdon. Although UK indicators have been identified, there is a shortage of Welsh indicators in the public domain.

Prevent it or live with it?

Climate change can be reduced by **mitigation**: reducing the net emissions of greenhouse gases, notably CO₂. The main focus of the Government has been on mitigation, which is outside of the scope of the present study. The climate will continue to change whatever steps are taken now in mitigation, because of the gases we are still emitting, and there are some impacts which we are now committed to and have to tackle (**adaptation**). This study concerns how Wales might adapt. Clearly, methods of adaptation need to be consistent with techniques of mitigation, and so integrated planning



Wind turbines, Cemaes Bay. Design of turbines will need to allow for higher wind speeds.

strategies will need to consider the two together. If you cope with higher temperatures by turning on the air conditioning, the additional fossil fuel required adds to the greenhouse effect.

What is special about Wales?

Does Wales have to think about the impacts of climate change in any way that is different from the rest of the UK? Can't UK-led policies solve the problems of Wales? Wales should be pro-active in thinking about adapting to climate change because:

- many decision-making bodies and utilities are Welsh or have semi-autonomous Welsh sections
- its ability to change is limited by the relatively low mean GDP and poorer skills base compared with other parts of the UK
- there is a higher proportion of primary and manufacturing industry
- outdoor tourism is important to its economy
- of the importance of rural issues and the preponderance of livestock and forestry
- it has taken the lead in the introduction of agri-environmental schemes in the UK
- its upland ecology is important and particularly sensitive
- it has a very high proportion of land and coast with some degree of environmental protection, with three national parks and a higher density of SSSIs than England
- its climate has high spatial variability
- its coastline is long relative to its area
- its population and tourism are concentrated on the coast
- Wales exports water to England

The three big themes: this study has shown that climate change will

- **change our natural environment and built heritage**
- **alter the environment in which our economy operates**
- **increase the importance of water management both to prevent flooding and to ensure the supply of water**

Our natural environment and built heritage

Ecosystems and their component species are already being affected. The increasingly Mediterranean climate will be accompanied by a migration northwards of sensitive species, but their migration will be hampered unless there are 'corridors' connecting similar habitats, and species which can neither adapt nor migrate may be lost. Biodiversity action plans cover many parts of Wales and whilst some mention climate change they do not fully allow for its impacts; nor do site designations for Sites of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs).



Cwm Idwal, a National Nature Reserve and part of a Site of Special Scientific Interest in the Snowdonia National Park.

Stakeholders have a good qualitative understanding of the problems, but the comparative lack of firm quantitative information for Wales (even relative to the rest of the UK) makes it difficult to predict impacts and plan adaptation sensibly. One plus to the process of climate change is that it should cause the public to become more knowledgeable about environmental issues.

Terrestrial environment. The coastal and lowland zones, estuaries (Dee, Severn), saltmarshes and sand dunes (Morfa Harlech) will be impacted by storms and sea level rise, and in many cases managed retreat may be too expensive. The internationally important raised bogs at Cors Eddreiniog and Cors Tregaron may dry out unless their water tables are artificially maintained. Dormouse and nightingale may increase their Welsh range northwards; char, northern footman moth and bird cherry may decrease. The most important effects will be on the upland semi-natural communities of the north and west (48% of the land area). Heather moorland,



Woodlands such as Coed Padarn have high biodiversity.

blanket bog and oak woodland are internationally important for maintenance of biodiversity. For these and the very local arctic-alpine communities, climate and soil conditions are crucial, so they are particularly vulnerable. Arctic-alpines such as the Snowdon lily may be lost. We do not know how climate change will interact with other environmental pressures such as acid rain, nitrogen deposition and intensity of grazing in shaping the future of these communities.

Freshwaters. The freshwater resources of Wales include nationally and internationally important sites: the Wye, Llangorse lake, Cors Llyn. The kingfisher and Cettis Warbler may increase in the north with warming; the dipper and goosander retreat. Migrant birds use wetlands in Wales adding an international dimension. We do not know enough about many processes influencing these habitats and species to be sure in our predictions. River temperatures track air temperature. Summer warmth and drought might reduce salmonid growth; species would be expected to migrate following their temperature ranges. Warmer waters carry less dissolved oxygen, and low river flows in dry summers may have greatly concentrated products of organic decomposition and of agrochemicals. Blue-green algal blooms may become more frequent.

Built heritage. Archaeological sites in low-lying regions will be subject to flooding, and other built heritage will suffer damage from both severe winter storms and, in dry summers, subsidence as the ground dries out.

Human health. Patterns of human health and mortality will shift as a result of changes in temperature and of rainfall. Cold-linked winter mortality will fall, more than offsetting an increase in high-temperature linked mortality in summer. Insect-carried diseases, and water-borne infections, will be commoner. Sunnier summers will mean more exposure to UV-B and so more skin cancers. Photochemical smogs could become more prevalent since sun promotes ozone pollution. Overall though the proportional effect on health will be small.



Dinas Dinlle - an iron age fort which is being eroded by the sea.

Our economy

...and the international economy. It is not only the Welsh economy which will be affected by climate change. For example, marketing Welsh lamb will depend upon how climate change affects farming

in New Zealand. The weather in the Mediterranean will determine how many people spend holidays there rather than Wales. Economic planning will need to take account of the worldwide impacts of and adaptations to climate change. Key features of the economy cannot be predicted far ahead. The population of Wales will probably increase slowly, although it will depend critically on migration, but it is difficult to predict GDP beyond 2005. One prediction is that the economy will continue to grow but with a shift from agriculture and manufacturing to the service sector. Wales has set itself the target of achieving 90% of UK GDP per person by 2010. Wales has traditionally been strong in agriculture, forestry, outdoor tourism and water supply. These are precisely the sectors most affected by the climate.

The effects of climate change will depend on the nature of the economy and society it is impacting. Current socio-economic scenarios incorporating climate change apply to the whole of the UK, not regions, and are of necessity only crudely quantitative. Insurance is already predicting the consequences of climate change: for example, buildings will be more at risk because of both storm damage and flooding in winter, and subsidence due to dry ground in summer.

Agriculture and forestry . The fertilising effect of extra CO₂ in the atmosphere will increase plant growth, and interact with temperature rise and altered patterns of precipitation and evapotranspiration. Although cereal crops may benefit from carbon dioxide fertilisation, increased temperature shortens grain ripening



Prolonged rain in winter makes it hard to get agricultural machinery onto the land.



Sheep can suffer heat stress at higher temperatures, and there will be seasonal changes in the growth of the grass they eat.

and depresses yield. Grass yields should increase. We do not know enough to predict exactly how grass and cereal growth will respond to the combination of climate change, poor soils, increased nitrogen inputs, and air pollution. Dairy cows suffer heat stress above 25 °C. Other biological changes are harder to predict, pests and diseases of crops and livestock for example. Forests, which cover 12% of Wales, will be damaged by an increased frequency of storms and high winds, and the spruce aphid may survive better over warm winters to cause more damage the next year; forest fires may be more frequent in dry summers. Such biological changes can be addressed by adaptation: growing different crops (more fodder maize) or varieties, and changing between livestock and arable farming, but there may be a demand for irrigation in hot, dry summers. Getting machinery onto the land will be harder if the land is waterlogged in autumn and winter. Patterns of land use will also be driven by market forces internationally: the current prediction is that the uplands will be little affected but arable farming will increase in eastern Wales. Mitigation policies and agri-environmental schemes may also alter agricultural priorities. In the UK, Wales leads the way with agri-environmental schemes, although neither Tir Cymen nor Tir Gofal deal specifically with climate change impacts.

Transport, energy and water industries in Wales are tightly linked to those in England. The transport industry is particularly vulnerable to extreme events which can result in a route becoming temporarily impassable, although transport infrastructure will be little affected. In contrast, the power and water industries are already planning and adapting, both because they will be so greatly affected, and because of the long life of their infrastructure (hard coast defences, reservoirs, power generating plant and lines). Leaving aside mitigation, which may shift the balance of power generation between fossil fuels and nuclear and renewable resources, shifts in weather can threaten power lines, and less summer rain will reduce the performance of hydro-electric plants. Planning of offshore wind power developments needs to consider the peak wind speeds and wave heights which will occur during the life of the plant, but these are hard to predict.



Design of oil rigs will need to allow for higher peak wind speeds and wave heights.

Tourism is a major contributor to the Welsh economy – 7.5% of GDP, 10% of jobs, with a strong multiplier effect and prospects for growth, especially in short break holidays. However, it is very seasonal, with 61% beach holidays and a strong summer bias. Only 20% of trips are in the shoulder periods (autumn and spring) and the industry plans to expand by developing the shoulder periods. Whilst warming should benefit tourism, the prediction of increased precipitation in autumn may mitigate against increased trips then. Further, effects of sea level rise and storm on the conditions of beaches are hard to predict. The industry will be closely dependent on other factors including how climate change impacts resorts and leisure opportunities in other countries.

Business. Relatively few businesses have thought seriously about the impacts of climate change. Others see climate change as occurring so slowly that its impacts will be felt, if at all, beyond their planning horizons, and that they can adapt rapidly when necessary. It is perhaps disappointing that the opportunities that climate change might offer business are not being sought and seized. In the building sector, there may be a mis-match between future climate and both the location and design of buildings, and the industry has not yet taken account of the



Penrhyn slate quarry. Working outdoors will be hampered by extreme weather events.

weather conditions that may prevail during the buildings' life. Although relatively few production lines are sensitive to temperature, workers are. Old factory buildings may not be adequate to resist more stormy weather. Hotter summers and warmer winters will shift consumer demand towards outdoor products.

The overall impact of climate change on the economy currently looks set to be negative. Even though business is moving beyond its initial concerns with the climate change levy and abatement, the costs of adaptation are not being offset by the seizing of opportunities which climate change might offer. The economy as a whole needs to take a more long-term view.

Water supply and increased flooding

Flooding. Consider the example of Towyn, in the north. On 26 February 1990, a 467 m length of the sea defences were breached by a combination of a storm surge of 1.3 m, high tide and 4.5 m high waves. Floods covered 10 square kilometres with a maximum depth of 1.8 m; power to sewage pumping stations was lost so the flood waters were contaminated. 2800 properties were affected and over 5000 people evacuated. The total cost was estimated at £35 million; 6% of households had no property insurance, and 38% no contents insurance. The conditions producing this flooding would return every 500-1000 years – with our current climate. Sadly, the Towyn floods are not an isolated event. Cliff falls in Pembroke in 1999 were associated with high water and storm. On 8 and 9 April 1998 heavy rain caused rivers to overflow; Talgarth, on the Afon



Overflow from drains after heavy rain, Tregarth.

Ennig, was badly flooded for the first time, and damage across England and Wales was estimated to be £350 million. This event would recur every 20 – 75 years with our current climate. Will climate change make such events more frequent?



Rocky coasts such as this part of the Llyn provide natural defence against sea level rise. Softer coasts will need to be managed if erosion is to be prevented.

The sea level will rise around the Welsh coasts, by about 40 cm by 2080. A significant amount of coastal land in Wales is less than 1 m above current sea level. When rising sea level is coupled with storm surges at sea of up to 1.9 m, and large waves during storms, the frequency of flooding of low-lying areas is expected to increase greatly. One estimate is that flooding events will be between 10 and 50 times as frequent by 2090. When heavy rain falls inland – and more rain than now will fall in intense episodes – it can add to coastal flooding and cause flooding of low-lying areas inland if drainage and rivers cannot cope. Thus three factors - sea level rise, increased intensity of rainfall, and increased frequency of storms – will have a strong cumulative effect.

In consequence, planning of developments in flood-prone coastal areas and floodplains should take into account the likely frequency and severity of floods expected in the lifetime of the buildings. Detailed digital elevation models of the Welsh coast are needed urgently. There is acute awareness of the problems by those responsible for hard sea defences, and these defences are in generally good condition around the coast of Wales. Further, much of the coast is rocky, providing natural protection against marine flooding. But hard defences are expensive to maintain, and there is much coast with soft natural defences such as sand dunes which is vulnerable. Managed retreat, or allowing natural events to take their course, must be considered for significant sections of the Welsh coast.

Water supply. The water industry in Wales faces major challenges. There are estimates that up to 18 of the 43 supply zones could go into water deficit over the next 25 years in dry summers. Summer demand may increase from current levels as more water is needed for irrigation and cooling. The changed seasonality of precipitation will mean that assured supply in summer may depend on increased storage of rain from winter, addressing the 30% loss which occurs in pipes, or using less. Over half of the water abstracted in Wales is sent from Wales to the English midlands and Merseyside. Winter storms and increased intensity of daily precipitation will lead to the capacity of drains and sewers being exceeded; in built up areas water is often diverted directly into rivers and so does not replenish aquifers and reservoirs.

Snapshots of Wales in 2080: what climate change could mean

Cardiff Bay. Because both foresight and finance were available, hard sea defences were built years ago and have been well maintained – so the coastline looks much as it did in 2000. There are more houses, of course, because the population is greater. On the surface, the factories are still there, but now more are making outdoor toys and clothes for the warmer summers; the insurance offices process many more claims than before for storm damage in winter and for building subsidence in the summers when the soil dries out. Indoor leisure facilities have expanded to reduce dependence on weather conditions.

Aberdyfi. You are standing at Ynyslas, at the end of the long spit running north from Borth near Aberystwyth, and looking over the Dyfi to the houses of Aberdyfi nestling under the Tarren hills. The name Ynyslas is all too frequently apt as the higher sea level and frequent flooding often cut it off, especially during storms which coincide with high tide.

The agricultural land of east Wales. As you drive through eastern Wales you marvel at the multi-coloured landscape, all yellows and blues, basking in the sunlight. For once, where once livestock roamed on a green carpet, is now nearly all crop land. The fields are bigger than they used to be, but the strong agri-environmental legislation ensures adequate habitats are maintained to support biodiversity. Every now and then you can see large units of pig and poultry production that depend on the locally produced grain. Overall less people work on the land now than at the turn of the century, but those that persist are much richer than their predecessors. In the towns, many people work in the processing industries that accompany the food and industrial crops.

Snowdon summit. You've picked the day carefully, avoiding the many when rain was forecast. You are climbing Snowdon by one of the great eastern cwms; even if you know where to look, you may not find any of the rare arctic-alpine plants. Snowdon lily, alpine sorrel, holly fern – all have been out-competed by plants from lower altitudes as the temperatures have risen and the rocks have been drier in summer. On top of the mountain, even on this cold spring day, there is much less snow than years ago. When you join the main path up from Llanberis, you notice the many small erosion gullies in the grit surface of the path, carved by heavy rain in spite of new storm drains.

What the stakeholders say and the need to communicate

Interviews showed that stakeholders have a good understanding of climate change, particularly in the ecological, water resource and flooding sectors. Businesses are in general less well informed. There is clearly a need for reliable information on climate change to be widely disseminated among concerned professionals within Wales. The wider public will also need to know more, since a widely held view of stakeholders is that adaptation will need to proceed with the consent and co-operation of an informed public. For some sectors, environmental issues such as climate change are part of their core business and are already considered when planning and developing strategies. For others, the issues are seen as peripheral and often in conflict (for resources, for example) with their core business. Remarkably, those interviewed often cited institutional inertia as a reason for there being little or no adaptation yet. It may not be coincidence that there is a wide perception that thinking about both mitigation and adaptation needs a firm lead from government.

Crucially there is a clear vision of the need for integrated planning. Even those bodies which rightly consider that they have a good understanding of, and policies for adapting to, climate change, tend to work and think in isolation. Across most sectors, there was an acceptance that action within one sector might work against that in another, unless they plan jointly. The framework within which the sectors operate is often not conducive to adaptation – for example, the regulators of the water and power industries set short-term financial, rather than long-term integrated, goals.

Integrated planning

Climate change will affect many aspects of life in Wales. It will not affect them independently; rather, the impact of climate change on one sector will have consequences for activities in, and adaptation to, another sector. Some of the interactions are outlined in the table. For example, if agricultural land needs irrigation during dry summers, more pressure will be placed on the water industry to meet the sum of its needs when precipitation is also lower. The many interactions point to a need for integrated planning. Current planning of all kinds takes place largely within sectors. For example, even within national parks, where long-term planning is considered on a broad front, many agricultural and forestry decisions are not subject to the park authorities. In addition to the current disadvantages of fragmented planning decisions, the consequences of climate change will add many more. It seems obvious that decisions taken in one sector should not prejudice mitigation or adaptation in another sector. Integrated planning, demanding new levels of co-operation and consultation, is the only way to address such problems.

The choices

Our recommendations for adapting to climate change in Wales focus on the need to put in place

- policies for adapting to climate change,
- strategies to improve communications and integrate planning, and
- programmes to collect information on climate trends and to research impacts and adaptation options.

Policies for Adapting to Climate Change

- The Assembly needs to ensure that climate change is considered as a component of sustainability - a key cross-cutting theme of the Assembly - in determining policies.
- The Assembly needs to develop economically viable strategies which recognise the interactions between climate change, agriculture, conservation and water resources.
- The Assembly needs to take account of the potential impacts of climate change in revising planning guidance (Technical Advice Notes) particularly in areas susceptible to flooding. The Assembly also needs to influence Building Regulations to ensure that they address climate change impacts during the lifetime of the structures being planned.
- Regulators need to ensure that the water and power utilities place sufficient emphasis on measures to assist adaptation to climate change. In the longer term, there may be pressure to build reservoirs in Wales to supply consumers in England. This will raise significant political issues.
- Government needs to clarify the responsibilities for flood defence which are distributed between a range of bodies.
- The Assembly and Welsh organisations need to ensure that Welsh issues are fully incorporated into UK-wide research on climate change impacts.
- Organisations need to consider how corporate strategic plans should be informed by a wider range of issues than currently, due to the high degree of interaction between sectors which climate change will highlight.
- Business needs to consider the opportunities as well as the threats offered by climate change.

Strategies To Improve Communications And Integrate Planning

- The Assembly needs to consider setting up a forum of local stakeholders and experts to exchange information, concerns and ideas, to act as a focus and facilitator for the climate change debate, and to start building the networks which are needed to underpin integrated planning.
- The Assembly and other organisations need to consider how to increase public awareness of climate change issues.

Programmes to Collect Information on Climate Trends and to Research Impacts and Adaptation Options.

- Socio-economic scenarios need to be developed for Wales, taking account of the regional economic statistics to provide a more detailed picture of how the interaction of climate change and socio-economic scenarios might impact on Wales.
- The Assembly and other Welsh organisations need to advocate and support research on the impacts in sectors such as freshwaters, upland habitats, agriculture and forestry.
- The Assembly and other Welsh organisations need to advocate and support research to determine how local climates in Wales will be affected, particularly the nature and frequency of extreme climatic events.
- The Assembly needs to consider the selection of indicators of climate change for Wales, consistent with the UK indicators, and make arrangements for collecting data.

Quotes from stakeholders interviewed:

“If we are building a jetty, ship or planning routes, we take weather conditions into consideration, but not weather conditions linked with climate change, it is based on historical experience of the weather.”

“Attitudes, especially among local politicians, are a problem. Our politicians are more interested in parochial matters, there is a lack of understanding and a lack of appreciation of what these matters can ultimately lead to.”

“Seasonal re-distribution of rainfall and increased temperatures in summer will require planning to ensure consistency of water supply.”

“Demand might increase in lowland England for Welsh water.”

“Water supply companies cannot respond quickly because new infrastructure may take up to 20 years to complete.”

“We are seeing iron age hill forts on the coast which have been eroded to over half their extent.”

“There are difficulties in getting reasoned information into the public domain.”

“Research is required on health impact assessment, but we don’t know the links between things like housing and energy consumption and health.”

“There is a lack of commitment at government level to things like climate change.”

“The insurance industry would seek to reflect the costs of climate change in its insurance pricing policy. The industry could geographically discriminate different densities of claims.”

“The coastal communities that are dependent on tourism will be significantly effected by climate change.”

Examples of interactions between sectors which will be driven by climate change

C A U S E D B Y				
	terrestrial and freshwater habitats	flood defence	agriculture and forestry	water resources
agriculture and forestry	agri-environmental schemes; need for corridors between fragmented habitats	loss of agricultural land		low supply will restrict irrigation
tourism	visual; potential for ecotourism; fishing	visual	visual	visual
water resources	need for water to maintain water-tables and river flows	need to ensure that inland flood defences allow water to be diverted to reservoirs and aquifers	need for irrigation; runoff and water quality	
flood defence				need to divert inland waters to reservoirs and aquifers
biodiversity and terrestrial and freshwater habitats		loss of habitats; saline incursions may cause species loss	land use changes may cause loss of sites	low water flows in rivers and low water tables may cause species changes
archaeology		loss of sites from flood or construction of hard defences	loss of sites with land use changes	
human health	insect vectors; water-borne pathogens	sewage in floodwater	water-borne pathogens; agrochemicals	water-borne pathogens