

Meeting the Challenge of Climate Change

Summary of the South East Climate Threats and Opportunities Research Study (SECTORS) Project: A Study of Climate Change Impacts and Adaptation for Key Sectors in South East England

Introduction



This report summarises the results of a detailed research study which was carried out in 2003/04 by Atkins plc and Oxford Brookes University, and commissioned and funded on behalf of the South East Climate Change

Partnership (SECCP) by the South East England Development Agency (SEEDA).

The Study begins from the premise that although we can clearly influence the extent of future climate change through reducing the quantities of 'greenhouse gases' emitted into the atmosphere, the response of the climate system lags behind these emissions. Thus, we are already 'locked into' a level of unavoidable climate change for the next half century or so. The Study focuses largely on this unpreventable climate change, and how it will impact on key sectors in the South East over the next few decades; it addresses the need and scope for adaptation - and the need to plan for it, ahead of time. SECTORS will be taken forward by SECCP sector groups and SEEDA, as a basis for closer engagement with key organisations, particularly businesses, in raising awareness of climate change impacts and the need for forward planning for adaptation. To underpin further work, the consultants were also asked to bring together key data and to develop a set of climate change indicators for the region, to map relevant research activities and to provide a specification for a Geographical Information System (GIS) based tool to help with adaptive planning for climate change - these elements of the project are also summarised here.

SEEDA and SECCP were instrumental in identifying the priority sectors for review, in terms of the risks and opportunities from climate change impacts. There are strong relationships between the sectors, and the ability of any sector to adapt to climate change will depend upon the responses of others. The sectors reviewed were:

Agriculture	Biodiversity
Business and Economy	Emergency Planning
Health	Land-Use Planning
Tourism	Utilities & Infrastructure

The 1999 report "Rising to the Challenge: the Impacts of Climate Change in the South East" (Wade et al 1999) set the agenda for addressing climate change in the South East and led to the formation of SECCP. Commissioned to assess the impacts of climate change on the region's environment, economy and society, "Rising to the Challenge" concluded that "the South East has potentially more to gain, and certainly more to lose, from climate change than any other region in the UK". Since 2001, SECCP has provided advice to regional stakeholders and promoted research on the likely impacts of climate change and how to respond to them. The Partnership works closely with the UK Climate Impacts Programme (UKCIP) SECTORS provides an update on the issues and risks identified in "Rising to the Challenge" and takes a more detailed look, based around detailed sector surveys, at the scope for adaptation to climate change and the development of associated adaptation strategies.

Aims and Approach

SECTORS has four main objectives:

1. To assess the South East's key sectors in terms of their expected climate change impacts, related issues and responses and to identify sector-based adaptation strategies;
2. To map existing datasets and data collection systems relating to climate change and to develop a set of regional climate change indicators;
3. To map existing research activities relevant to climate change impacts and adaptation within the region;
4. To advise on the development of a GIS tool to aid adaptive planning in the region.

The project involved a combination of desk-based research and development, literature review and a questionnaire survey, together with workshops and direct consultation with stakeholders. The consultants reported to a small steering group of SECCP partners, chaired by SEEDA.

Progress since “Rising to the Challenge”

In the five years since the publication of “Rising to the Challenge” there has been a considerable amount of research into the science and impacts of climate change, including a range of regional impact studies and investigations of the impacts on particular sectors and resources. SECTORS includes a review of the key publications, particularly in terms of their implications for the South East. Improvements in modelling led to publication of a new set of UK climate change scenarios in 2002 (Hulme et al., 2002), superseding the UKCIP98 scenarios (Hulme and Jenkins, 1998) on which “Rising to the Challenge” was based. Although the same broad changes are predicted, the UKCIP02 scenarios are ‘drier’ than their predecessor, suggesting an overall decline in rainfall in the South East; winters, however, are expected to be relatively wetter. (For details of the UKCIP02 scenarios and information about climate change impacts and adaptation, see the UKCIP website <http://www.ukcip.org.uk>).



Adaptation Research & Tools

In contrast to the good geographical and sectoral coverage of climate change impacts in the UK, little substantive research has been published on adaptation. At the UK level, one study (ERM, 2000) has reviewed the priorities for adaptation and attempted to cost adaptation using cost-benefit analysis. The only sub-UK adaptation study relates to Scotland (Kerr and McLeod, 2001).

UKCIP has published a climate adaptation decision-making framework which incorporates guidance on dealing with climate change risks and uncertainty. UKCIP has also recently published guidelines for costing climate change impacts and adaptation, which includes techniques for valuing different types of impacts, decision support tools and illustrative case-studies.

Consultation: Climate Change Issues and Responses

Questionnaire Survey

SECTORS included extensive consultation based around a large questionnaire survey, followed up by direct contacts to ensure coverage within and across sectors. Two workshops were also held specifically to address the biodiversity and tourism sectors and inform the development of the questionnaire survey. Two further workshops were held to test the regional climate change indicators and outline adaptation strategies.

The findings of the questionnaire and interviews and the various workshops (included in the full SECTORS report) do not attempt to repeat the comprehensive survey of possible impacts contained in “Rising to the Challenge”, but report on the perceptions of the respondents and participants. These have been brought together with the review of other relevant studies completed since “Rising to the Challenge” to identify sector-specific issues.

The research assessed a range of weather and climate change related issues of significance to stakeholders in the region - including the importance of weather to their activities, their attitude to climate change, its potential effects on their ability to meet their business objectives, and their awareness of climate change advice and approaches to adaptation. Threats and opportunities associated with climate change were also identified for each sector.



Planning Ahead

For most sectors, a two to five year planning horizon appears to be the norm. Although, as might be expected, the sectors with long lead times and long life projects (such as biodiversity, planning, infrastructure and utilities) planned further ahead, many respondents explained that they worked to all time horizons: for instance, for budgeting, an annual cycle is used, while for those organisations which worked within political horizons, a three to five year period is important. Benefits, similarly, were seen across all time horizons.

The Current Importance of Weather

At least 80 per cent of respondents considered that current weather affects their business or organisation in some way. Some, whose work was policy based, did not consider that they were affected, while others evidently discounted what they saw as abnormal conditions: “apart from rain or extreme cold conditions, work continues”; and “no significant impact over normally expected delays in the event of snow, ice etc, for travel to work for employees”.

Current impacts of Weather, as reported by Respondents, by Sector

Wet	Dry	Cold	Hot	Windy
<i>Agriculture, forestry and fisheries, inc. horticulture</i>				
crop damage, flooding, soils, costs increase, pests	poor germination, fires, yield loss, stress, cultivation problems	frost damage, varietal choice, rodents	heat damage, dry streams, pest problems	wind damage, electricity supply affected, spraying difficulties
<i>Biodiversity</i>				
costs increase, water-logging, difficult survey work	fires, plant loss, water shortage	energy sourcing, damage to road surfaces, heating bills	anti-social behaviour increases, public health problems, difficult working conditions	tree damage, damage to structures
<i>Business and economy</i>				
problems with using or moving heavy equipment, disruption to outside work and access, some pests increase	movement on construction sites easier, limitations on planting	damage to construction materials and practices, outdoor activities, reduction in some pests	ground shrinkage affects foundations and materials, outdoor activities, pest problems	problems in handling materials and bulky goods
<i>Emergency planning</i>				
flooding, staff access to work, services affected	clay shrinkage, disruption of public water supply	increased slips and falls, risks to elderly and vulnerable, transport	increased support needs, heat-related illness	increased need for support, disruption of activities, traffic disruption
<i>Health</i>				
disruption of staff travel, incidence of illness	dehydration	cold-related deaths	heat-related illness	
<i>Planning</i>				
new work on land drainage and storm overflow schemes, many LA services affected, delays in surveys or site visits, delays in construction, flooding issue for stakeholders and risk management, infrastructure and growing season, litter control, staff access, flood damage to historic building fabric and archaeology	new work on water resources, attract people to area, site work easier, biodiversity and environment, increased landscape or grounds maintenance costs, building and hard landscaping stability/subsidence, grassland fires	burst pipes, health/fuel poverty, heating costs, extreme weather hastens erosion of historic fabric, increased anti-social behaviour	increased costs of electricity and equipment, air conditioning failure, south facing buildings affected, leisure facilities, care of elderly, food poisoning, air quality, use of open spaces	tree damage, coastal defence damage, grid failure, building and infrastructure maintenance costs, access disruption, coastal erosion
<i>Tourism, leisure, sport</i>				
visitor numbers down, event cancellation, more heating needed, structures affected, unusable areas outdoors	reduces gardening activities, damage to grass areas, lake water levels fall	plant damage, low visitor numbers livestock care problems, structural damage, indoor tourist sites may benefit	glasshouse climate control, lower activity levels, algal blooms, outdoor sites may benefit	unsafe conditions, sailing problems, costs of damage to buildings
<i>Utilities and infrastructure</i>				
landfill management, line/road flooding, soils stability, delays, access, outages, contamination	bank stability, demand increase, ground-water recharge low, resource shortages, asset damage	landfill gas yields down, increased electricity cost, ice hazard, maintenance problems	increased water demand, increased packaging waste, rail track damage	temporary closure of landfill, excessive leaf fall, ferry diversion, infrastructure damage, outages

Attitudes Towards Climate Change

Despite the differences between the sectors, the responses showed a remarkable similarity in estimating when climate change might affect their activities. 81 per cent of respondents agreed that climate change will affect their business or organisation within the next 10 years, and 88 per cent beyond the next 10 years, while 62 per cent agreed that climate change was already affecting them. Very few (only five respondents altogether) considered that climate change would never affect them.

Examples of Effect of Climate Change on Ability to Meet Objectives, by Sector

Sector	Examples of effect on ability to meet objectives as reported by respondents
Agriculture and forestry	Land use and farming could change with climate change, thus affecting productivity and profit
	Climate change may affect social habits. People may find it too hot to visit gardens, or interest in gardening generally may decline
Biodiversity	Could help rare amphibian and reptile species (natterjack toad, sand lizard, smooth snake, pool frog) become more common and lessen the need for conservation action
	Not sure – it depends how adaptive/responsive they are to extreme events as well as how effective longer-term adaptive planning is
	Potentially it could affect the nature of best practice advice we give and affect woodland areas and individual trees (including street trees) through increased summer drought or winter flooding
	Naturally functioning systems will lead to biodiversity enhancement
	Changes to natural structure and species composition of woods
Business and economy	Lack of supplies
	Negative – flooding, raised water levels, affecting business sites, both coastal and inland Positive – warmer boating conditions, new water-borne opportunities
Emergency planning	Could be swamped by requests
	Long-term provision of recreation service might be affected
Health	Our objectives include adapting to climate change
	Extreme change may affect the way in which future sports provision is planned
Town and country planning	Through delays to timely production if flooding/weather prevents site and traffic surveys, computer failures in extreme temperatures
	Could disrupt roads, health etc
	Will affect all residents and local businesses, so will feed into democratic process
	It may do at some point, but it is not clear at this point
	Loss of land to flood plain
	Impact on development potential of sites
	Hotter summers may lead to increased incidents of anti-social behaviour, particularly neighbourhood disputes and underage/teenage drink and drug-taking, as well as accidental and deliberate fires ie on open spaces and derelict or vacant sites. Wetter winters tend to lead to increased maintenance of roads and pavements, cost of restoring after floods – housing stock but also generally drainage
	Service provision – costs not budgeted for, need to review strategic plans eg economic development
	Budget implications for flood defence Development issues (shortage of land)
	Will make job of providing flood protection increasingly difficult
PPGs advise that land liable to flooding cannot be built on, therefore when planning location of future housing development, our options are restricted somewhat (Thames floodplain in our District)	

Tourism	Any disruption to power or transport prevents SMEs from attracting customers therefore reducing sales and ultimately profits at some tourist attractions. Also rely on "natural beauty" which may disappear with erosion etc
	If we are right about the nature of the changes then our primary objective should be easier to meet - more people using the site. But, local habitat conservation will be adversely affected - which is a secondary objective.
	Storm damage, flooding, erosion, poor vegetative cover, but more visitors, better use of outdoors, less damage to property if dry
	The Thames, rich in biodiversity and character, may be destroyed
	Severe adverse weather will have a detrimental effect
	Probably not affected - although flexibility will be required
	There will be both opportunities and threats - although on balance the threats outweigh the opportunities
Utilities and infrastructure	Change to water resources - groundwater storage
	Depends on extent of change

Approaches to Planning for Climate Change:

The range of organisational approaches which emerged from the consultation can be characterised as follows:

■ Strategic view

Already committed to adaptation policies or with a corporate planning strategy with sufficient lead time to allow adaptation to climate change.

■ Acting on (and reacting to) current climate-related issues

Undertaking pragmatic actions in response to natural changes in the environment (e.g. agricultural organisations), or taking business decisions to invest in response to climate (e.g. tourism) and those responding as and when the need arises.

■ Wait and see

Expecting to adapt only when change (inferred through cost) is paramount, generally those with short planning horizons with a high dependency on guidance from authorities.

■ Do nothing

Those who do not see climate change as an issue in the context of their organisational delivery - because other pressures are of greater significance. This group also includes those sceptical of climate change.

Advice on Adaptation Strategies



The consultants have defined adaptation as “the response of whole eco-systems or species, including human populations, by changing their behaviour, practices and policy to adapt to changed climatic conditions”, and took the view that an adaptation strategy might take the form either of a specific policy or a strategic change in practice or behaviour. The Study considered three possible approaches (or combinations of approach) which SECCP could take to improve awareness and planning:

Adaptation hierarchy: promoting a conceptual framework that encourages organisations to move up a ‘ladder’ of approaches;

- Prioritising adaptation strategies and adopting these in forward planning;
- Appraising measures to increase resilience to climate change, and to maximise opportunities;
- Assessing potential threats and opportunities, including uncertainties;
- Appreciating how current practices relate to climate e.g. increased demand for a product in hot weather;
- Understanding current practices.

Tiered response: assessing and planning for impacts;

- Be active;
- Engage with the future;
- Review and revise.

Function-based response: capturing generic responsibilities within a range of organisations (e.g. employer, estate manager / property owner, purchaser / supplier, influencer / champion).

A strong recommendation from the consultees was the need to develop case studies / demonstration projects of good adaptation practice.

Obstacles to Preparing an Adaptation Strategy

Given the differences between the sectors, there is again a noticeable similarity in their perception of obstacles to the preparation of an adaptation strategy. The most common reasons given are lack of money and uncertainty about climate change, rather than lack of awareness of possible climate change impacts (although of course the factors may be connected). For most organisations, funding for any new initiative such as preparing a strategy is seen as an obstacle, and uncertainty over climate change is perceived as significant, even though it may not be any greater than other uncertainties which an organisation may face.

Outline Adaptation Strategies - Generic Themes

Given the strong degree of interconnectedness both within and between many of the sectors, it is not surprising that a number of generic or cross-cutting themes emerged for adaptation, as well as sector specific measures. Generic themes - and possible actions - include the following:

▪ Buildings and infrastructure management

Improving the thermal efficiency of buildings:

Apply sustainable construction and best practice guidelines for both retrofit and new-build to improve the thermal properties of buildings (cooling during summer, heat retention during winter). Reduce solar gain using recessed windows, roof overhangs and shades; maximise natural ventilation and use of energy and water efficient air conditioning where essential. Outside buildings, use trees to provide shade.

Environmental management systems (EMS):

Carry out an EMS audit to establish how utilities (e.g. energy & water) are used, and to identify the characteristics of the supply chain. Take action on site to improve energy and water efficiency and reduce emissions of greenhouse gases. The health, education and planning sectors could potentially make significant gains here (hospitals, offices, schools, depots etc). They should, at least, ensure that all new development proposals are thoroughly tested for resilience to climate change.

■ Integrated water management and land use planning

Resilience to flooding:

Particularly in rural areas, assess soil management, land drainage and land use to characterise impacts and risks, and to identify options for changing practices to minimise risks.

In urban areas, assess infrastructure capability and risks (current and future), and identify options e.g. for sustainable drainage technologies through retrofit and new build.

Resilience to drought:

Secure the sustainable management of water resources, incorporating a balance of both supply and demand management, and promoting practical approaches, methods and advice. For the rural economy this will include support for on-farm water efficiency techniques and development of water storage for irrigation. For many sectors, there will be synergies with EMS, seeking options to minimise water use, reduce leakage and incorporating recycling where feasible. Options for recycling. Public water supply companies and a number of businesses are already taking action.

Integrated management solutions providing multiple benefits

A key outcome in delivering integrated water management and land use planning will be the promotion of solutions and approaches that provide multiple benefits. Schemes that provide benefits to flood risk management, for example, can also provide benefits to water resources, water quality and biodiversity.

The increasing integration of water management planning through the Water Framework Directive and new strategic flood risk management planning should together be expected to provide solutions and benefits that will be resilient to climate change. The Strategic Environmental Assessment (SEA) Directive will require planning authorities to have due regard to the requirements of these plans both in terms of their routine duties and strategic planning.

■ Biodiversity, soils and land use management

In rural areas, assess soil management and land use to characterise risks of soil erosion, diffuse pollution etc. and changing practice to minimise risks. Develop the value of soil as a carbon sink and promote agri-environment schemes to support good soil management. Both agri-environment and conservation schemes will increasingly need to take account of climate change and the wider implications of, and benefits to, countryside management.

The rural economy will need to explore more adaptive business strategies and synergies with local tourism strategies.

■ Energy management

As well as site and sector EMS audits and energy efficient construction and design, adaptation measures include the use and development of renewable energy sources (e.g. wind, low-head hydropower, biomass and bio-digesters) and combined heat and power (CHP), including micro-systems. Within the business and economy and infrastructure sectors, many of the larger organisations are already active in energy management, particularly to reduce costs.

Sector Specific Issues

For each sector, the summaries focus on threats and opportunities and approaches to adaptation. The full report offers more information and greater detail.

Agriculture, Horticulture & Forestry



Picture courtesy of Denbies Vine Estate, Dorking

Threats and Opportunities

This sector perceives some risk from climate change (particularly flooding and drought, and high summer temperatures) where crop and livestock varieties may need to be reviewed.

Climate change impacts driving change in agriculture were identified as flooding, changes in the pattern and timing of the seasons, storms, summer water shortages and higher summer temperatures. These impacts are seen as likely to lead to soil erosion, diffuse pollution, depleted water resources and deteriorating water quality.

Expected effects on farming include loss of grazing and forage yields, possible losses of milk production, animal welfare problems, and difficulties with disposing of slurry and surface water in the wetter winters, flourishing pests and diseases, and changing species viability.

In economic terms, the risks are seen as lower incomes, lower yields and higher crop costs. Nevertheless, opportunities for agriculture were also identified, including new crops (including biomass crops for fuel), new varieties of existing crops, new markets, an extended growing season and the potential for fuel cost savings.

Adaptation

Although this sector is already highly adaptive to natural processes, there is a clear need to build on the current work on adapting to other business drivers such as reform of the Common Agricultural Policy. The sector offers significant opportunities both to develop new markets and new businesses and to raise awareness. There will be a need to develop strategies within horticulture to provide flexibility and resilience in planting, such as the development of more weather-resistant plant varieties, particularly enhancing drought tolerance which will also require more innovative approaches to irrigation and water management. Adaptation strategies for agriculture will include changes to variety and crop type. Emerging trends in medicinal crops (e.g. trials of opiate poppies) may well be an indication of future trends for the region.

Adapting to Climate Change: Case Study: Country Land and Business Association

The CLA's policy statement assesses the likely impacts of climate change on eight themes related to the rural economy, and for each impact suggests adaptation (or mitigation) strategies that land managers and rural businesses could adopt. These are summarised here:

Theme	Impact	Response
Water	Less security of supply for irrigators, low river flows in summer, adverse water quality	Support for farm water efficiency, incentives for on-farm reservoirs and flood-washlands
Soil	More difficult to work, possibly reduced supply from floods	Value use as carbon sink, use agri-environment schemes to support good soil management
Arable and livestock farming	Some crop yields may increase, but grazing season reduce, changes in working day, change in pests	More integrated audits of on-farm activities (eg GHG), more research
Energy	Increased demand for new/ renewable sources	Effective support and more research for biomass and biodigesters
Forestry	Increased tree yields if not limited by drought, fires, gales, species shift	Support for areas for forest planting and management to sequester carbon and provide alternative materials
Rural businesses	Extended UK holiday season, but negative impact on fisheries and game?	Support for adaptive business strategies, including home tourism, visitor management and locally-based business development
Flooding	Impacts on agricultural land, property and habitats	Incentives for managed realignment/ recreation of habitats, for land to control flooding and for soil management to increase water-holding capacity
Biodiversity	Changes in terrestrial habitats and species including pests/diseases	Agri-environment schemes to take account of climate change in wider countryside

Adapted from "Climate Change and the Rural Economy" CLA 2001

Biodiversity

Threats and Opportunities

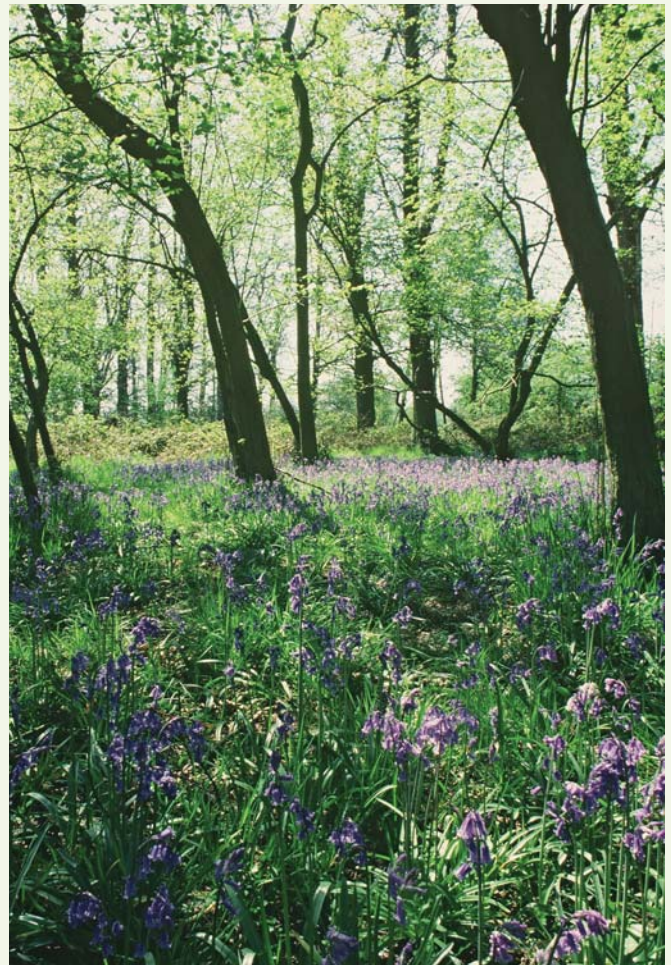
While the biodiversity sector (organisations with an interest in nature conservation and biodiversity) does not constitute a strong economic component in itself, it contributes to other economic sectors, notably tourism and leisure, as well as agriculture. SEEDA's report on the Environmental Economy of the South East estimates that there were one billion leisure visits in the region in 1998, of which 31 per cent were to the countryside, 5 per cent to the seaside/coast, 7 per cent to woodland, and 5 per cent to inland water.

The biodiversity sector is expected to be strongly affected by climate change, as habitats change through a warmer and drier climate, but with periods of flooding. Invading species may also displace indigenous species as habitat conditions change.

Threats identified by respondents included habitat change, such as the drying up of ponds, rivers and aquifers, leading to habitat and species loss. A particular threat to ancient woodland was noted. Other species might be affected either by poorer winter conditions or as a result of warmer summer conditions (in some cases because of greater competition from invading species). Increases in pests and disease were mentioned by many respondents, invading exotics and severe weather are also seen as threats - the latter especially in the case of trees.

Changes in habitable range may mean that some species increase and benefit naturally, while climate change may offer opportunities for artificial extension of habitats. Coastal realignment and managed retreat, associated with the creation of marshlands, were highlighted by several respondents. Flood alleviation schemes and projects to restore floodplain function are also seen to offer biodiversity opportunities and to facilitate species movement in response to climate change.

Economic benefits for the biodiversity sector include expanding markets for renewable energy technology, income via carbon sequestration arrangements and a longer active season where there are economic activities (e.g. fisheries) associated with biodiversity, together with research opportunities for scientists.



Picture courtesy of English Nature

Adaptation

Dynamic conservation is already a feature of this sector, and there is general awareness and engagement with current research on the impacts and responses to climate change. Nevertheless, biodiversity issues, including climate change need to be integrated and promoted more strongly through other regional strategies.

While at the local scale adaptive management is likely to be more of a mechanistic response to change, there are opportunities at a more strategic level to provide a framework for forward planning for climate change. There are clear opportunities for integrating biodiversity aims and improvements with the new land use and water management requirements of the Water Framework Directive and SEA Directive. 'Soft' engineering and design should be explored, for example in new flood risk management schemes and green corridors as well as through new development.

Emergency Planning

Threats and Opportunities

Respondents highlighted increased rainfall and sea level rise as having implications for coastal erosion, weathering, landslides, land loss, and flooding, causing disruption to homes, businesses, transport and utilities, with consequent cost to communities and councils.

Adaptation

This sector is largely focused on planning for civil emergencies in the short-term, rather than 'distant' future risks and uncertainties, such as - in their view - climate change.

The sector needs to be encouraged to include climate change in its use of scenario planning and to build on the new Local Authority duty for business continuity planning. It is becoming increasingly clear that emergency planning strategies should address the potential future risks of climate change to ensure that emerging impacts can be managed effectively.



Picture courtesy of Southern Water



Picture courtesy of Jared Crossley

Health

Threats and Opportunities

Health services are a major employer in the region. In 2002 some 6.3 per cent of employment in the region was in “human health activities”. The NHS is also a major owner of property in the region. Although Public Health is currently focused on surveillance of disease and the threat of bio-terrorism, there is an awareness of climate change. Perceived threats related to operational factors, such as bad weather (especially flooding) causing traffic delays (hence restricting access to and for patients), disruption or damage to business or assets. There was uncertainty about heatwaves, although an increase in heat-related deaths was expected. The effect of hot weather on air quality is also an issue, although respondents expected that winter air quality might improve.

Respondents made no mention of the possible increases in cancer or of the effects of water shortages, although both were mentioned in the Department of Health report on the effects of climate change in the UK.

Adaptation

Many in the health sector take the view that the best strategy is to ‘wait and see’, on the grounds that the dimensions of impact ‘are not possible to quantify’. This view notwithstanding, there will be a need to enhance capacity to detect the early health impacts of climate change, and research, monitoring and integrated assessment activities should be supported.

A co-ordinated pan-European surveillance system may be needed to detect changes in incidence and distribution of infectious diseases associated with environmental or climate change.



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Land-Use Planning

Threats and Opportunities

The threat most frequently mentioned by Local Planning Authorities is flooding - both increased risk of flooding and the consequences for affected areas. Water resources and drought, with consequent effects on land and building stability, and deteriorating air quality, were also mentioned, although less frequently. A number of respondents mentioned landscape and biodiversity, including the threats to existing designated habitats and species, loss of landscape features, e.g. trees, in both rural and urban settings, was also mentioned. Surprisingly, few Local Authority respondents identified specific planning implications for the location of development, although non-governmental organisations referred to the risk of not achieving the potential of development sites in coastal or fluvial locations. Among the impacts mentioned were the effects on the elderly (often a high proportion in coastal districts) and on areas where flooding might cause insurance difficulties, leading to lower land and property values.

Far fewer opportunities than threats were cited, but almost all mentioned tourism, especially the scope for increased domestic tourism to contribute to the health of the local economy. Further economic benefits for rural and urban areas were expected from new crops or products (such as renewable energy), and there was potential for generally improved design and

more sustainable development, with residents coming to realise the importance of more energy and water efficient design. The threat of flooding might lead to the protection or designation of some natural areas which might otherwise have been developed.

Flood risk and compliance with the flood risk assessments required by PPG25 (Development and Flooding) are already taken seriously at the strategic level, and allowance is made for a one in 100 year event and the possibility of a 20 per cent increase in peak flow but uncertainty over the extent of further change beyond 10 - 15 years may deter developers.

Adaptation

Even though planning authorities, especially at strategic level, are engaged in longer-term planning, they appear to be constrained by shorter term political horizons when it comes to climate change. Where climate change had been considered, it was viewed as an issue of mitigation (reduction) rather than adaptation, and it was seen to be addressed through environmental policy. The EU Strategic Environmental Assessment Directive may however lead local planning authorities to greater engagement with climate-proofing strategies and guidance.

Tourism - Leisure



Picture courtesy of Southern Water

Threats and Opportunities

The Tourism sector (including recreation and leisure) regarded variations in water availability at different times of year as the major threat associated with climate change. Wet weather and flooding were the most frequently mentioned threats; flooding was expected to affect travel and electricity supplies, causing damage to buildings and sites as well as soil and river bank erosion. Unsympathetic flood defences were also mentioned as possibly causing unwelcome landscape impacts. On the other hand, hotter drier summers are also expected to lead to problems linked to vegetation. Again, landscapes and views would be affected as grassed areas for sport and recreation suffered drought. One respondent noted that costs might rise as a result of the need to install air conditioning.

Climate change is also perceived to offer a range of opportunities. The UK would become a more attractive destination for overseas and domestic tourism and leisure, stimulating greater use of outdoor locations. River sites might provide more tourism and leisure opportunities and one interest group thought more opportunities for river cruising and for off-line moorings might result. Catering sales would

increase generally, and more “al fresco” dining might occur during a prolonged tourism season and into the evenings. It is also suggested that warmer drier weather might encourage use of more sustainable modes of transport, and conditions for walking would be better over longer periods.

Adaptation

Development of strategies to exploit the opportunities associated with climate change - the ‘evening economy’, increasing regional tourism, enhancement of visitor opportunities and numbers in association with other initiatives e.g. agri-environment, flood risk management - is essential if this sector is to anticipate and to benefit from the impacts of climate change in the region.

Adapting to Climate Change: Case Study: National Trust

The National Trust takes the view that it needs to prepare for climate change, but as all climate change projections are uncertain, and even properties in close proximity to each other may be affected very differently (for instance, through localised storm damage), the response has to be one of flexibility and adaptation. The Trust especially has to be ready to respond to both gradual change and to extreme events that may cause a threshold shift in a location – and to make instant decisions promptly (for instance, after a storm) to make the best of an opportunity for change.

The Trust therefore addresses the issues as follows:

Changes underway and projected in UK [UKCIP02]	Likely impacts	Main types of NT property and interests affected	Possible responses (actual response will depend on various factors on site)
Increase in storms and severe weather events, with possible changes in prevailing wind directions	Soil erosion from wash-outs	Gardens, open spaces, farms, potential loss of income	Assess soils and land uses at risk of soil erosion. Change land use and management practices to minimise risk eg change arable to permanent grass, use set-aside or planting to avoid rapid run-off into streams and lakes. Alter cropping and timing of work e.g. stop “de-stoning”
Hotter, drier summers	Health/exposure of staff and visitors	Coast, countryside, gardens, potential loss of income	Use thermal properties of materials to improve cooling in buildings and maximise natural ventilation. Only when these alone are insufficient retrofit energy-efficient air-conditioning, reduce solar gain using recessed windows, roof overhangs and shades, provide shade or cooled waiting areas
Milder, wetter winters	Wetter winters causing damp, condensation and mould problems in buildings	Buildings	Manage internal environment and increase ventilation. Reduce thermal bridging/increase insulation in building envelope
Sea level rise and increased wave height	Restricted public access to coast paths/roads due to erosion/landslip	Coast, access, potential loss of income	Negotiate with farmers/neighbouring landowners to move rights of way and accesses away from the coast

Utilities & Infrastructure

Threats and Opportunities

Some very full responses were provided, especially from water and waste companies. Most respondents considered that adverse weather will require contingency plans to be adapted, but will have a negative impact on business profitability through either downturn in business or a need for investment. Secondary impacts (such as low river flows affecting the ability of receiving waters to dilute treated effluent, and the availability of water for abstraction), are also of concern, as is the potential conflict between mitigation and adaptation, with tighter effluent standards requiring more energy intensive treatment systems. Stress on infrastructure (causing premature failure of assets) and changes in patterns of demand will exacerbate other issues (e.g. providing for increased housing growth).

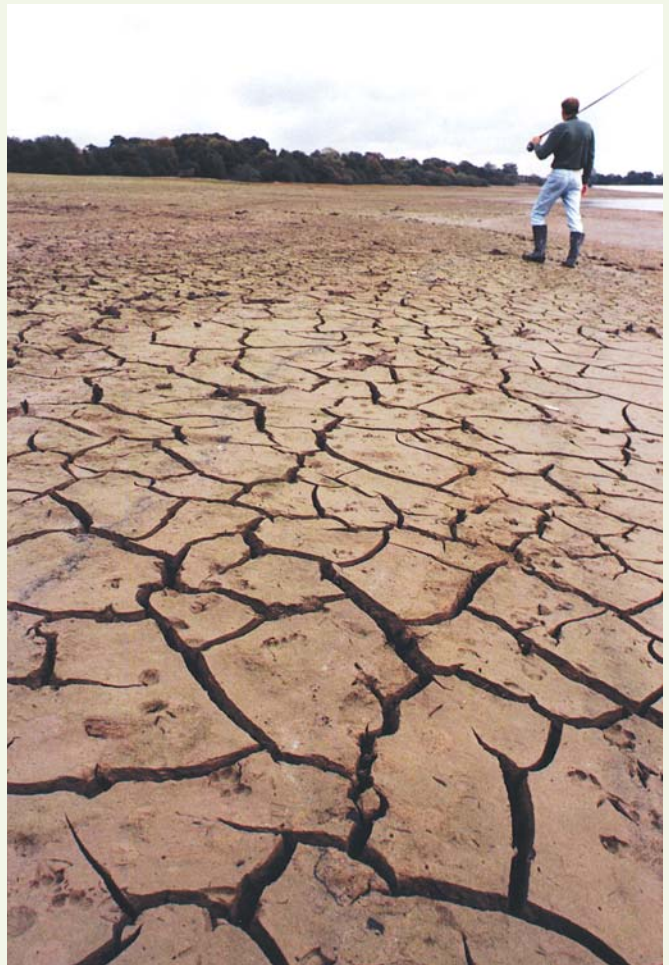
One major water utility expressed concern also at the problems of lack of joined up political or regulatory thinking, and legislation which is not climate change proofed.

For some services, climate change offers the possibility of increased revenues and/or increased investment. Good weather should encourage greater use of sustainable transport modes (e.g. walking and cycling). The renewables and energy efficiency industry sees potential for market development and more business.

Operational opportunities include the development of new technologies to identify and exploit new resources or new treatment methods. There are also learning opportunities in applying lessons from overseas operations, in participating in regional awareness, education and research partnerships and in promoting best practice and climate proofed legislation.

Given the large, capital intensive nature of much of the water and energy sectors, companies have already engaged in both climate change mitigation and adaptation.

Nevertheless there is a need to raise awareness among businesses in other sectors, particularly through the co-ordination of industries (e.g. waste and minerals, transport) where longer term strategies could be better integrated to facilitate climate change adaptation. There could also be opportunities to make use of the utilities' customer base for the distribution of awareness raising information.



Picture courtesy of Southern Water

Adaptation

The majority of industries and organisations within this sector are already active in climate change planning and adaptation with particularly good examples from water, rail and power. Adaptation within the water industry includes: metering, leakage management, water efficiency and new resource development. Options for 'water scarcity' status are being considered in parts of the region. The Water Framework Directive will provide SEEDA and SECCP with a new opportunity for engagement and promotion of sustainable development in the face of a changing climate.

Transport strategies will need to take account both of the impacts of increasing temperatures on road surfaces, rails and passenger comfort and of increased flood risk.

For the energy sector, adaptation strategies will need to consider how greater use can be made of renewable sources and associated planning and promotion opportunities (e.g. wind farms).

Climate change should be considered within the design brief for new infrastructure requirements, although this is likely to require a change in planning policy.

Business & Economy

Threats and Opportunities

This sector includes many of the other sectors; ranging from small agricultural, horticultural and tourist accommodation enterprises, and a range of planning and environmental/engineering consultancies, to large land estates, and major international companies involved in the provision of utilities in the region. This section therefore focuses on sub-sectors which are not already covered.

Threats to construction include delays and damage, reduced productivity in winter and hot summers, with possible risk of skin cancers for employees. Business may be lost for manufacturers of outdoor goods, and food may become more expensive where yields are reduced under higher temperatures.

Opportunities include the use of different materials, the development of portable work shelters, and a move away from wet trade work (brick, plaster, concrete). Business growth can be expected from the construction of sea defences, or rebuilding programmes, or from the greater use of wind energy, or from products specifically designed to cope with all types of weather.

Respondents made no mention of wider changes, such as the impacts on international trade or significant changes in global economic conditions.

Adaptation

The sector as a whole needs to develop a more strategic approach to planning and adaptation, linking climate change to business management, business continuity and corporate social responsibility, as well as mitigation measures (carbon trading, energy efficiency supply chains, land holding and health and safety). Key sub-sectors for more targeted advice included: retail & logistics (influencing sector leaders on issues such as refrigeration and air conditioning etc), manufacturing (processes and working conditions) and construction (design standards and development).



Picture courtesy of Omicron NanoTechnology Ltd in East Grinstead

The insurance sector is already well engaged with the potential risks of climate change and this is likely to provide significant financial incentive for adaptation in due course. There are likely to be new business opportunities - new products and markets - as well as risks to established business. The potential shifts in markets, demand and costs will need further research and appropriate strategies for adaptation. Small businesses, in particular, are likely to need support (e.g. technical, financial) in planning for adaptation. SEEDA and SECCP are likely to need to develop communication strategies in association with local chambers of commerce and trade associations to facilitate adaptation at the SME level.

Development Of Regional Climate Change Indicators

A range of 56 potential indicators appropriate to the South East has been identified and tested through stakeholder workshops leading to a set of 25 recommended indicators. This is the first stage in deriving a full set of accepted climate change indicators for the South East.

List of Indicators Recommended for Adoption by SECCP

Indicator Name	Sector*	Links to Other Sets / Likely Data Source	Headline or Specialist	Comments
Annual average surface temperature	All	National (#1) and SoE (#22)	Headline	Need SE data
Frequency of Intense Precipitation	A, T, UI	FCD	Specialist	
Quantity of summer rainfall	A, B, T, UI	SoE (#15), seasonality in National (#2)	Headline	May need a regional index
Quantity of winter rainfall	A, B, T, UI	SoE (#15), seasonality in National (#2)	Headline	May need a regional index
Sea level rise at Sheerness, Kent	P, T	National (#9), SoE (#23), FCD	Headline	
Frequency of river high flows	BE, P, EP, UI	National (#7), FCD	Specialist	
Frequency of low river flows	A, B, UI	National (#7)	Specialist	
Soil moisture	A, B	National (#5)	Specialist	Need further definition
High groundwater levels	B, UI	National (#8), SoE (#16), FCD	Specialist	
Low groundwater levels	B, UI	National (#8), SoE (#16)	Specialist	
Date of insect appearance and activity	B	National (#27), SF	Specialist	
Insect abundance	B	National (#28), SF	Specialist	
Egg-laying dates of birds	B	National (#30)	Specialist	Need regional data
Arrival date of the swallow	B	National (#29)	Specialist	Dungeness used in national set
Date of leaf emergence on trees in spring	B	National (#25)	Specialist	Record from Ashtead, Surrey
Health of beech trees	B	National (#26)	Specialist	
Number of outdoor fires	B, EP, T	National (#16)	Specialist	
Area of vines	A	National (#22)	Specialist	Need regional data
Emissions of greenhouse gases	UI	IRS (#26), RSDF (#21)	Headline	
Installed capacity for energy production from renewable sources	UI	IRS (#43), RSDF (#36)	Headline	
Atmospheric ozone levels in summer in rural areas	H	National (#11). Related to IRS (#25), RSDF (#18), SoE (#1)	Specialist	Note caveats
Household consumption of gas (winter % of annual)	UI	National (#13). Related to IRS (#13), RSDF (#7)	Specialist	Note caveats
Length of the thermal growing season	A	New National Indicator	Specialist	
Frequency of grit applied to roads	BE, UI	Highways Agency, Local Authorities	Specialist	New indicator; needs support
Heat wave alerts	H	Met Office	Specialist	

KEY: A = Agriculture; B= Biodiversity; BE = Business & Economy; EP = Emergency Planning; H = Health; P = Planning; T = Tourism; UI = Utilities and Infrastructure; FCD = (National) Flood and Coastal Defence environmental change indicators (Law et al., 2003); IRS = (Draft) Integrated Regional Strategy indicators (Integrated Regional Strategy Working Group, 2004); National = UK climate change indicators (Cannell et al., 1999; Defra, 2004); RSDF = Regional Sustainable Development Strategy indicators (SEERA, 2001); SF = Solent Forum potential indicators for the Solent (Solent Forum, 2003); SoE = State of the Environment report indicators (Environment Agency, 2003)

Indicators - Recommendations

The consultants have recommended the following actions relating to the further development of climate change indicators in the South East:

- The recommended indicators should be used now, with further work undertaken or data collected to assess and improve newly suggested indicators. In future, those indicators identified in this study as waiting for further data or analysis should be re-visited.
- A hierarchy approach is recommended with “headline” indicators to measure basic changes in state or responses, together with more specialist indicators for particular sectors (e.g. mean temperature as a headline indicator for the region, with summer night time temperatures pertinent to the health sector to aid understanding of summer mortality).
- Sector groups should adopt specialist indicators and lead on the development and testing of further indicators relevant to their particular interests. This will ensure that indicators are actively maintained and are of use to the sector, or a sub-sector. Sector groups could also identify indicators gaps and seek to collate new or existing data in support of possible new indicators.
- The indicators should be used to cover several purposes and audiences.
- Headline indicators would be useful for political and public awareness, while more detailed indicators would benefit policy makers and technical specialists. The indicators could be used for cross-regional comparison in the future, but at present Wales is the only other part of the UK to have published a set of possible climate change indicators (Buse et al, 2001).
- There should be a focus on adopting ‘ready-made’ indicators i.e. those indicators already maintained as part of other indicator sets, often by SECCP members. This will reduce the cost and effort in maintaining an indicator set for the South East and will provide effective linkages with other regional strategies and plans.
- The indicators should, where possible, be mapped and graphically represented, to facilitate understanding.
- The indicators should be made available on the Internet, on the SECCP website, to allow access to a wide range of interested parties.
- The indicators should be updated periodically, probably on an individual basis in association with the ‘host’ indicator set. This will, of course, have a resource implication.

Current Research Activities

The survey of research in the region has revealed a wide range of research that has been completed or is underway. The level of research activity related to climate change has increased dramatically in the past decade and is set to expand further in the near future, with many new research projects funded. Despite this, there are many gaps in research and in its application in industry and policy making.

SECCP can play an important facilitating role at the interface between academia, business, industry, policy-makers and the wider public. The following actions are recommended in relation to climate change research:

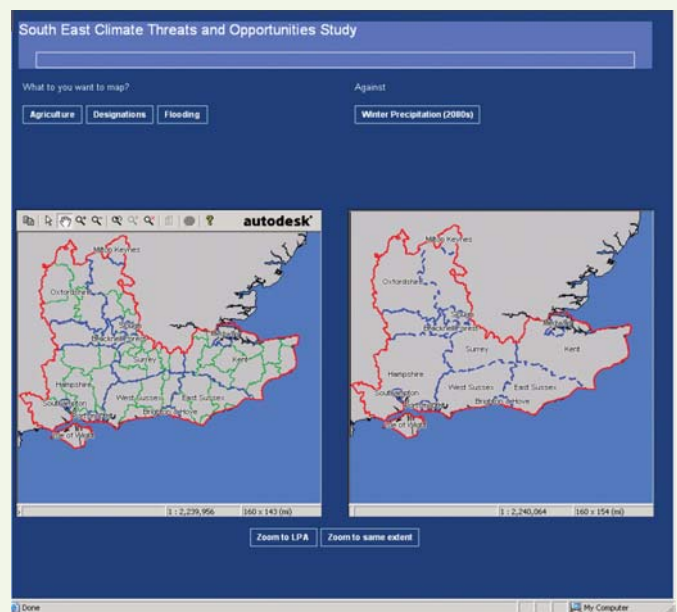
- Research Forum: has already attracted some 29 researchers from a wide variety of disciplines and institutions. SECCP should feed results from the Forum into the research database and update the SECCP website to allow stakeholders to appreciate and understand the latest research. SECCP should also brief the Research Forum on user needs, current issues and questions that researchers may be able to answer.
- Integration with sector groups: is essential to foster dialogue between researchers and stakeholders and to identify priorities and requirements at the sector level regarding climate change indicators, impacts and adaptation.
- Integration with other regional and local bodies: to support climate change research relevant to the South East, drawing on SECCP's unique facilitation role.
- Create and maintain a research section on the SECCP website: to provide a virtual focus for the Research Forum and provide information to researchers and other stakeholders on current and planned research activities.
- Adopt and maintain the research database: developed under this project as single point of information on research activities for SECCP. This could be made available online and linked to a GIS.

The Development of GIS To Aid Adaptive Planning in The Region

The development of a GIS will be essential to integrate and visualise mapped climate data, climate change scenarios and various environmental, social and economic data that may aid adaptive planning. SECTORS provides a summary of the range of data sets available and evaluates data standards, technical and user requirements and links in order to underpin the development of a web-based GIS tool.

A GIS demonstrator has been constructed to illustrate the potential power and influence of using GIS as a tool in adaptive planning. The demonstrator provides an indication of the links that can be developed between climate change scenarios and mapped data available from a variety of sources.

A specification for a full GIS tool has been provided together with an estimate of system requirements and potential costs.



Next Steps

We encourage you to consider the possible implications of climate change for your organisation and the responses that might be appropriate for you. You can download the full report of the SECTORS project from the SECCP website at <http://www.climatesoutheast.org.uk>

This Study reinforces the broad range of impacts that climate change will have on our region – including opportunities as well as risks for many different sectors and organisations. We need to plan ahead for adaptation to unavoidable climate change over the next few decades at the same time as taking actions to avoid even more pronounced climate change further ahead. Adaptation by one sector or organisation will both affect and depend on the responses of others; partnership approaches will therefore be important to our continued success as a region.

SEEDA and SECCP will be taking the Study's findings forward as a basis for closer engagement with businesses and other key organisations. We would be pleased to receive your comments on this summary or the full report, and to provide further information on the work of the South East Climate Change Partnership, you can contact SECCP at info@climatesoutheast.org.uk.

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SECCP brings together organisations in the public, private and not-for-profit sectors in the South East. It exists to investigate, inform and advise on threats and opportunities arising from the impacts of climate change in the region and to promote adaptive planning.



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